

ANNEXE 5



4034 MAINWAY
BURLINGTON ON L7M 4B9
CANADA

Phone: (905) 335-9670
Fax: (905) 335-0119
Internet: zephyrn@io.org

1995 October 31

NORTHERN QUÉBEC WIND RESOURCE STUDY

for
Hydro-Québec

HISTORICAL WIND DATA AND NUMERICAL MODELLING

J. R. Salmon
P. G. Stalker

DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

This Report was prepared by Zephyr North of Burlington, Ontario, Canada as an account of work sponsored by Hydro-Québec. Neither Zephyr North nor any person acting on its behalf:

(a) Makes any warranty or representation whatsoever, express or implied, (i) with respect to the use of any information, apparatus, method, process, or similar item disclosed in this report, including merchantability and fitness for a particular purpose, or (ii) that such use does not infringe on or interfere with privately owned rights, including any party's intellectual property, or (iii) that this report is suitable to any particular user's circumstance, or

(b) Assumes responsibility for any damages or other liability whatsoever (including any consequential damages, even if Zephyr North or its representatives have been advised of the possibility of such damages) resulting from your selection or use of this report or any information, apparatus, method, process or similar item disclosed in this report.

EXECUTIVE SUMMARY

Historical wind data from the Atmospheric Environment Service of Environment Canada were acquired, processed, quality-controlled and summarized in order to assess the wind energy resource potential at fourteen remote villages in Northern Québec.

Many of the stations had relatively short (two years) data records and limited daily and weekly sampling intervals. Many stations also displayed what appeared to be serious observer bias in the wind speed data.

There appears to be a significant variability in the wind resource over the large region studied with local terrain exerting significant influence on the wind speed at each of the stations. Wind speeds at 10m (above ground level) range from 4.3 to 7.9ms^{-1} while at 25m estimated speeds range from 4.9 to 8.7ms^{-1} . The respective power densities range from 134 to 686Wm^{-2} at 10m and from 199 to 909Wm^{-2} at 25m. In order of decreasing average power densities, the stations are:

- Cape Hopes Advance
- Umiujaq Airport
- Quaqtaq
- Kangiqsujuaq Airport
- Salluit Airport
- Aupaluk Airport
- Kangirsuk Airport
- Akulivik Airport
- Tasiujaq Airport
- Povungnituk Airport
- Ivujivik Airport
- Inukjuak Airport
- Kangisualujjuaq Airport
- Kuujjuaq Airport
- Kuujuarapik Airport

All of these sites, particularly those near the beginning of the list would likely be suitable for installation of wind turbines.

The influence of the topography and surface roughness on the distribution of wind speeds around the stations was investigated with the MS-Micro numerical model. At all stations, there are sites where the wind speed is enhanced by terrain influences. These effects are documented in maps of the estimated long-term turbine (AOC 15/50) output in the vicinity of each station.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Location and Purpose	1
2	HISTORICAL WIND DATA	1
2.1	Introduction	1
2.2	Atmospheric Environment Service Stations	1
2.3	AES Meteorological Measurement Details	3
2.3.1	Wind Speed	3
2.3.2	Wind Direction	4
2.3.3	Air Temperature	4
2.3.4	Barometric Pressure	4
3	DATA TREATMENT	5
3.1	Introduction	5
3.2	Data Completeness	5
3.3	Data Accuracy	5
3.4	Anemometer Height Adjustments	5
3.5	Treatment of Binning Biases	6
3.6	Adjustment for Obstacles	6
3.7	Adjustment for Complex Terrain	6
4	DATA SUMMARIES AND DISCUSSION	7
4.1	Introduction	7
4.2	Geographical Distribution of Long-Term Average Wind Speed and Power Density	8
4.3	Directional Distribution of Long-Term Average Power Density	8
4.4	Weibull Shape Factors	8
4.5	Temporal Trends in Wind Speed and Power Density	11
4.6	Monthly Variation in Power Density	11
4.7	Diurnal Variation in Power Density	11
5	NUMERICAL MODEL ESTIMATES OF TURBINE POWER PRODUCTION	12
5.1	Introduction	12
5.2	Model Background	12
5.3	Topography Data	13
5.4	Surface Roughness Data	13
5.5	Model Run Details and Results	13

6	CONCLUSIONS	14
6.1	Data Quality	14
6.2	The Wind Resource	14
7	ACKNOWLEDGEMENTS	15
8	REFERENCES	15
9	APPENDIX A - DEFINITIONS AND FORMULAE	16
9.1	Average Wind Speed	16
9.2	Wind Power Density	17
9.3	Weibull Distributions	18
9.4	Air Density	18
9.5	Average Turbine Power	18
10	APPENDIX B - DATA TREATMENT	20
10.1	Introduction	20
10.2	Data Completeness	20
10.3	Data Accuracy	20
10.4	Anemometer Height Adjustments	21
10.5	Treatment of Binning Biases	21
10.5.1	Wind Speed	22
10.5.2	Wind Direction	22
11	APPENDIX C - STATION DATA	24
12	APPENDIX D - WIND DATA SUMMARIES	25
12.1	Wind Distribution (Graph)	25
12.2	Annual Averages (Graph)	25
12.3	Annual Averages (Table)	26
12.4	Monthly Distribution (Graph)	26
12.5	Monthly Roses (Graph)	26
12.6	Diurnal Distribution (Graph)	26
13	APPENDIX E - WINDS AT STANDARD LEVELS	27
13.1	Annual Averages (Table)	27
14	APPENDIX F - MS-MICRO INPUT AND RESULTS	29
15	APPENDIX G - AOC 15/50	30

TABLES

Table 1	Station averages for wind speed and power density (PD) at several heights.	9

FIGURES

Figure 1	Map of the study area showing station names and locations.	2
Figure 2	Map showing station averages for wind speed and power density at 25m a.g.l. . .	10

1 INTRODUCTION

1.1 Location and Purpose

This project was initiated to study the wind energy resource for fourteen remote villages in the northern part of the province of Québec. The study area (shown in Figure 1) extended roughly from Hudson Bay east to eastern Ungava Bay and from Kuujjuarapik north to the northern tip of the province.

Within or near all of the villages there are large tracts of cleared, unobstructed land suitable for the production of clean, economical, renewable, wind-generated electricity.

Two aspects of wind resource assessment were considered. First, the historical wind data were examined to attempt to determine the long-term wind regime at each of the historical measurement sites (15 in total). Second, this estimated long-term wind regime was used as input, along with topography and surface roughness to the MS-Micro numerical model in order to predict the output of an Atlantic Orient Corporation AOC15/50 wind turbine at any point in the region surrounding each village.

2 HISTORICAL WIND DATA

2.1 Introduction

Historical data for this assessment were gathered from the archives of the Atmospheric Environment Service (AES) of Environment Canada. Only digitally archived wind data were used, as the effort to incorporate hard-copy data would have been prohibitive. However, hard-copy auxiliary data (site reports, maintenance reports, site descriptions, instrument reports, photographs, etc.) were used wherever required and available.

2.2 Atmospheric Environment Service Stations

In the study region, wind information has been recorded by the Atmospheric Environment Service of Environment Canada for many decades. A summary of the data collected is available in the *Canadian Climate Normals, Volume 5, Wind* (1982). The ultimate source of wind data and information pertaining to these data is the data archive of AES.

For this study, we obtained wind speed, wind direction, dry bulb air temperature (where available) and station barometric pressure (where available) data from AES.



Figure 1 Map of the study area showing station names and locations.

Note that there are two types of data sets available from AES. The first, referred to as 'HLY01', consists of wind speed, wind direction, dry bulb temperature and station pressure. These parameters are measured at regular, manual observing stations as well as 'auto' stations where remote observing equipment is/was situated. The second type of data set, designated 'HLY15' or 'wind run', consists of wind speed and wind direction measured at AES climatological observing stations or affiliate climatological observing stations, often research stations. For these data, the wind speed and wind direction were extracted from charts or reported by automated equipment. Hourly temperature and barometric pressure are not generally available in this type of data set. It is thought that the data obtained for this study all came from HLY01 type stations although this is not entirely clear from AES documentation.

Data were received from AES for Akulivik Airport, Aupaluk Airport, Cape Hopes Advance, Inukjuak Airport, Ivujivik Airport, Kangiqsualujuaq Airport, Kangiqsujuaq Airport, Kangirsuk Airport, Kuujuaq Airport, Quaqtaq, Kuujuarapik Airport, Povungnituk Airport, Salluit Airport, Umiujaq Airport and Tasiujaq Airport (15 stations in all).

Appendix C provides brief physical descriptions for each station and a note on the data availability. These are taken from the archived station reports. Figure 1 shows the locations of the stations.

2.3 AES Meteorological Measurement Details

The following sections describe how the data were acquired. The tables of Appendix C

provide the background meteorological information for the stations.

2.3.1 Wind Speed

At older HLY01 stations, the wind speed was measured with either a U2A cup anemometer or a modified 45B cup anemometer, while an R.M. Young Wind Monitor may be used at some of the newer auto stations. Wind speed was measured at a variety of elevations above the ground, although there has been a trend towards standardization at 10m.

At manned stations, the wind speed was determined as a one minute (up to 84/12) or two-minute (thereafter) average speed ending on the hour (*i.e.*, from xx:59 or xx:58 to yy:00). It was read from an anemometer display unit or extracted from an anemograph chart. At automatic stations, the wind speed was determined as a ten minute average ending on the hour, using electronic means. It is worth noting that these values are not true averages for the complete hours which they represent, but samples taken at a specific time.

At one time or another, these wind speed data have been observed in whole (no decimal portion) miles/hour or knots and/or processed in whole miles/hour or knots. All processed data in the AES archive have since been converted to whole km/hr. These procedures can create a 'binning bias' problem with the data. Appendix B describes the method used for treating this binning bias.

The HLY15 wind speed data differ from the HLY01 data in that the wind speed is extracted from charts as the total wind run recorded during the hour divided by the length of observation (*i.e.*, one hour). In

other respects, the data share characteristics similar to the HLY01 data.

2.3.2 Wind Direction

The HLY01 wind direction at older AES stations was measured with the wind vane on either a 45B or U2A anemometer, while newer, auto stations, use R.M. Young Wind Monitors. The measurement heights varied but, as mentioned above, there is a present-day trend toward compliance with the World Meteorological Organization's (WMO) standard of 10m above the ground.

As was the case for wind speed measurements, at manned stations the wind direction was determined as a one minute (up to 84/12) or two-minute (thereafter) average direction ending on the hour (*i.e.*, from xx:59 or xx:58 to yy:00). It was read from an anemometer display unit or extracted from a graph. At automatic stations, the wind direction was determined as a ten-minute average ending on the hour, using electronic means. Again, it is worth noting that these values are not true averages for the complete hours which they represent, but samples.

At various times in the history of AES wind measurement, the wind direction has been reported to 8 direction points (*i.e.*, compass points) or 16 direction points or 36 direction points (*i.e.*, 10° intervals). All data, however, are stored in the AES digital archive to the nearest whole 10° value (*i.e.*, 10, 20, ..., 350, 360°; 0° represents calm). As was the case with the wind speeds, these observing and processing procedures can lead to a binning bias in the data. The direction data were also treated for this bias as described in Appendix B.

The HLY15 wind direction differs from the HLY01 data in that the directions are

estimated to 8 directions (only) from the whole hour of data recorded on charts at the stations.

2.3.3 Air Temperature

At AES stations, air temperature is measured by a mercury thermometer in a Stevenson Screen. The screen protects the thermometer from thermal radiative effects. At unmanned stations an electronic thermometer (a YSI 44212 thermistor) is used. At both types of station, the sensor is usually mounted 1.5m above the ground.

For data processing, the AES temperature values were transferred to the data archive with conversion from integer units of 0.1C to units of decimal degrees C.

Note that there are no hourly temperature data in the HLY15 data sets.

2.3.4 Barometric Pressure

Barometric pressure is measured at AES manned stations by reading a mercury barometer. At unmanned stations, a Setra 207A electronic barometer is used. Note that AES reports two pressures, station and m.s.l. (mean sea level). It is station pressure that is required for the calculation of air density. Note that for some types of automatic station, the sea-level barometric pressure is reported and archived, while the station pressure is not.

For data processing, the AES barometric pressure values were transferred to the archive with conversion from integer units of .01kiloPascals (kPa) to decimal kiloPascals.

Note that the HLY15 data sets do not contain barometric pressure information.

3 DATA TREATMENT

3.1 Introduction

The meteorological data were treated as described in Appendix B to try to extract the maximum amount of correct, appropriate and useful information from them. A summary of the results of the data treatment is presented in the following sections.

3.2 Data Completeness

The stations had annual blocks of contiguous data with no long missing sections for periods ranging from one to fifteen years. Note that a large number of the stations had two or less years of data. Two years is not enough time to establish an accurate climatological average wind speed.

Within the contiguous blocks of data used for the analysis, there were shorter, randomly-distributed blocks of missing data. These blocks were deemed to be short enough that they would have only a very minor effect on the long-term averages and so they were ignored in the analysis.

Table 1 lists the data coverage showing the year and month at the beginning and end of the observations, the number of complete years of observations, the hours per day and

the days per week that observations were taken.

The observation regimes broke down into four types:

1. Hourly, full day, seven days a week,
2. Every three hours, full day, seven days a week
3. Hourly, daytime only, seven days a week
4. Hourly, daytime only, five days (Monday to Friday) a week.

It was decided that no data would be rejected on the basis of the incompleteness of any of the above types of observations. Otherwise, many of the stations would have no data at all.

3.3 Data Accuracy

As these data were provided by the Atmospheric Environment Service, it was assumed that the maintenance and data quality-control procedures followed by this organization would be adequate to ensure reasonable data accuracy.

3.4 Anemometer Height Adjustments

Where required, adjustments to the data to account for differences in elevation were made according to the procedure described in Appendix B. Note that most of the stations

had anemometers located at or near the WMO standard height of 10m.

3.5 Treatment of Binning Biases

All data were treated for binning biases as described in Appendix B.

A few of the stations showed severe biases in the wind speed observations that were not corrected by the treatment described in the appendix. It is presumed that these are additional problems due to observer bias at the individual stations. Significant problems can be seen in the wind speed distribution histograms for Aupaluk A, Cape Hopes Advance, Kangiqsualujjuaq A, Kangiqsujuaq A, Kangirsuk A and Quaqtaq. Minor, but discernible, problems are evident at Ivujivik A, Salluit A and Tasiujaq A. Without further analysis, it is not clear what effect these biases would have on the results. Note, also, that further analysis might not resolve this question.

There is no obvious evidence of observer bias in the direction data except for Cape Hopes Advance. However, it may be that by the type of equipment used at this station did not conform to the reporting standard of the day. Further work would be required to determine if this were the case.

3.6 Adjustment for Obstacles

Because no information was available regarding nearby obstacles that could potentially shelter the anemometers and cause reductions in the reported wind speeds, no adjustments were made to the data for sheltering. It is unlikely that there were any significant speed reductions due to obstacles at any of the stations because of their remote

disposition - primarily in small villages with terrain characterized by tundra. A more thorough analysis could include site visits and measurement and assessment of any potential obstacles to the wind flow.

3.7 Adjustment for Complex Terrain

A numerical model analysis of the effect of the local topography and surface roughness on the wind flow at each of the stations (except Cape Hopes Advance) is contained in Section 5.

4 DATA SUMMARIES AND DISCUSSION

4.1 Introduction

In this section, summaries of the data and discussions of these summaries will be presented. Note that the data are already summarized to some extent in the appendices.

Appendix C contains station information. It includes tables describing meteorological measurement parameters, geographic, terrain and siting information.

In Appendix D, the graphs for each station summarize the data at the original level of measurement, *i.e.*, the anemometer level on the measurement tower. The graphs and tables available for each station in the appendix are as follows.

1. Polar graphs of wind frequency by 16 direction sectors, average wind speed by 16 sectors, average wind power density by 16 sectors; histograms of wind speed distribution by sector for 16 sectors with sector-wise Weibull parameters, and overall wind speed distribution for all direction sectors with overall Weibull parameters.
2. Histograms of wind speed and power density year by year for the period 1969

to 1995 inclusive (where data are available).

3. Histograms of the monthly variation of wind speed and wind power density (averaged over the complete station period).
4. Polar graphs of the monthly variation of wind frequency, average wind speed and power density (averaged over the complete station period).
5. Monthly histograms of the diurnal variation of wind speed and power density (averaged over the complete station period).
6. Monthly histograms of the diurnal variation of wind power density (averaged over the complete station period).

In Appendix E, the tables summarize the annual averages at the station for a number of 'standard levels'. For this study, we have chosen to extrapolate the data to 10 (where necessary) and 25m levels. These extrapolations use Equation 1 of Appendix B with the direction-dependent roughness lengths, z_0 , shown at the top of the appropriate table of the appendix. Values of z_0 used were:

- 0.0002m (Sea)
 - open water
- 0.03m (Open)
 - unobstructed landscape with widely separated obstacles (tundra)
- 0.10m (Roughly Open)
 - open landscape, low vegetation, occasional obstacles
- 0.25m (Rough)
 - open landscape, variable height vegetation, scattered woods

The tabulation at standard levels serves two purposes. One, it allows station-to-station comparison of wind speeds and power densities where the original measurement levels may have been at different heights, and two, it serves as a quick reference for the estimated wind speed at a level which is perhaps close to the hub-height of a wind turbine under investigation. There is only one type of table in this appendix as the graphs of Appendix D are generally sufficient to provide a good understanding of the characteristics of the local wind regime. The format of the tables in this appendix is as follows.

1. Table of annual averages of station temperature, barometric pressure, air density, wind speed, wind direction, maximum wind speed, maximum gust speed (if available), wind power density and turbulence intensity (if available). Wind speed, maximum wind speed, maximum gust speed, wind power density and turbulence intensity are adjusted to standard levels.

4.2 Geographical Distribution of Long-Term Average Wind Speed and Power Density

Table 1 presents summaries of the wind speed and power density averages for all stations. Three sets of averages are given. Each set consists of an average wind speed followed by the corresponding power density, in brackets. The first set is the measured wind speed/power density at the anemometer height. The second and third sets are the extrapolated wind speed estimates/power densities at the 'standard' heights of 10 and 25m. Figure 2 also shows the 25m estimates on a map of the region. The estimated wind

speed at 25m is printed next to the station marker. The power density is shown in brackets. Examination of the data from Table 1 and Figure 2 suggests that the average wind speed and power density are not distributed in any simple, large-scale pattern. This is likely due to the effect of local terrain influences - hills, ridges, proximity to open water, *etc.*, at each of the stations, as well as to larger scale regional differences.

4.3 Directional Distribution of Long-Term Average Power Density

Examination of the power density roses of Appendix D shows that there is no consistent prevailing direction for the power density. In general, the sectors exhibiting a high percentage of the overall power density are those with open water upwind. However, this is not always the case. For example, at Umiujaq A, there is a very strong component of power density from the east, a hilly region, while Hudson Bay is found in the western sector.

It is evident that there are significant local effects at all stations and that each one should be treated individually in terms of directional analysis.

4.4 Weibull Shape Factors

The Weibull shape factor parameters, k , for all stations range between 1.3 and 2.0. The average for all stations is 1.6. However, it should be remembered that a number of the stations had badly biased wind speed distributions, so that the fitted shape factors

Table 1 Station averages for wind speed and power density (PD) at several heights.

Station	Begin - End Record YY/MM	Years	Diurnal data coverage	Weekly data coverage	Anemo-meter height z_a (m)	Ave. speed (PD) at z_a ms^{-1} (Wm^{-2})	Est. speed (PD) at 10m ms^{-1} (Wm^{-2})	Est. speed (PD) at 25m ms^{-1} (Wm^{-2})
AES Stations (HLY01 Data)								
Akulivik Airport	93/01 - 94/12	2	daytime	7 days	10.0	6.2 (306)	6.2 (306)	7.1 (471)
Aupaluk Airport	93/01 - 94/12	2	daytime	M - F	10.0	6.3 (338)	6.3 (338)	7.1 (467)
Cape Hopes Advance	69/01 - 70/12	2	3-hourly all day	7 days	9.1	7.8 (665)	7.9 (686)	8.7 (909)
Inukjuak Airport	77/01 - 91/12	15	all day	7 days	10.0	5.7 (251)	5.7 (251)	6.5 (390)
Ivujivik Airport	93/01 - 94/12	2	daytime	M - F or 7 days	10.0	5.7 (286)	5.7 (286)	6.7 (444)
Kangiqsualujuaq Airport	93/01 - 93/12	1	daytime	7 days	10.0	4.9 (139)	4.9 (139)	5.7 (216)
Kangiqsujuaq Airport	93/01 - 94/12	2	daytime	7 days	12.2	5.9 (384)	5.7 (347)	6.6 (539)
Kangirsuk Airport	93/01 - 94/12	2	daytime	7 days	12.2	6.3 (369)	6.1 (334)	7.1 (518)
Kuujuuaq Airport	80/01 - 94/12	15	all day	7 days	10.0	4.3 (135)	4.3 (135)	4.9 (210)
Kuujuarapik Airport	80/01 - 89/12	10	all day	7 days	10.0	4.5 (134)	4.5 (134)	5.1 (199)
Povungnituk Airport	93/06 - 95/05	2	daytime	7 days	10.0	6.0 (291)	6.0 (291)	6.9 (451)
Quaqtaq	72/01 - 80/12	9	3 hourly all day	7 days	10.0	6.5 (445)	6.5 (445)	7.5 (686)
Salluit Airport	93/01 - 94/12	2	daytime	7 days	10.0	5.9 (346)	5.9 (346)	6.8 (537)
Tasiujaq Airport	93/06 - 95/05	2	daytime	M - F	10.0	5.7 (299)	5.7 (299)	6.6 (464)
Umiujaq Airport	93/02 - 95/01	2	daytime	7 days	10.0	7.0 (509)	7.0 (509)	8.1 (790)

daytime - data collected only during daytime hours

all day - data collected daytime and nighttime

3-hourly - data collected only at 3 hour intervals

7 days - data collected 7 days per week

M - F - data collected Monday to Friday only

may not be representative of the true wind speed distribution for these stations.

4.5 Temporal Trends in Wind Speed and Power Density

The time-series histograms of Appendix D show that the wind speed and power density at the stations with longer records are reasonably consistent from year to year with the power density showing more variation than the wind speed (as would be expected from Equation 4 of Appendix A).

Examination of the graphs and data from the longer-term stations (Inukjuak A, Kuujuaq A, Kuujuarapik A and Quaqtaq) suggest that, generally, the largest deviations from the average wind speed over the record period are in the $\pm 5\%$ to $\pm 10\%$ range with the higher variation occurring at the stations with the lower wind speeds and *vice versa*.

As expected, the maximum power density excursions are significantly larger, ranging from $\pm 15\%$ to $\pm 35\%$ with the lower range again occurring at the higher average wind speeds. These excursions are significant for the wind turbine operator, who should not be surprised to find year to year differences in the power produced, with maximum annual differences up to $\pm 35\%$ from the long-term average. This figure is expected to be lower in areas with higher average wind speeds.

4.6 Monthly Variation in Power Density

All of the longer-term stations show a regular, cyclic month-by-month variation in the power density characterized by winter maxima. It is interesting to note that the primary maximum occurs in November while

a secondary maximum sometimes occurs anywhere from February through to April with the January-February period showing less power. The minimum occurs in the June-July-August period. The shorter-record stations show some of these characteristics but there is greater variation in individual monthly power densities.

In terms of the monthly variation of the directional distribution of power density, there seems to be no consistent pattern for all stations, although the graphs of Appendix D suggest that the prevailing wind direction often remains dominant throughout the annual cycle while there are short seasonal variations during individual months. It is suggested that these graphs be consulted for each station individually if the intra-annual cycle of dominant power density directions is required.

4.7 Diurnal Variation in Power Density

From the graphs of the average diurnal variation of the wind power density for the longer-term stations (Appendix D), we can discern almost no variation in the winter months with a slight increase in the summer months. It should be remembered, however, that while the diurnal variation increases slightly during the summer months, the overall wind power density decreases. Where there is one, the daily maximum power density occurs one or two hours after local noon.

5 NUMERICAL MODEL ESTIMATES OF TURBINE POWER PRODUCTION

5.1 Introduction

The historical wind data summarized in the previous sections describe the wind regime at those single points where wind data were obtained and would be adequate for the prediction of turbine output for a turbine placed precisely at the original anemometer location and with a hub-height of 10m. However, this is not likely to be the case. It is more likely that the wind energy user will want to place a number of turbines in logistically convenient locations that take advantage of topographic and surface roughness features of the local terrain to augment power production.

This section describes MS-Micro model estimates of the average production for an Atlantic Orient Corporation AOC 15/50 wind turbine in the vicinity of the fourteen villages under consideration. The results are presented as isodyne (lines of constant power) maps of the estimated, long-term average output from this turbine over a small region surrounding the village. The wind turbine installer can examine these maps to estimate the average turbine output for any location on the map.

5.2 Model Background

The terrain affects the wind speed in two ways - one is attributable to the variation in the topography; the other to the variation in the surface roughness. To estimate the magnitude of these effects, we used the Canadian-developed computer model, MS-Micro, which is described in Walmsley *et al.* (1986, 1993). A full discussion of this model is beyond the scope of this report but it is useful to keep the following features and limitations of the model in mind.

- (1) The atmospheric boundary layer is assumed to be neutrally stable.
- (2) The terrain slopes modelled should be less than about one in four.
- (3) The terrain being modelled should not be so extensive that synoptic variability must be considered. The model assumes a homogeneous, well-developed, logarithmic incident wind profile. It also assumes that Coriolis effects are negligible.
- (4) The prediction levels are assumed to be low enough that they are well within the atmospheric boundary layer and high enough that they are well above the roughness element heights.
- (5) It must be possible to represent the region as an area of complex topography and aerodynamic roughness surrounded by a flat, homogeneous plain.

Two types of information are required to use this model to generate corrections for the influence of the terrain on the wind. First, the topographic elevations must be known on a regular grid surrounding the station being examined; second, the roughness lengths need to be provided on the same grid.

5.3 Topography Data

The topography was obtained by scanning and then semi-automatically digitizing contours from 1:50,000 National Topographic System (NTS) maps. (The NTS maps used for each station are available from Natural Resources Canada and are listed in Appendix C.) Elevations were interpolated from the contours to generate regular grids around the stations. These elevations grids were then used as inputs to the MS-Micro model. Relief and contour maps of these grids for each of the stations are shown in Appendix F. Note that the relief maps are characterized by an exaggerated vertical scale.

5.4 Surface Roughness Data

The surface roughness (roughness length) was estimated from the same NTS maps as were used for the topography. In this case roughness lengths were assigned to the areas depicted on the map covered by water, clear land and forested land. In the case of the clear land, it was assumed that the land was characterized by tundra and assigned a roughness length, z_0 , of 3cm. Again, as for the topography, regular grids were generated from the land-type areas of the maps and were used as input to MS-Micro. Maps depicting the surface roughness are shown in Appendix F.

5.5 Model Run Details and Results

Model runs for all 14 northern villages were made using local model domains of 16km x 16km with 256 x 256 grid lines for a grid point separation of 62.5m horizontally. In addition to gridded topography and

roughness length data, the model runs required a choice for the 'upstream roughness length' for each of the sixteen upstream directions used. These were provided by examining the surface types on the NTS maps for each of the upstream directions. For the required upstream topographic elevation, the model made its own calculation from the topography 'master grid'. The parameters chosen for each of the runs are presented in Appendix F in the tables labelled 'MS-Micro MASTER PARAMETER SUMMARY'.

One model run was carried out for each of the fourteen villages (excluding Cape Hopes Advance) to determine what the terrain influences were precisely at the anemometer location. This information was then used with the joint-frequency (wind speed v , wind direction) tables represented by the wind-rose graphs of Appendix D to generate a basis joint frequency table that would represent the wind regime without the influence of the local topography and surface roughness. This synthesized joint-frequency table was then combined with model runs for the area to generate wind speed and AOC 15/50 turbine power output isoline maps.

The wind speed and turbine power isoline maps are shown in Appendix F. The latter can be used to estimate the average turbine output for any location in an 8km x 8km region around the village.

Note that the scales on the maps are in metres in the UTM (Universal Transverse Mercator) coordinate system and that the villages are located within a variety of UTM zones.

6 CONCLUSIONS

6.1 Data Quality

It is felt that the data at a number of the stations were characterized by observer bias as described in Section 3. In some cases, the bias was quite severe.

Unfortunately, a number of the stations only have daytime observations and some of these only have observations taken Monday-to-Friday.

Fortunately, there were a few long-term stations with good data coverage (Inukjuak A, Kuujjuak A, Kuujjuarapik A and Quaqtaq) which permitted examination of long-term statistics.

6.2 The Wind Resource

There appears to be a significant variability in the wind resource over the large region studied. Wind speeds at 10m above the ground range from 4.3 to 7.9ms⁻¹ while at 25m they range from 4.9 to 8.7ms⁻¹. The respective power densities range from 134 to 686Wm⁻² and from 199 to 909Wm⁻². There does not appear to be any large-scale, overall pattern to the distribution of the wind resource. However, this may be overshadowed by the local topographic and

terrain influences at individual stations and cannot easily be detected in the data.

In order of decreasing power densities, the stations analyzed are ranked as follows:

Cape Hopes Advance
Umiujaq Airport
Quaqtaq
Kangiqsujuaq Airport
Salluit Airport
Aupaluk Airport
Kangirsuk Airport
Akulivik Airport
Tasiujaq Airport
Povungnituk Airport
Ivujivik Airport
Inukjuak Airport
Kangiqsualujuaq Airport
Kuujjuak Airport
Kuujjuarapik Airport

Many of these sites, particularly those near the beginning of the list would be suitable for installation of wind turbines.

Further, use of the maps of predicted AOC 15/50 turbine power output (Appendix F) will allow turbine installers to enhance the resource by a judicious choice of turbine locations.

7 ACKNOWLEDGEMENTS

The authors wish to thank Hydro-Québec for the funding for this study. Our thanks also go out to M. Bernard Girard of AES (Québec Region) for kindly supplying precise locations for the AES anemometer towers.

8 REFERENCES

Atmospheric Environment Service, 1982: **Canadian Climate Normals, Volume 5, Wind, 1951-1980**, Climatological Services Division, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4.

Atmospheric Environment Service, 1989: **Climatological Station Catalogue, Ontario**, Climatological Services Division, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4.

Walmsley, J.L., P.A. Taylor and T. Keith, 1986: A Simple Model of Neutrally Stratified Boundary-Layer Flow Over Complex Terrain with Surface Roughness Modulations (MS3DJH/3R), **Boundary-Layer Meteorology**, Vol. 43, pp. 273-286.

Walmsley, J.L., D. Woolridge, J.R. Salmon, 1993: **MS-Micro/3 User's Guide**, Report ARD-90-008, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4.

9 APPENDIX A - DEFINITIONS AND FORMULAE

Some of the concepts used in defining and measuring the power of the wind will be presented in the following paragraphs. The formulae presented will also serve as definitions and references for the calculations presented in the graphs and tables of the appendices.

9.1 Average Wind Speed

We define the average wind speed at a fixed height above the ground, $U(z)$, as a simple average of sampled wind speeds:

$$U(z) = \frac{1}{N} \sum_{i=1}^N u_i(z) \quad (1)$$

where,

$U(z)$ (ms^{-1}) is the wind speed at height z ,
 z (m) is the elevation above the ground,
 $u_i(z)$ (ms^{-1}) is the individual, sampled wind speed.

Note that the sampled wind speeds can be instantaneous wind speeds or averages

generated by the data collection system themselves. The sum is taken over the appropriate number of samples to produce the desired average - *e.g.*, hourly, daily, monthly, *etc.*

Investigation (see, *e.g.*, Oke, 1987) has shown that, for most practical purposes, the variation of the average wind speed with height above the (flat) ground can be represented by a simple equation (the logarithmic wind profile) as follows:

$$U(z) = \frac{u_*}{\kappa} \ln \left(\frac{z}{z_o} \right) \quad (2)$$

where,

u_* (ms^{-1}) is the 'friction velocity',
 κ is von Karman's constant ($=0.4$),
 z_o (m) is the aerodynamic 'roughness length' and
 $\ln$ is the 'natural logarithm'.

For clear, open terrain with very low vegetation in the summer, for example, z_o is typically about 3cm. For this value of the roughness length, a 6ms^{-1} wind at $z=10\text{m}$ would be characterized by a friction velocity of 0.41ms^{-1} . Equation 2 applies strictly to 'neutral' atmospheric conditions, *i.e.*, where the influence of thermal stratification is weak. Fortunately, for the higher wind speeds of interest to a wind energy generation facility, the atmosphere is usually neutral, or close to neutral.

9.2 Wind Power Density

The instantaneous power in the wind depends on the density of the air and the speed of the wind as follows:

$$p_i = \frac{1}{2} \rho_i u_i^3 \quad (3)$$

where,

p_i (Wm^{-2}) is the power density,
 u_i (ms^{-1}) is the sampled wind speed,
 ρ_i (kgm^{-3}) is the sampled density of the air.

Equation 3 represents the instantaneous power density in the wind. The average power density is calculated as:

$$P(z) = \frac{1}{2N} \sum_{i=1}^N \rho_i u_i^3 \quad (4)$$

where,

$P(z)$ (Wm^{-2}) is the average power density at height z ,
 ρ_i (kgm^{-3}) is the sampled air density and
 u_i (ms^{-1}) is the sampled wind speed.

Note again that the sampled densities and wind speeds may themselves be averages and the summation is taken so as to provide the desired average.

We can visualize the wind power density as the power in the motion of the air passing through a $1\text{m} \times 1\text{m}$ window directly facing the wind. Equations 2 and 4 show that the average power in the wind will normally increase quite rapidly with increasing height above the ground. For a 6ms^{-1} wind speed the power density is about 130Wm^{-2} .

Unfortunately, a wind turbine cannot extract all of this power from the wind – this would

require the wind to come to a dead stop! Typically, on average a turbine will extract roughly 25% of this power, with the actual instantaneous extraction efficiency varying with the instantaneous wind speed.

If we use long-term (say daily, monthly or annual) averaged values of the wind speed, $U(z)$, and density, ρ_{LT} , and try to calculate the long-term average power density, $P(z)$, as $\frac{1}{2}\rho_{LT} U(z)^3$ there will almost always be a serious discrepancy between this value and the average power density calculated using Equation 4. This is because, for a variable quantity like wind speed, simple mathematical analysis shows that average power is not always directly proportional to the cube of the average speed (although the instantaneous power is). The difference depends on the nature of the variability of the wind speed. Because of this, the average wind power density is a useful supplementary indicator of the energy available in the wind (and hence extractable by wind machines) when used in conjunction with the average wind speed. A consequence of the above is that two locations with identical annual average wind speeds can and often do display quite different power densities.

In the tables and appendices of this report the power density is calculated as a true average using Equation 4. The air density and wind speed are determined at each measurement time to produce an instantaneous power density. These instantaneous power densities are then averaged by hour, by month, by year, by direction, *etc.*

9.3 Weibull Distributions

As stated above, a knowledge of the distribution of wind speeds is important for an accurate calculation of the wind power density. It is also important for calculating the energy output of a wind turbine. The graphs and tables of the appendices provide information on the distribution of the wind speeds but can be unwieldy for simple wind energy assessment calculations. Therefore, for ease of use, the wind speed distributions have been summarized using the Weibull distribution function, which is defined as follows:

$$f(u) = \left(\frac{k}{c} \right) \left(\frac{u}{c} \right)^{k-1} e^{-\left(\frac{u}{c} \right)^k} \quad (5)$$

where,

$f(u)$ is the Weibull probability density function in which the probability of encountering a wind speed of u (ms^{-1}) is $f(u)$,

c (ms^{-1}) is the Weibull scale factor, which can be related to the average wind speed through the shape factor, and k is the Weibull shape factor which describes the distribution of wind speeds.

The wind rose graphs of the appendices list the Weibull function parameters, c and k , both for individual wind directions (16 sectors) and for all directions taken together.

Calculation of the Weibull factors is carried out by fitting the best curve to the cumulative probability distribution corresponding to Equation 5.

9.4 Air Density

In Equations 3 and 4, the density of the air depends on its temperature, barometric pressure, humidity, *etc.* Temperature and pressure are the most important of these factors and the air density can be written in a simplified form as follows:

$$\rho = 1.225 \left(\frac{288.15}{T_a + 273.15} \right) \left(\frac{P_a}{101.325} \right) \quad (6)$$

where,

T_a (C) is the air temperature and P_a (kPa) is the barometric pressure.

This simplification is taken from the Canadian Standards Association (1986) 'Wind Energy Conversion Systems Performance Standard'.

9.5 Average Turbine Power

Average turbine power and annual turbine energy output can be calculated by the programs that produce the tables and graphs shown in the appendices. These quantities are also calculated as true averages (as above for the wind power density). At each time step, the nominal (at standard conditions) turbine power is determined from the measured wind speed and its power curve. This value is then adjusted for the difference in density from standard conditions (to which the turbine power curve applies) as in the following equation.

$$P_{Ti} = \frac{\rho_i}{\rho_o} P_{PC}(u_i) \quad (7)$$

where,

P_{Ti} (kW) is the instantaneous density-corrected power output from the turbine for sampled wind speed u_i ,

$P_{PC}(u_i)$ (kW) is the turbine output power corresponding to sampled wind speed u_i in the turbine power curve for standard conditions ($T_a = 15^\circ\text{C}$, $P_a = 101.325\text{kPa}$),

ρ_i is the ambient air density calculated using Equation 6, and

ρ_o (kgm^{-3}) is the density of the air at standard conditions ($= 1.225\text{kgm}^{-3}$).

The calculated power outputs, P_{Ti} , at each time step are averaged to determine the average turbine output, P_T .

$$P_T = \frac{1}{N} \sum_{i=1}^N P_{Ti} \quad (8)$$

It is worth noting that for a climate like that found in most of Canada, the winter period is characterized both by higher wind speeds and higher air densities (due to the lower temperatures). Since these occur in phase, they have the effect of amplifying the average power density (Equation 4) and average turbine power (Equation 8) extremes over those that would be calculated using simple averages of the air density and wind speed.

REFERENCES

Canadian Standards Association, 1986:
**Wind Energy Conversion Systems
 (WECS) - Performance**, CSA
 Preliminary Standard F417-1986, ISSN
 0317-7874, Canadian Standards

Association, 178 Rexdale Boulevard,
 Rexdale, Ontario, Canada, M9W 1R3.

Oke, T., 1987: **Boundary-Layer
 Climates**, Second Edition, Methuen,
 London, 435 pp.

10 APPENDIX B - DATA TREATMENT

10.1 Introduction

Zephyr North treats meteorological data in a number of ways to try to extract the maximum amount of correct, appropriate and useful information from them. These methods are outlined in the following sections.

10.2 Data Completeness

Annual graphs of the data availability for all stations were plotted in a format that would allow easy identification of missing blocks of data. These missing portions of data could take a number of forms as follows.

1. Long contiguous blocks of missing data.

These were easy to identify and, if sufficiently long, would disqualify the particular year in which they occurred from being used in the statistical analysis. The reasons for the absence of these long blocks of data may be recorded in station archives, but since the data were unavailable no effort was expended to determine the cause. The particular year was simply excluded from the analysis.

2. Short blocks of randomly missing data.

Short blocks of missing data were not given any special data treatment, as long as they were randomly distributed.

3. Short blocks of periodically missing data.

At some types of stations, observations are taken only during a portion of the day (9am to 5pm at smaller airport locations, for example) resulting in missing data during the same portion of the diurnal cycle every day. Normally, years in which this type of missing data occurred ought to be excluded from statistical analysis, as wind speeds can be biased during a particular part of the day. However, in the present case, as there were no other data available, the data were used and a note was made describing the nature of the missing data. It should be noted also that data were only taken from Monday to Friday at a number of stations. Again, these data were used since they were the only data available and this type of periodic omission is not as serious.

In all cases, an attempt was made to choose contiguous years for data analysis in which 95 to 100% of the data were available in each year. Note that the percentage of data available for analysis is tabulated in some of the tables.

10.3 Data Accuracy

An attempt is always made to assess the accuracy of the reported data. Generally, inaccuracies can arise from inappropriate

monitoring instruments, poorly or not calibrated instruments, poorly or not functioning instruments and/or errors in reporting procedures.

Some agencies, such as the Atmospheric Environment Service of Environment Canada for example, have a program of instrument maintenance and data quality control, so data from this type of agency is accepted at face value.

In other cases, data accuracy is assessed by whatever means is available.

Where wind speed and wind direction are observed and/or recorded by human observers, there is a possibility of inadvertently biasing the data towards some preferred values. For example, it has been shown in some jurisdictions that individual observers showed preferences towards even-numbered observations and/or observations in the 5,10,15,20... series. This type of inaccuracy, while not always difficult to detect, can be difficult to correct, since individuals exhibit individual characteristics in the way in which they may apply a bias to the observations.

Note that we do not include inaccuracies due to poor siting in this category unless the instrument is extremely poorly sited. An example would be an anemometer placed near a large obstruction such as a building.

10.4 Anemometer Height Adjustments

After the data at each station have been scanned to isolate long, contiguous periods of available data, the station records are examined to determine the disposition of the anemometer and its height above the ground.

Periods of data (usually up to a maximum of the ten most recent years) are then chosen in which the anemometer was fixed in one location and its height remained unchanged.

For summaries of wind data extrapolated (and/or interpolated) to standard heights, Equation 2 of Appendix A was used to convert the wind speed from the measured height to the standard height. The values of the roughness lengths used in the conversion are tabulated at the beginning of the tables and depend on the measured wind direction. Note that the conversion equation is as follows:

$$\frac{U_2}{U_1} = \frac{\ln \left(\frac{z_2}{z_o} \right)}{\ln \left(\frac{z_1}{z_o} \right)} \quad (1)$$

where,

U_1 (ms^{-1}) is the wind speed at height z_1 ,

U_2 (ms^{-1}) is the wind speed at height z_2 .

In the case of interpolation of a wind speed between two levels where the wind speeds are known, a logarithmic interpolation based on Equation 2 of Appendix A is used.

10.5 Treatment of Binning Biases

If a wind speed or direction observation is made and/or recorded and/or converted with insufficient resolution for statistical purposes, the resulting data set will not be continuous. That is, there will be concentrations of observations at certain values in the continuum of possible values and few or no

observations at other values in the continuum. This can cause statistical problems as demonstrated below.

10.5.1 Wind Speed

As an example of the treatment of the wind speed data for biases due to inadvertent binning caused by the observational technique, consider the HLY01 wind speed data collected by the Atmospheric Environment Service of Environment Canada. At one time or another, these wind speed data have been observed in integer (*i.e.*, no decimal places were considered) miles/hour or knots and/or processed in integer miles/hour or knots. All processed data in the AES archive have since been converted to integer km/hr.

These observing and processing differences cause problems for wind energy resource analysis because the original observations were taken only to the nearest integer mi/hr or knot. Because these original data are discrete, when they are converted to other units and then rounded off to the nearest integer in the new system of units, it is possible for gaps to appear in the continuum of possible wind speeds. For example, in a conversion from integer knots to integer km/hr, the only possible resultant wind speeds are 0, 2, 4, 6, 7, 9, 11, 13, 15, 17km/hr... and a problem arises when we try to examine the distribution of wind speeds. For example, if we place all the data in wind speed bins of 1km/hr width, there would be no data at all in bins representing 1, 3, 5, 8, 10, 12, 14, 16km/hr... and our representation of the distribution of the wind speeds would be unrealistic. To get around this problem we treated the data as follows.

Each wind speed datum was converted back from its archive value (km/hr) to the

integer value (mi/hr or knots) that was measured originally. In this original system of units (mi/hr or knots), we added a random offset to the back-converted value so that the modified number ranged from half way to the previous integer value (except for zero) to half way to the next integer value. We then used the modified number (which, of course, would still have the same rounded integer value that it originally had) as input to the entire conversion process to which it had originally been subjected. However, in this process we did not round off to integer values but kept the decimal portion of the number. The overall effect was to create a continuum of wind speeds in the original measurement units, which converts in a reasonable way to the archived units. We call this process 'whitening' the data by analogy to the procedure used in spectral analysis. Note that, ultimately, Zephyr North converts all data received to ms^{-1} data for archiving.

10.5.2 Wind Direction

As an example of direction binning bias, consider the AES wind direction measurements. At various times in the history of AES wind measurement, the wind direction has been reported to 8 direction points (*i.e.*, compass points) or 16 direction points or 36 direction points (*i.e.*, 10° intervals). All data, however, are stored in the AES digital archive to the nearest whole 10° value (*i.e.*, 10, 20, ..., 350, 360° ; 0° represents calm). As described above for wind speed, this can cause problems because the data have not come from a continuum of directions so that a conversion of units means that some directions are not represented in the new system. We solved this problem in a manner entirely analogous to the solution of the problem for the wind speed—by conversion back to the original direction

measurements, whitening of the original data and re-conversion to the archive system in which wind directions are stored as decimal degrees.

11 APPENDIX C - STATION DATA

This appendix contains station summaries with geographic, meteorological, terrain and station siting information.

Station: **Akulivik A**

Abbreviation: **AKULIVIK**

Network ID: **15**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-78.1558E**

Latitude: **60.8197N**

Elevation(amsl): **9m**

Easting: **654,673m**

Northing: **6,745,856m**

UTM Zone: **17**

NTS Map References: **35D/16, 35D/9, 35C/13**

Data start: **93/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at the airport which is on the east shore of Hudson's Bay. The airport is sitting in a south-west - north-east valley and surrounded by small hills...and the anemometer tower are located 150 meters north of the terminal building. All sites are filled with gravel."
2. From photographs it is noted that the terrain is tundra.
3. The data are collected only during the day (no night-time data) seven days a week.

Station: **Aupaluk A**

Abbreviation: **AUPALUK**

Network ID: **14**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-69.6003°E**

Latitude: **59.3006°N**

Elevation(amsl): **38m**

Easting: **465,813m**

Northing: **6,573,466m**

UTM Zone: **19**

NTS Map References: **24N/5, 24N/3, 24N/4, 24N/6**

Data start: **93/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at the new Aupaluk Airport. The village is located on the west shore of Ungava Bay. The Airport is located on a relatively flat area, with a hill of nearly 107 meters on its east side. The instrument site is located at 150 meters south of the terminal building, it is made of compact gravel. The wind tower and ceiling projector are located in that site."
2. From photographs it is noted that the terrain is tundra.
3. Data are collected during daylight hours from Monday to Friday only.

Station: **Cape Hopes Advance**

Abbreviation: **CPHPSADV**

Network ID: **13**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude:

Latitude:

Elevation(amsl): **74m**

Easting: **469,025m**

Northing: **6,771,355m**

UTM Zone: **19**

NTS Map References: **25F/4, 25F/3, 25C/13, 25C/14**

Data start: **69/01**

Data end: **70/12**

Data archiving interval: **60min³**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	9.1m	60min ³
Wind Direction	WDir	°(true)	9.1	60 ³
Air Temperature (dry bulb)	Temp	C	1.5	60 ³
Station barometric pressure	BPress	kPa	1.5	60 ³
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "Located on a point of Rock on Hudson strait, between Diana Bay and Ungava Bay."
2. From photographs, the station is located on a high, steep cliff overlooking the ocean.
3. Data were recorded every three hours (not hourly), 24 hours a day, seven days a week. The archive is hourly but there are data only every three hours.

Station: **Inukjuak A**

Abbreviation: **INUKJUAK**

Network ID: **2**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-78.0797°E**

Latitude: **58.4700°N**

Elevation(amsl): **6m**

Easting: **670,324m**

Northing: **6,484,530m**

UTM Zone: **17**

NTS Map References: **34L/8, 34L/9**

Data start: **77/01**

Data end: **91/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "Located on the west bank of the Inukjuak River at entrance to Hudson Bay, hills are situated 1.5km to the northwest. The anemometer is unobstructed in all directions except to the northwest."
2. From photographs, the terrain is tundra.

Station: Ivujivik A

Abbreviation: IVUJIVIK

Network ID: 3

Network: AES Regular (HLY01)

Network Abbr: R4AE

Type: AES Synoptic and Auto Stations

Longitude: -77.9286°E

Latitude: 62.4147°N

Elevation(amsl): 42m

Easting: 348,728m

Northing: 6,923,609m

UTM Zone: 18

NTS Map References: 35K/5, 35L/8

Data start: 93/01

Data end: 94/12

Data archiving interval: 60min

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located on Ivujivik point which is on the shore of Digges Sound, at the north-west end of the Province of Quebec....The ceiling projector and the anemometer tower are located 140 meters west of the terminal building and 110 meters south of the runway (center line). The sites are all filled with gravel. The close area is flat but there are mountains in the east, south and west quadrants."
2. From photographs, the surrounding area is tundra.
3. Data were collected during the daytime hours only for five days a week for part of the data analysis period and seven days a week for the remaining portion of the analysis period.

Station: **Kangiqsualujuaq A**

Abbreviation: **KNGQSLJK**

Network ID: **12**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-65.9925°E**

Latitude: **58.7086°N**

Elevation(amsl): **60m**

Easting: **326,653m**

Northing: **6,511,267m**

UTM Zone: **20**

NTS Map References: **24I/12, 24I/13, 24J/9, 24J/15, 24J/16**

Data start: **93/01**

Data end: **93/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at the Kangiqsualujuaq Airport. The community is on the east side of Ungava Bay, on the north shore of the George River. The runway lies in a valley bordered by hills approximately 135 meters high on both sides. This valley is one kilometer wide (so visibility are limited to the SW and NE) and five kilometers long, oriented NW-SE. The Anemometer tower is influenced by the valley effect. The instrument site is made of compacted gravel. The ceiling projector and the anemometer tower are 140 meters NNW of the terminal building."
2. From photographs, the surrounding terrain appears to be tundra.
3. Data were collected only during the daytime hours, seven days a week.

Station: **Kangiqsujaq A**

Abbreviation: **KNGQSJQ**

Network ID: **5**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-71.9322°E**

Latitude: **61.5897°N**

Elevation(amsl): **156m**

Easting: **344,388m**

Northing: **6,831,777m**

UTM Zone: **19**

NTS Map References: **25E/12, 35H/9**

Data start: **93/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	12.2m	60min
Wind Direction	WDir	°(true)	12.2	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at the new Kangiqsujaq Airport, on the shoreline of Wakeham Bay, south shore of Hudson Strait. The topography is very much accidented; the area is surrounded by rocky hills and the station is at the high end of a through leading to the bay. The only flat surfaces are the airstrip, the building area and the instrument site which is made of compacted gravel...The ceiling projector and the anemometer tower are 152 meters south of the terminal building on a compacted gravel pad, on the other side of the airport road."
2. From photographs, the terrain seems to be tundra.
3. Data were collected only during the daytime period, seven days a week.

Station: **Kangirsuk A**

Abbreviation: **KNGRSK**

Network ID: **6**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-70.0047°E**

Latitude: **60.0253°N**

Elevation(amsl): **117m**

Easting: **444,001m**

Northing: **6,654,445m**

UTM Zone: **19**

NTS Map References: **25C/4, 25D/1, 24M/16, 24N/13**

Data start: **93/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	12.2m	60min
Wind Direction	WDir	°(true)	12.2	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located on the west shore of Ungava Bay, close to Arnaud River. The old name of the locality is Payne Bay. The general topography is uneven with hills and mountains. The local topography is in an east-west slope and has been levelled. The site is made with gravel...the ceiling projector and the anemometer tower are located 150 meters north-east of the station, on a site enclosed with a fence which is close to the water supply access road."
2. From photographs, the surrounding terrain appears to be tundra.
3. Data were collected only during the daytime hours, seven days a week.

Station: **Kuuujuaq A**

Abbreviation: **KUUJJUAQ**

Network ID: **7**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-68.4281°E**

Latitude: **58.0917°N**

Elevation(amsl): **37m**

Easting: **533,722m**

Northing: **6,438,848m**

UTM Zone: **19**

NTS Map References: **24K/1, 24K/2**

Data start: **80/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The instrument site is situated 55 meters to the south of the airport FSS tower. The site is covered with gravel and is slightly inclined for drainage. The nearby terrain is relatively flat and clear. The Koksoak River runs about 700 meters further south on an ENE-WSW axis. Mountains (about 500 meters elevation) rise in all cardinal directions at various distances. The closest are about 5 kilometers away. Everywhere, the ground is covered with lichens and rocks. The anemometer tower is situated on a cleared apron on the north side of runway 07-25 and about midway between the ends of the runway."
2. From photographs, the terrain seems to be tundra.

Station: **Kuujjuarapik A**

Abbreviation: **KJJRPK**

Network ID: **4**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-77.7558°E**

Latitude: **55.2761°N**

Elevation(amsl): **10m**

Easting: **324,943m**

Northing: **6,128,764m**

UTM Zone: **18**

NTS Map References: **33N/5, 33N/4**

Data start: **80/01**

Data end: **89/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The instrument site is situated about 20 meters to the west of the operations centre of Transport Canada. The terrain is sandy and slopes slightly towards Hudson Bay except at the station and the instrument site where the ground has been levelled. The Grande Baleine River is located about 1.3 kilometers south of the station. Hudson Bay occupies the quadrants from the south-west to the north. The other sectors are made up of hills with tundra type vegetation and valleys partially wooded with small pines. The wind measurement site is located 75 meters to the east of the runway and is well exposed to the wind from all sectors."
2. From photographs, some of the terrain appears to be tundra, while some of it is wooded with small trees.

Station: **Povungnituk A**

Abbreviation: **PVNGNTK**

Network ID: **11**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-77.2789°E**

Latitude: **60.0439°N**

Elevation(amsl): **18m**

Easting: **373,069m**

Northing: **6,658,280m**

UTM Zone: **18**

NTS Map References: **35C/3, 34N/14**

Data start: **93/06**

Data end: **95/05**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "Povungnituk is located on the east side of Hudson Bay and on the north shore of Povungnituk Bay. The station is at the airport in the terminal building. The surface of the ground in general is covered by rocks and grass...The anemometer tower along with the ceiling projector are located 140 meters to the north of the station. The instrument sites are filled with compact gravel from the runway. The instruments are all well exposed and within standards.
2. During the analysis period, the data were recorded only during the daytime hours, seven days a week, with a few additional observations during the night.

Station: **Quaqtaq**

Abbreviation: **QUAQTAQ**

Network ID: 1

Network: AES Regular (HLY01)

Network Abbr: R4AE

Type: AES Synoptic and Auto Stations

Longitude: -69.6300°E

Latitude: 61.0464°N

Elevation(amsl): 29m

Easting: 465,975m

Northing: 6,767,914m

UTM Zone: 19

NTS Map References: 25F/4, 26F/3, 25C/13, 25C/14

Data start: 72/01

Data end: 80/12

Data archiving interval: 60min³

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min ³
Wind Direction	WDir	°(true)	10.0	60 ³
Air Temperature (dry bulb)	Temp	C	1.5	60 ³
Station barometric pressure	BPress	kPa	1.5	60 ³
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at Quaqtaq Airport which is situated on the east coast of Diana Bay. The general topography is uneven with many small hills. The instrument site is on gravel...the ceiling projector and the anemometer tower are 300 meters south-east of the station."
2. From photographs, the surrounding terrain seems to be tundra.
3. During the analysis period, the data were recorded at three hour intervals, with one missing (three-hour) observation most mornings during the first half of the period.

Station: **Salluit A**

Abbreviation: **SALLUIT**

Network ID: **10**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-75.6695°E**

Latitude: **62.1802°N**

Elevation(amsl): **226m**

Easting: **465,140m**

Northing: **6,894,230m**

UTM Zone: **18**

NTS Map References: **35J/4, 35J/3, 35J/5, 35J/6**

Data start: **93/01**

Data end: **94/12**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located near Saglouk Fjord on the south shore of Hudson Strait. The former name of the village is Saglouk. The local topography is well accidented. The only flat areas are the runway, the area around the terminal building and the instrument site...The ceiling projector and the anemometer are 150 meters south of the terminal building on a compacted gravel surface. This area is approximately 5 meters below the runway level."
2. From photographs, the surrounding terrain appears to be tundra.
3. Date were taken only during daytime hours, seven days a week.

Station: **Tasiujaq A**

Abbreviation: **TASIUJAQ**

Network ID: **9**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-69.9519°E**

Latitude: **58.6689°N**

Elevation(amsl): **37m**

Easting: **444,784m**

Northing: **6,503,366m**

UTM Zone: **19**

NTS Map References: **24K/12, 24K/13, 24L/9, 24L/16**

Data start: **93/06**

Data end: **95/05**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at Tasiujaq Airport which is situated at 2.5km south-west of "Deep Bay". The general topography is uneven with few small hills. The instrument site is on gravel...The ceiling projector and the anemometer tower are 152 meters south-west of the terminal building."
2. From photographs, the surrounding terrain seems to be tundra.
3. During the analysis period, data were collected during daytime hours only, Monday to Friday only.

Station: **Umiujaq A**

Abbreviation: **UMIUJAO**

Network ID: **8**

Network: **AES Regular (HLY01)**

Network Abbr: **R4AE**

Type: **AES Synoptic and Auto Stations**

Longitude: **-76.5033°E**

Latitude: **56.5375°N**

Elevation(amsl): **71m**

Easting: **407,547m**

Northing: **6,266,704m**

UTM Zone: **18**

NTS Map References: **34C/10, 34C/7, 34C/8, 34C/9,**

Data start: **93/02**

Data end: **95/01**

Data archiving interval: **60min**

Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "Umiujaq is located on the east shore of the Hudson Bay. The station is at the airport in the terminal building. It is surrounded by hills (so the visibility is limited to the south, east and north) with the sea to the west. The surface of the ground in general is covered by rocks, grass and little bushes...The anemometer tower with the projector are located 140 meters to the south of the station. The sites of those instruments are all filled with compact gravel from the runway. The instruments are all well exposed and within their standards."
2. During the analysis period, data were only collected during the daytime hours, seven days a week.

12 APPENDIX D - WIND DATA SUMMARIES

This appendix contains graphs summarizing wind energy resource characteristics at all stations. The summarized data are presented for the anemometer height and are not corrected for obstructions to the anemometer. The following sections describe the graphs.

12.1 Wind Distribution (Graph)

The multiple plots on this diagram are derived from binned data expressed as joint frequency distributions of wind speed or wind power density with wind direction sector. Sixteen wind direction sectors were used. There is one page for each measurement level.

Left Side - Wind Rose Plots

Top - Distribution by direction of frequency of occurrence of the wind.

Note that calms have been distributed equally throughout all directions.

Centre - Distribution by direction of average wind speed.

The average wind speed in each direction is shown along with the overall average wind

speed. This includes calms distributed equally throughout all directions. Averages have been calculated as described in Appendix A.

Bottom - Distribution by direction of average wind power density.

The average wind power density in each direction is shown along with the overall average power density. This includes calms distributed equally throughout all directions. Note that it is the percentage of the overall power density that is shown in each sector.

Right Side - Frequency Histograms

Top - Percentage occurrence of wind speed v. wind speed for all directions.

Wind speed bins are 0.5m/s wide. Weibull parameters c and k are shown as well as the Weibull distribution represented by those parameters.

Below - Percentage occurrence of wind speed v. wind speed by direction bin.

Wind speed bins are 0.5m/s wide. Each histogram represents the distribution of the wind speed within the directions indicated on the graph. Weibull parameters c and k (for the particular direction plot) are shown as well as the Weibull distribution represented by those parameters.

12.2 Annual Averages (Graph)

These two graphs show the annual variation in mean wind speed and mean wind

power density at the measurement level(s).
The averages are calculated as described in
Appendix A.

12.3 Annual Averages (Table)

This table lists the annual statistics
(generally averages) for the station. The
format of the table is described in Appendix
E.

12.4 Monthly Distribution (Graph)

These two graphs show the monthly
variation in mean wind speed and mean wind
power density at the measurement level(s).
Each monthly average is computed over the
entire period of record.

12.5 Monthly Roses (Graph)

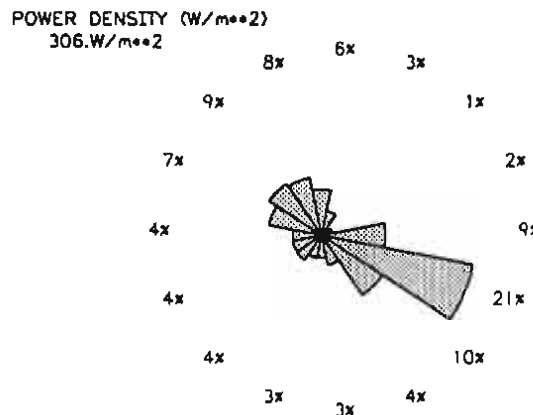
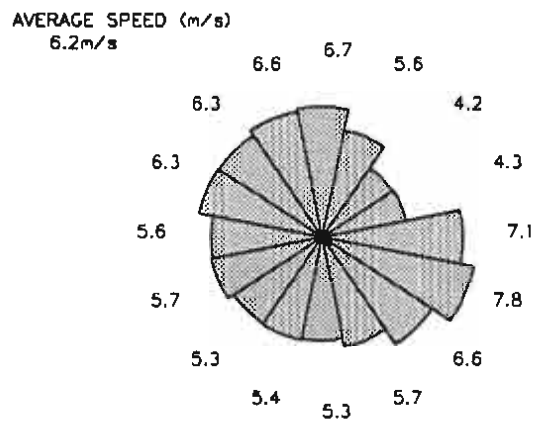
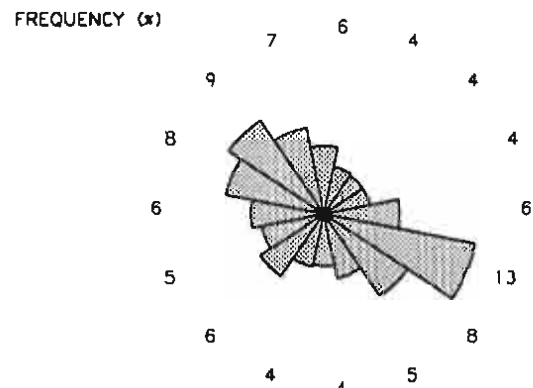
This graph shows the monthly distribution
by direction of the wind frequency, the
average wind speed and the average power
density. Note that for the power density, it is
the percentage of the total power density (all
directions) that is displayed for each direction
sector.

12.6 Diurnal Distribution (Graph)

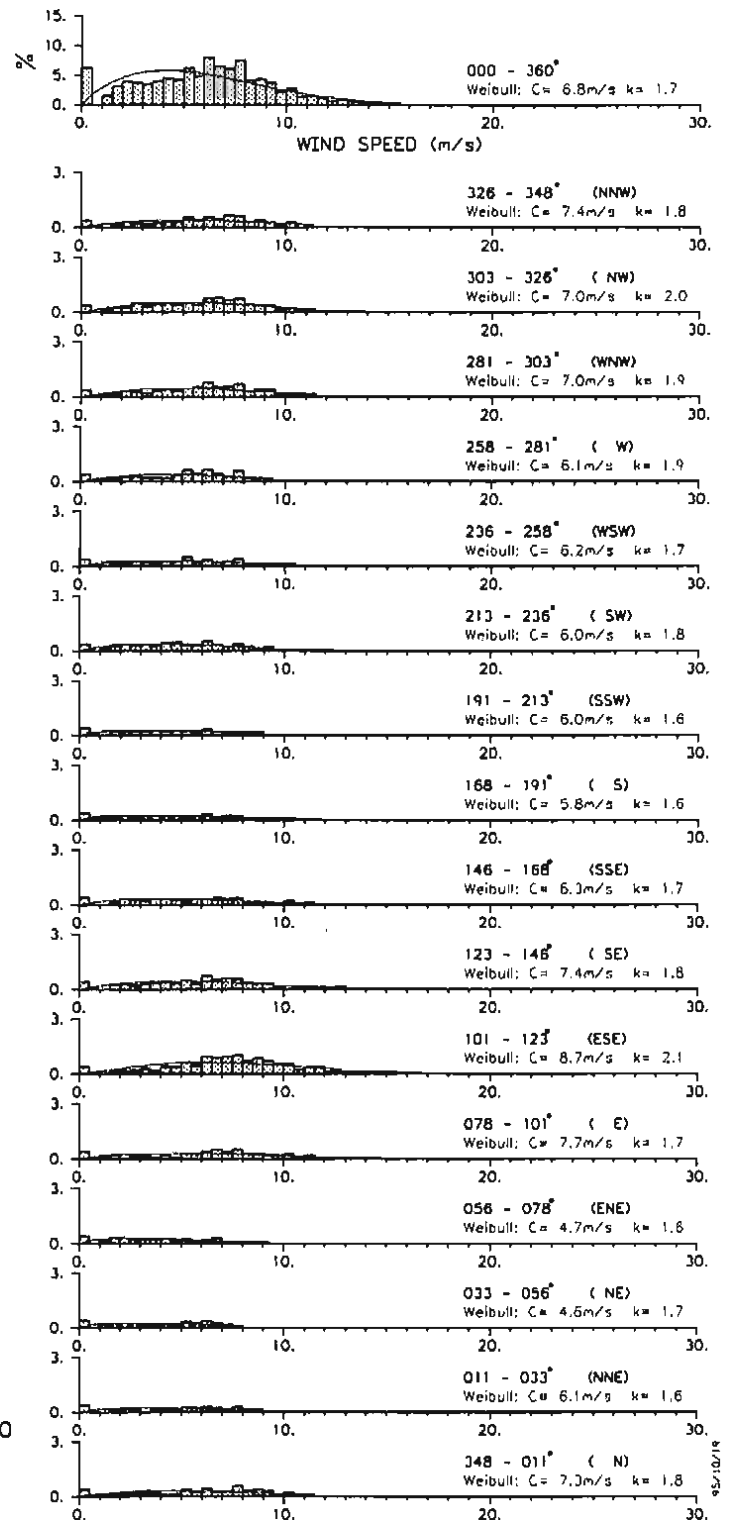
Separate graphs of the variation in wind
speed and wind power density with time of
day, are provided for each month of the year.
Averages are taken over the entire period of
record.

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

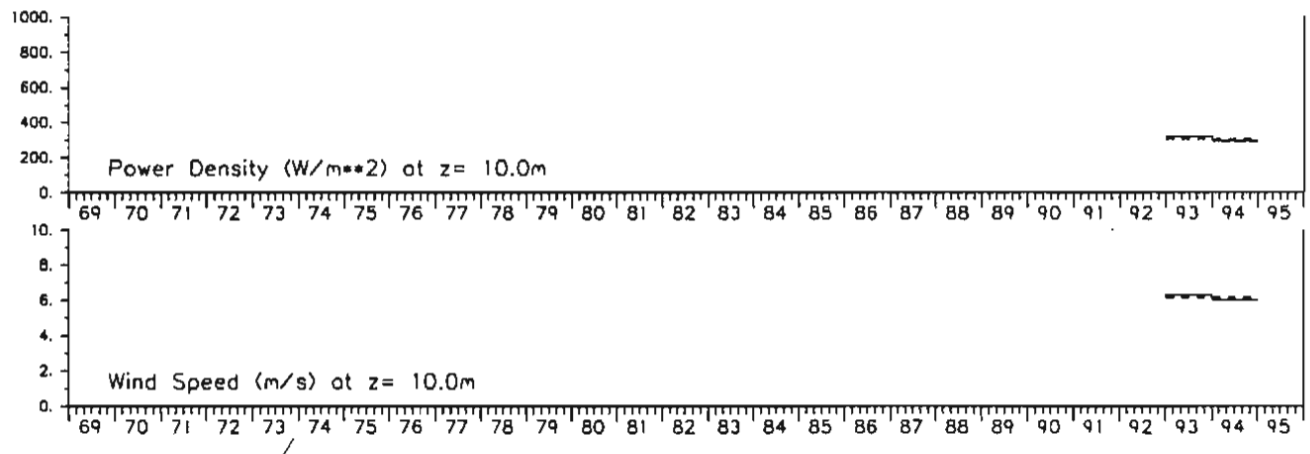


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Akulivik A (15)
 Wind Speed (m/s) at z= 10.0m
 Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Akulivik A (15)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Akulivik A (15)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-6.9	101.03	1.325	6.3	247.	19.7	-N/A-	318.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.1	101.07	1.327	6.0	72.	19.7	-N/A-	294.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	35.1	35.1	35.1	35.1	33.3	35.1	0.0	35.1	0.0	0.0	0.0
94/01/01->95/01/01	37.1	3.0	3.0	37.0	34.2	37.0	0.0	37.0	0.0	0.0	0.0

Period Average

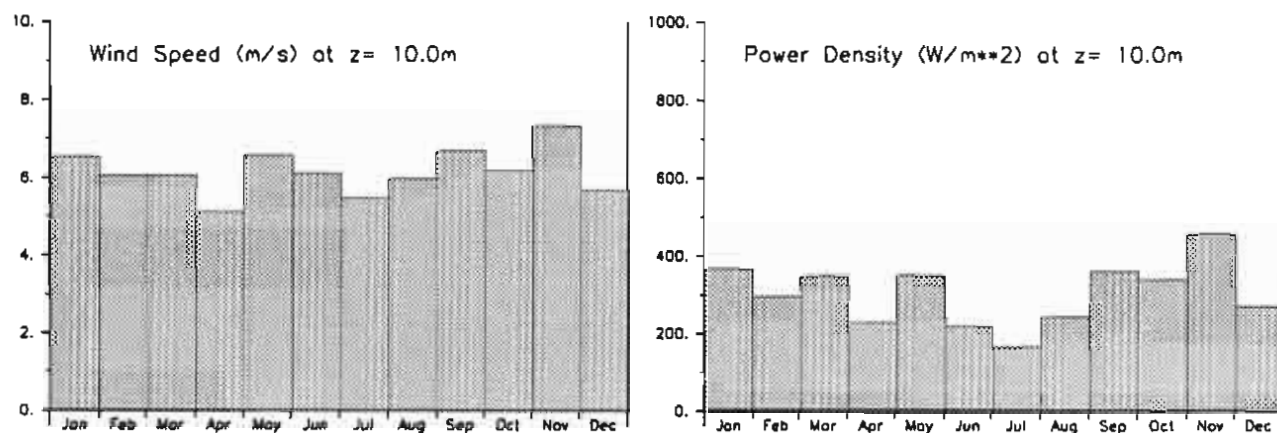
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	101.04	1.326	6.2	239.	19.7	-N/A-	306.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	36.1	19.0	19.0	36.1	33.8	36.1	0.0	36.1	0.0	0.0	0.0

95/10/20

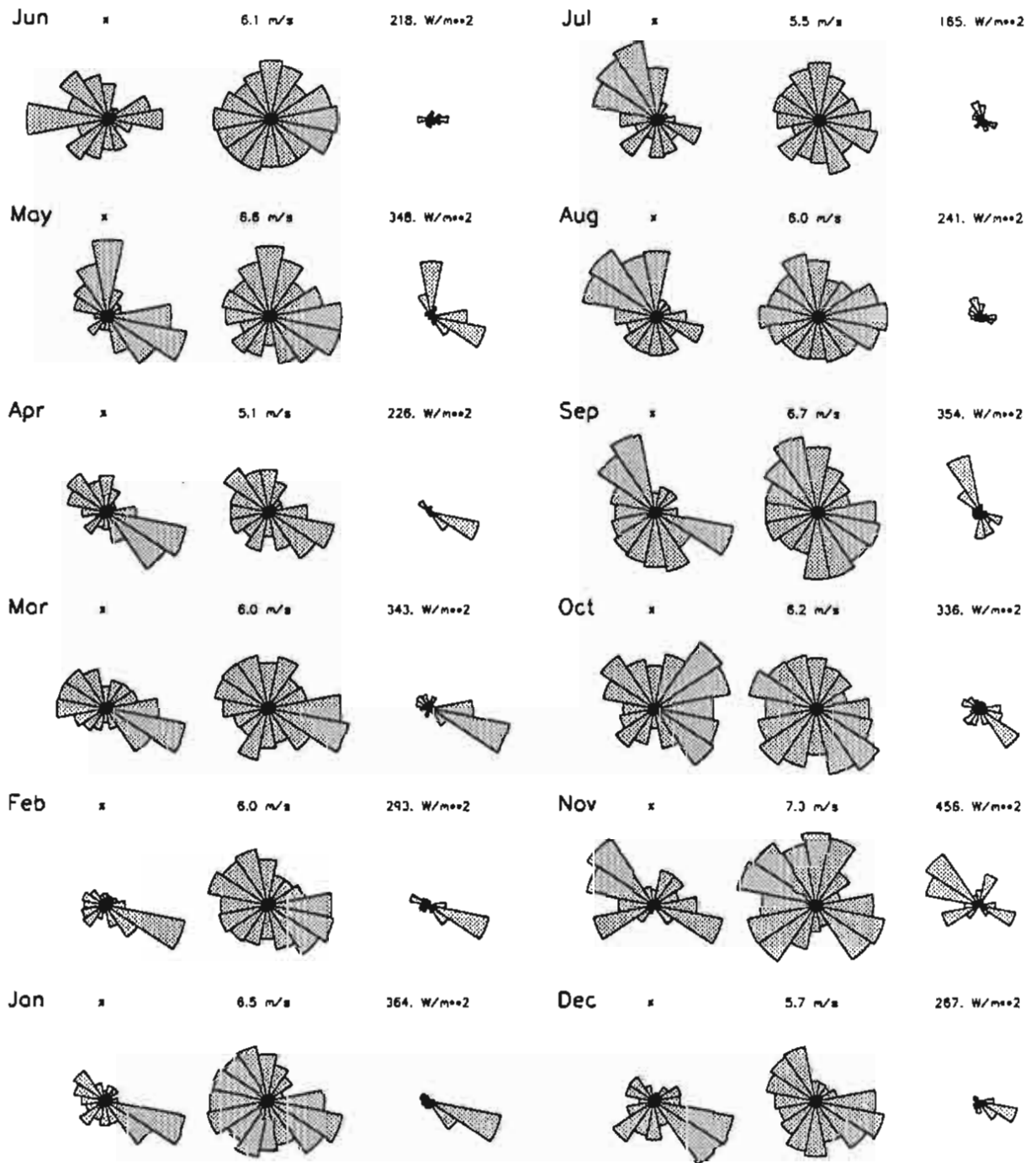
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Akulivik A (15)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

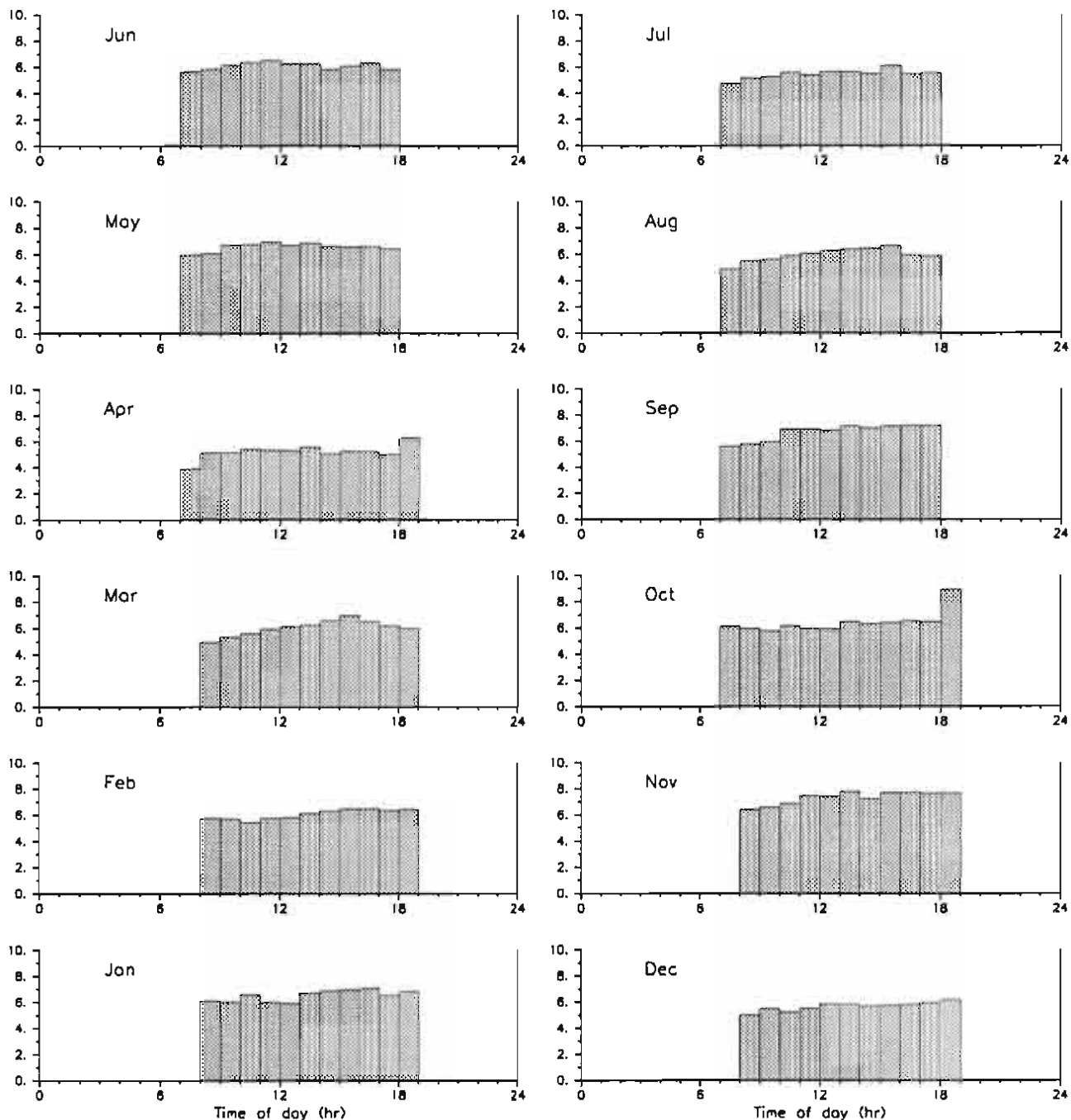
Station: Akulivik A (15)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

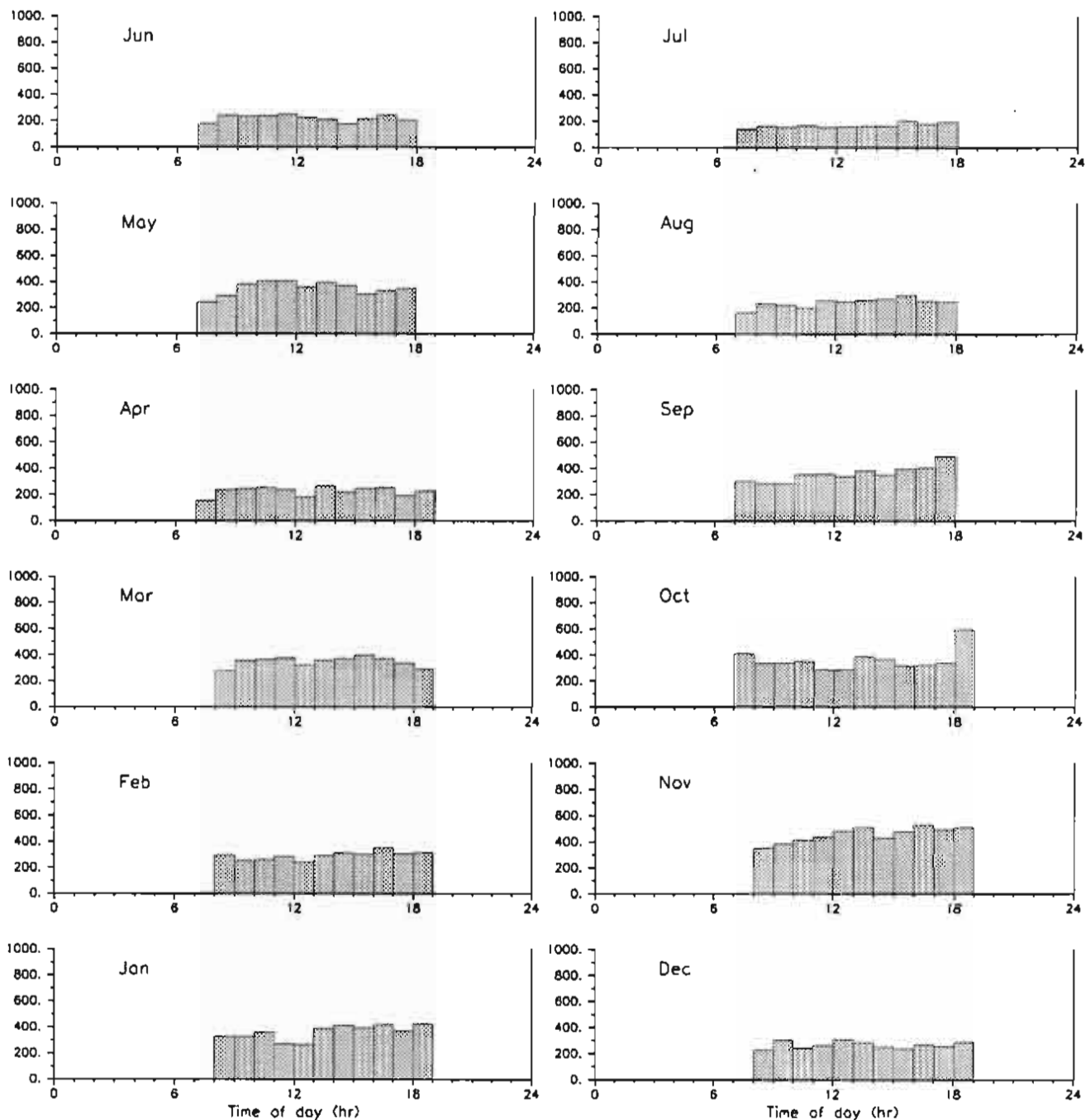
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Akulivik A (15)
 Wind Speed (m/s) at z= 10.0m

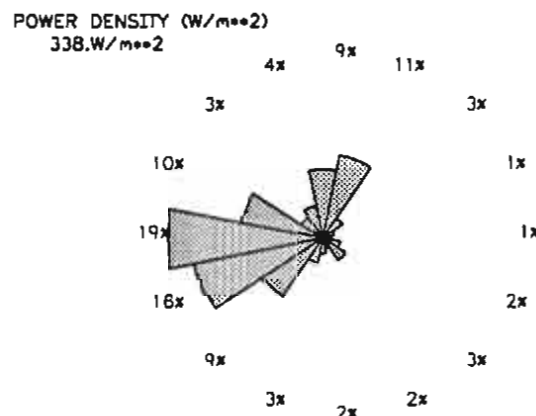
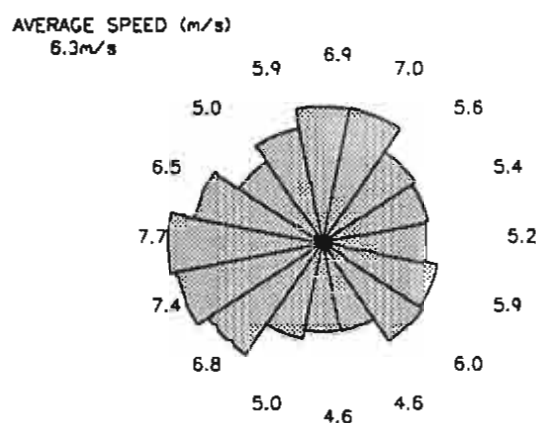
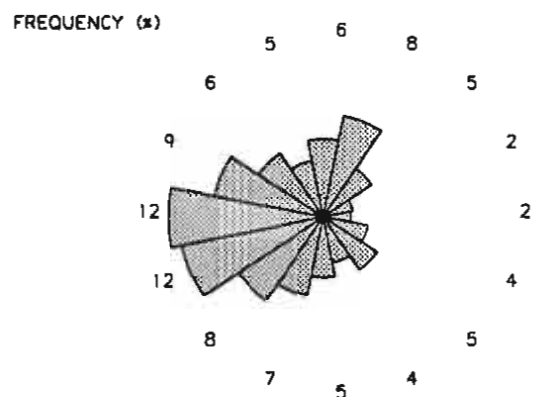
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



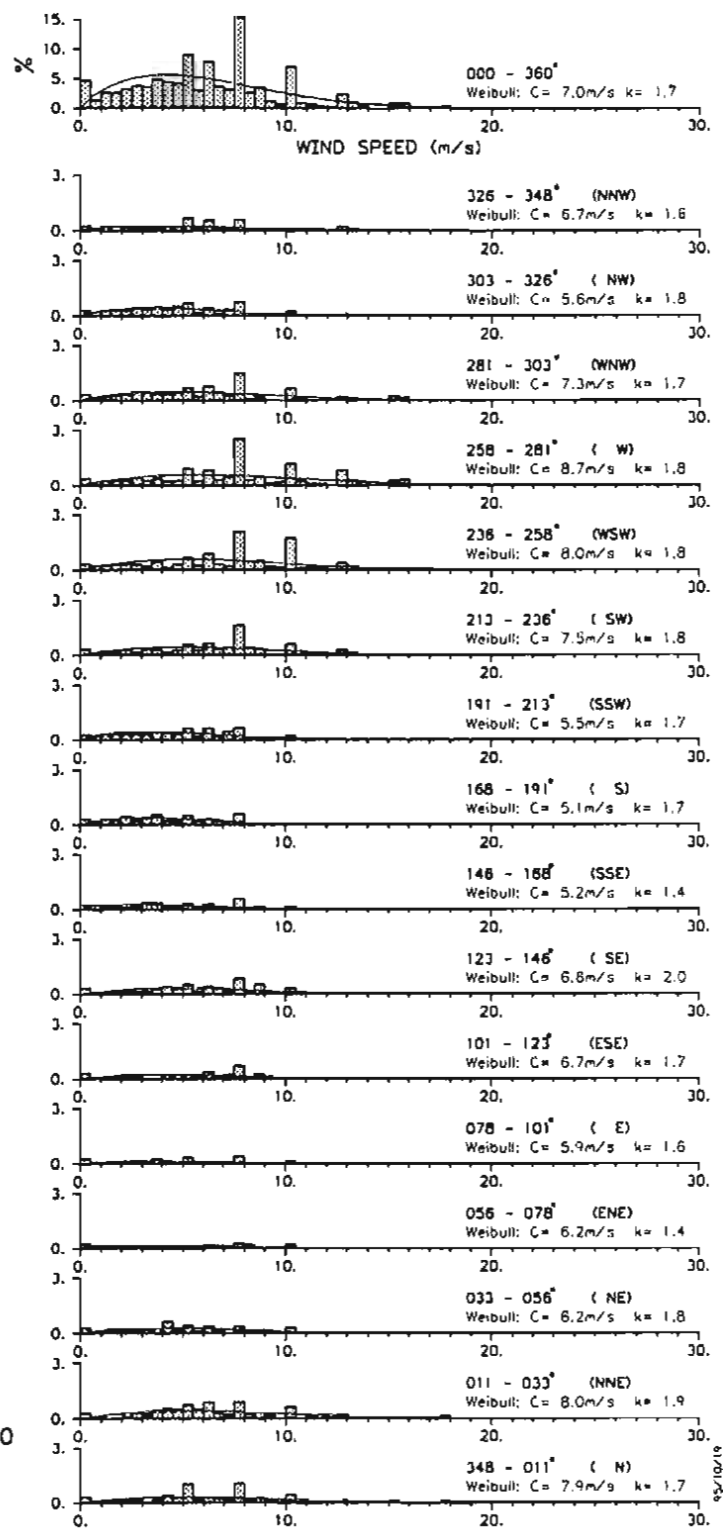
Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Akulivik A (15)
 Power Density (W/m²) at z = 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

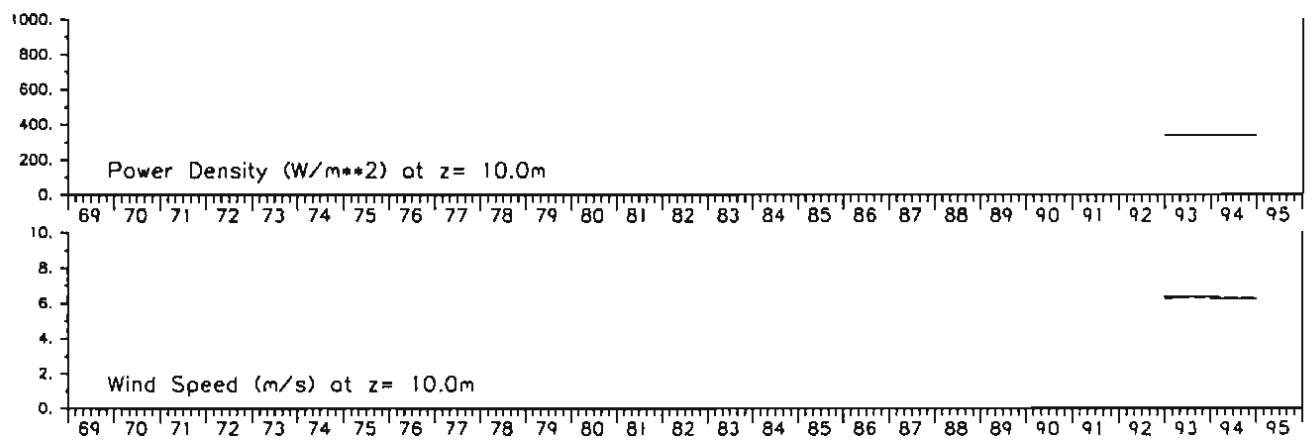


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Aupaluk A (14)
 Wind Speed (m/s) at z= 10.0m
 Wind Direction (deg) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Aupaluk A (14)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Aupaluk A (14)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.3	100.70	1.322	6.4	260.	20.6	-N/A-	337.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.70	1.320	6.3	285.	20.8	-N/A-	340.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	18.7	18.7	18.7	18.7	17.9	18.7	0.0	18.7	0.0	0.0	0.0
94/01/01->95/01/01	18.4	1.4	1.4	18.4	17.6	18.4	0.0	18.4	0.0	0.0	0.0

Period Average

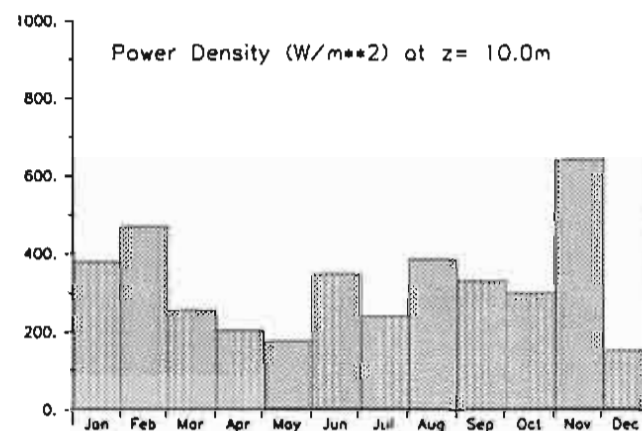
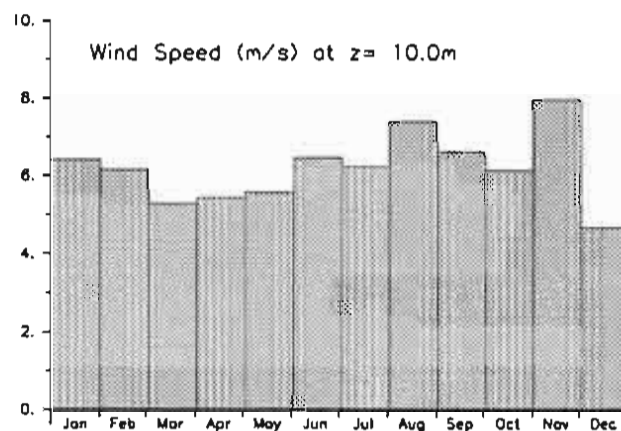
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	100.70	1.321	6.3	271.	20.8	-N/A-	338.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	18.6	10.1	10.1	18.6	17.7	18.6	0.0	18.6	0.0	0.0	0.0

95/10/20

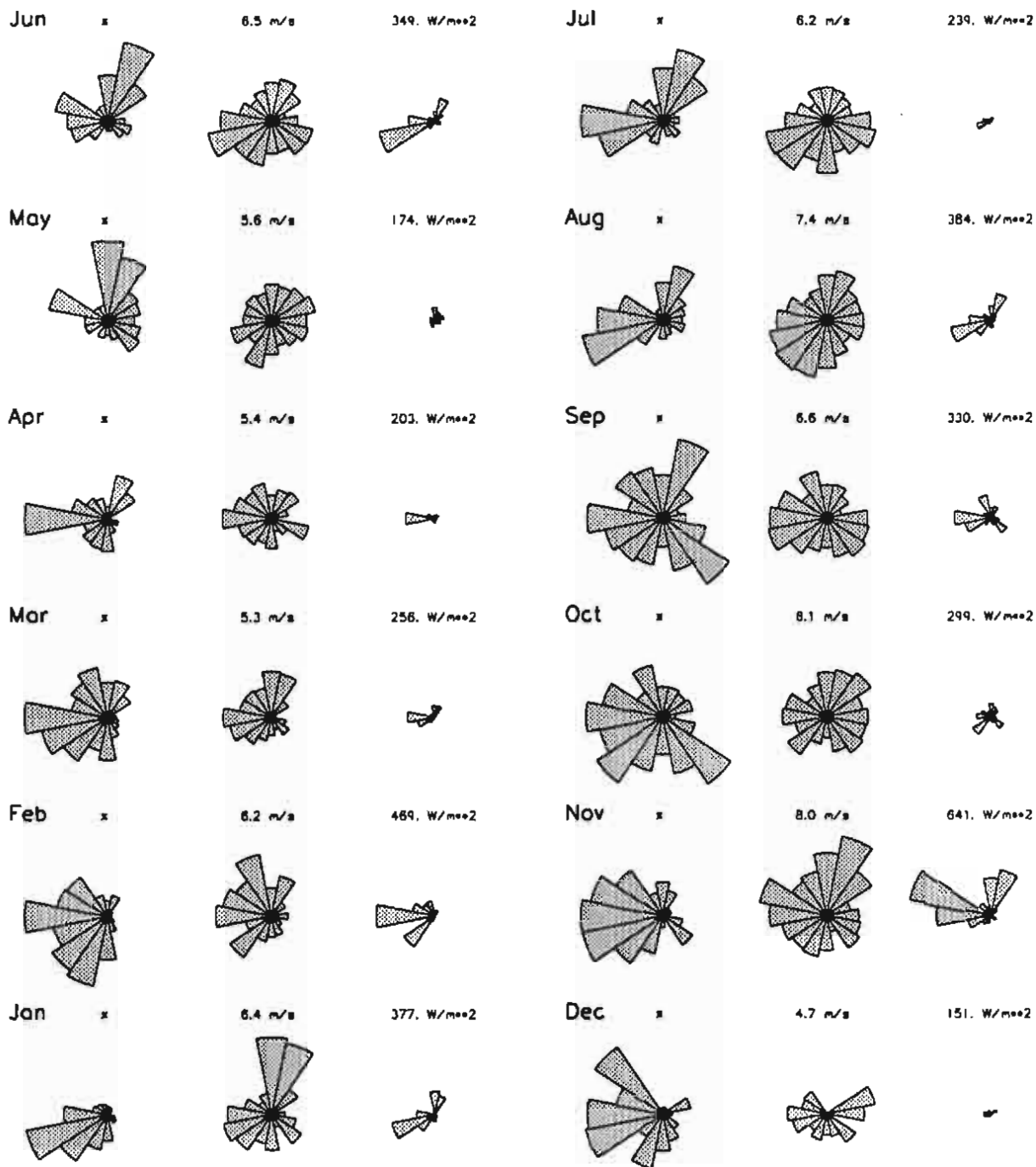
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Aupaluk A (14)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

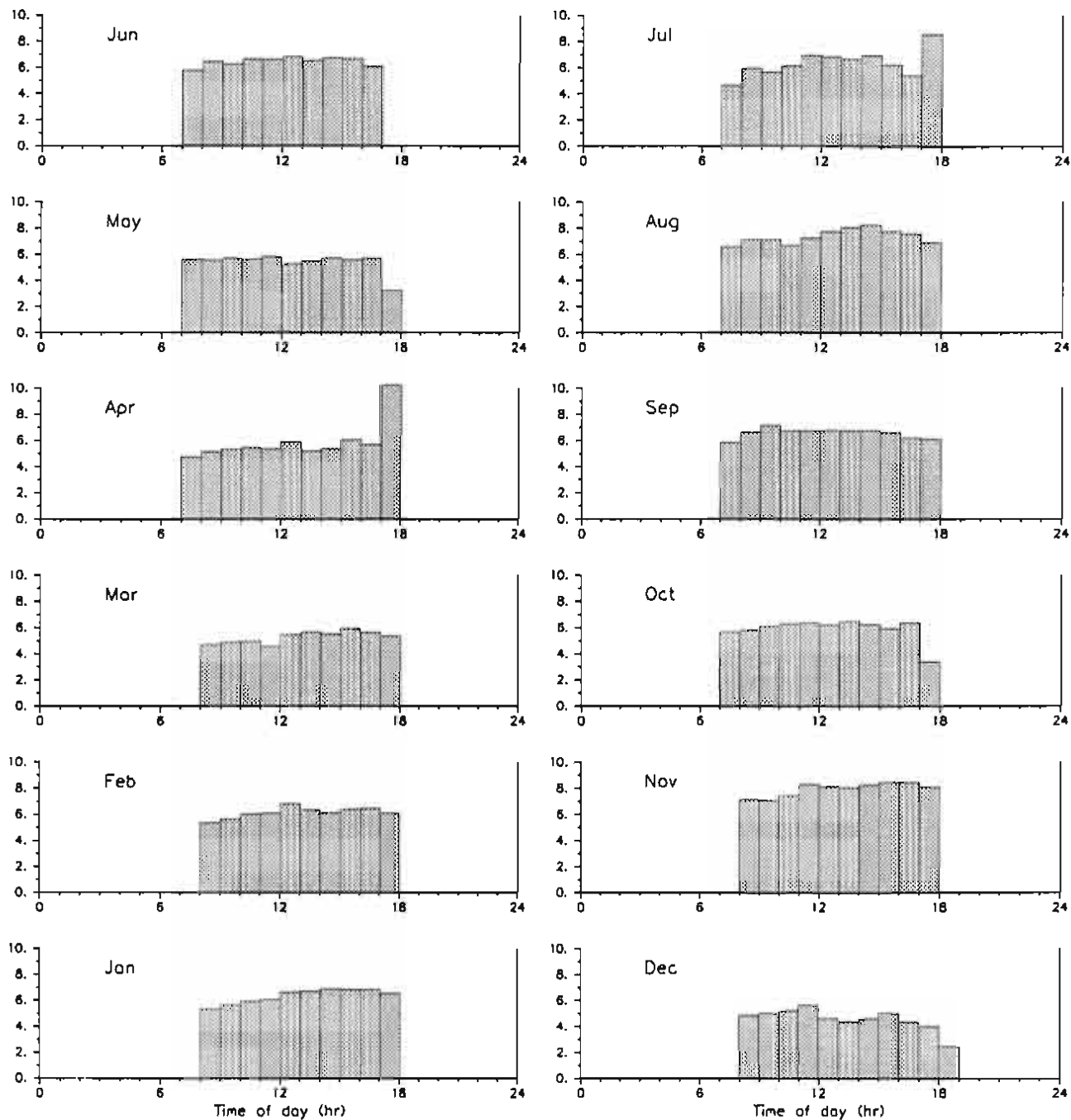
Station: Aupaluk A (14)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

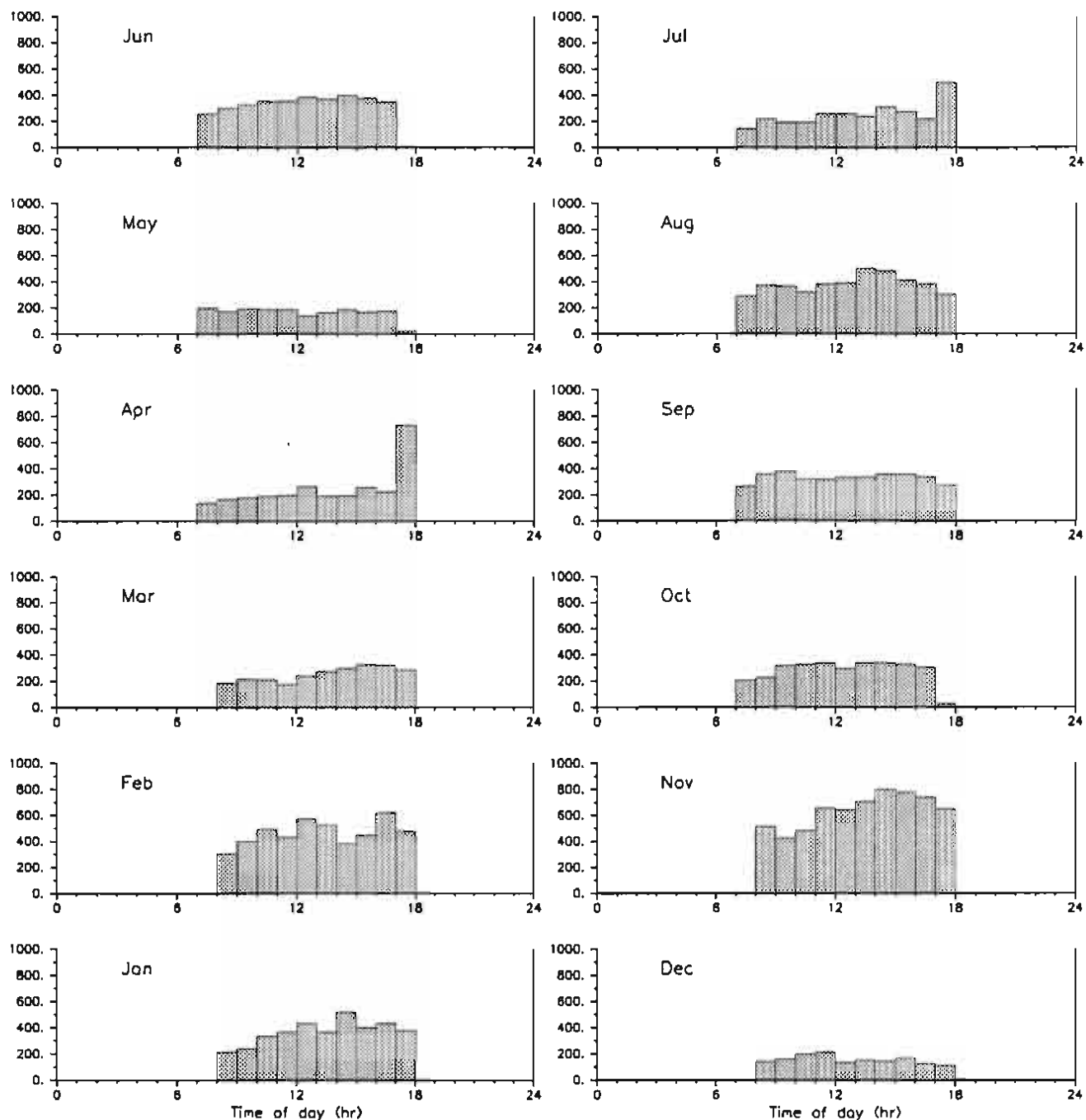
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Aupaluk A (14)
 Wind Speed (m/s) at z= 10.0m

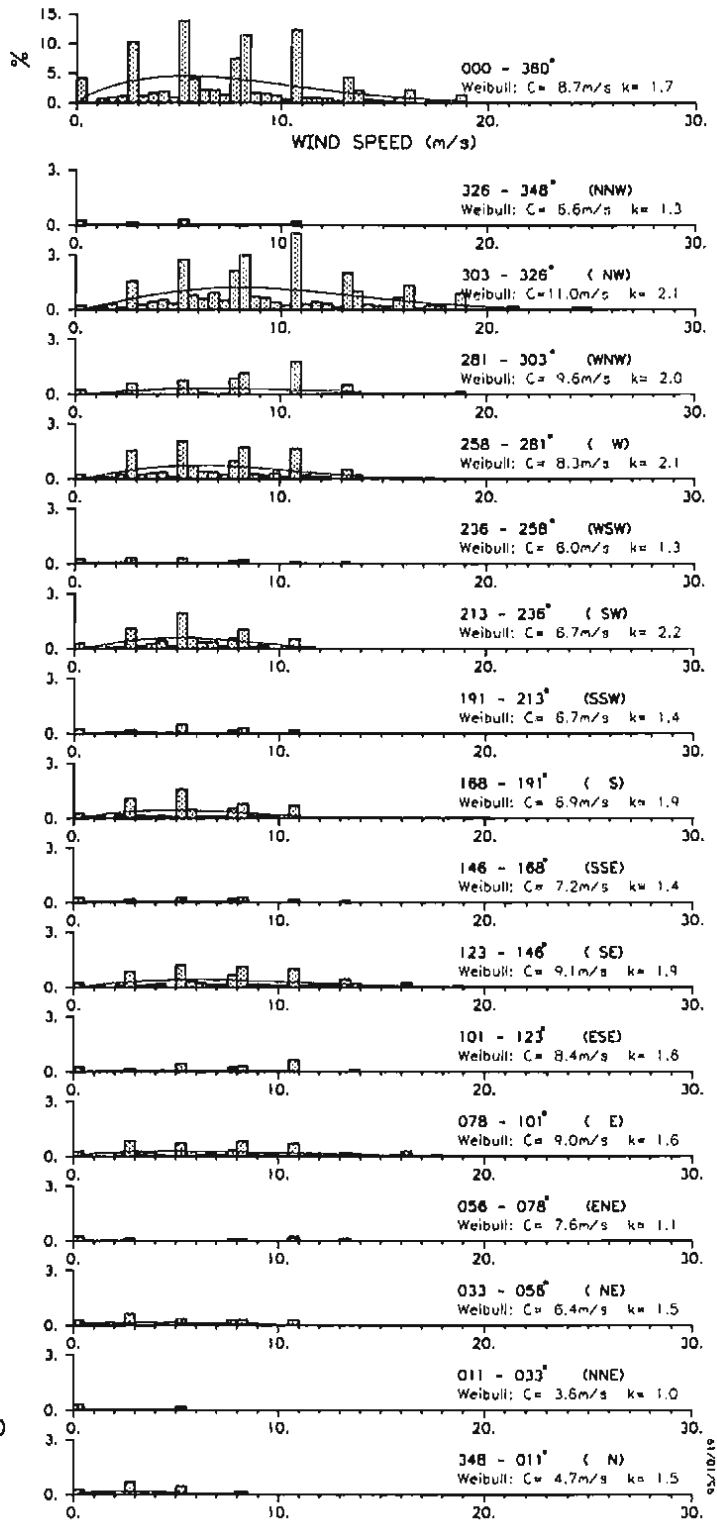
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Aupaluk A (14)
 Power Density (W/m²) at z= 10.0m

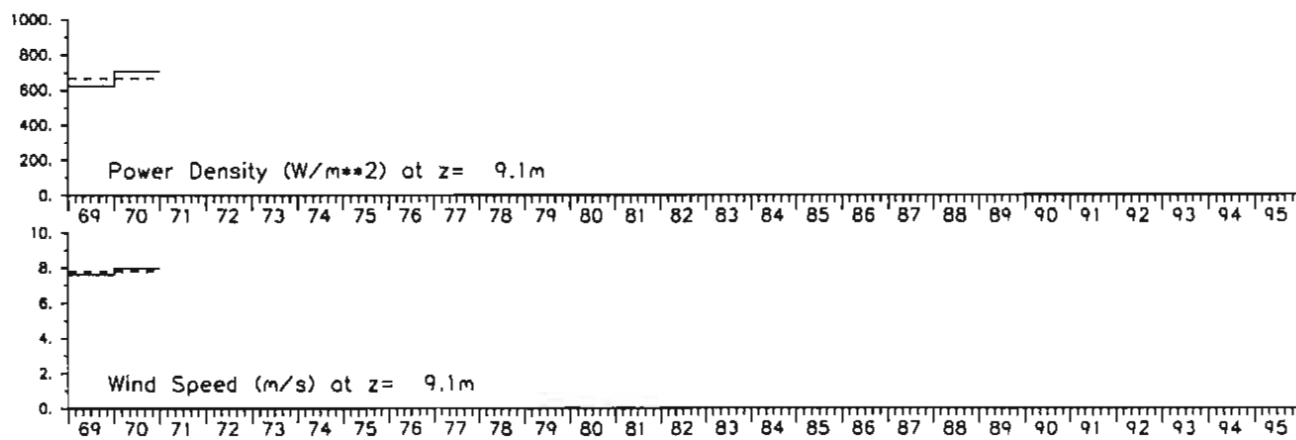
Northern Quebec Wind Resource Study - AES Stations

Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00
Station: Cape Hopes Advance (13)
Wind Speed (m/s) at z= 9.1m
Wind Direction (deg) at z= 9.1m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00

Station: Cape Hopes Advance (13)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00
Cape Hopes Advance (13)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 9.1m m/s	WDir 9.1m degt	MxWSpd 9.1m m/s	Gust 9.1m m/s	Power 9.1m W/m**2	TrbInts 9.1m	TrbnPwr 9.1m kW	TrbnOut 9.1m MWhr
69/01/01->70/01/01	-6.7	100.09	1.310	7.6	280.	30.6	-N/A-	623.	-N/A-	-N/A-	-N/A-
70/01/01->71/01/01	-7.0	100.06	1.312	8.0	281.	32.1	-N/A-	707.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
69/01/01->70/01/01	33.3	33.3	33.3	33.3	31.7	33.3	0.0	33.3	0.0	0.0	0.0
70/01/01->71/01/01	33.3	33.3	33.3	33.3	32.1	33.3	0.0	33.3	0.0	0.0	0.0

Period Average

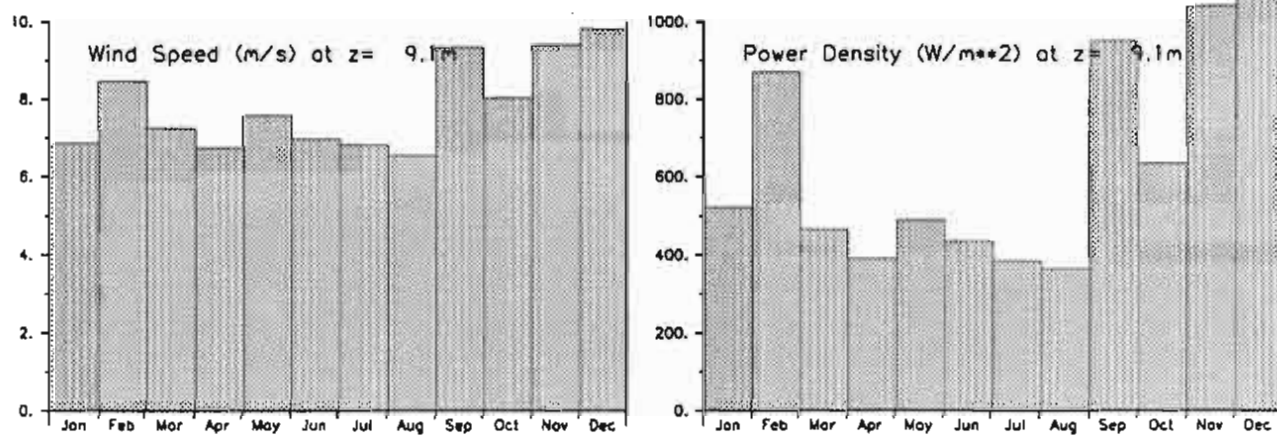
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
69/01/01->71/01/01	-6.9	100.07	1.311	7.8	281.	32.1	-N/A-	665.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
69/01/01->71/01/01	33.3	33.3	33.3	33.3	31.9	33.3	0.0	33.3	0.0	0.0	0.0

95/10/20

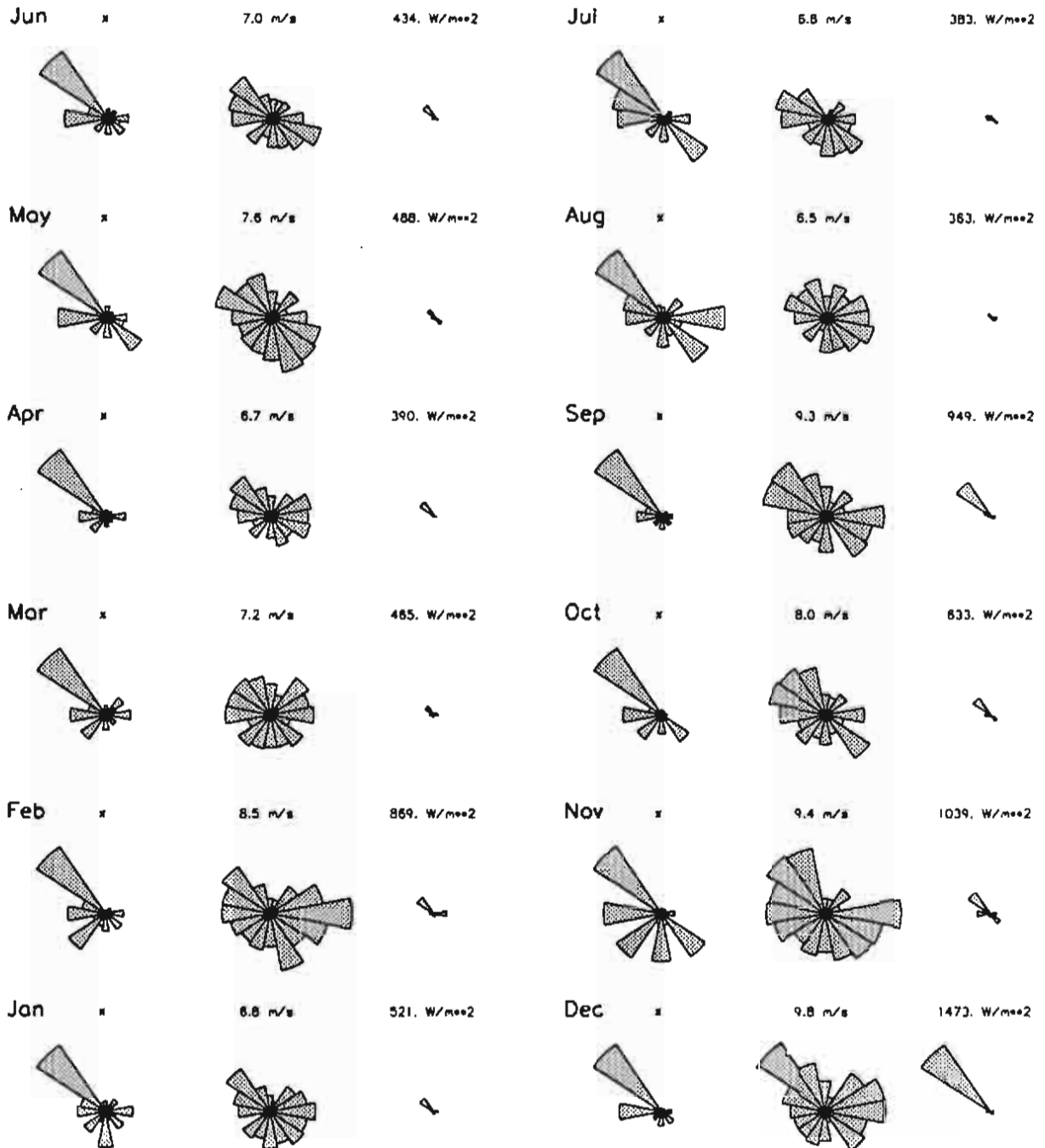
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00
 Station: Cape Hopes Advance (13)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00

Station: Cape Hopes Advance (13)

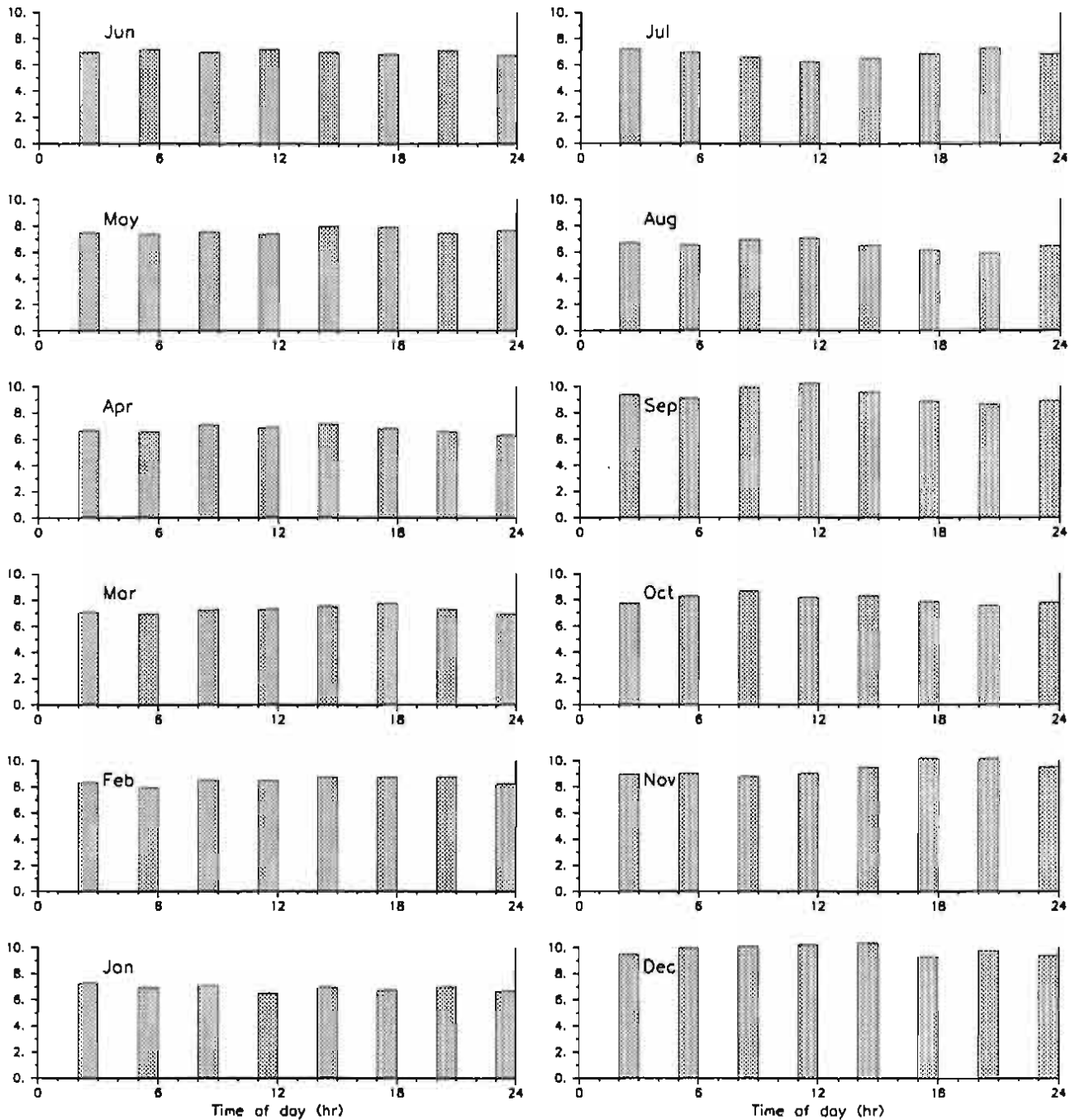
Wind Speed (m/s) at z= 9.1m

Wind Direction (degt) at z= 9.1m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

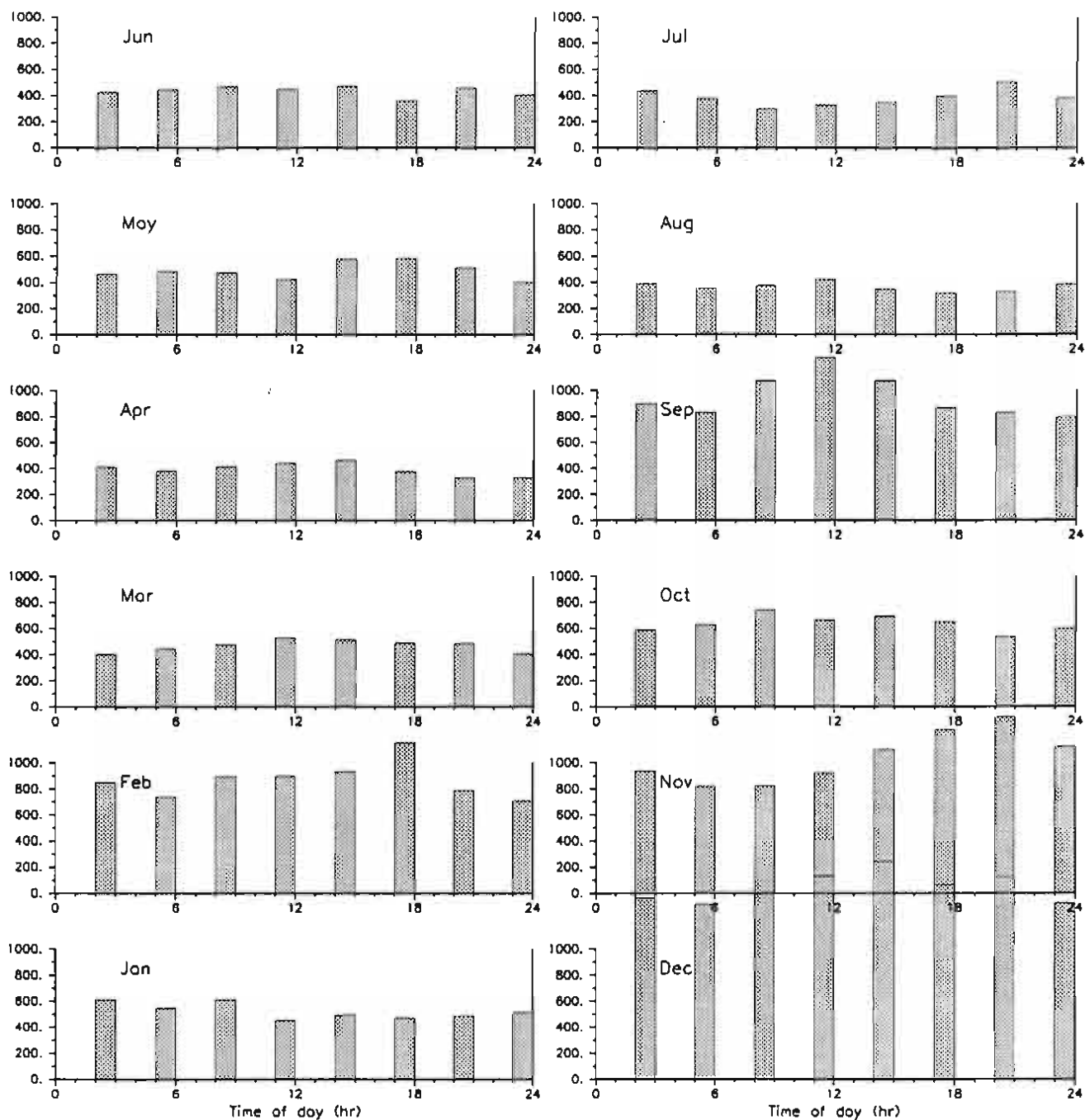
45/10/17

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00
 Station: Cape Hopes Advance (13)
 Wind Speed (m/s) at z= 9.1m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

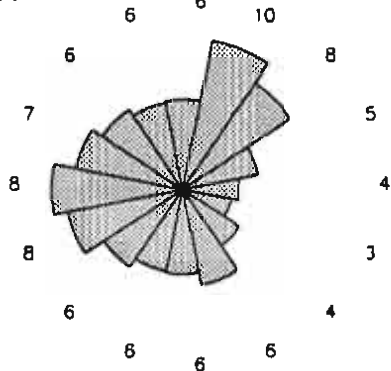


Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00
 Station: Cape Hopes Advance (13)
 Power Density (W/m²) at z= 9.1m

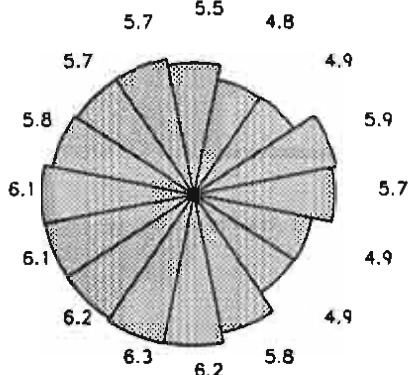
WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

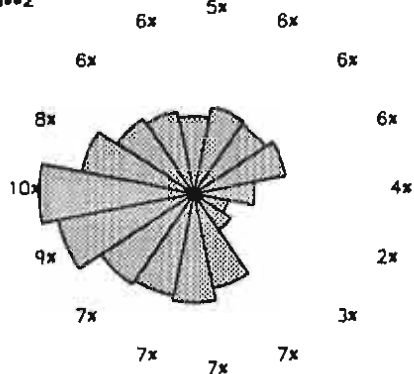
FREQUENCY (%)



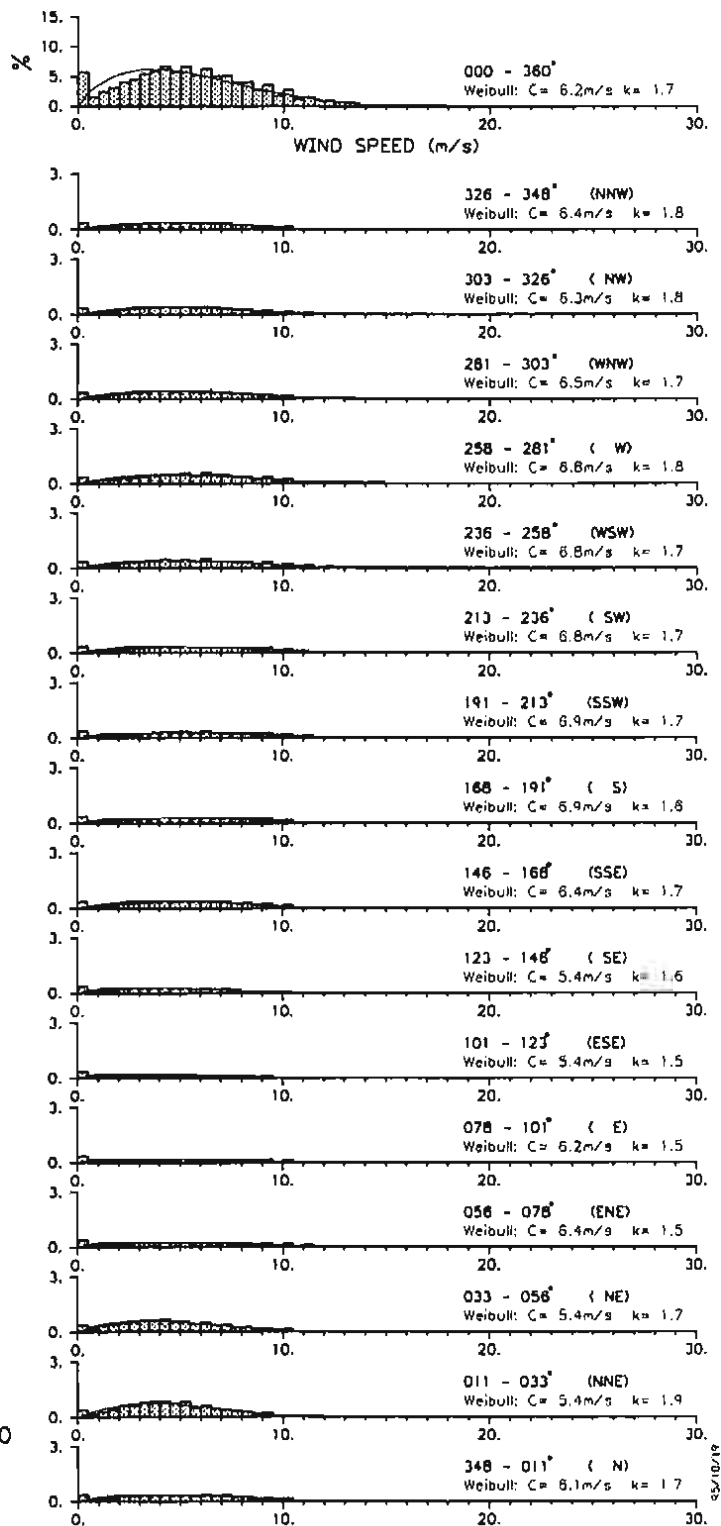
AVERAGE SPEED (m/s)
5.7m/s



POWER DENSITY (W/m²)
251.W/m²



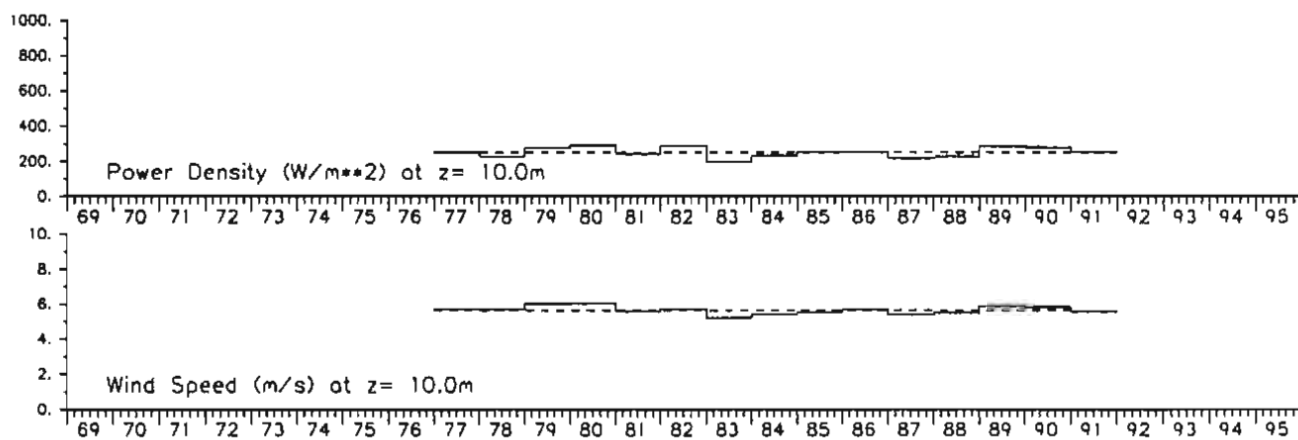
Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00
Station: Inukjuak A (2)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



53/10/19

ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00
Station: Inukjuak A (2)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00
Inukjuak A { 2 }

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m ³	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m ²	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
77/01/01->78/01/01	-5.2	101.14	1.318	5.7	349.	18.4	-N/A-	252.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-6.1	101.33	1.325	5.7	328.	20.6	-N/A-	229.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-6.8	101.21	1.327	6.0	263.	18.5	-N/A-	278.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-6.8	101.07	1.320	6.1	319.	17.8	-N/A-	291.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-6.4	101.08	1.318	6.6	318.	18.1	-N/A-	240.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-7.0	101.03	1.326	7	295.	20.0	-N/A-	289.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-7.3	101.28	1.332	7.2	316.	18.5	-N/A-	197.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-6.2	101.08	1.323	7.4	306.	23.4	-N/A-	231.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-6.4	101.05	1.319	7.5	349.	19.9	-N/A-	254.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-7.3	101.06	1.328	7	298.	19.9	-N/A-	253.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.6	101.13	1.320	7.4	355.	18.3	-N/A-	217.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-6.9	101.01	1.320	7.5	338.	22.2	-N/A-	227.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-8.1	101.01	1.331	7.9	291.	21.4	-N/A-	285.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-7.9	100.92	1.329	8	254.	20.0	-N/A-	279.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.5	101.05	1.325	8.6	294.	20.7	-N/A-	252.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
77/01/01->78/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
78/01/01->79/01/01	100.0	100.0	100.0	100.0	94.6	100.0	0.0	100.0	0.0	0.0	0.0
79/01/01->80/01/01	95.4	95.4	95.4	95.4	89.2	95.4	0.0	95.4	0.0	0.0	0.0
80/01/01->81/01/01	100.0	100.0	100.0	100.0	93.7	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	92.9	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	95.1	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	95.1	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	96.6	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	94.1	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	95.1	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	95.5	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	95.1	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	91.8	91.8	91.8	91.8	87.1	91.8	0.0	91.8	0.0	0.0	0.0
90/01/01->91/01/01	100.0	100.0	100.0	100.0	97.1	100.0	0.0	100.0	0.0	0.0	0.0
91/01/01->92/01/01	100.0	100.0	100.0	100.0	95.5	100.0	0.0	100.0	0.0	0.0	0.0

Period Average

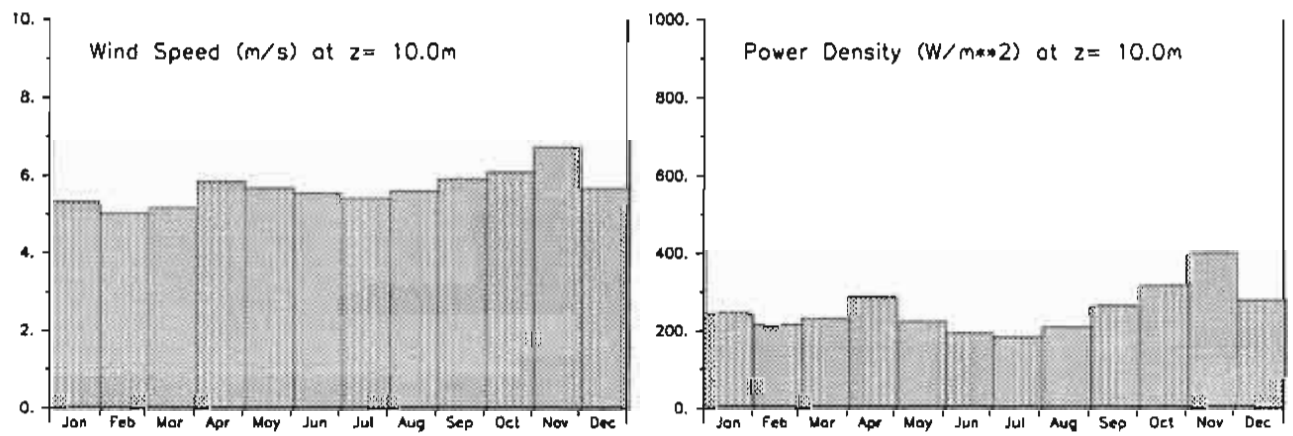
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
77/01/01->92/01/01	-6.6	101.10	1.325	5.7	311.	23.4	-N/A-	251.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
77/01/01->92/01/01	99.1	99.1	99.1	99.1	94.0	99.1	0.0	99.1	0.0	0.0	0.0

95/10/20

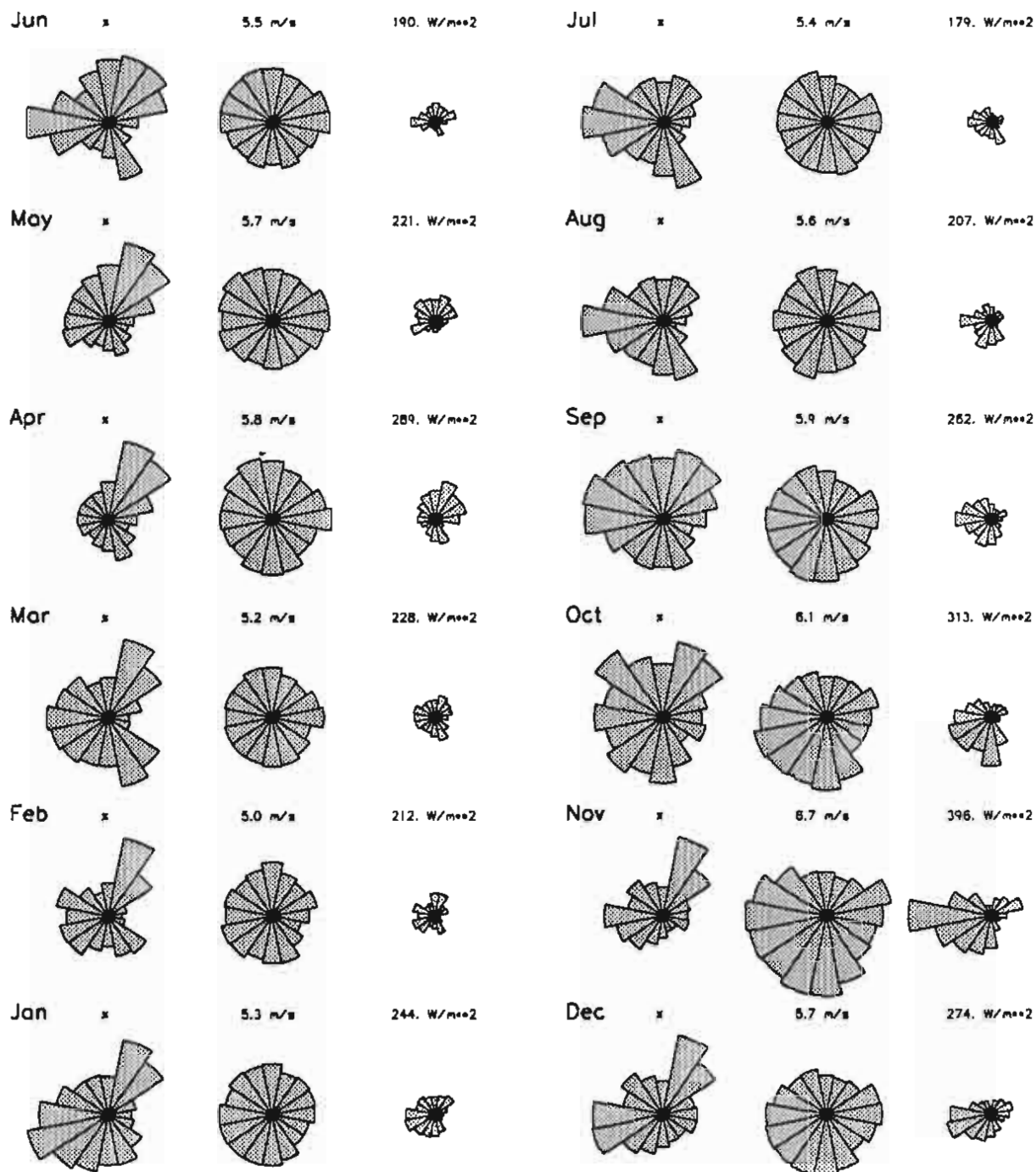
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00
Station: Inukjuak A (2)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00

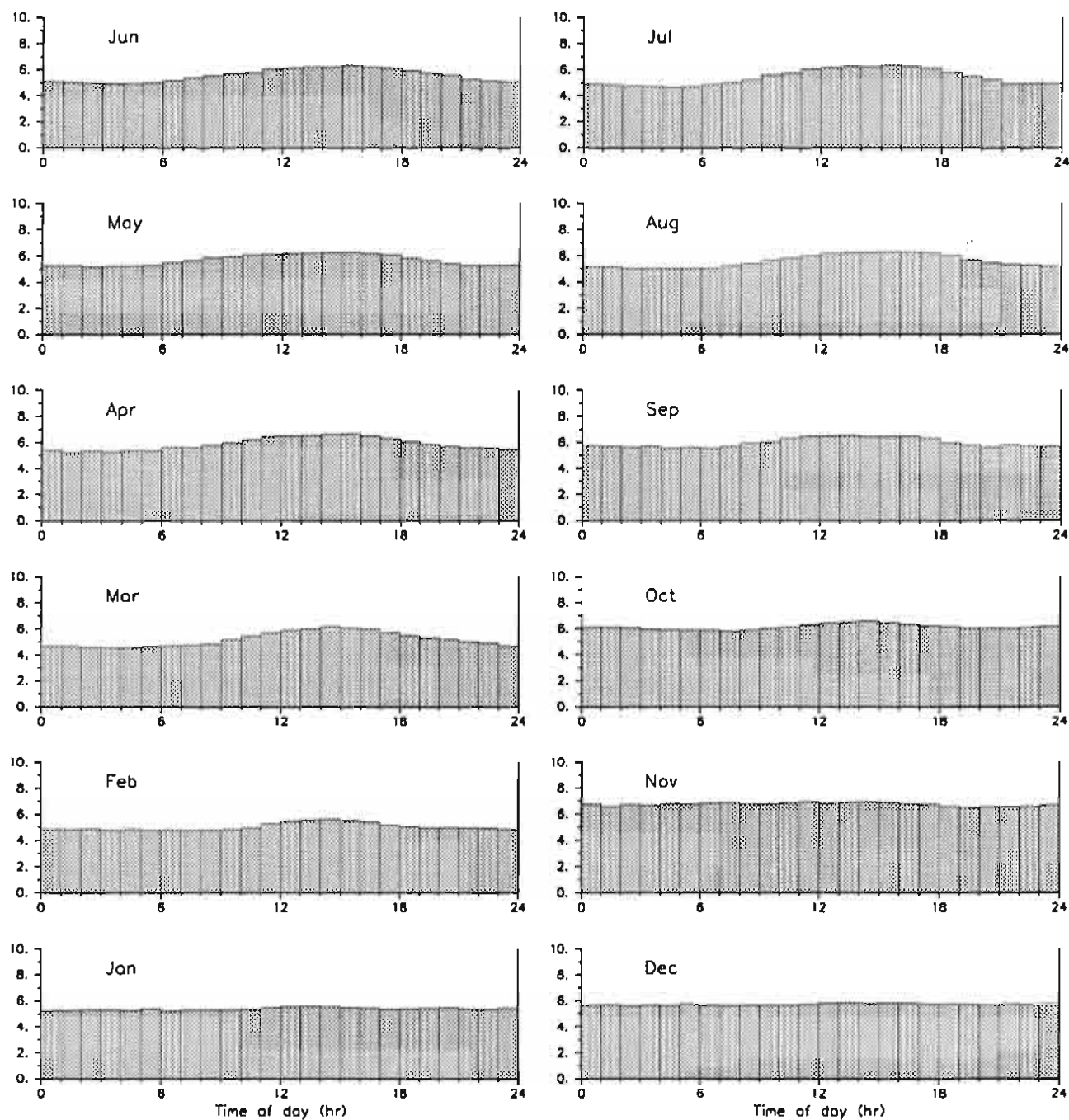
Station: Inukjuak A (2)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

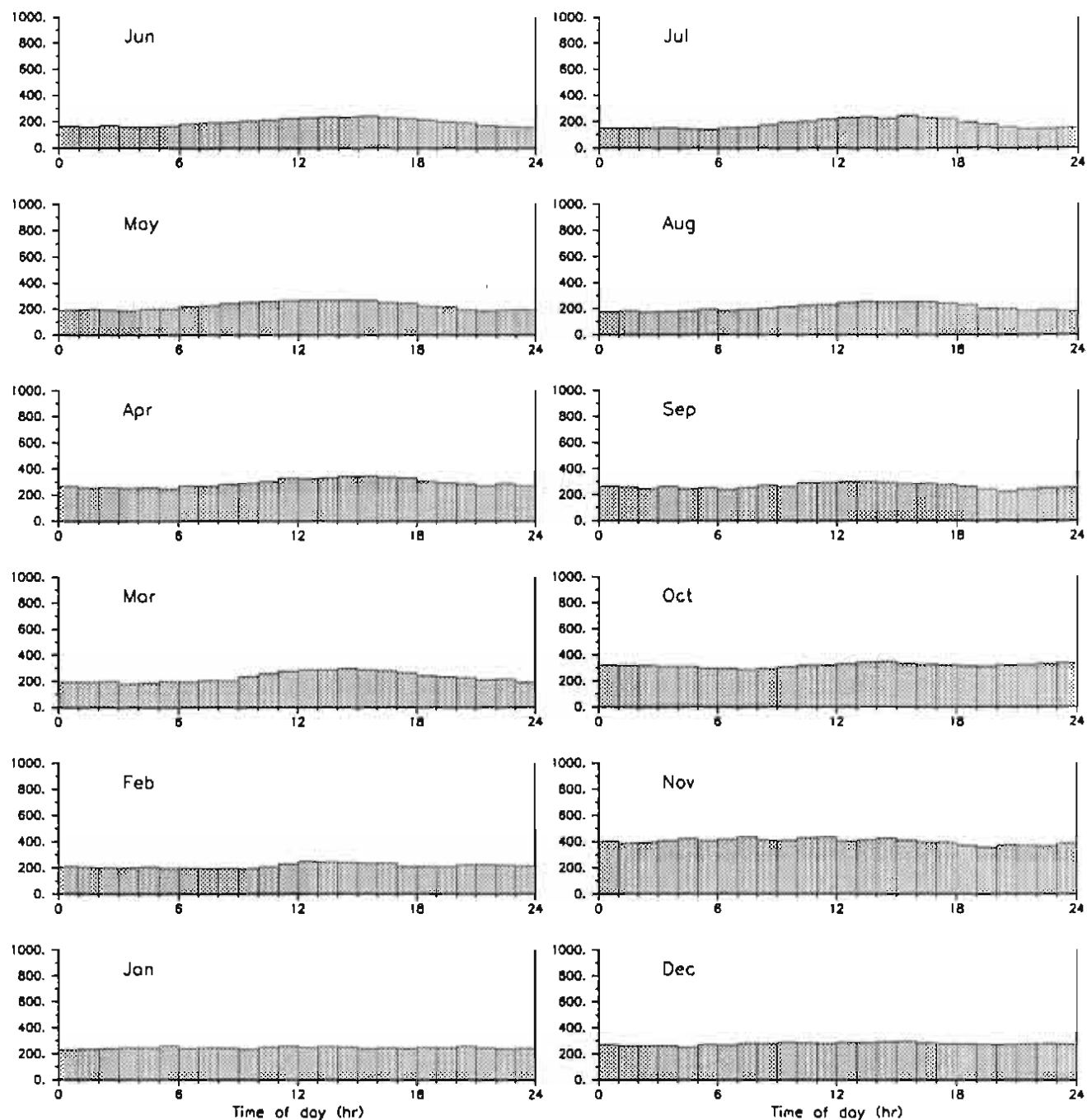
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00
 Station: Inukjuak A (2)
 Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



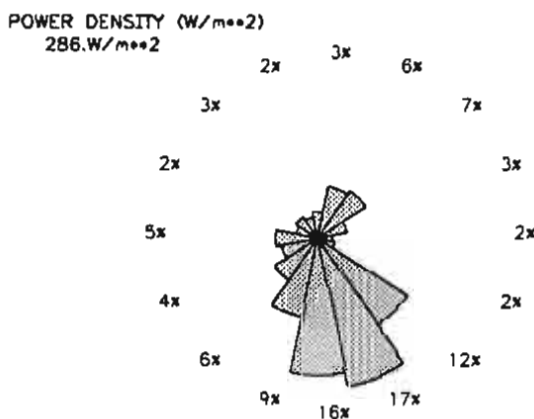
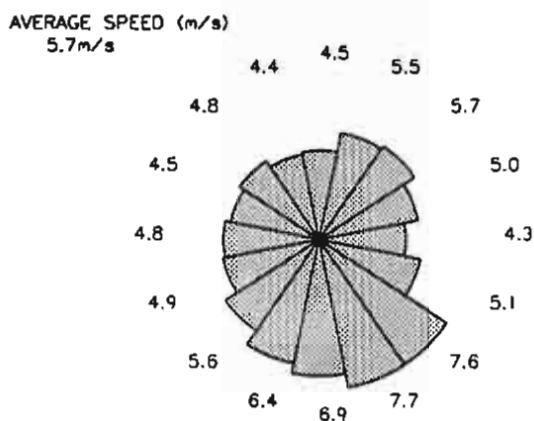
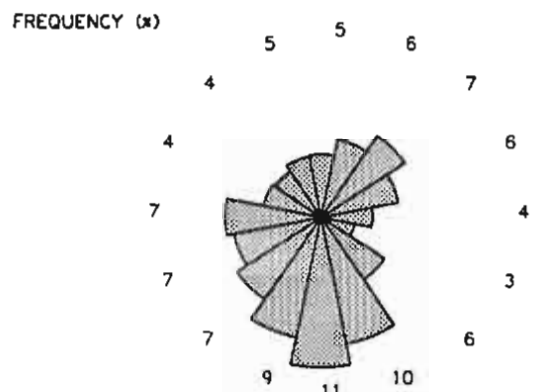
Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00

Station: Inukjuok A (2)

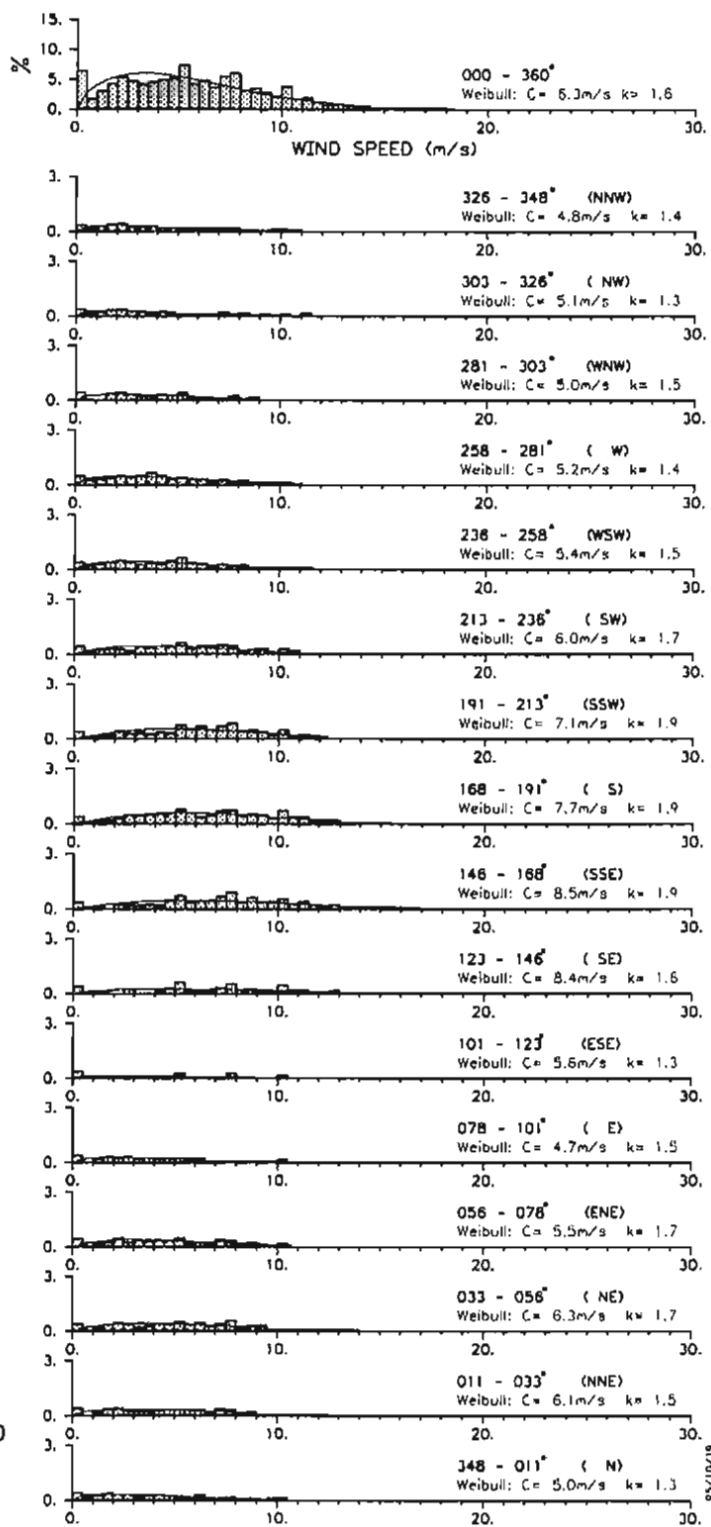
Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

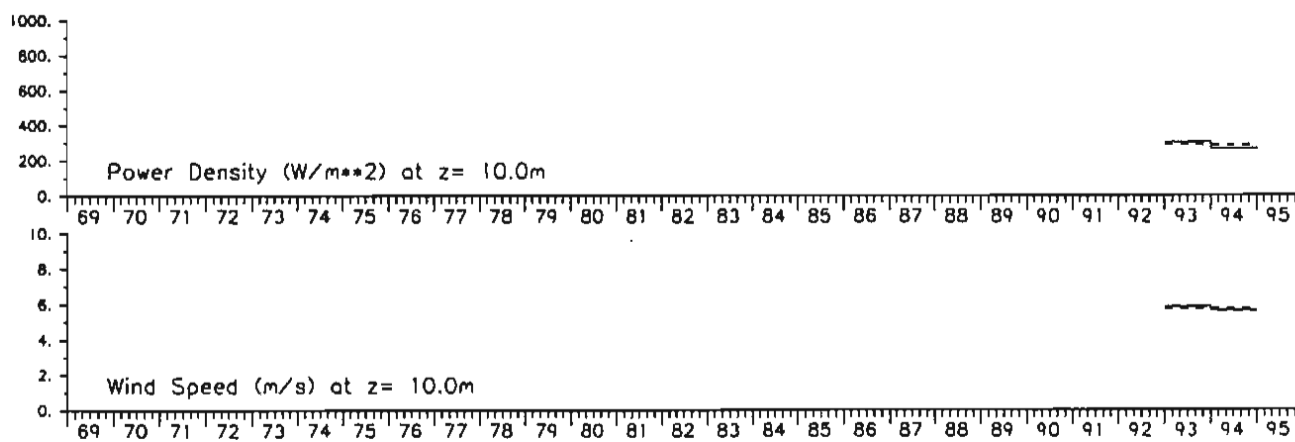


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Ivujivik A (3)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Ivujivik A (3)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Ivujivik A (3)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.1	100.60	1.320	5.9	195.	21.5	-N/A-	302.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.60	1.319	5.6	198.	21.6	-N/A-	266.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	32.8	32.8	32.8	32.7	30.8	32.7	0.0	32.7	0.0	0.0	0.0
94/01/01->95/01/01	25.5	1.8	1.8	25.5	24.1	25.5	0.0	25.5	0.0	0.0	0.0

Period Average

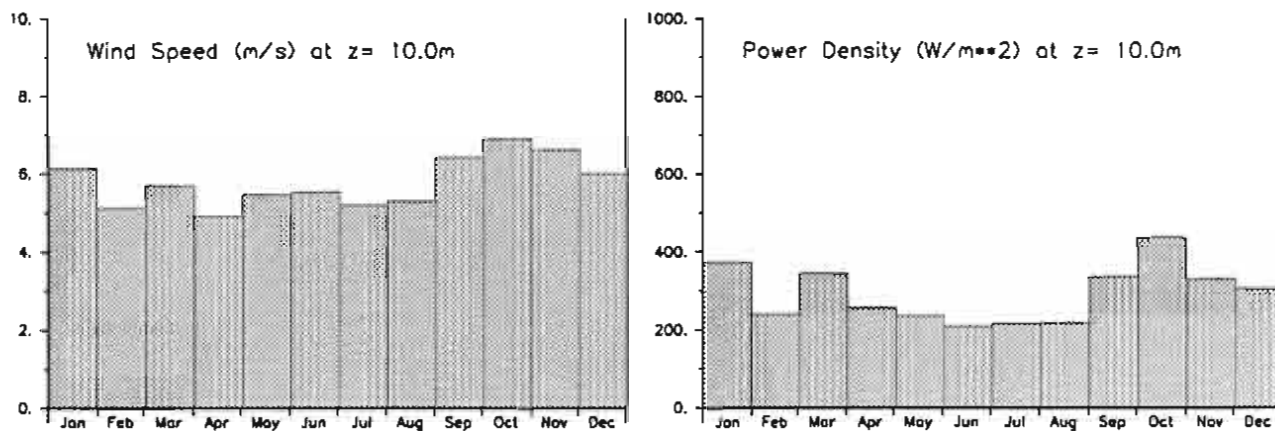
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	100.60	1.320	5.7	196.	21.6	-N/A-	286.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	29.1	17.3	17.3	29.1	27.4	29.1	0.0	29.1	0.0	0.0	0.0

95/10/20

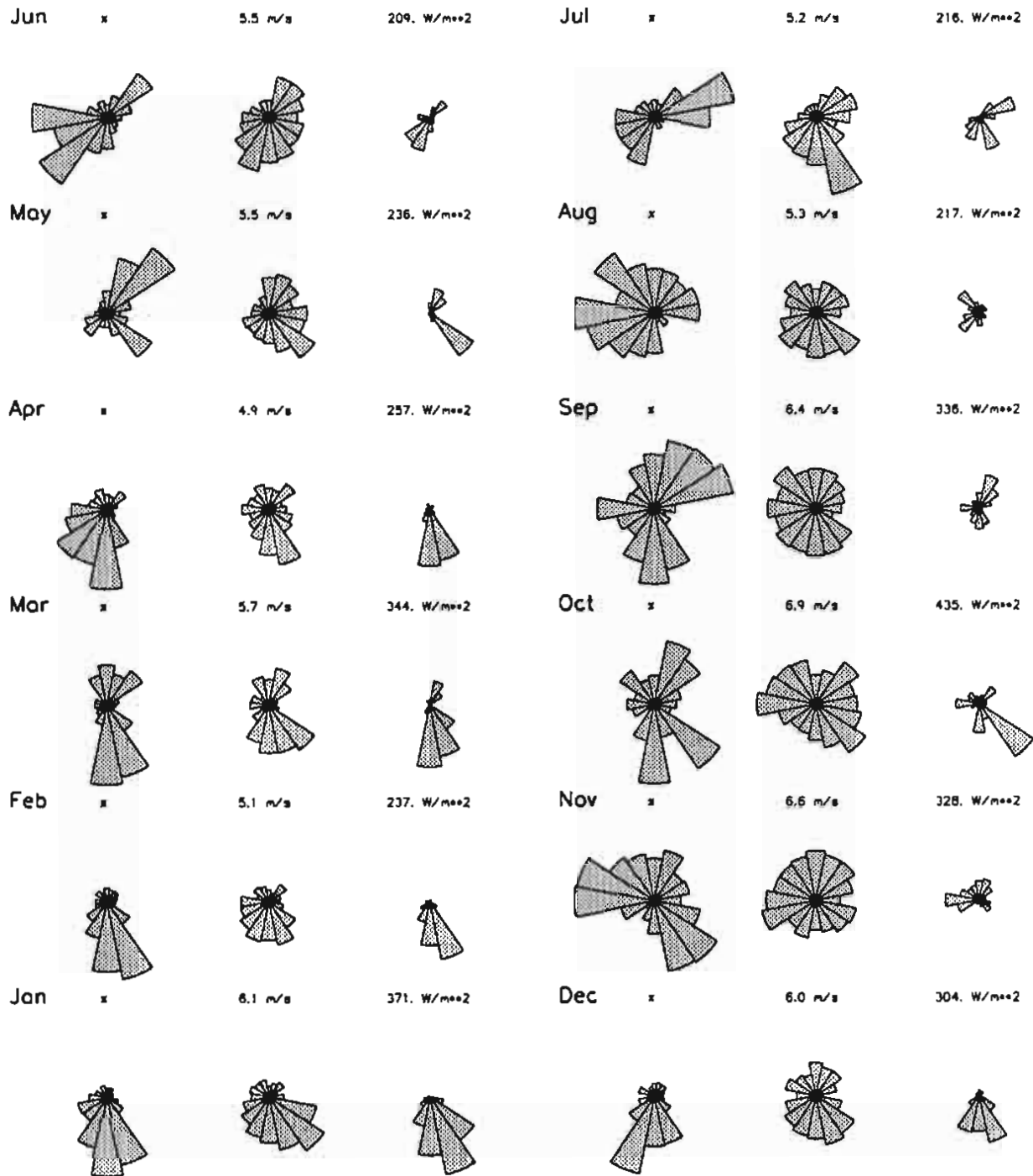
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Ivujivik A (3)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

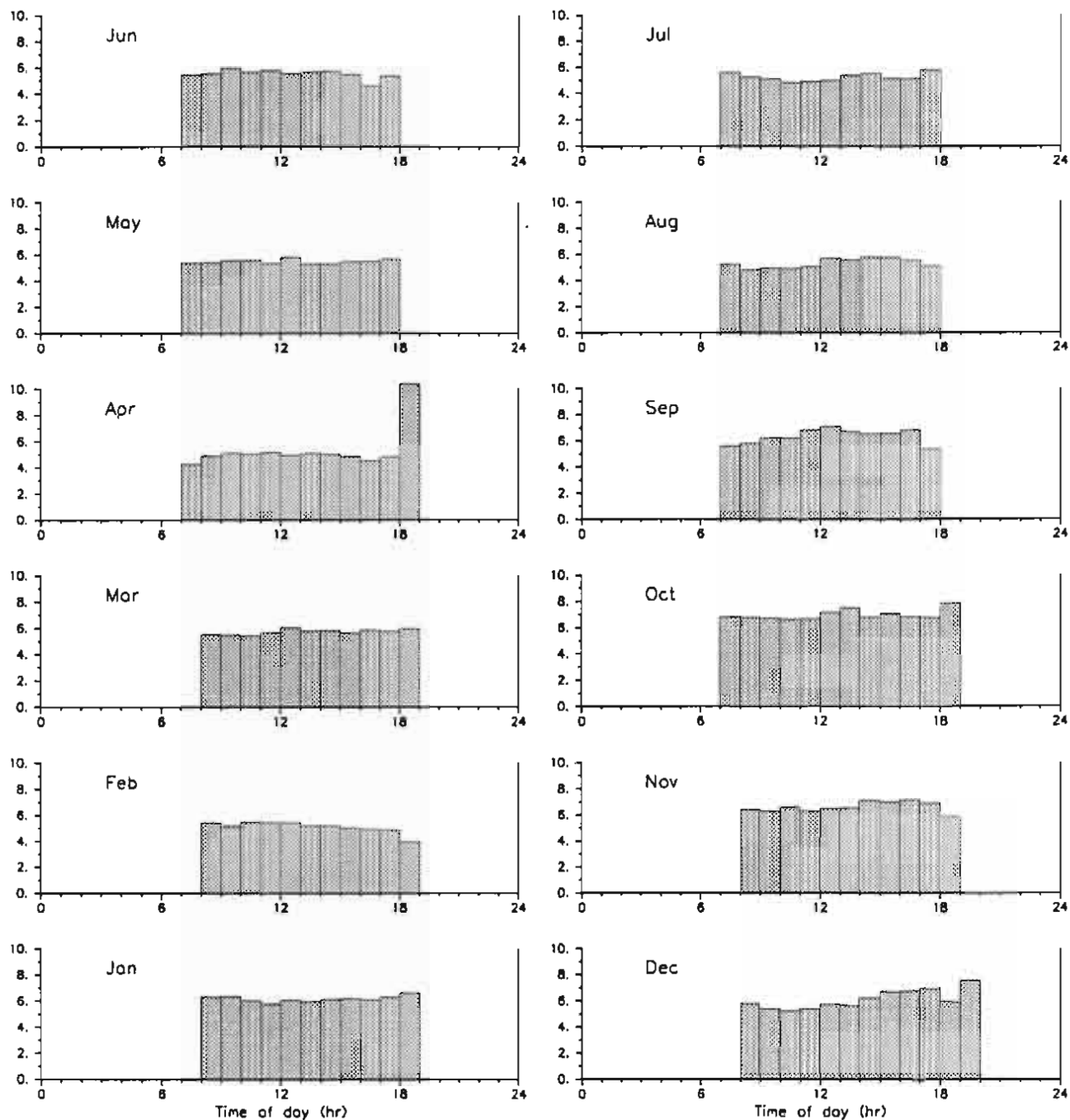
Station: Iqaluit A (3)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

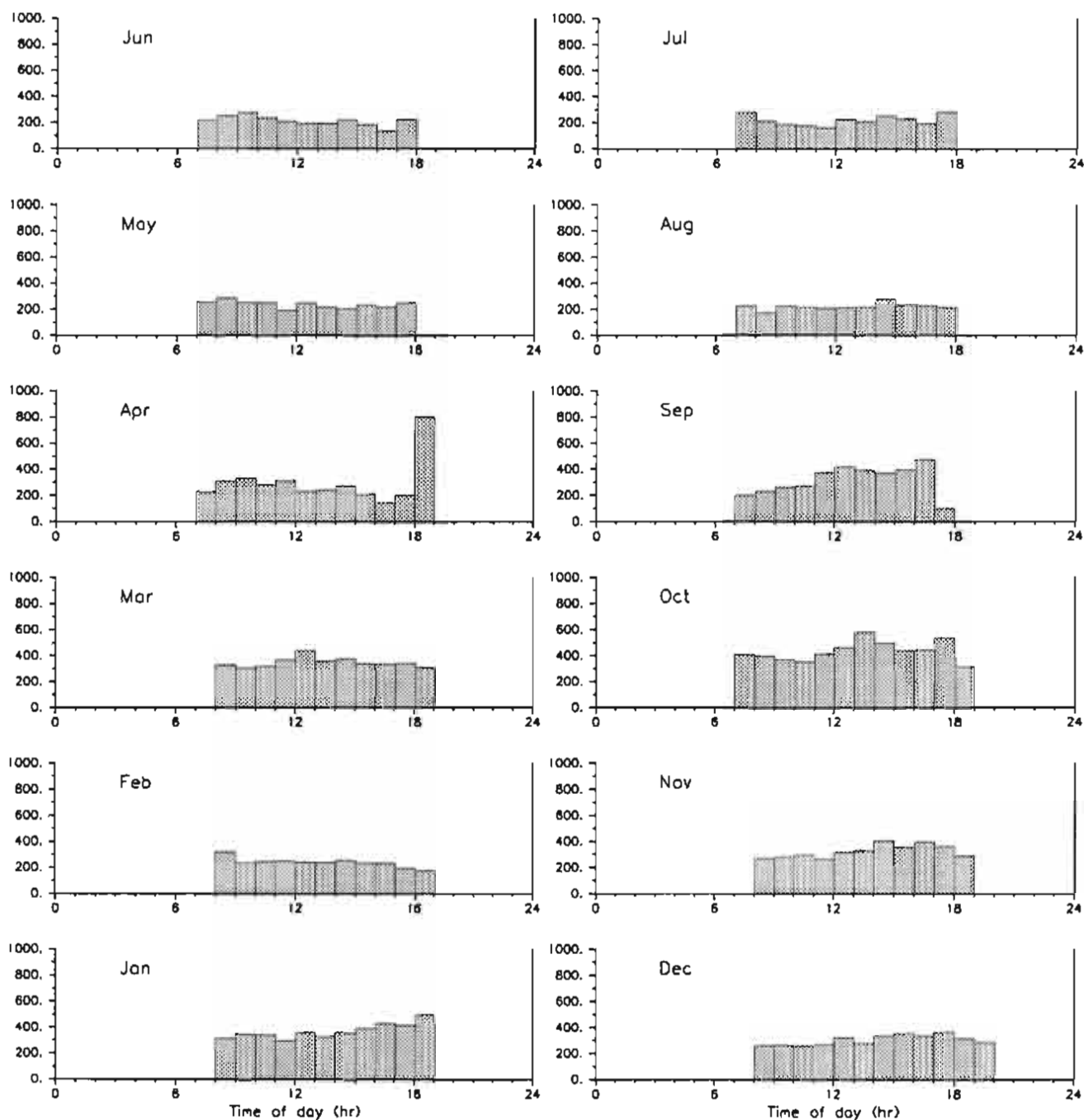
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Ivujivik A (3)
 Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

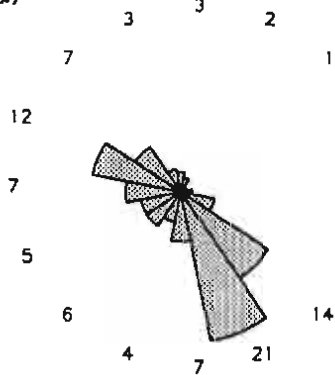


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Ivujivik A (3)
 Power Density (W/m²) at z= 10.0m

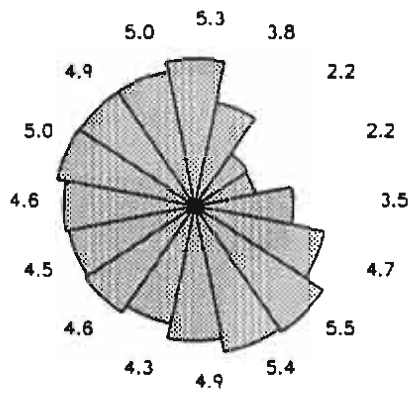
WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

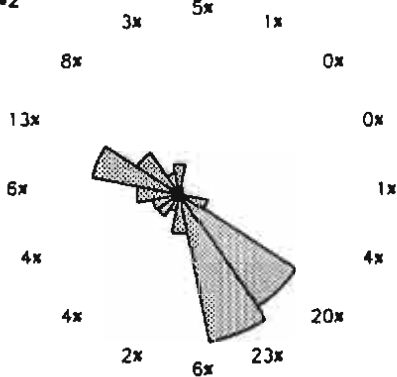
FREQUENCY (%)



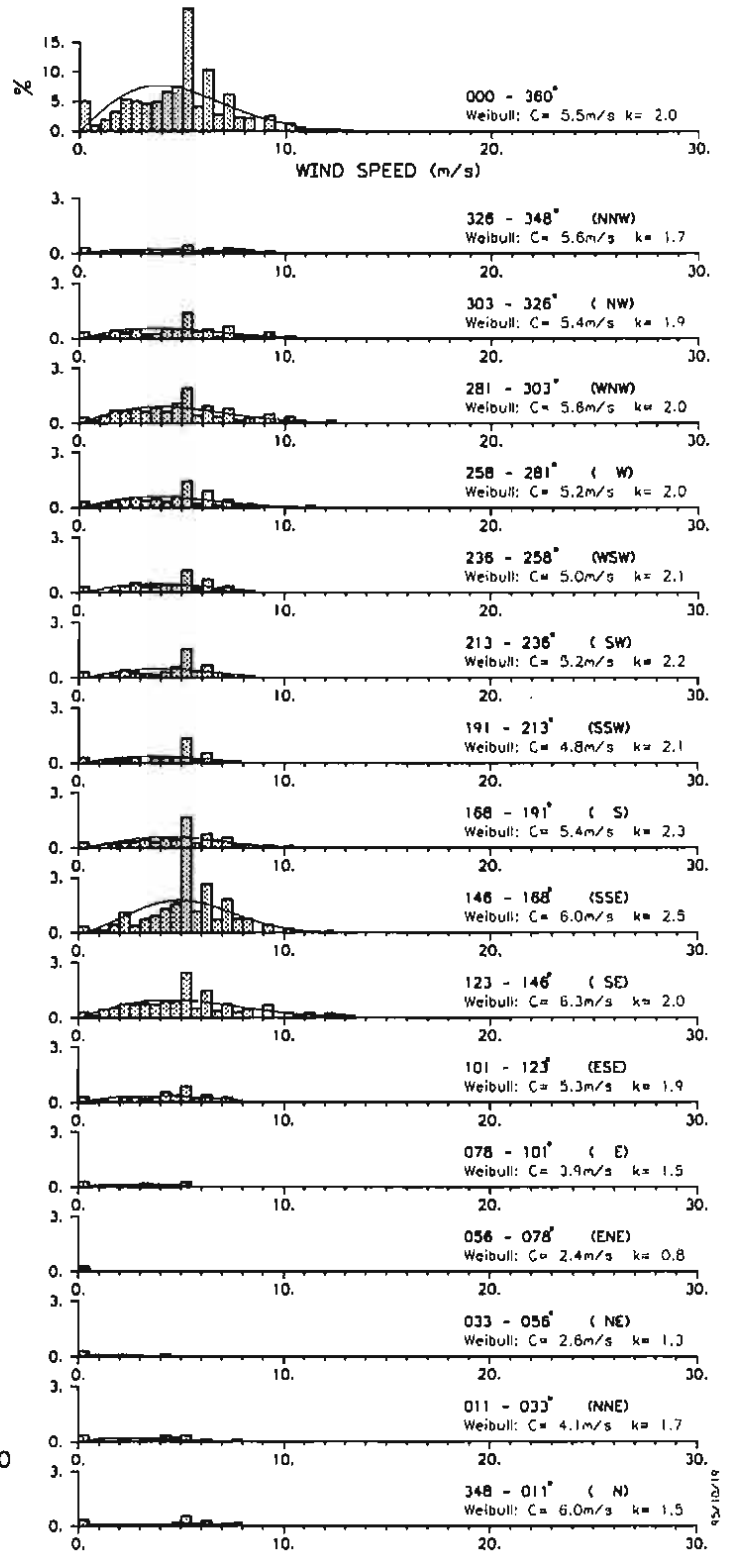
AVERAGE SPEED (m/s)
4.9m/s



POWER DENSITY (W/m²)
139.W/m²

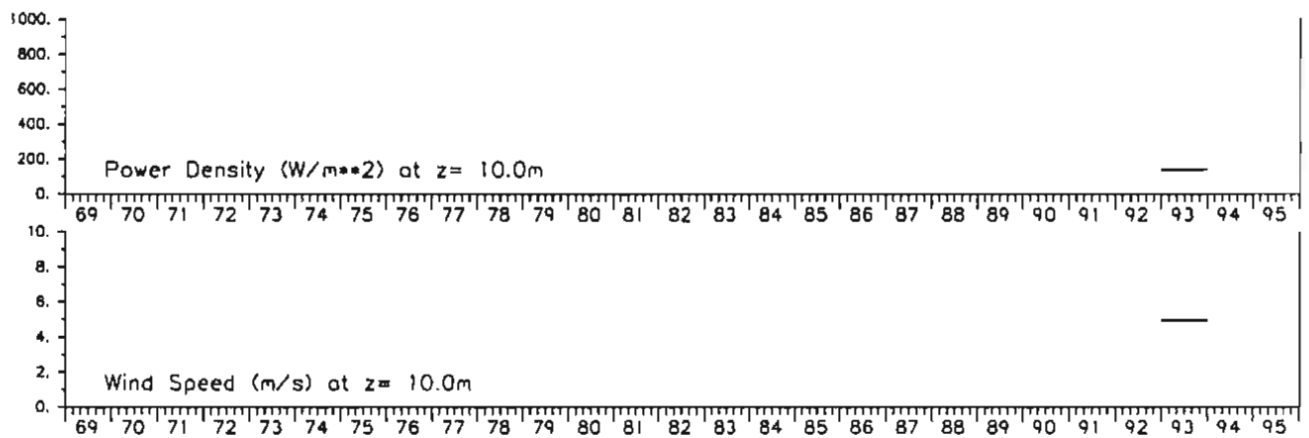


Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
Station: Kangiqsualujjuag A (12)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
Station: Kongiqsualujjuq A (12)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
Kangiqsualujjuaq A (12)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-5.2	100.38	1.308	4.9	198.	18.3	-N/A-	139.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	37.4	37.4	37.4	37.4	35.6	37.4	0.0	37.4	0.0	0.0	0.0

Period Average

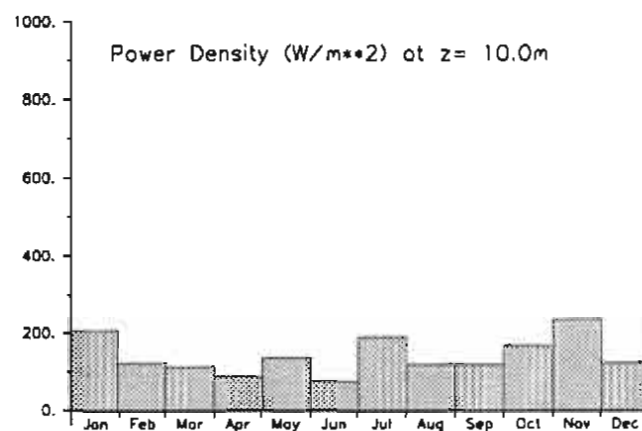
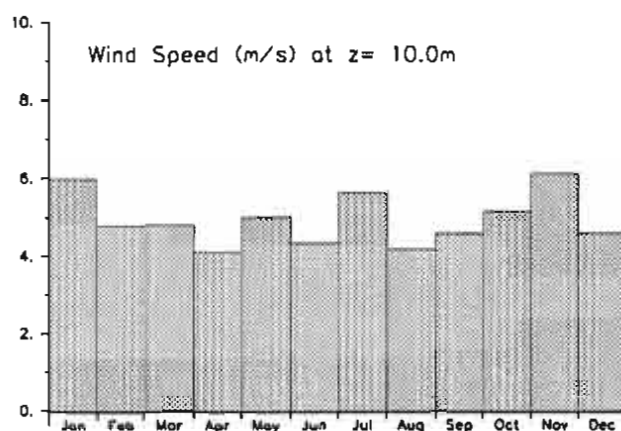
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	-5.2	100.38	1.308	4.9	198.	18.3	-N/A-	139.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	37.4	37.4	37.4	37.4	35.6	37.4	0.0	37.4	0.0	0.0	0.0

95/10/20

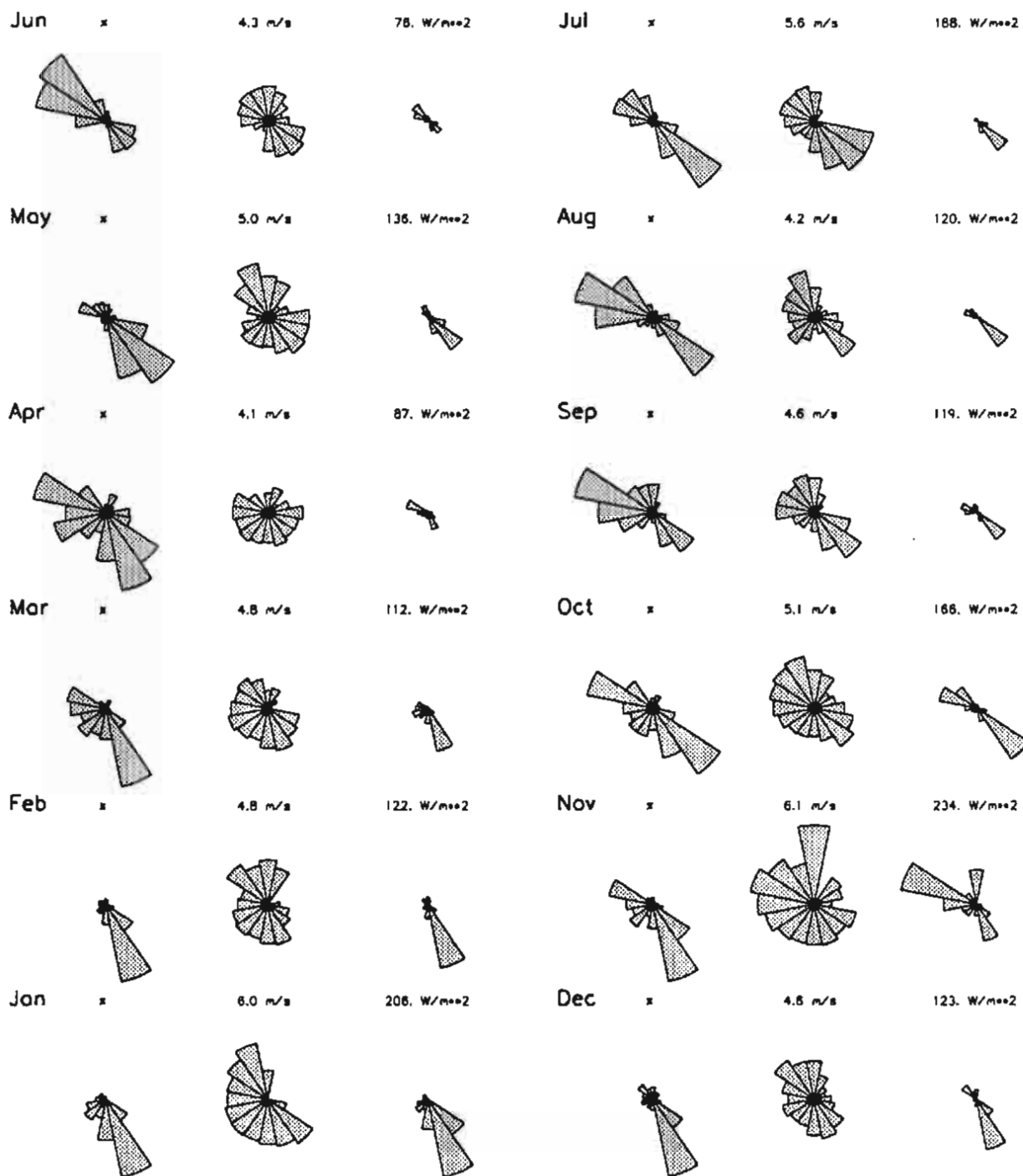
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
Station: Kangisualujjuq A (12)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00

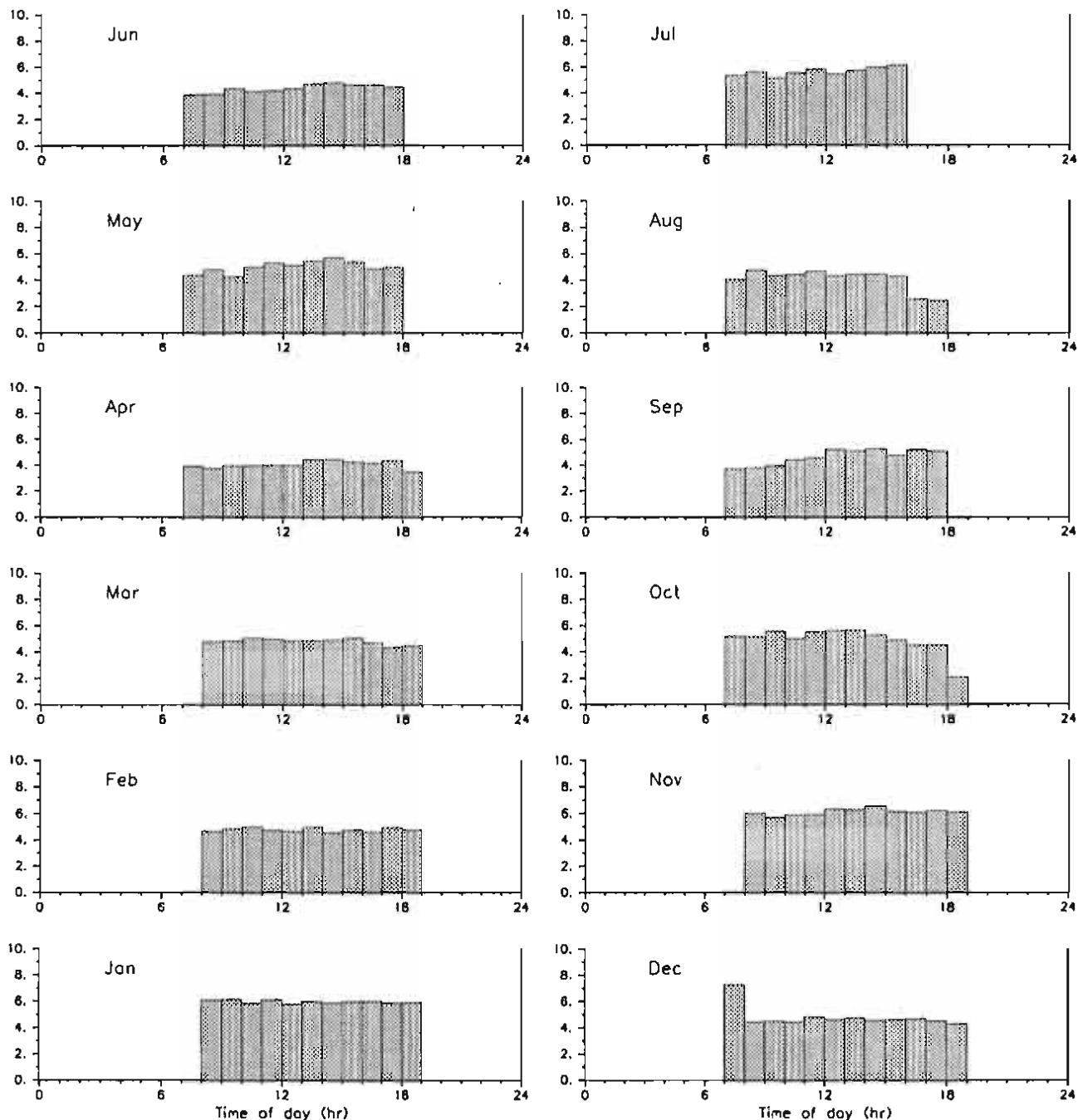
Station: Kangiqsuajjuaq A (12)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

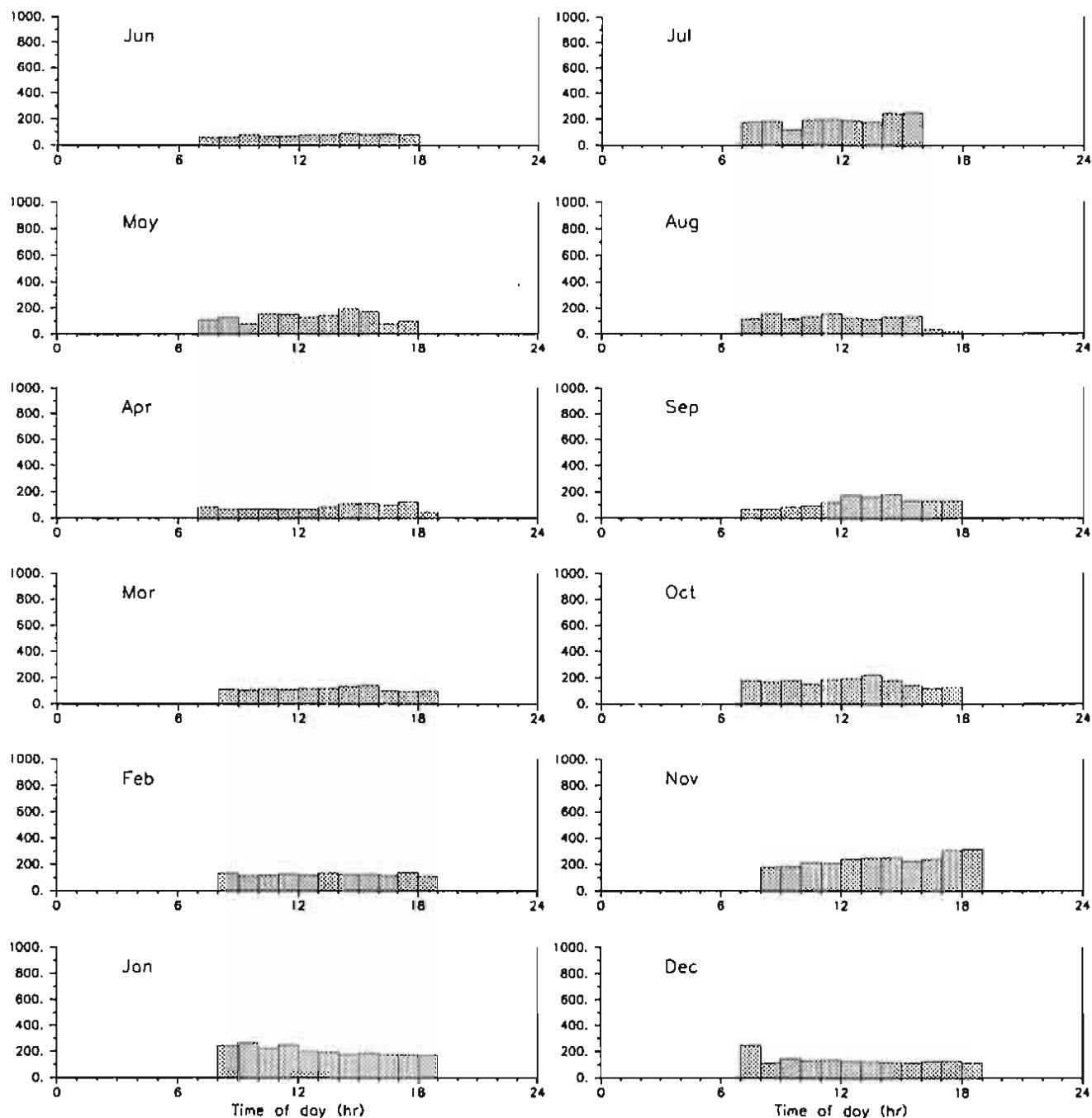
Frequency (%) / Average speed (m/s) / Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
 Station: Kongiqsualujjuag A (12)
 Wind Speed (m/s) at z= 10.0m

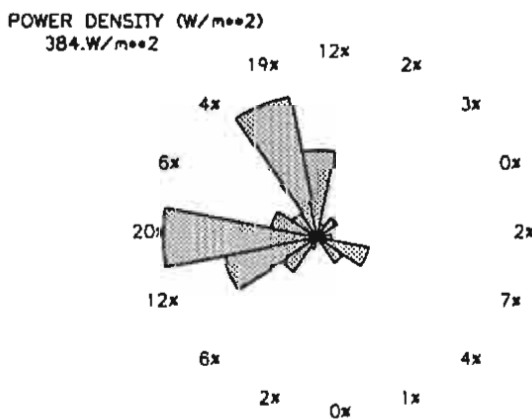
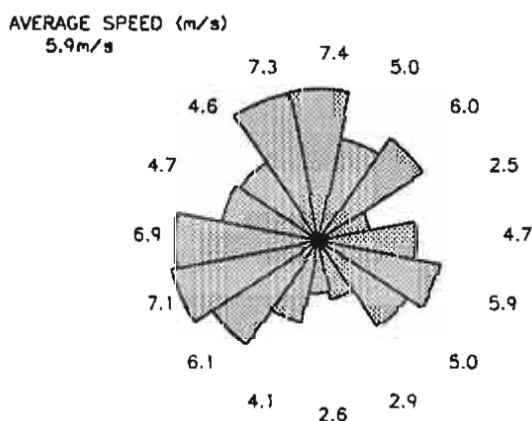
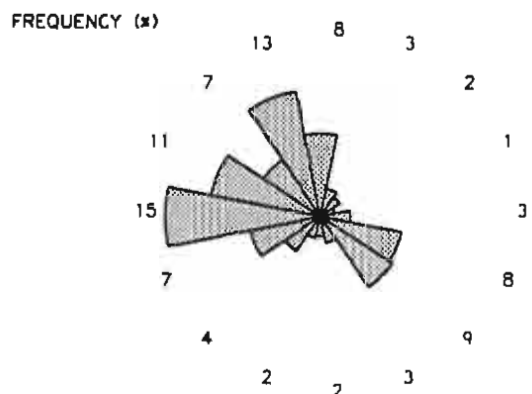
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



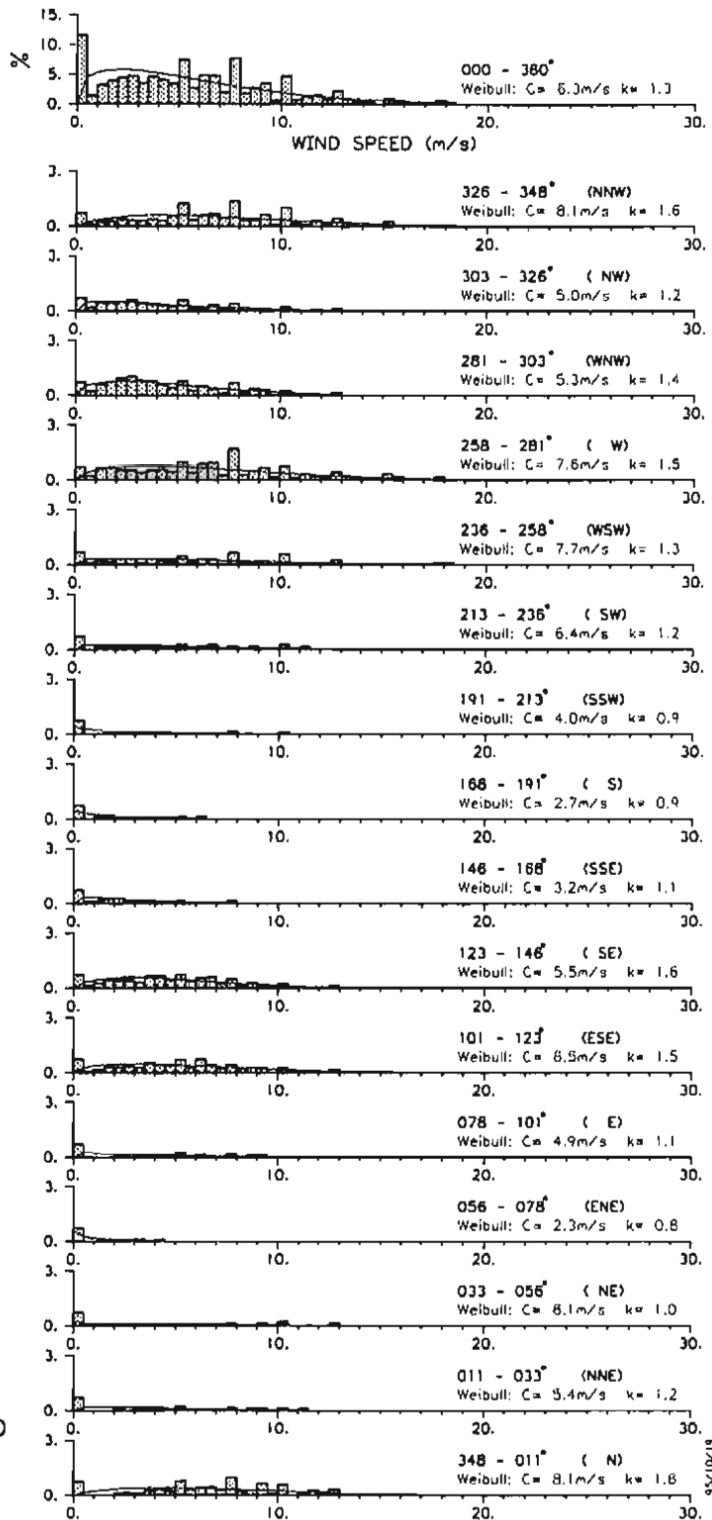
Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
 Station: Kongiqsualujjuq A (12)
 Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

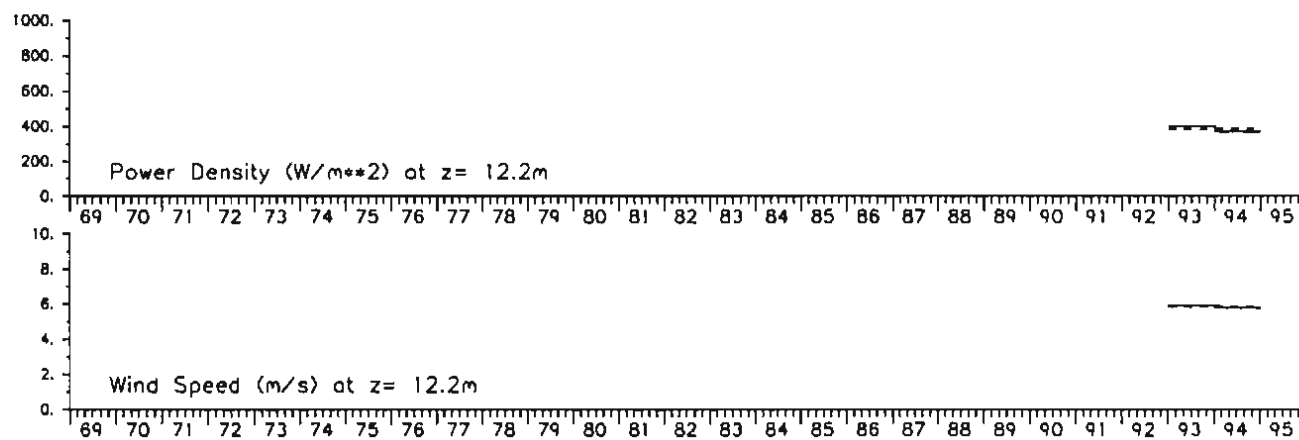


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangisujuaq A (5)
 Wind Speed (m/s) at z= 12.2m
 Wind Direction (degt) at z= 12.2m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Station: Kangiqsujuaq A (5)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Kangiqsujuag A (5)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 12.2m m/s	WDir 12.2m degt	MxWSpd 12.2m m/s	Gust 12.2m m/s	Power 12.2m W/m**2	TrbInts 12.2m	TrbnPwr 12.2m kW	TrbnOut 12.2m MWhr
93/01/01->94/01/01	-7.2	99.03	1.300	5.9	285	25.6	-N/A-	401.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	99.01	1.298	5.8	313.	22.7	-N/A-	367.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	34.2	34.2	34.2	34.2	30.5	34.2	0.0	34.2	0.0	0.0	0.0
94/01/01->95/01/01	33.9	2.9	2.9	33.9	29.7	33.9	0.0	33.9	0.0	0.0	0.0

Period Average

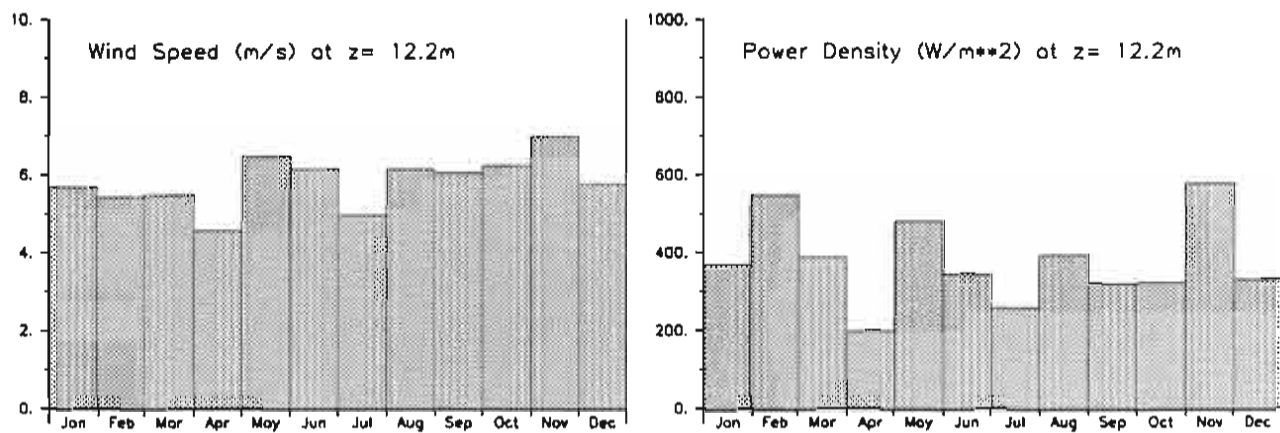
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	99.01	1.299	5.9	298.	25.6	-N/A-	384.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	34.0	18.5	18.5	34.0	30.1	34.0	0.0	34.0	0.0	0.0	0.0

95/10/20

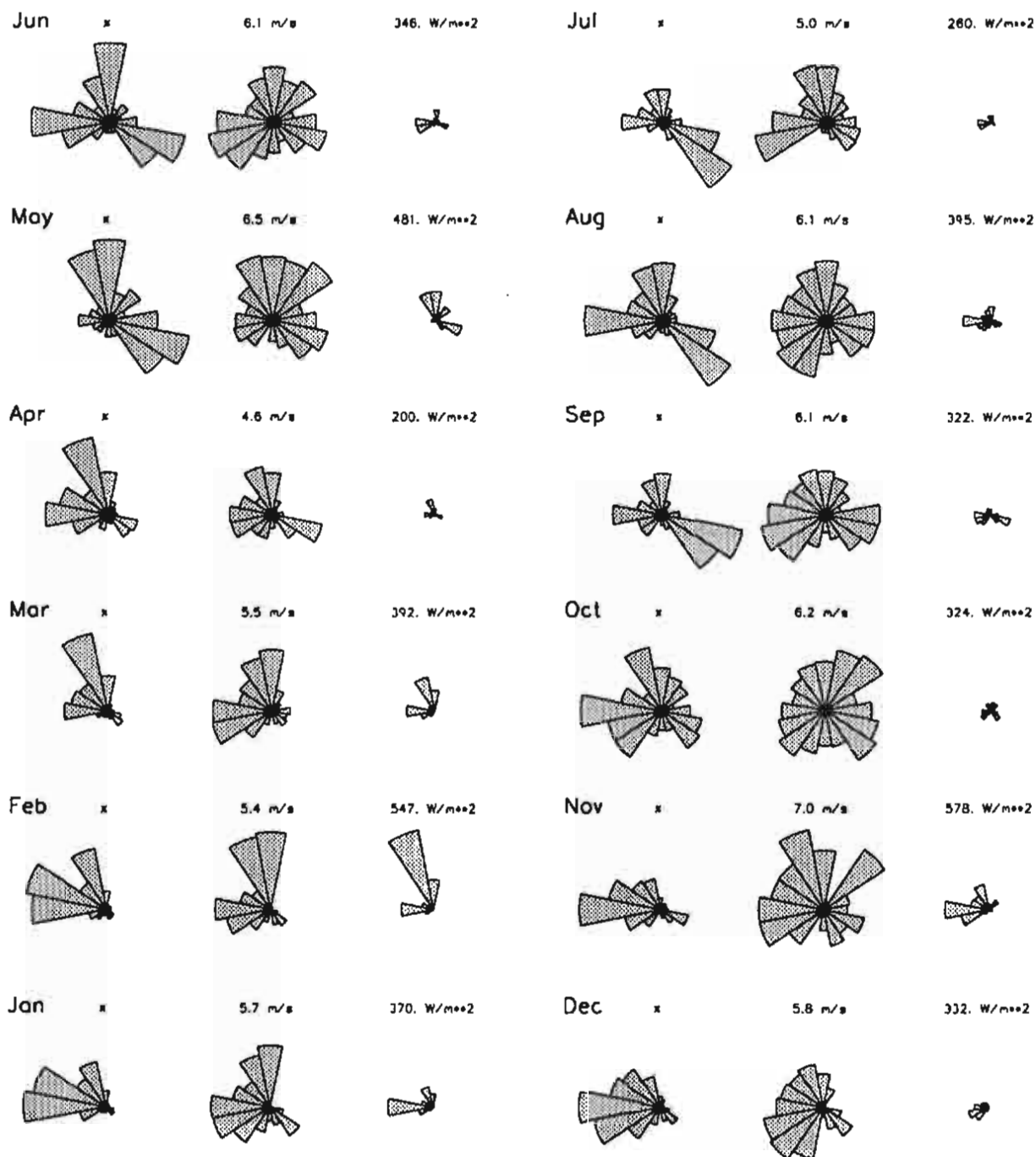
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Kangiqsujuaq A (5)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

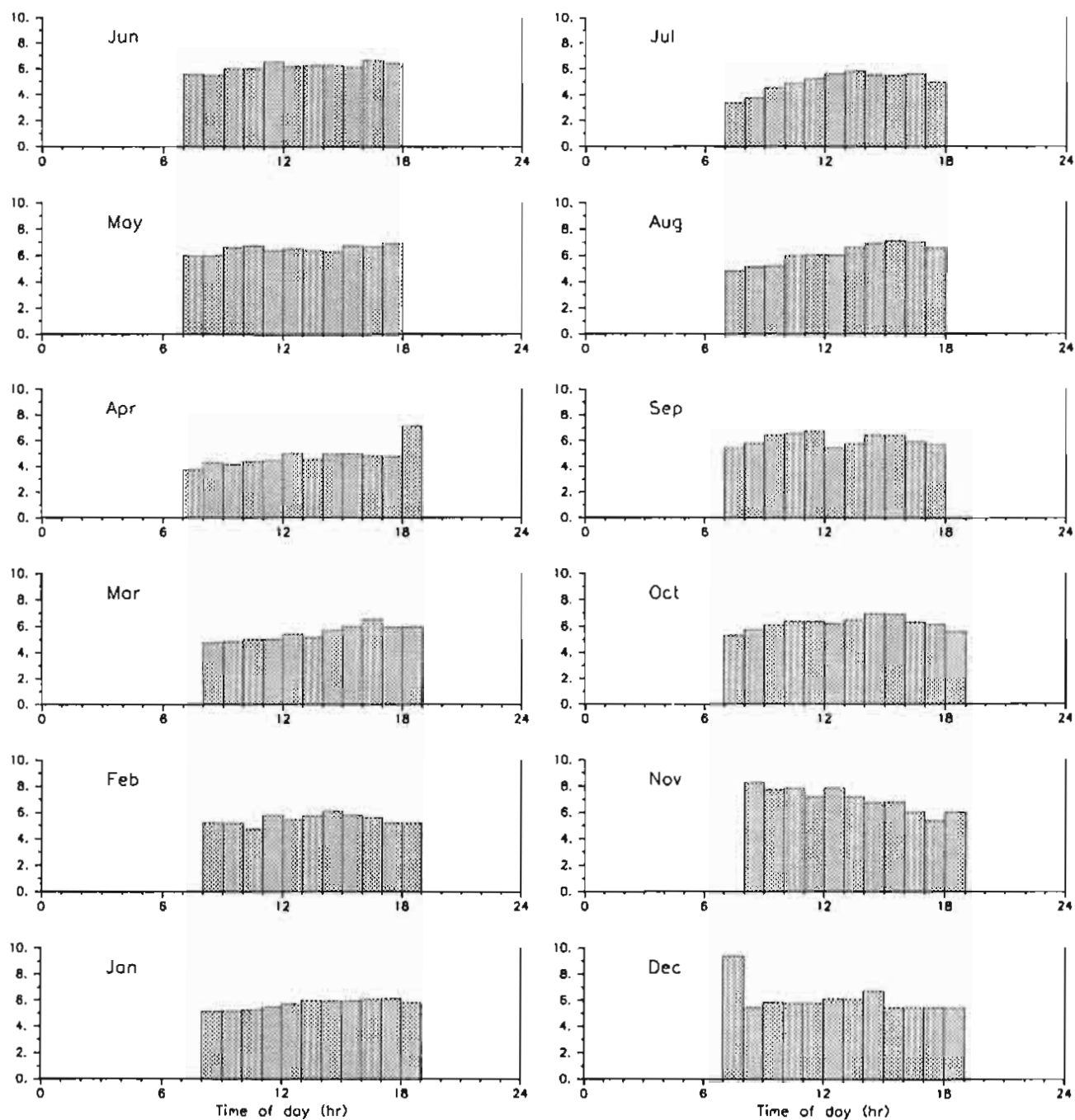
Station: Kangisujuaq A (5)

Wind Speed (m/s) at z= 12.2m

Wind Direction (deg) at z= 12.2m

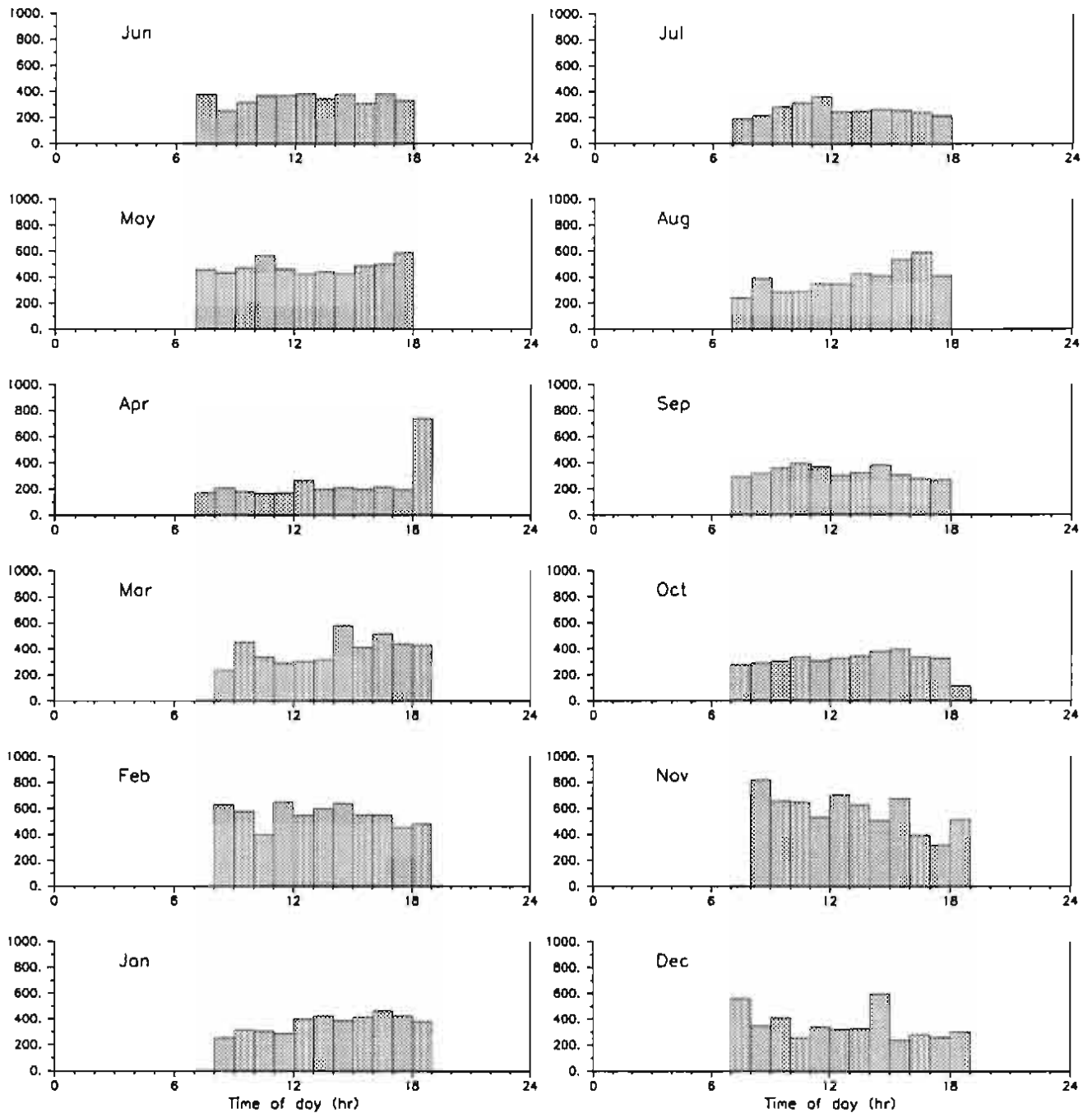
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangiqsujuag A (5)
 Wind Speed (m/s) at z= 12.2m

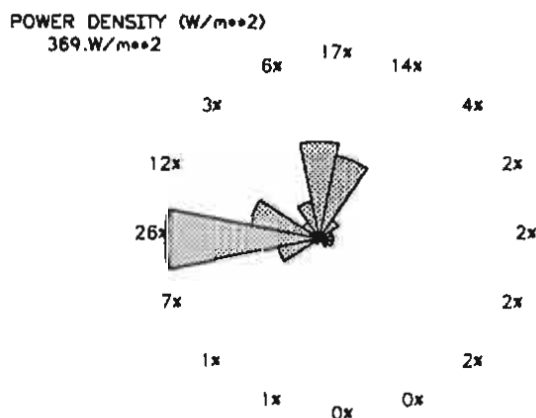
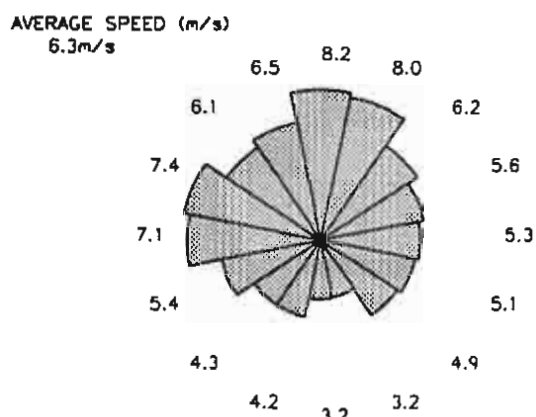
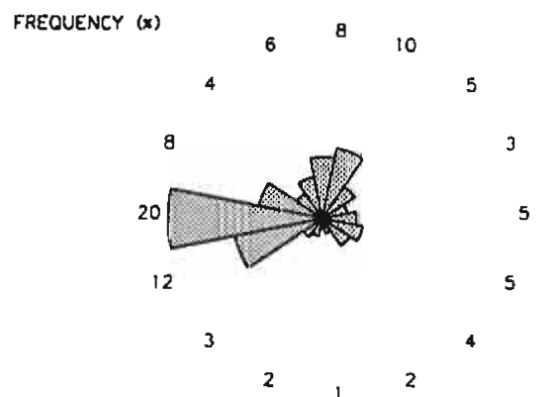
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



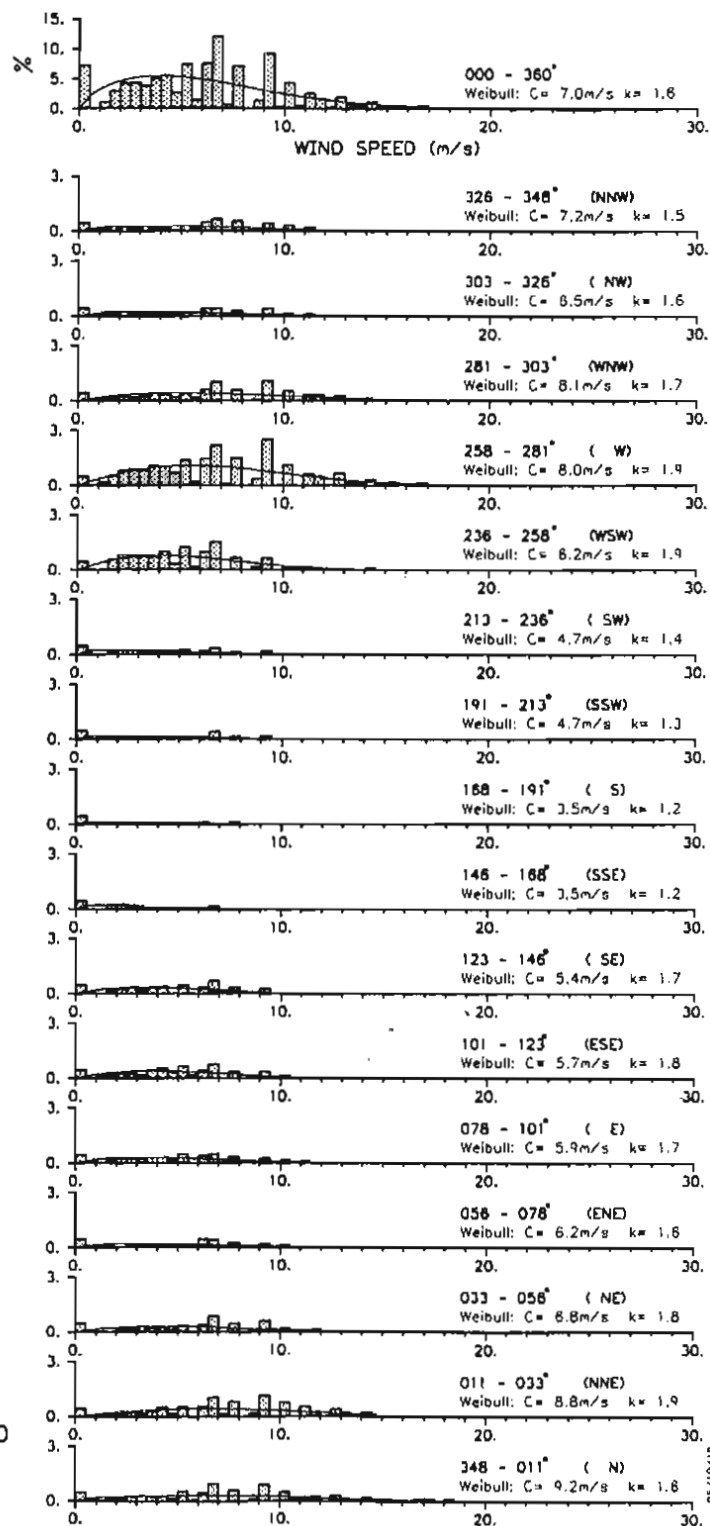
Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangiqsujuag A (5)
 Power Density (W/m²) at z= 12.2m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

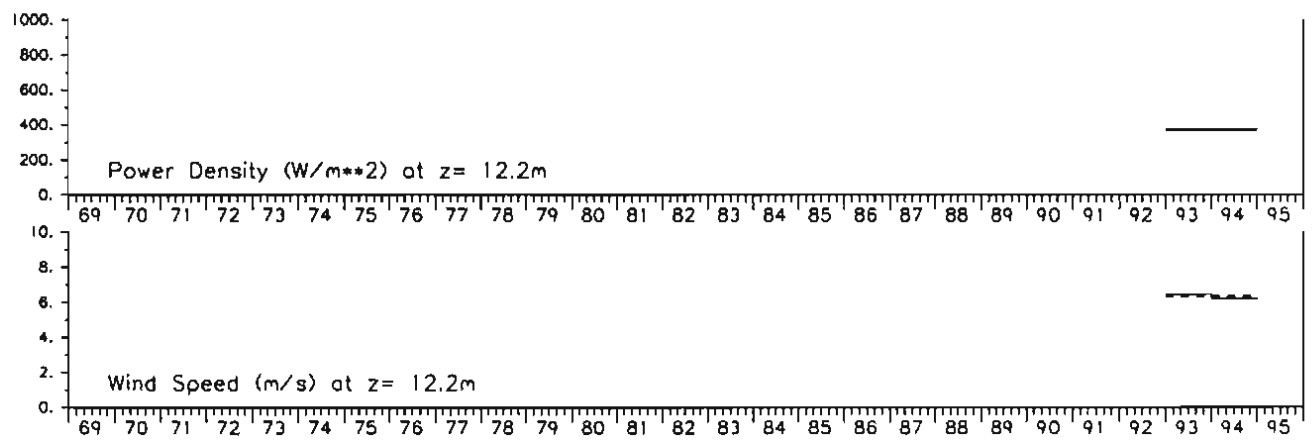


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangirsuk A (6)
 Wind Speed (m/s) at z= 12.2m
 Wind Direction (degt) at z= 12.2m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Kangirsuk A (6)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Kangirsuk A (6)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 12.2m m/s	WDir 12.2m deg	MxWSpd 12.2m m/s	Gust 12.2m m/s	Power 12.2m W/m**2	TrbInts 12.2m	TrbnPwr 12.2m kW	TrbnOut 12.2m MWhr
93/01/01->94/01/01	-7.5	99.51	1.308	6.5	301.	20.8	-N/A-	366.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.0	99.49	1.305	6.2	309.	22.6	-N/A-	373.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	39.9	39.9	39.9	39.9	37.6	39.9	0.0	39.9	0.0	0.0	0.0
94/01/01->95/01/01	34.0	3.5	3.5	34.0	31.0	34.0	0.0	34.0	0.0	0.0	0.0

Period Average

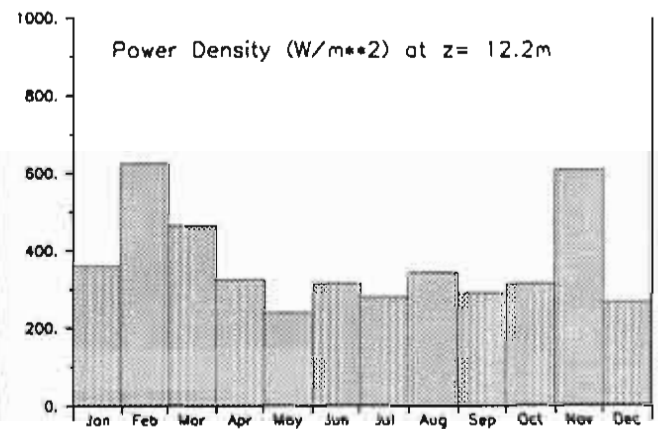
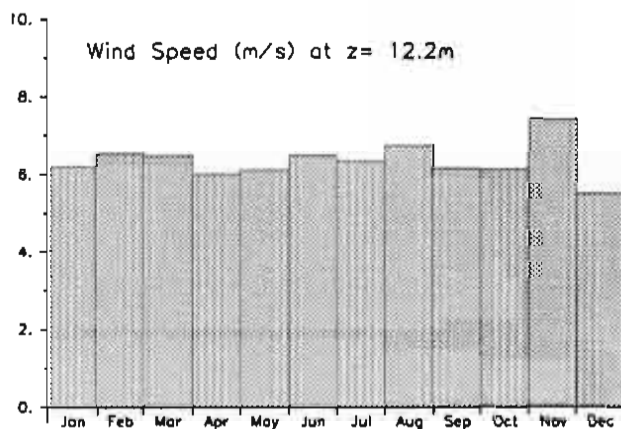
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.3	99.50	1.306	6.3	304.	22.6	-N/A-	369.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	37.0	21.7	21.7	37.0	34.3	37.0	0.0	37.0	0.0	0.0	0.0

95/10/20

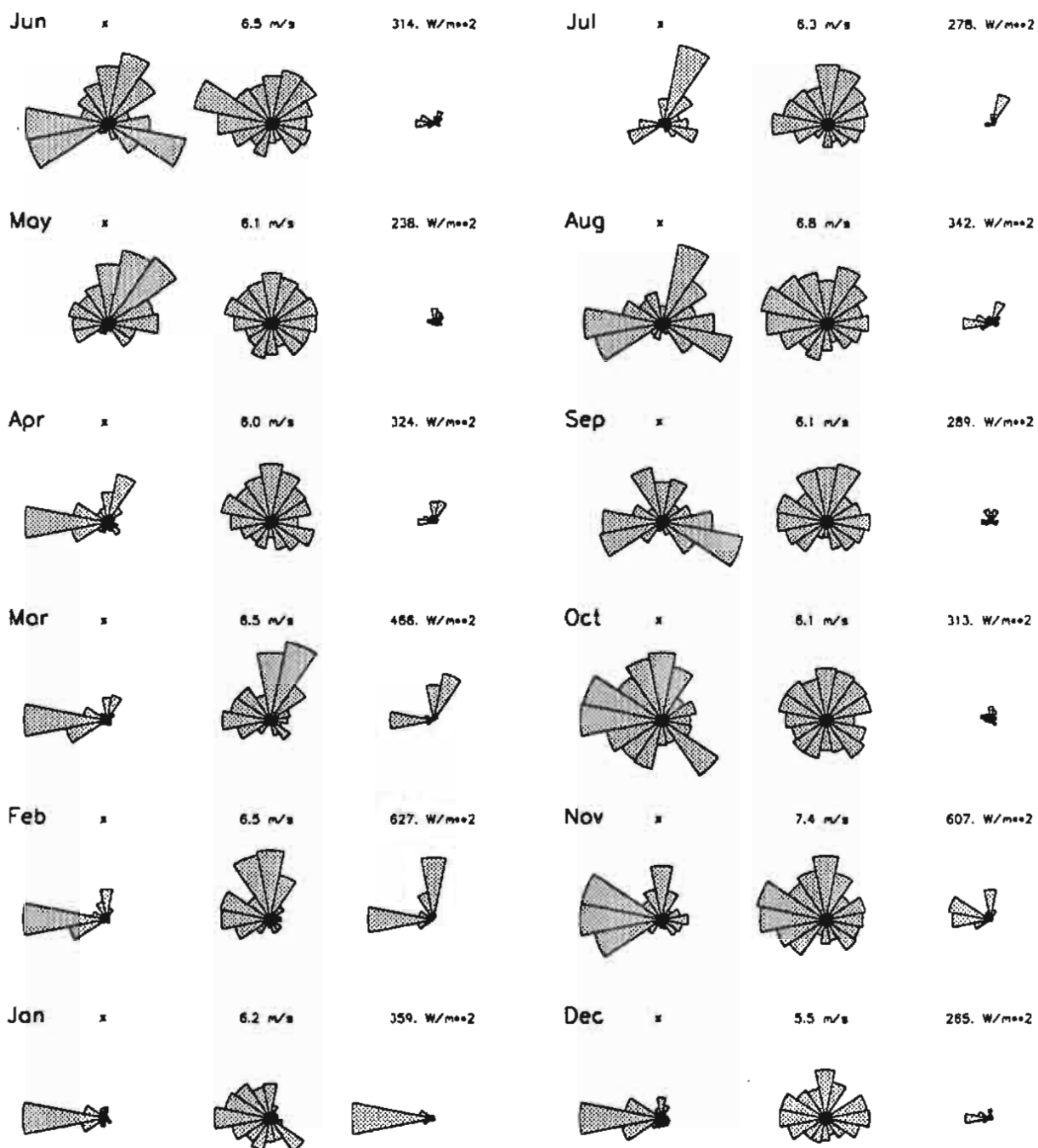
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Kangirsuk A (6)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Station: Kangirsuk A (6)

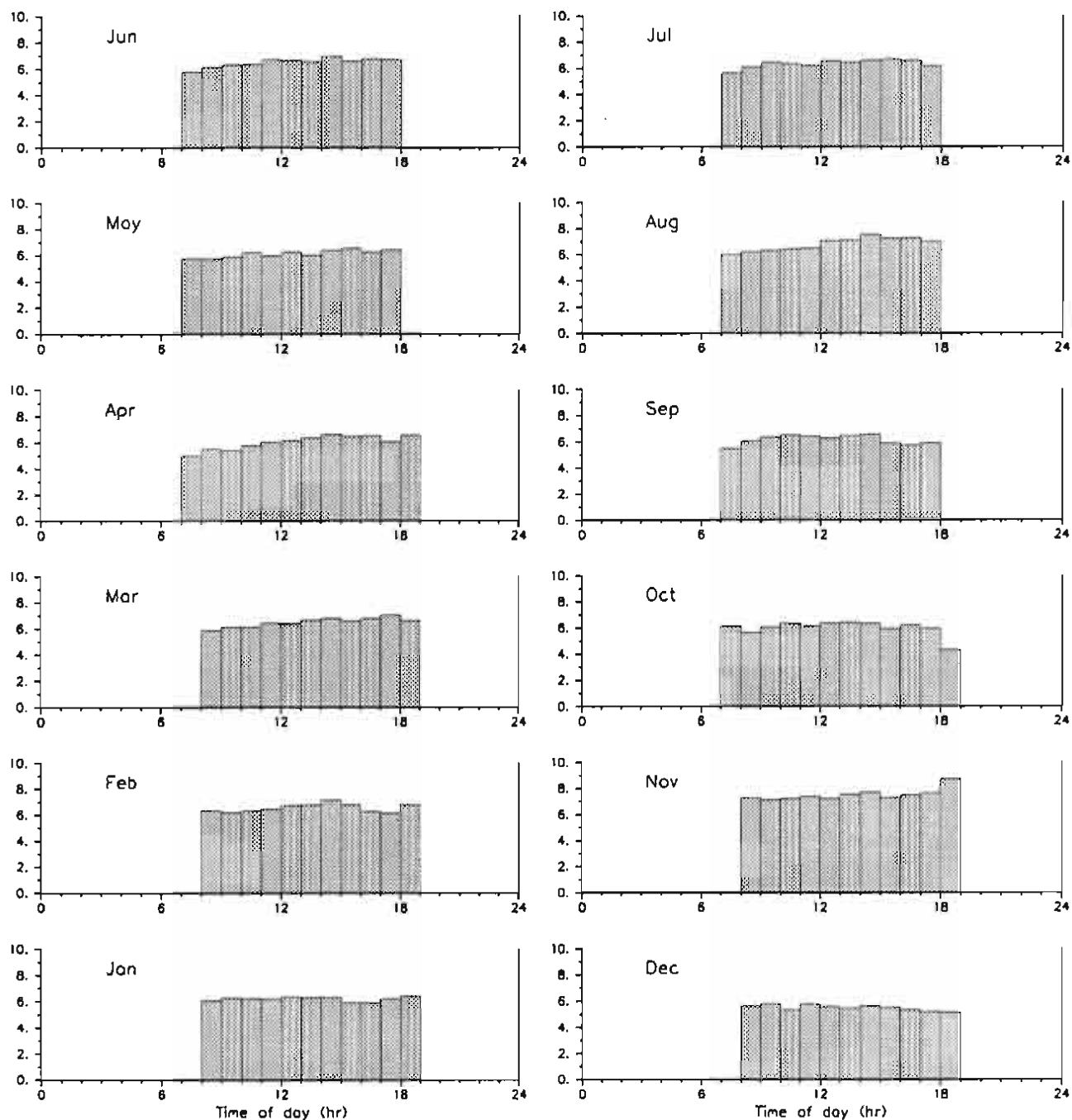
Wind Speed (m/s) at z= 12.2m

Wind Direction (deg) at z= 12.2m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

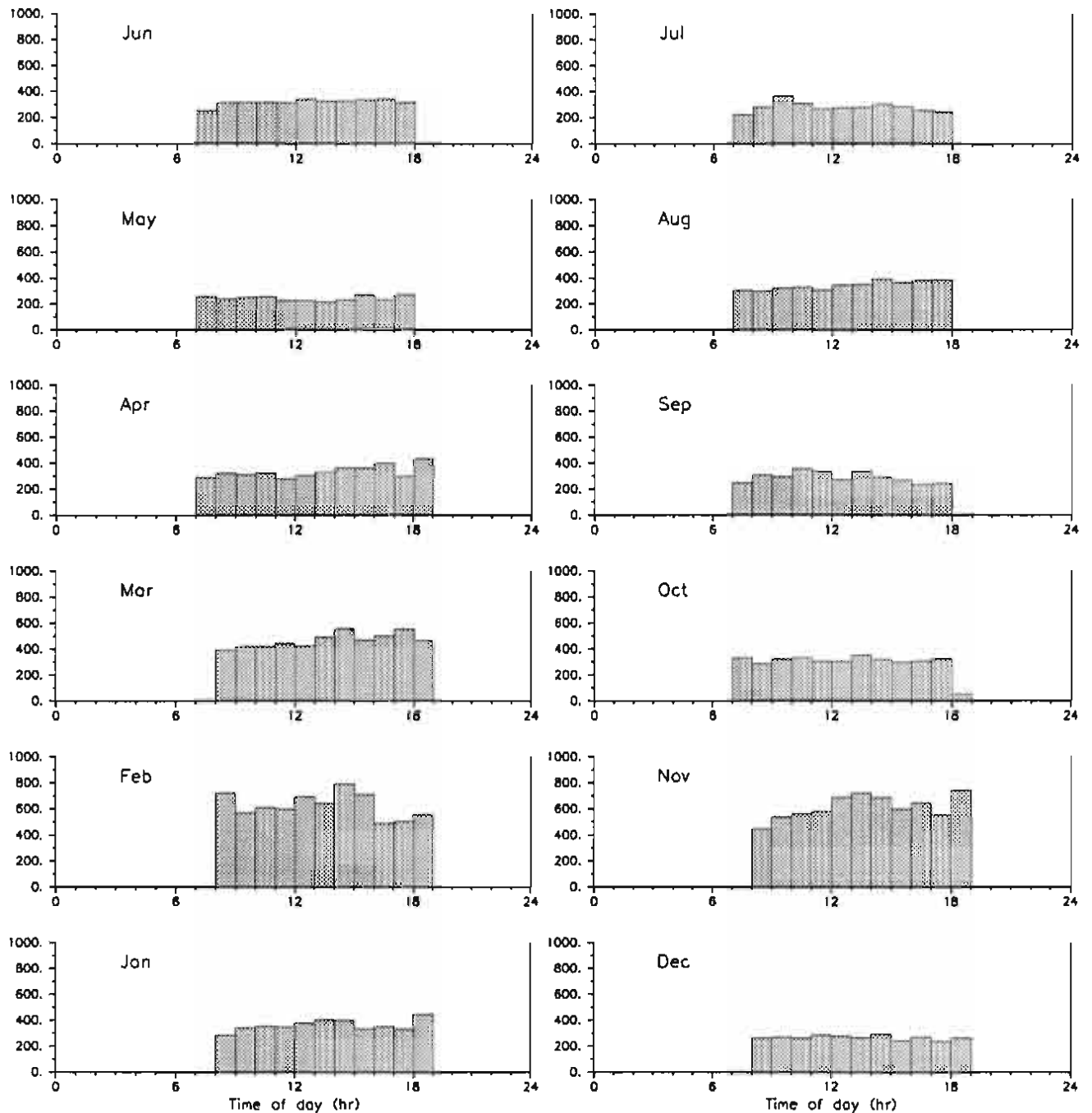
45/10/77

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangirsuk A (6)
 Wind Speed (m/s) at z= 12.2m

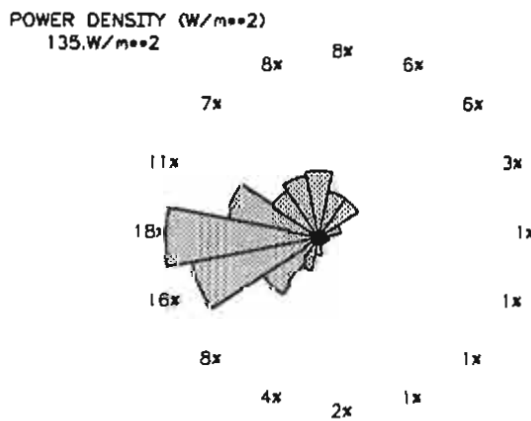
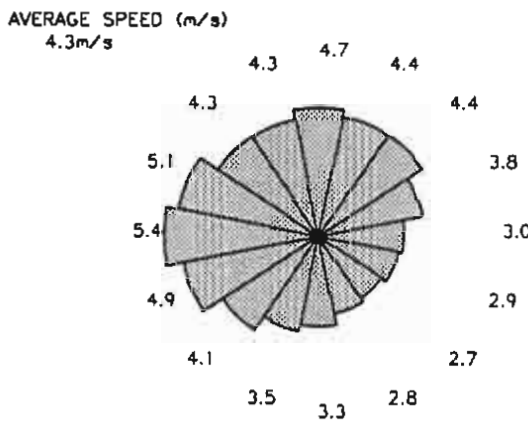
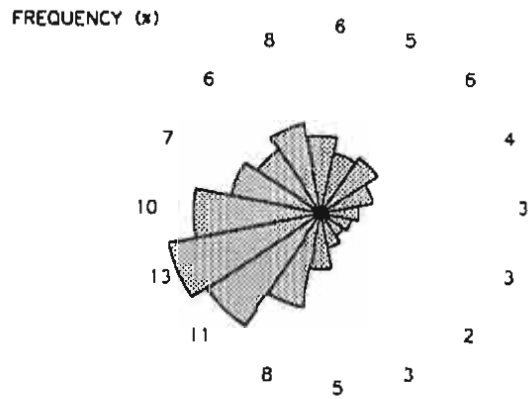
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



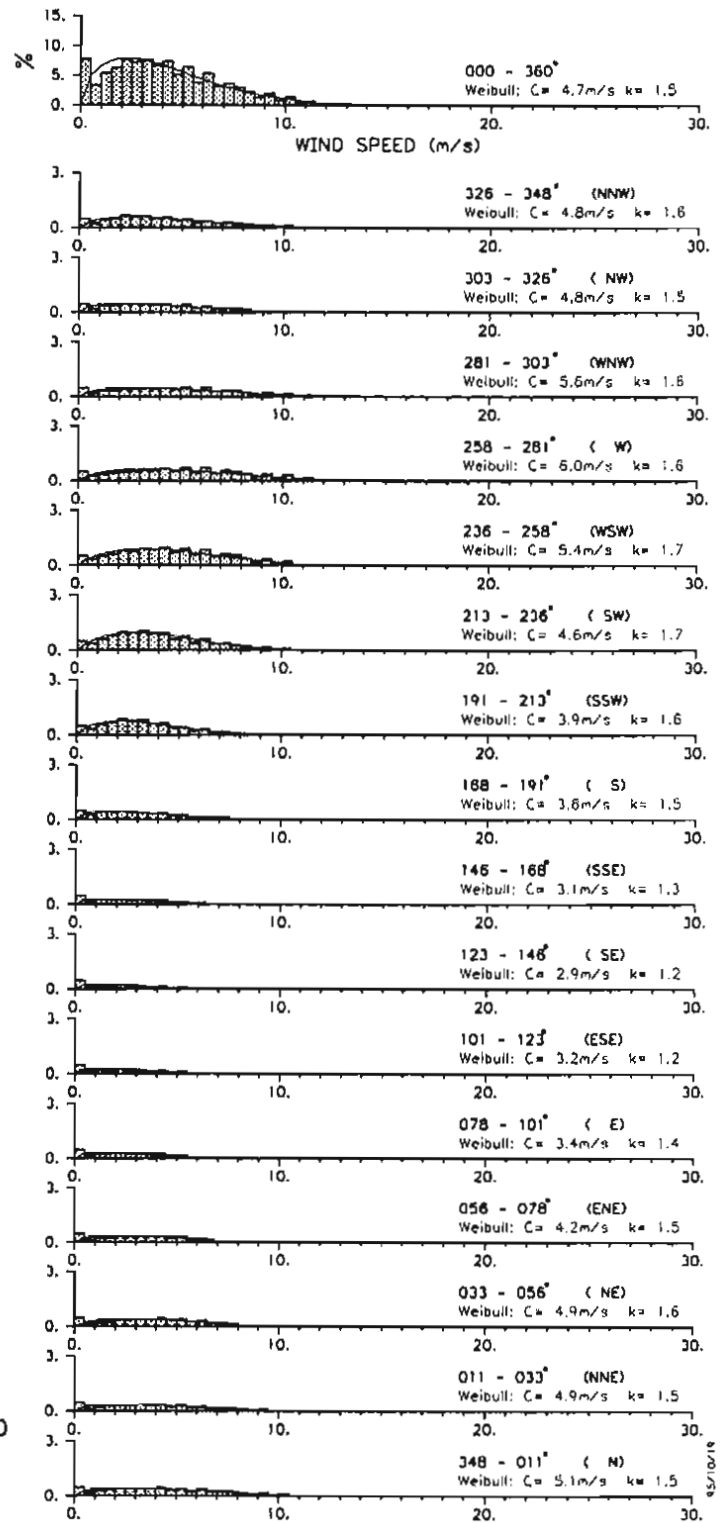
Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kangirsuk A (6)
 Power Density (W/m²) at z= 12.2m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

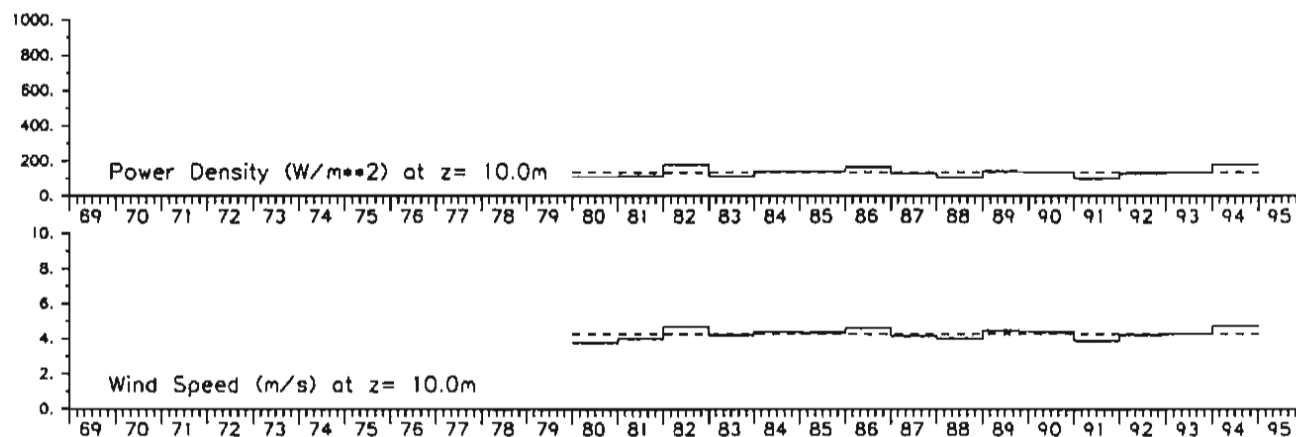


Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kuujuaq A (7)
 Wind Speed (m/s) at z= 10.0m
 Wind Direction (deg) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00

Station: Kuujuaq A (7)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00
 Kuujuaq A (7)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degC	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	3.8	278.	17.2	-N/A-	108.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.0	286.	19.7	-N/A-	115.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	4.7	268.	20.4	-N/A-	180.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-5.9	100.91	1.320	4.2	283.	18.6	-N/A-	112.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	4.4	272.	22.9	-N/A-	140.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	4.3	284.	19.1	-N/A-	142.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	4.6	264.	23.5	-N/A-	164.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.1	284.	17.7	-N/A-	128.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.0	268.	15.6	-N/A-	105.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	4.5	271.	19.3	-N/A-	143.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	4.4	261.	15.9	-N/A-	138.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	3.9	265.	23.7	-N/A-	129.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.2	271.	15.5	-N/A-	129.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.3	265.	27.4	-N/A-	138.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.78	1.316	4.7	273.	21.5	-N/A-	181.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->81/01/01	100.0	100.0	100.0	100.0	85.6	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	92.3	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	94.8	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	92.7	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	94.2	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	91.3	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	100.0	100.0	100.0	100.0	92.8	100.0	0.0	100.0	0.0	0.0	0.0
90/01/01->91/01/01	100.0	100.0	100.0	100.0	94.0	100.0	0.0	100.0	0.0	0.0	0.0
91/01/01->92/01/01	100.0	100.0	100.0	100.0	93.0	100.0	0.0	100.0	0.0	0.0	0.0
92/01/01->93/01/01	100.0	100.0	100.0	100.0	93.5	100.0	0.0	100.0	0.0	0.0	0.0
93/01/01->94/01/01	100.0	100.0	100.0	100.0	94.9	100.0	0.0	100.0	0.0	0.0	0.0
94/01/01->95/01/01	99.9	8.5	8.5	99.9	94.9	99.9	0.0	99.9	0.0	0.0	0.0

Period Average

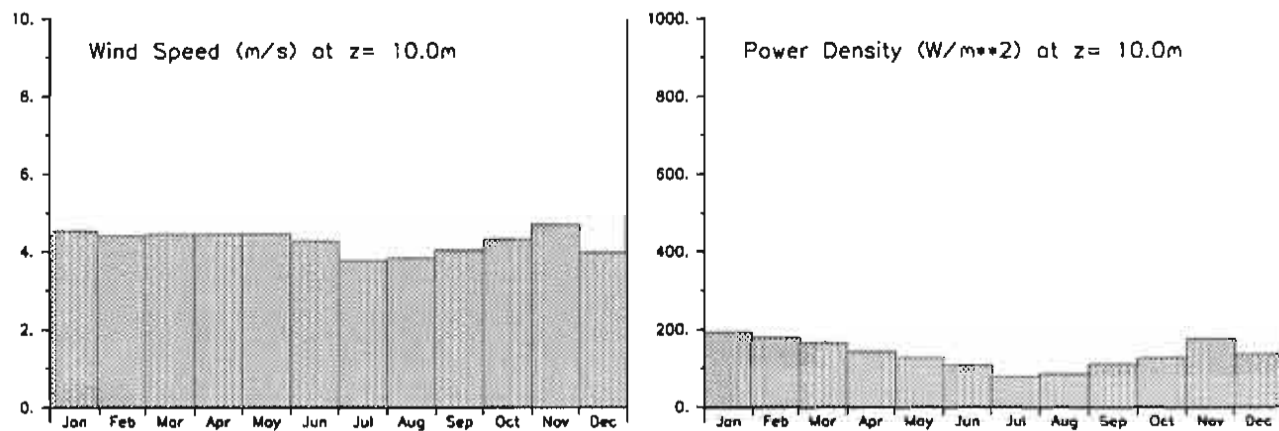
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->95/01/01	-5.7	100.69	1.316	4.3	272.	27.4	-N/A-	135.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->95/01/01	100.0	93.9	93.9	100.0	92.9	100.0	0.0	100.0	0.0	0.0	0.0

95/10/20

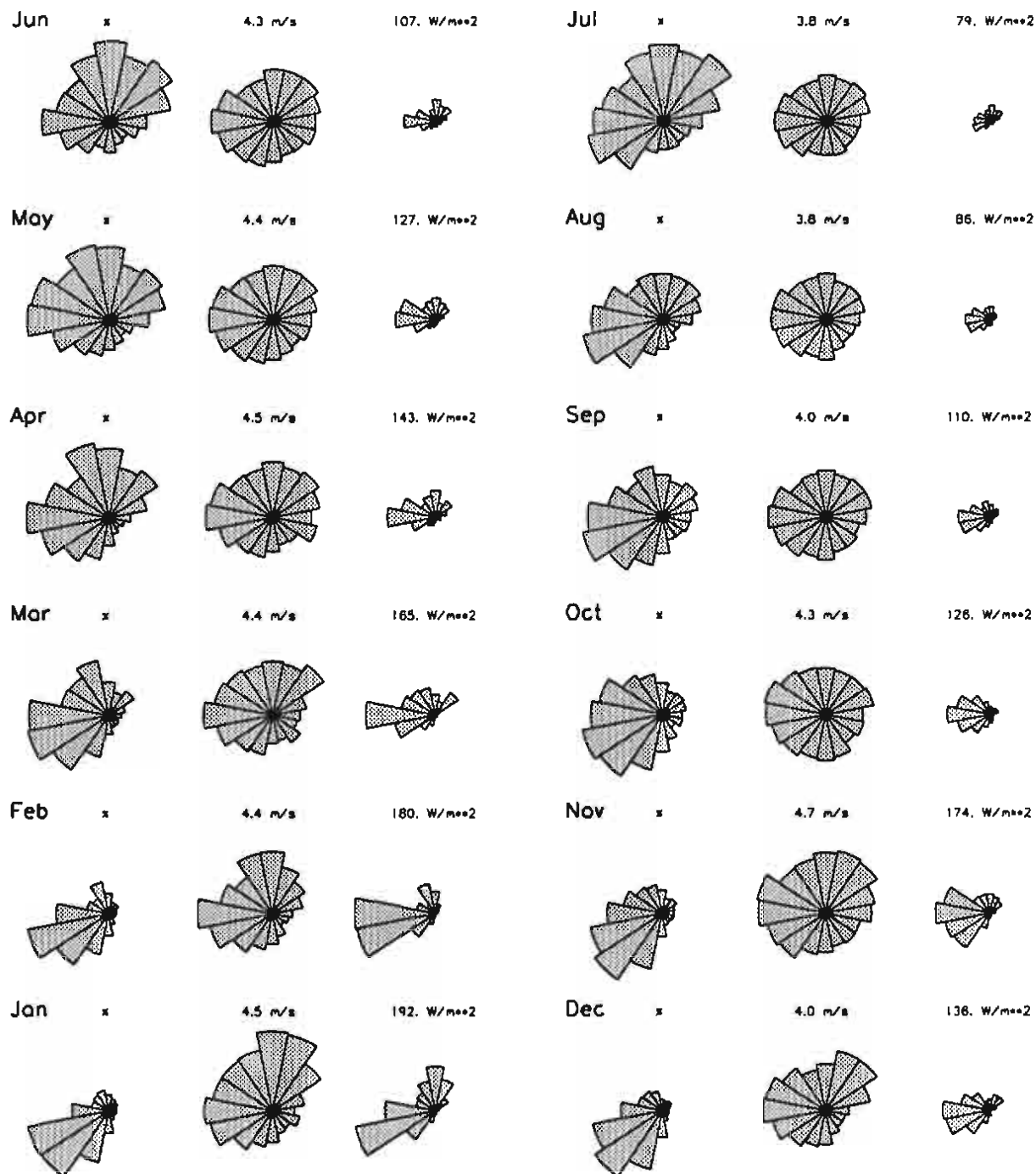
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Kuujuuaq A (7)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00

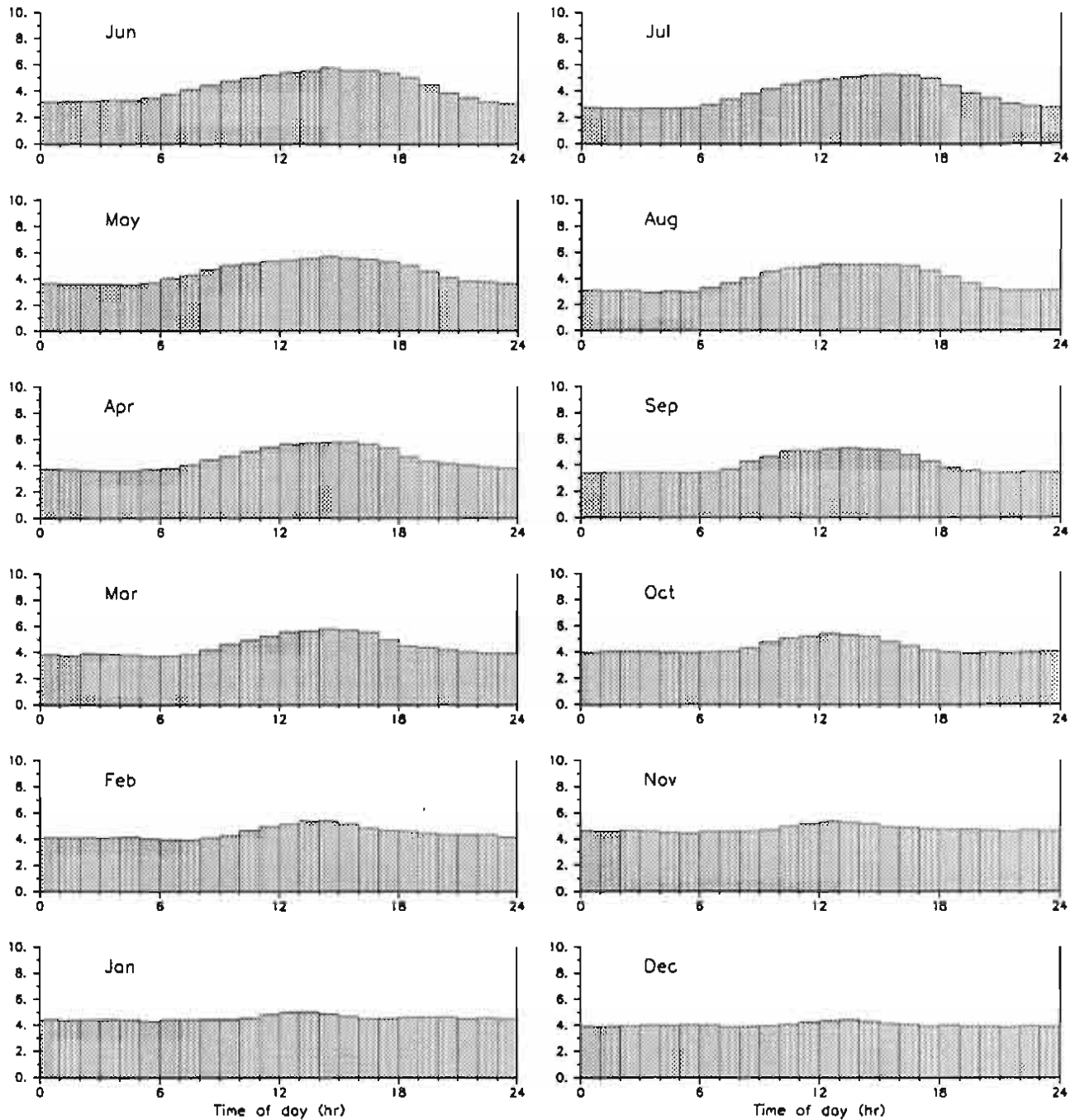
Station: Kuujuaq A (7)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

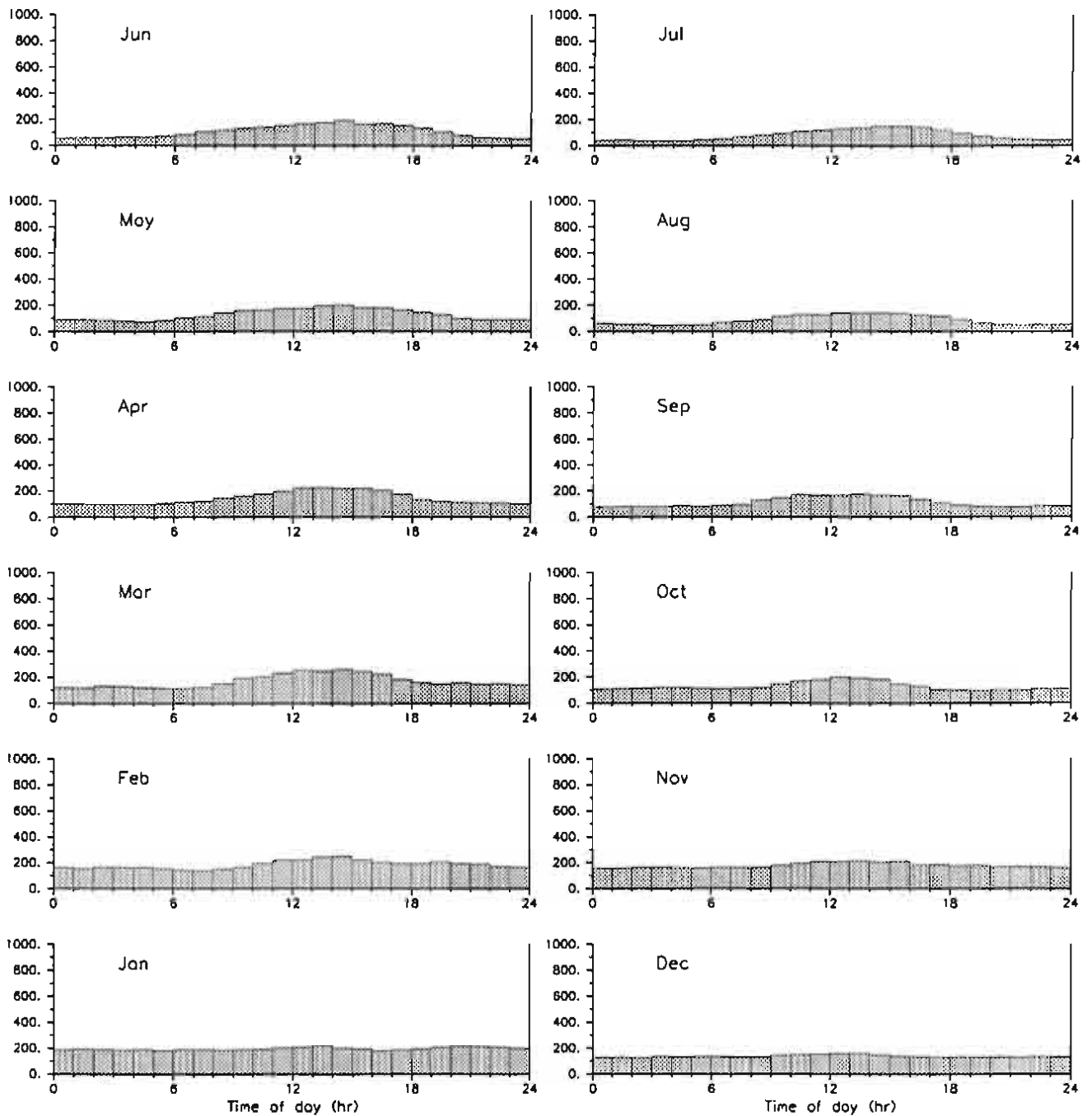


Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00

Station: Kuujuaq A (7)

Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

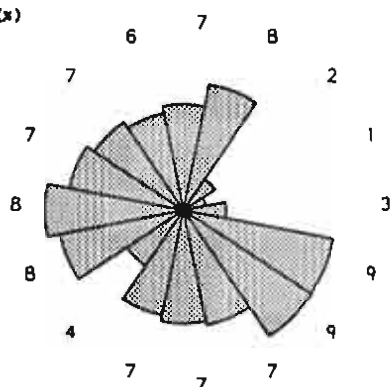


Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Kuujuak A (7)
 Power Density (W/m²) at z= 10.0m

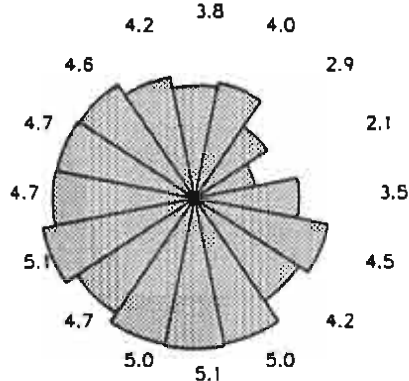
WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

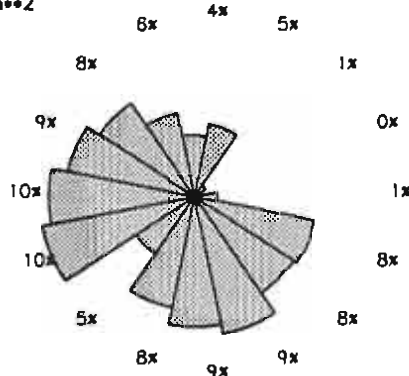
FREQUENCY (%)



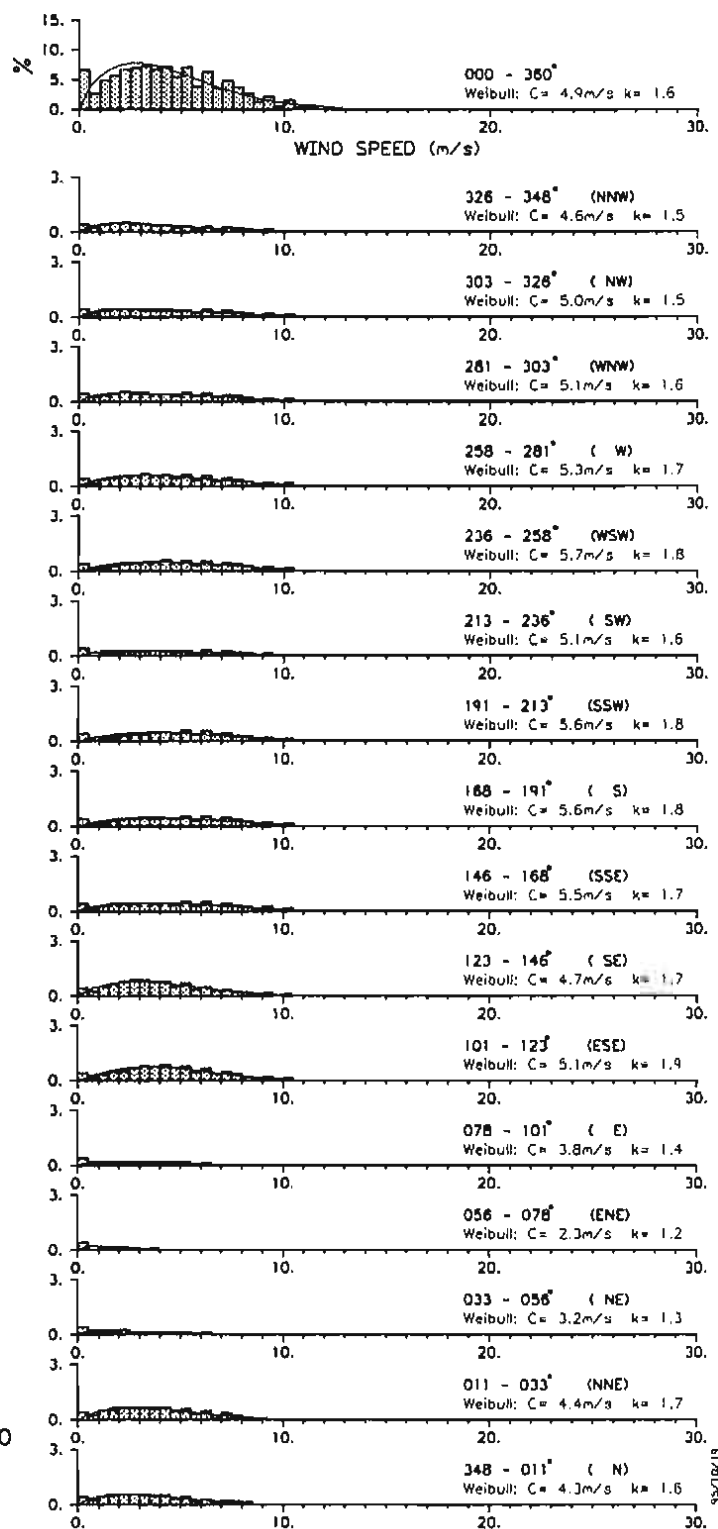
AVERAGE SPEED (m/s)
4.5m/s



POWER DENSITY (W/m²)
134.W/m²

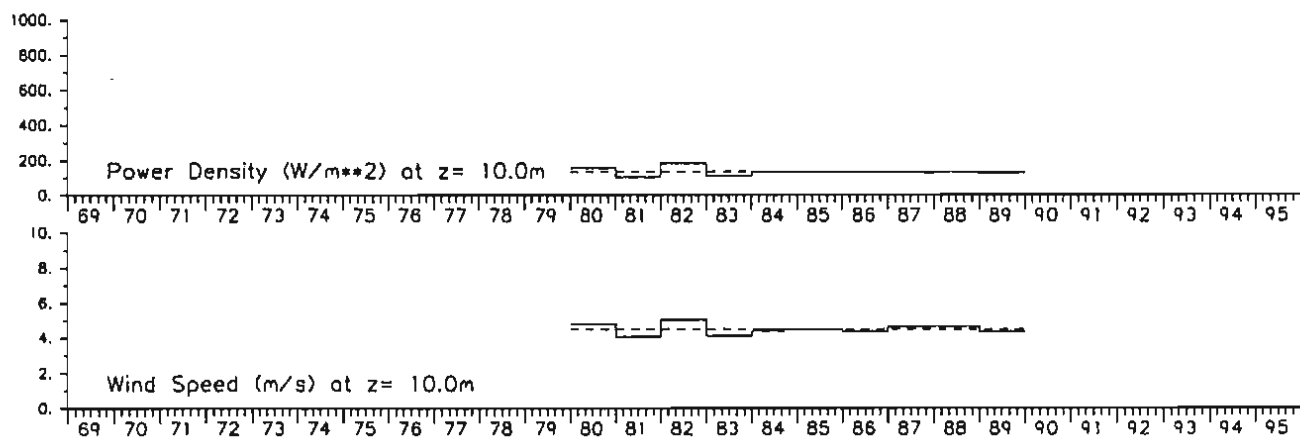


Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
Station: Kuujuaupik A (4)
Wind Speed (m/s) at z= 10.0m
Wind Direction (deg) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
Station: Kuujjuarapik A (4)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
 Kuujuaarapik A (4)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.3	101.01	1.313	4.8	226.	19.6	-N/A-	157.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-2.8	101.06	1.305	4.1	227.	18.1	-N/A-	102.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-4.6	101.06	1.315	5.0	236.	18.7	-N/A-	182.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-4.2	101.22	1.315	4.1	199.	15.6	-N/A-	110.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-3.8	101.08	1.311	4.4	232.	18.1	-N/A-	134.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-3.9	100.99	1.310	4.5	214.	17.1	-N/A-	136.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-5.2	101.06	1.318	4.3	237.	18.6	-N/A-	126.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-2.8	101.07	1.305	4.6	231.	15.5	-N/A-	132.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-3.8	100.97	1.310	4.7	195.	15.7	-N/A-	137.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-5.9	101.08	1.322	4.3	252.	16.6	-N/A-	127.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->81/01/01	100.0	100.0	100.0	100.0	93.9	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	91.8	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	94.9	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	91.2	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	93.9	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	93.3	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	94.4	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	94.5	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	94.5	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	100.0	100.0	100.0	100.0	94.4	100.0	0.0	100.0	0.0	0.0	0.0

Period Average

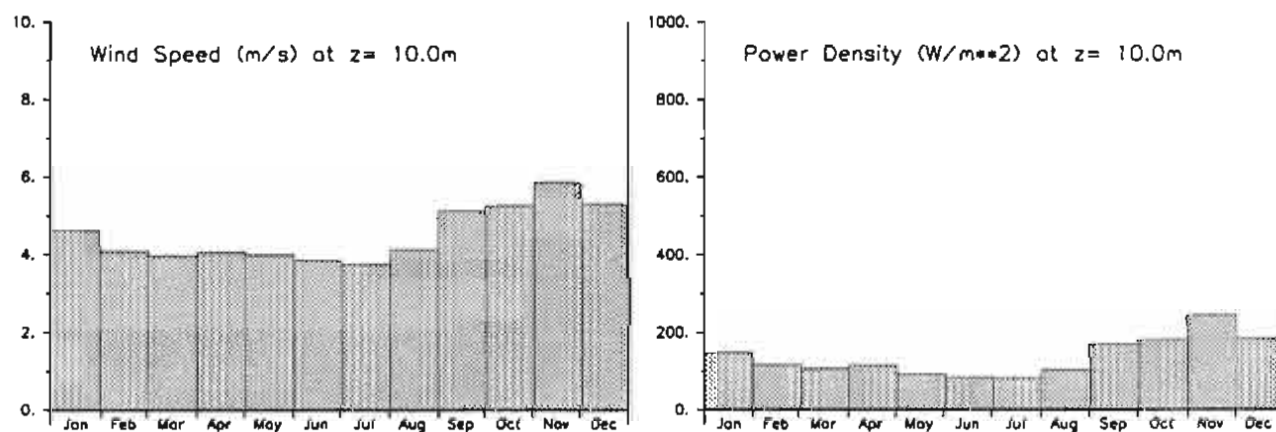
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->90/01/01	-4.1	101.06	1.312	4.5	229.	19.6	-N/A-	134.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->90/01/01	100.0	100.0	100.0	100.0	93.7	100.0	0.0	100.0	0.0	0.0	0.0

95/10/20

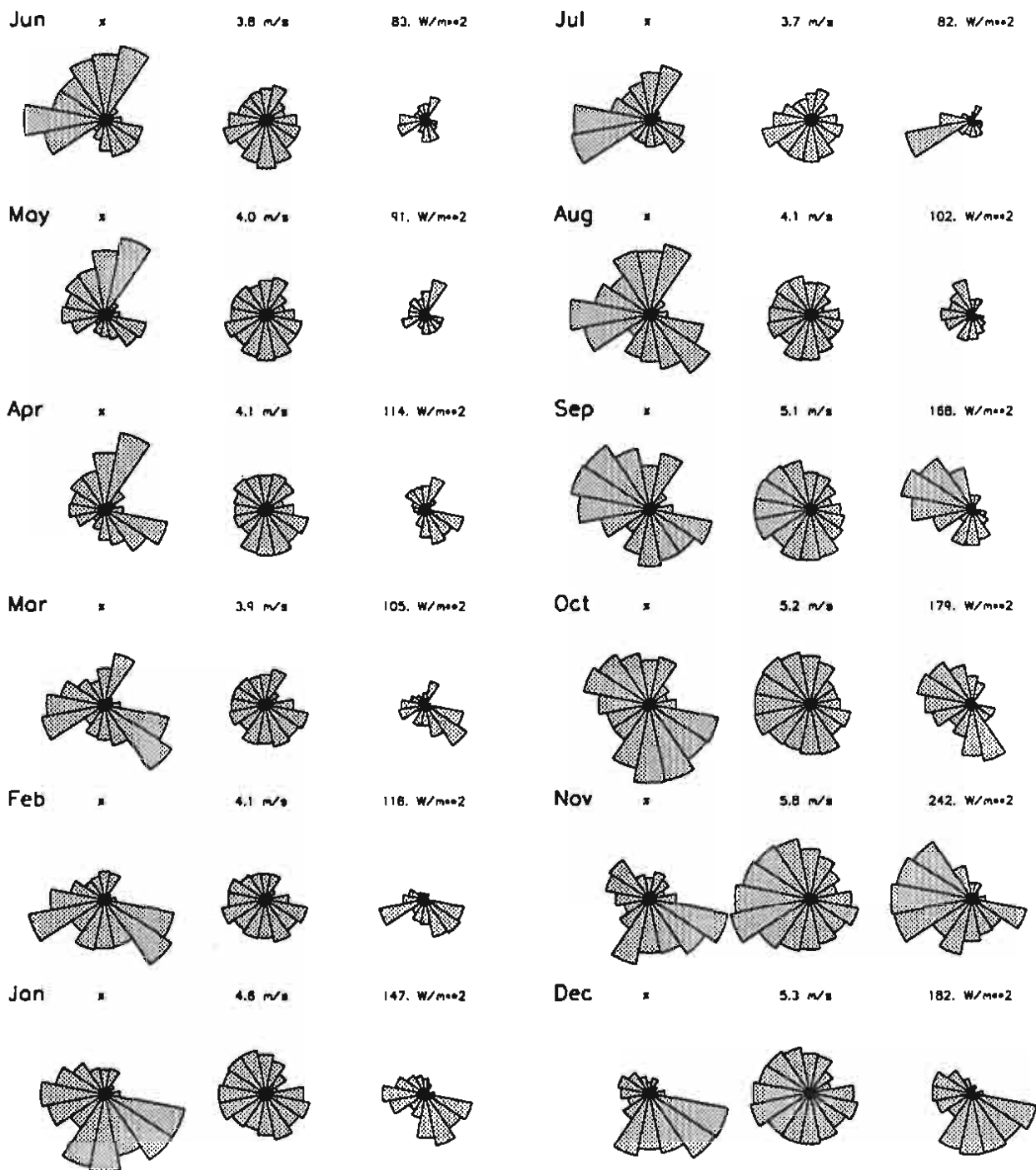
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
Station: Kuujjuarapik A (4)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00

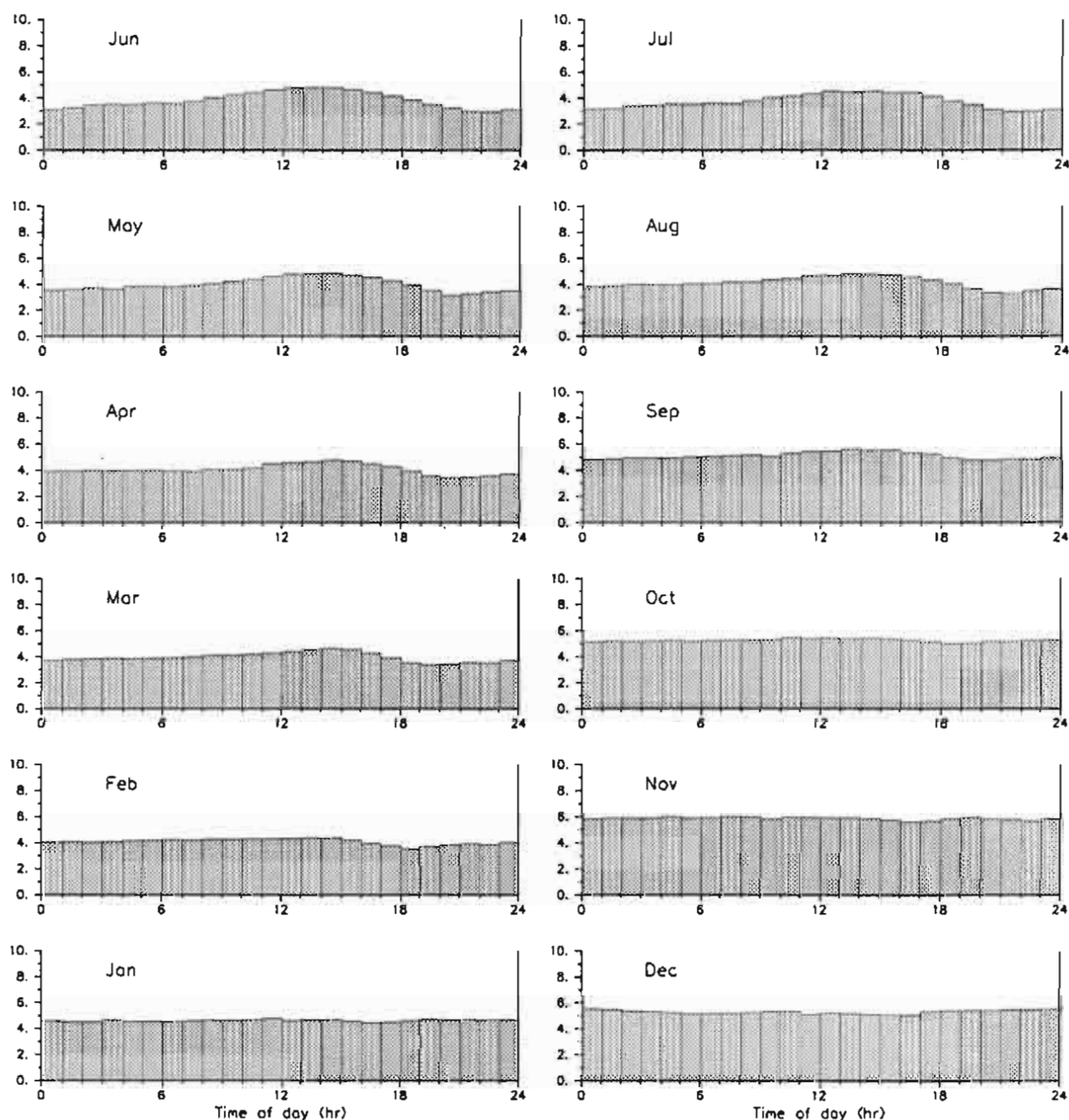
Station: Kuujjuarapik A (4)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

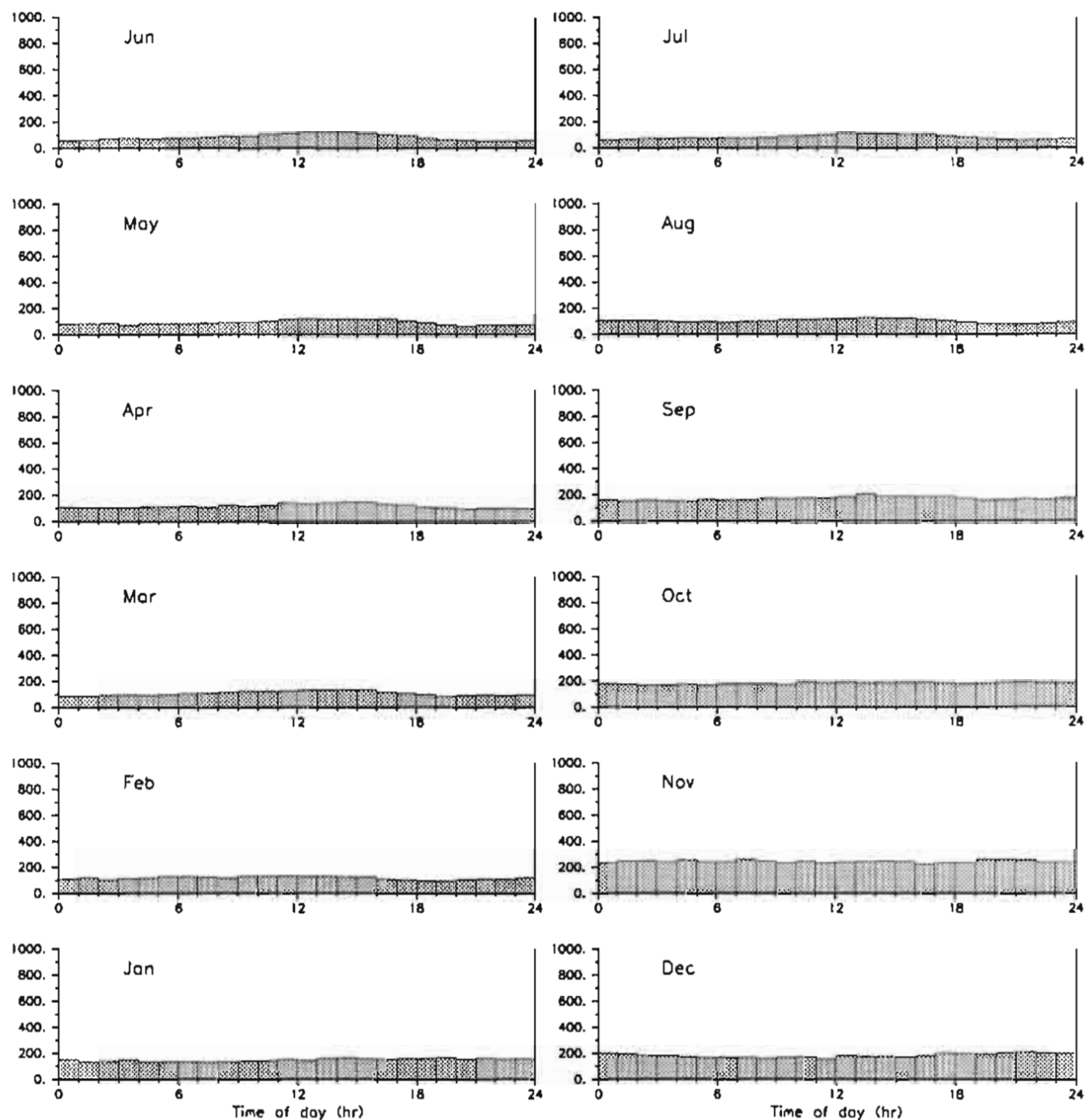
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
 Station: Kuujjuarapik A (4)
 Wind Speed (m/s) at z= 10.0m

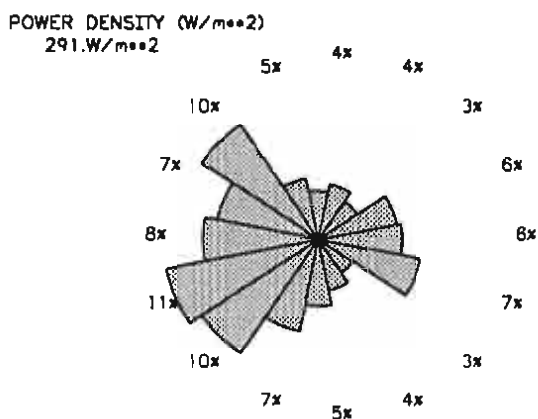
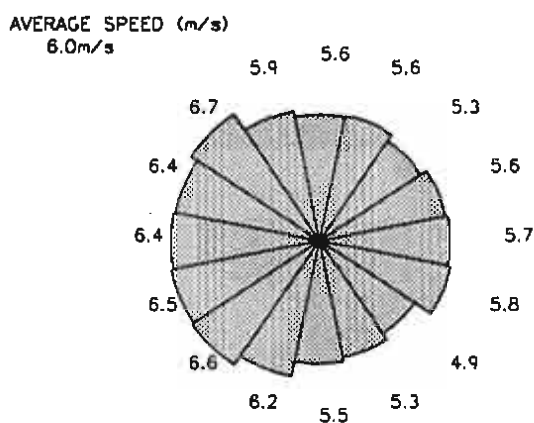
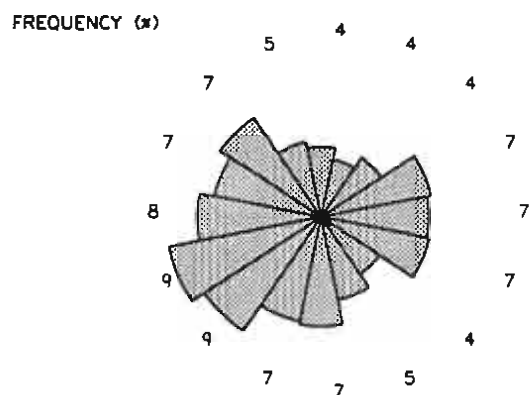
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



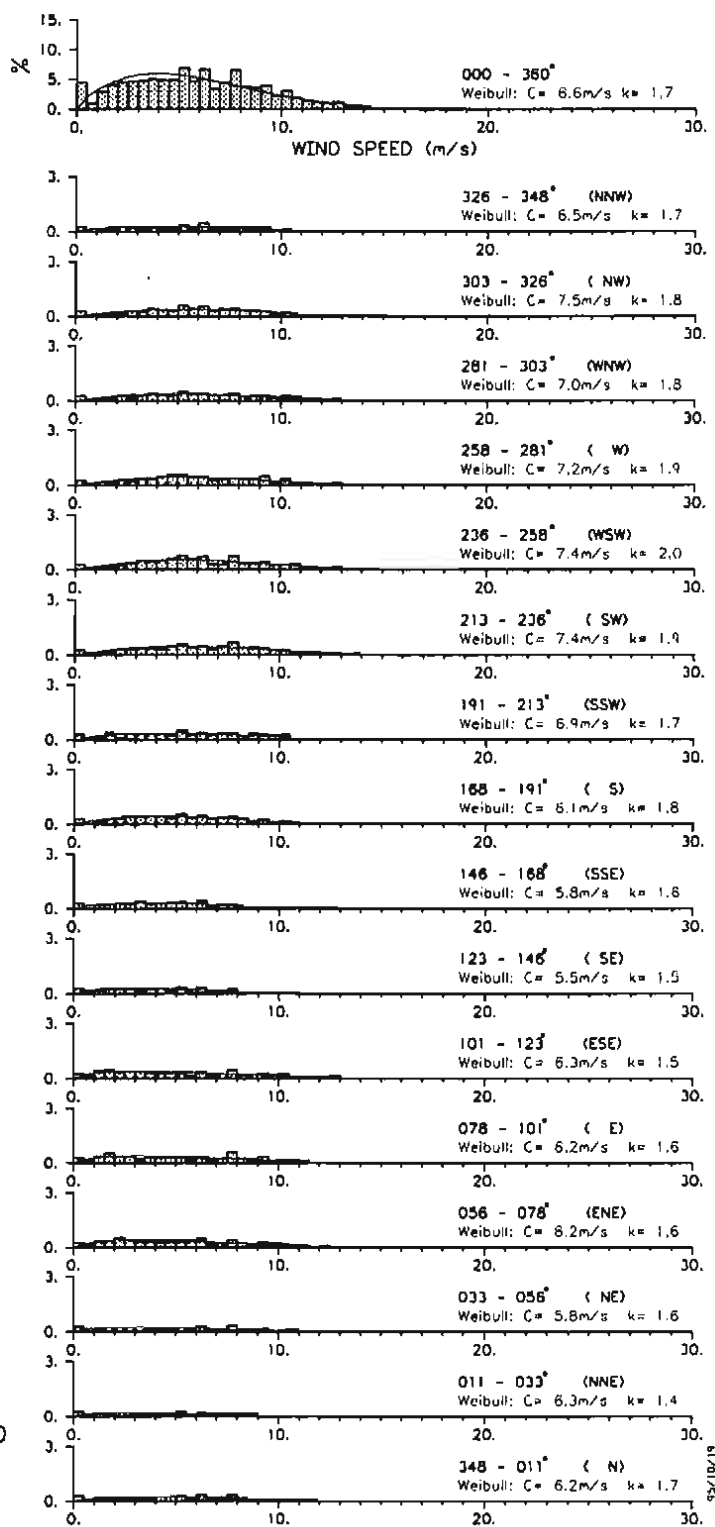
Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00
 Station: Kuujjuarapik A (4)
 Power Density (W/m**2) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

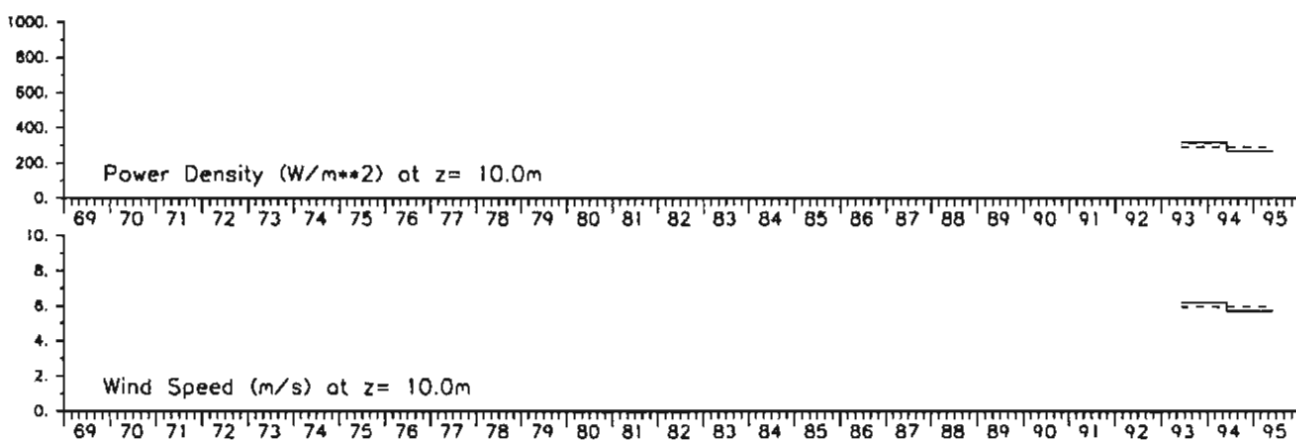


Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
Station: Povungnituk A (11)
Wind Speed (m/s) at z= 10.0m
Wind Direction (deg) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
Station: Povungnituk A (11)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
 Povungnituk A (11)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/06/01->94/06/01	-7.0	100.87	1.324	6.2	231.	19.5	-N/A-	317.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-6.6	100.90	1.322	5.7	233.	21.3	-N/A-	267.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->94/06/01	40.7	26.9	26.9	41.1	39.4	41.1	0.0	41.1	0.0	0.0	0.0
94/06/01->95/06/01	44.1	0.0	0.0	44.1	41.8	44.1	0.0	44.1	0.0	0.0	0.0

Period Average

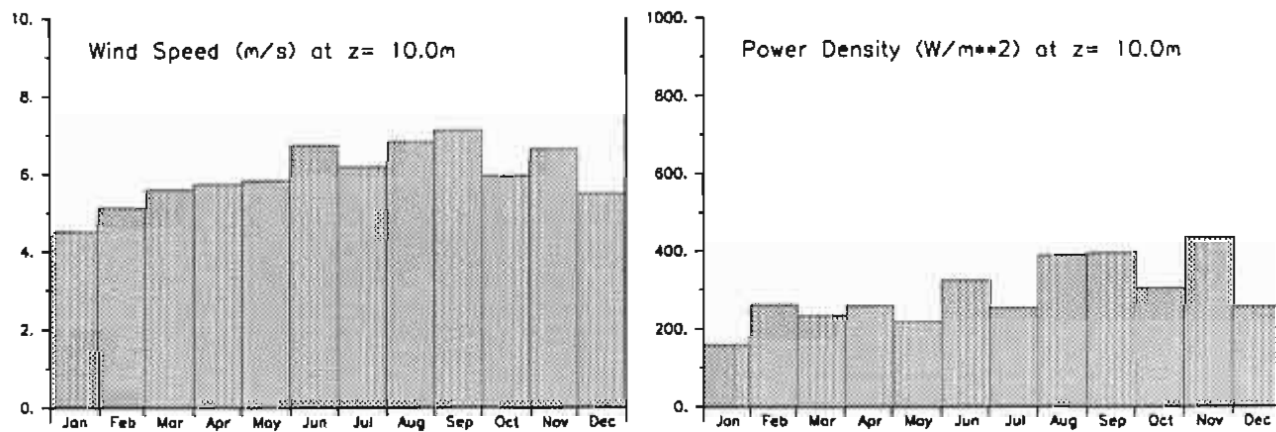
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-6.8	100.89	1.323	6.0	232.	21.3	-N/A-	291.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	42.4	13.4	13.4	42.6	40.6	42.6	0.0	42.6	0.0	0.0	0.0

95/10/20

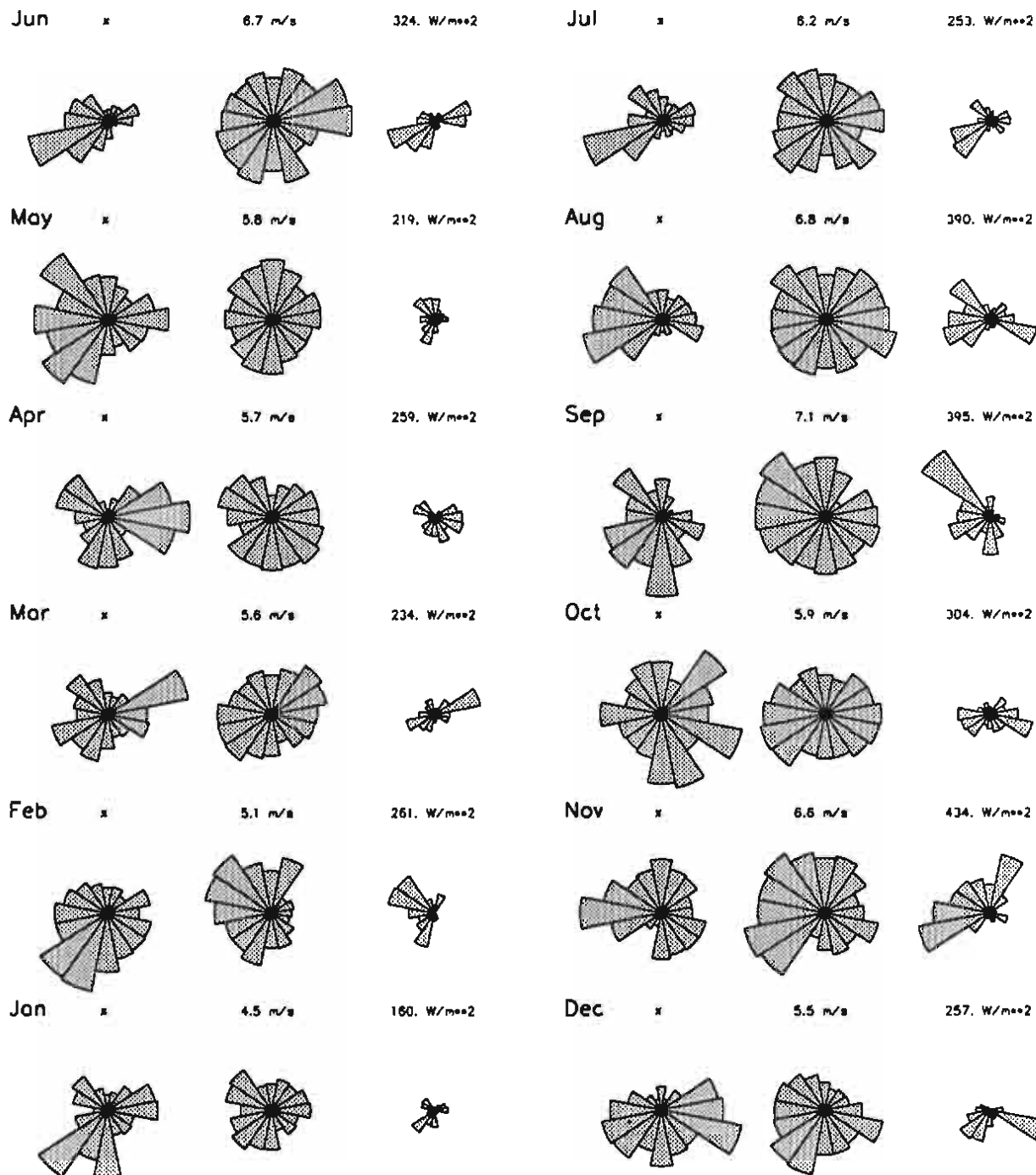
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
Station: Povungnituk A (11)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

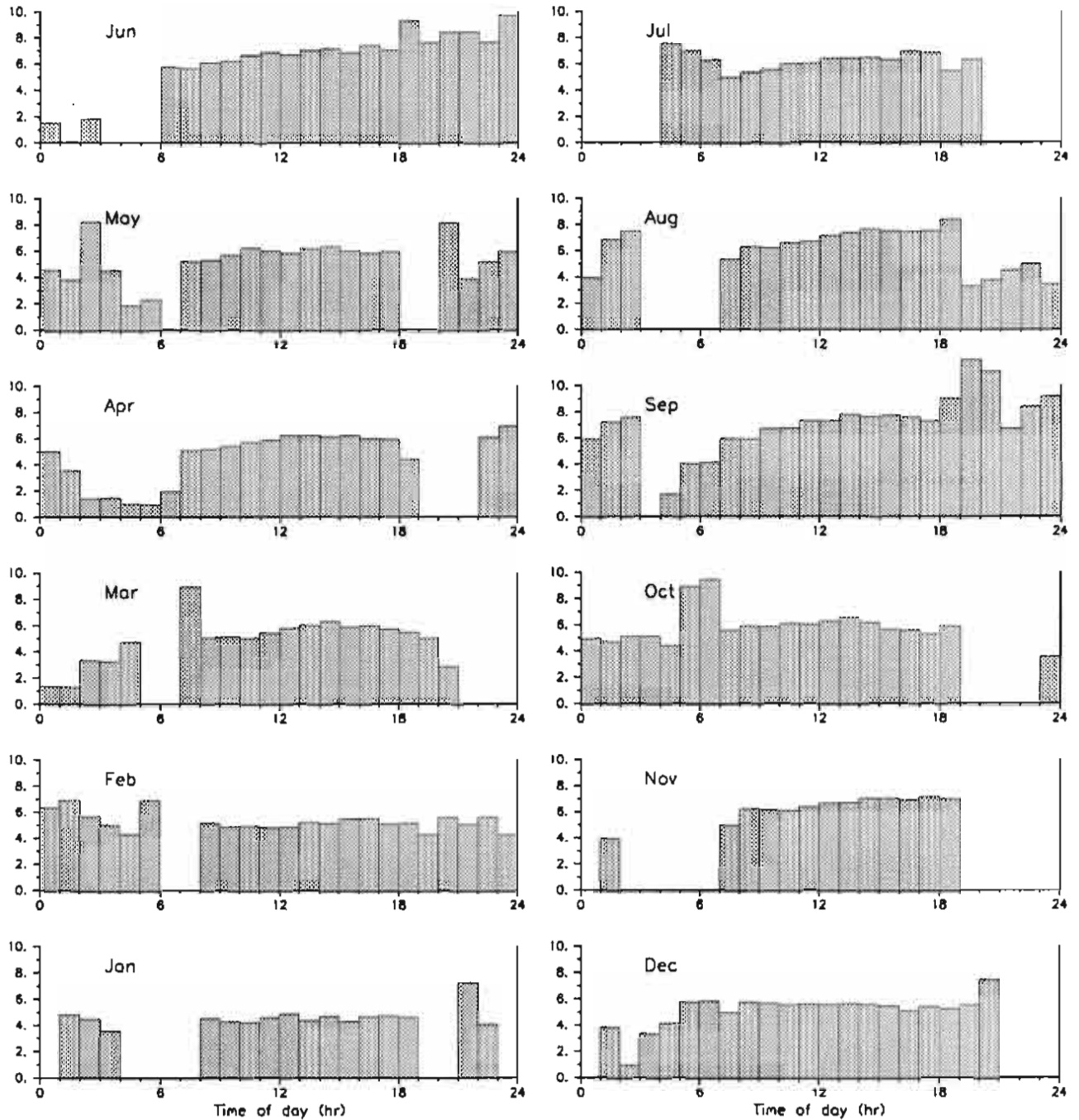
Station: Povungnituk A (11)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

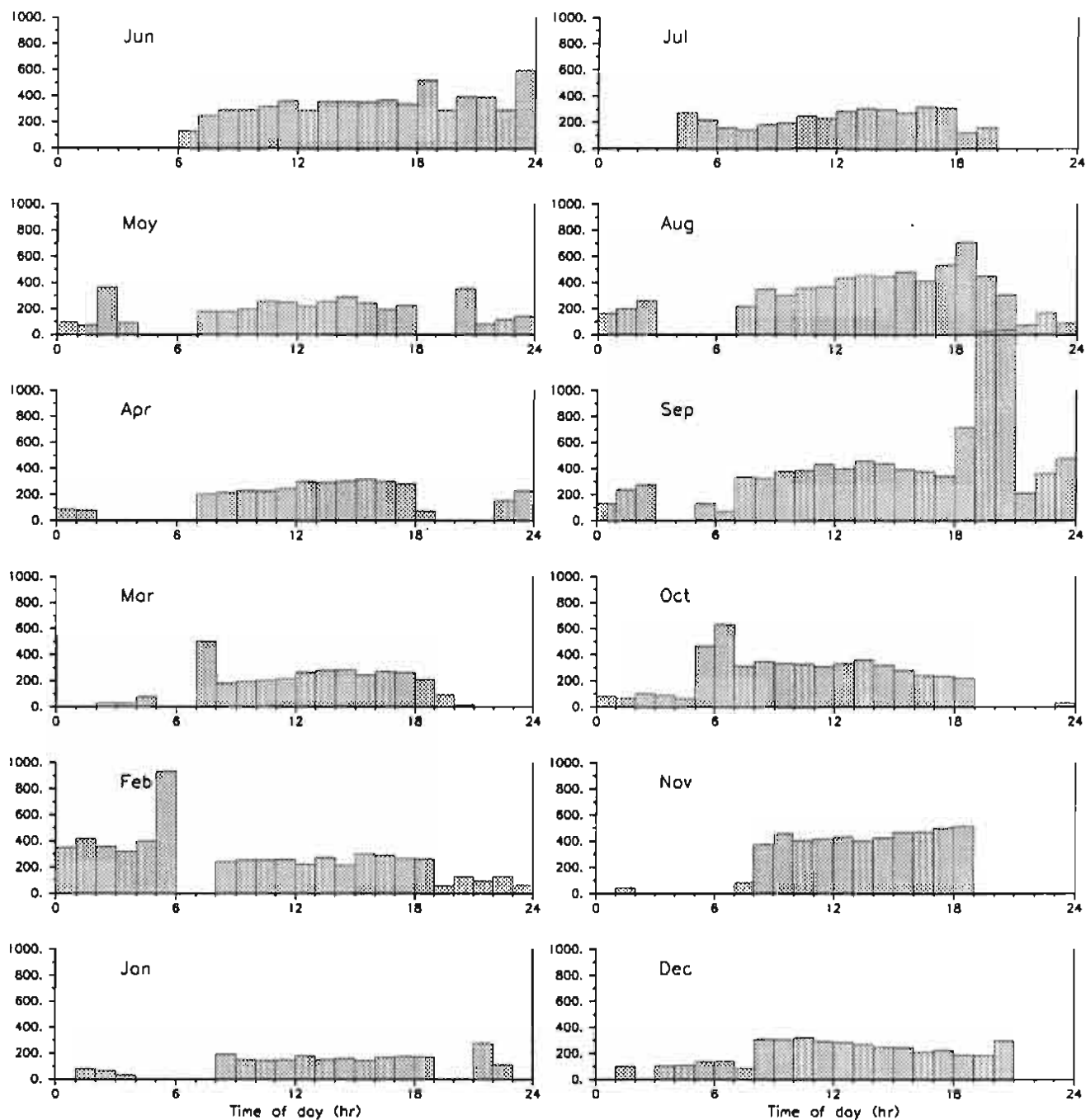
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
 Station: Povungnituk A (11)
 Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



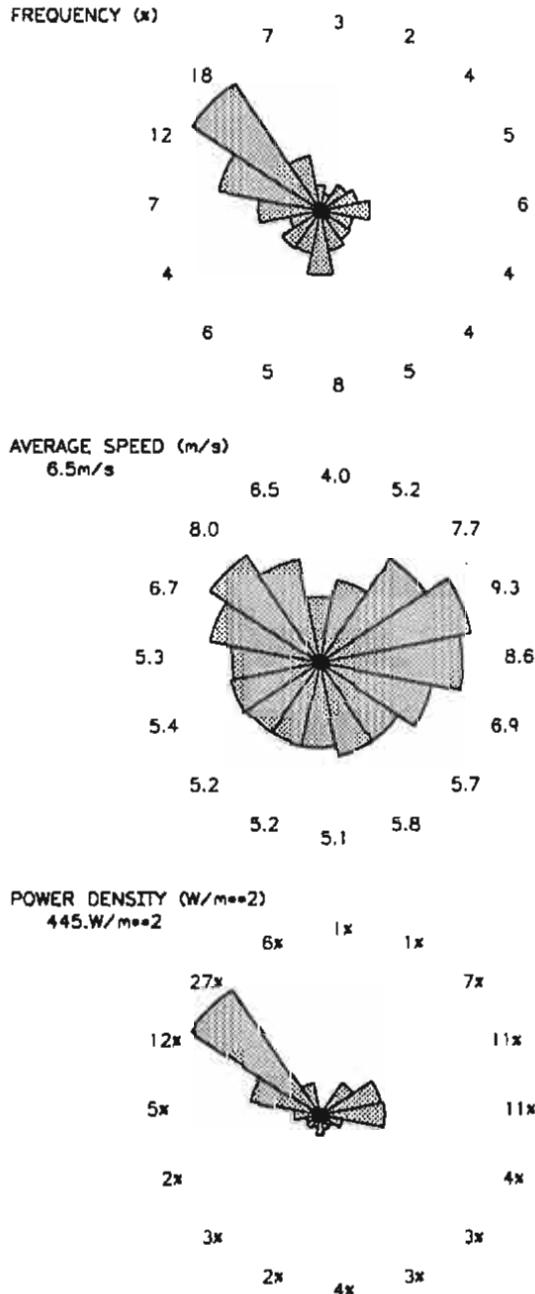
Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

Station: Povungnituk A (11)

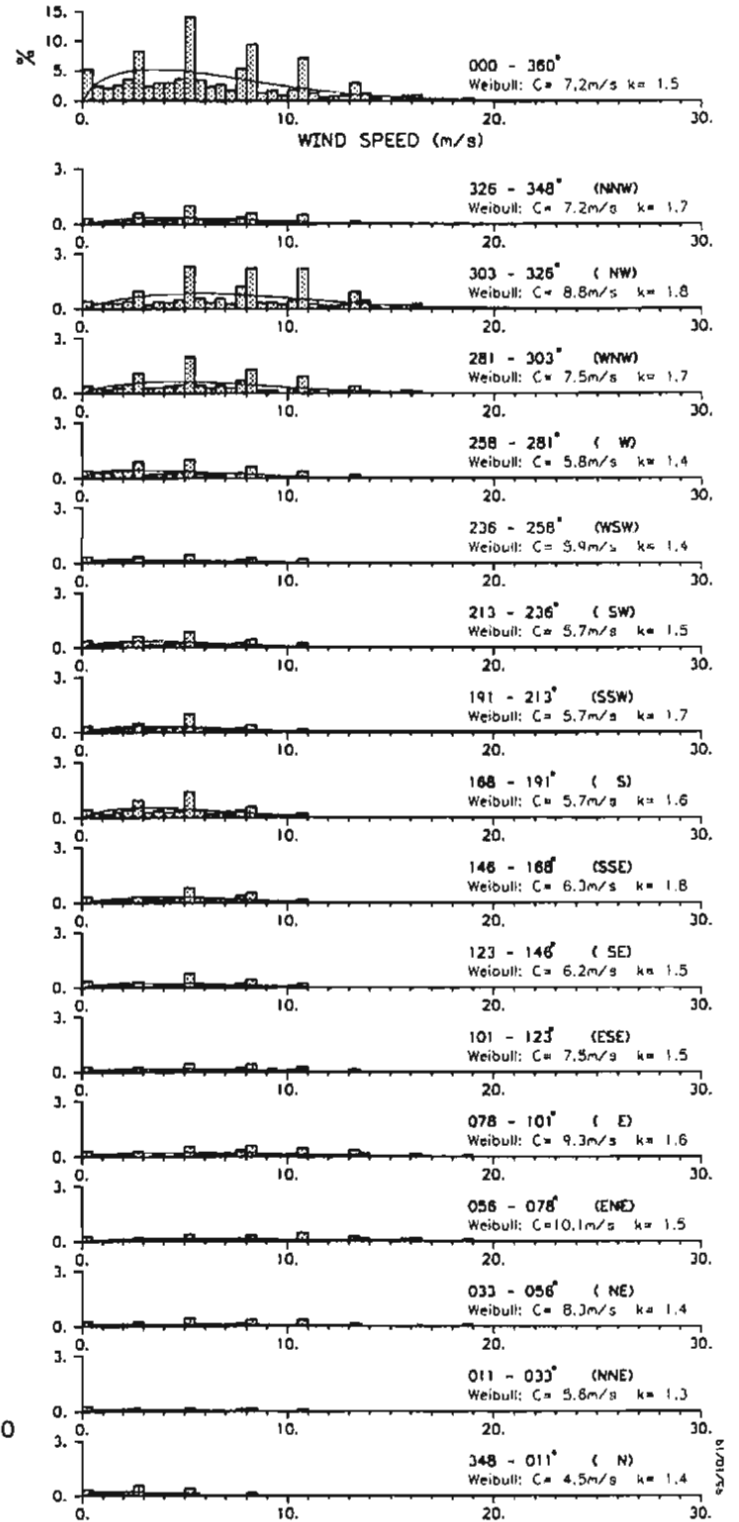
Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

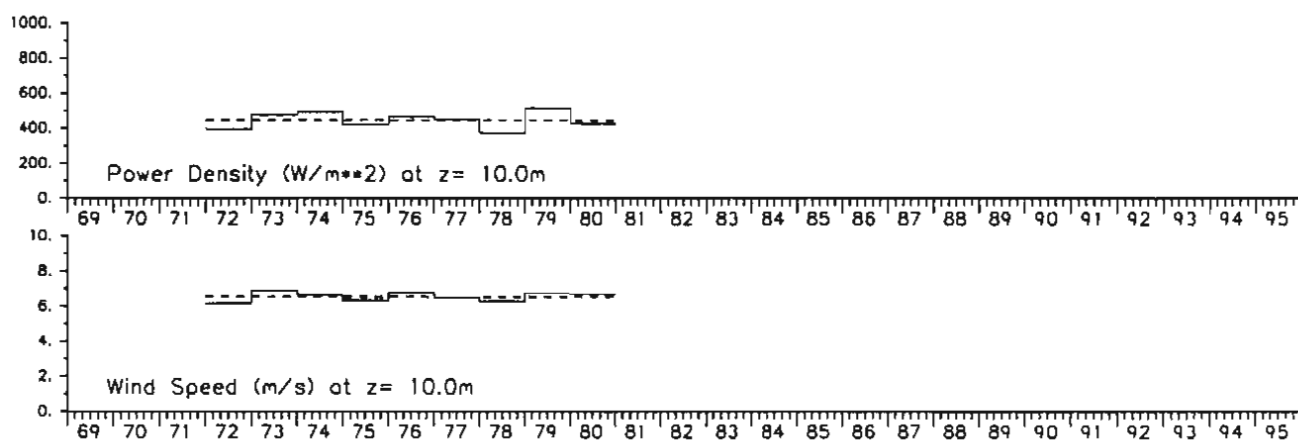


Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00
 Station: Quaqtaq (1)
 Wind Speed (m/s) at z = 10.0m
 Wind Direction (deg) at z = 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00

Station: Quaqtaq (1)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00
 Quaqtaq (1)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
72/01/01->73/01/01	-8.2	100.70	1.326	6.2	282.	26.6	-N/A-	392.	-N/A-	-N/A-	-N/A-
73/01/01->74/01/01	-6.9	100.70	1.320	6.8	304.	27.0	-N/A-	476.	-N/A-	-N/A-	-N/A-
74/01/01->75/01/01	-7.2	100.70	1.321	6.6	296.	26.6	-N/A-	494.	-N/A-	-N/A-	-N/A-
75/01/01->76/01/01	-7.0	100.70	1.321	6.3	277.	24.3	-N/A-	421.	-N/A-	-N/A-	-N/A-
76/01/01->77/01/01	-7.4	100.70	1.322	6.8	280.	24.3	-N/A-	466.	-N/A-	-N/A-	-N/A-
77/01/01->78/01/01	-6.7	100.70	1.318	6.5	285.	24.8	-N/A-	450.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-7.6	100.70	1.323	6.3	285.	20.8	-N/A-	373.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-7.0	100.70	1.320	6.8	279.	23.7	-N/A-	515.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-6.9	100.70	1.320	6.7	297.	22.5	-N/A-	426.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
72/01/01->73/01/01	31.9	0.0	0.0	31.9	29.8	31.9	0.0	31.9	0.0	0.0	0.0
73/01/01->74/01/01	28.8	0.0	0.0	28.8	28.0	28.8	0.0	28.8	0.0	0.0	0.0
74/01/01->75/01/01	29.0	0.0	0.0	29.0	28.3	29.0	0.0	29.0	0.0	0.0	0.0
75/01/01->76/01/01	28.6	0.0	0.0	28.6	28.2	28.6	0.0	28.6	0.0	0.0	0.0
76/01/01->77/01/01	28.4	0.0	0.0	28.4	28.1	28.4	0.0	28.4	0.0	0.0	0.0
77/01/01->78/01/01	29.4	0.0	0.0	29.4	28.5	29.4	0.0	29.4	0.0	0.0	0.0
78/01/01->79/01/01	30.5	0.0	0.0	30.5	28.9	30.5	0.0	30.5	0.0	0.0	0.0
79/01/01->80/01/01	28.2	0.0	0.0	28.2	28.7	28.2	0.0	28.2	0.0	0.0	0.0
80/01/01->81/01/01	26.8	0.0	0.0	26.8	25.6	26.8	0.0	26.8	0.0	0.0	0.0

Period Average

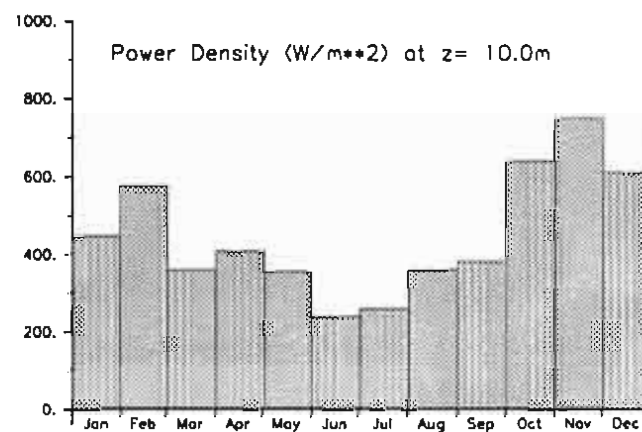
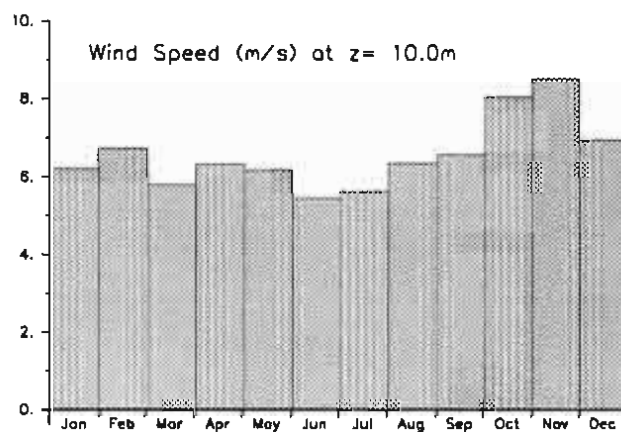
72/01/01->81/01/01	Temp -7.2	BPress 100.71	Density 1.321	WSpd 6.5	WDir 286.	MxWSpd 27.0	Gust -N/A-	Power 445.	TrbInts -N/A-	TrbnPwr -N/A-	TrbnOut -N/A-

Period Data Availability (%)

72/01/01->81/01/01	Temp 29.1	BPress 0.0	Density 0.0	WSpd 29.1	WDir 28.0	MxWSpd 29.1	Gust 0.0	Power 29.1	TrbInts 0.0	TrbnPwr 0.0	TrbnOut 0.0

95/10/20

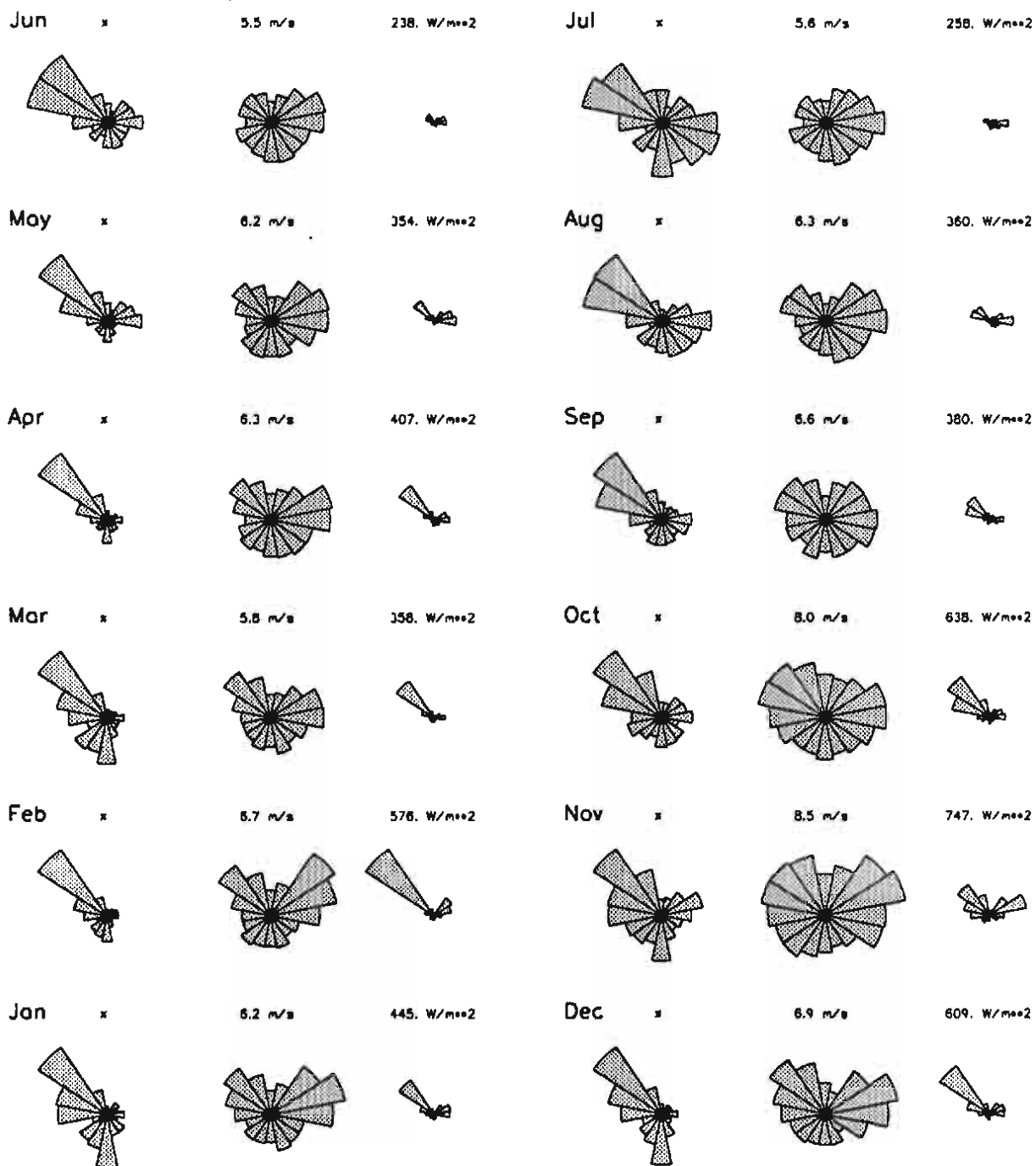
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00
Station: Quaqtaq (1)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00

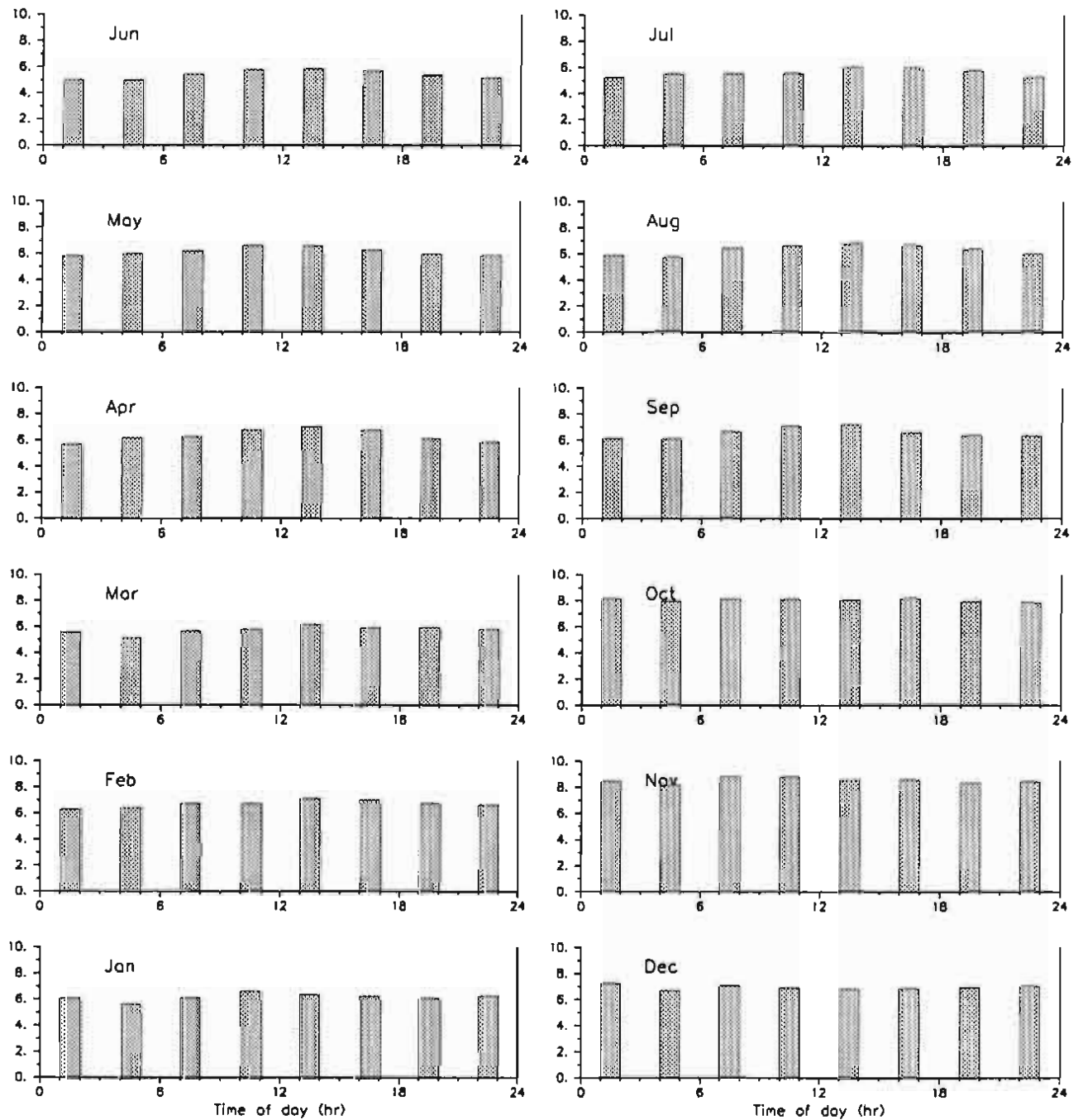
Station: Quaqtaq (1)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

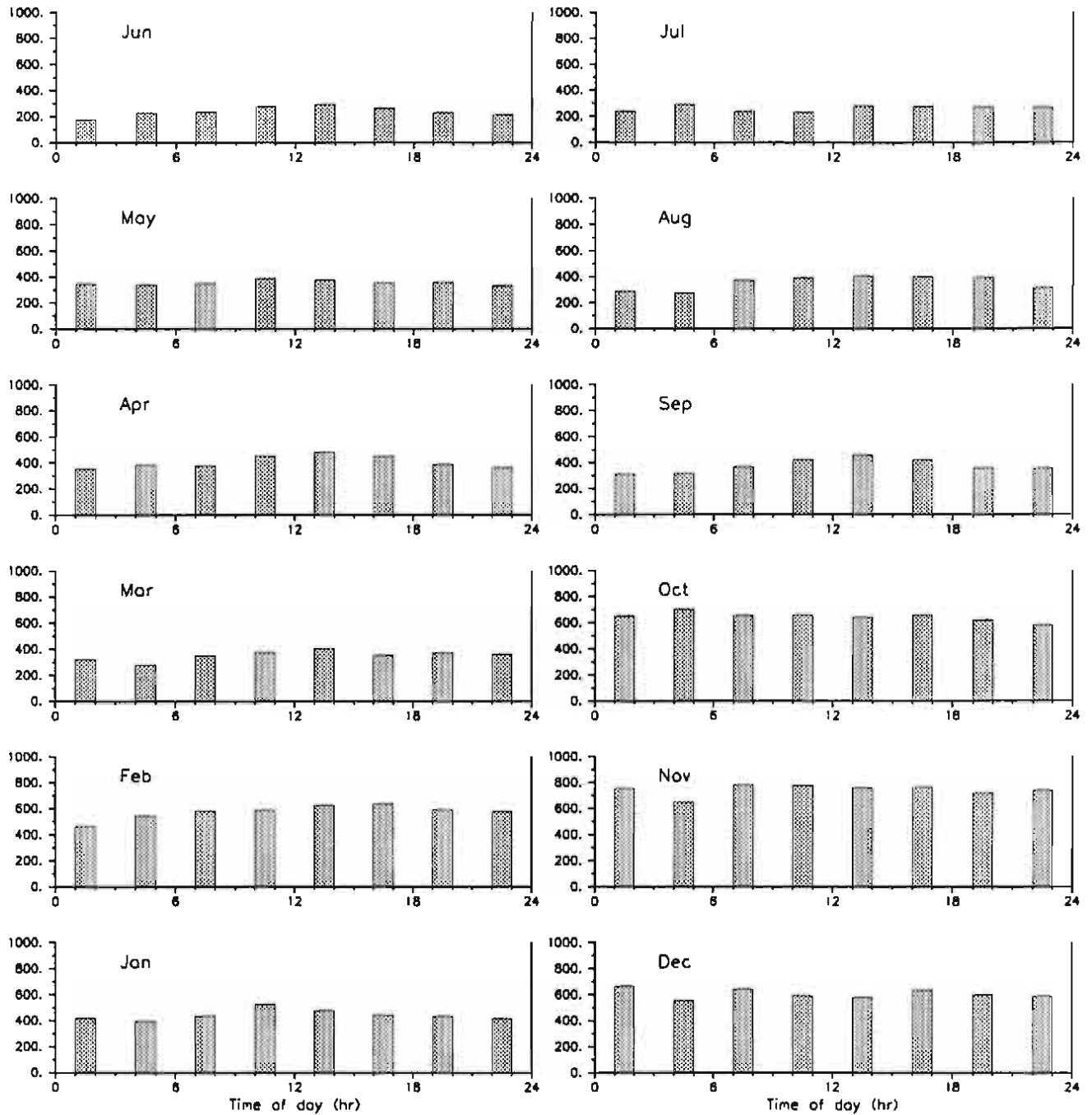


Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00

Station: Quaqtaq (1)

Wind Speed (m/s) at z= 10.0m

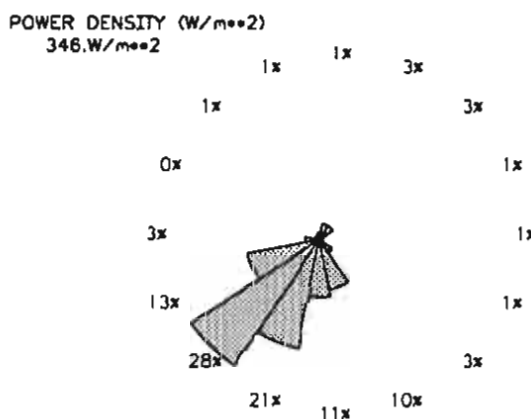
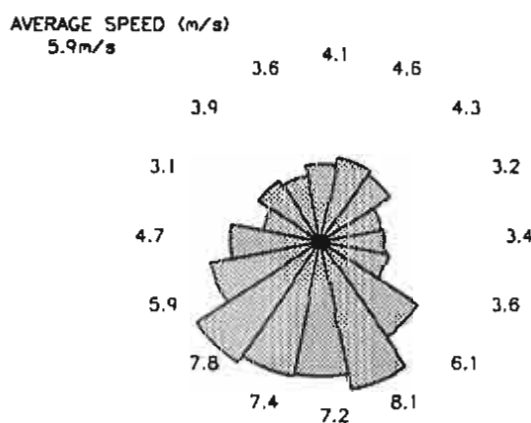
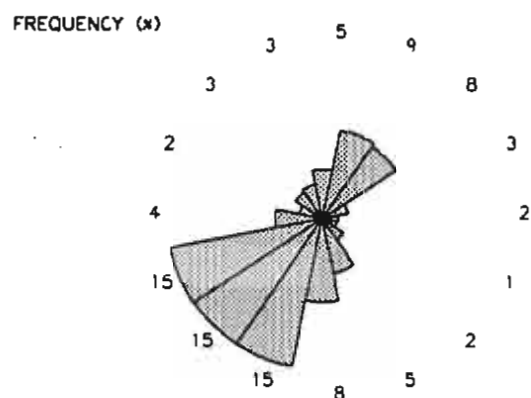
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



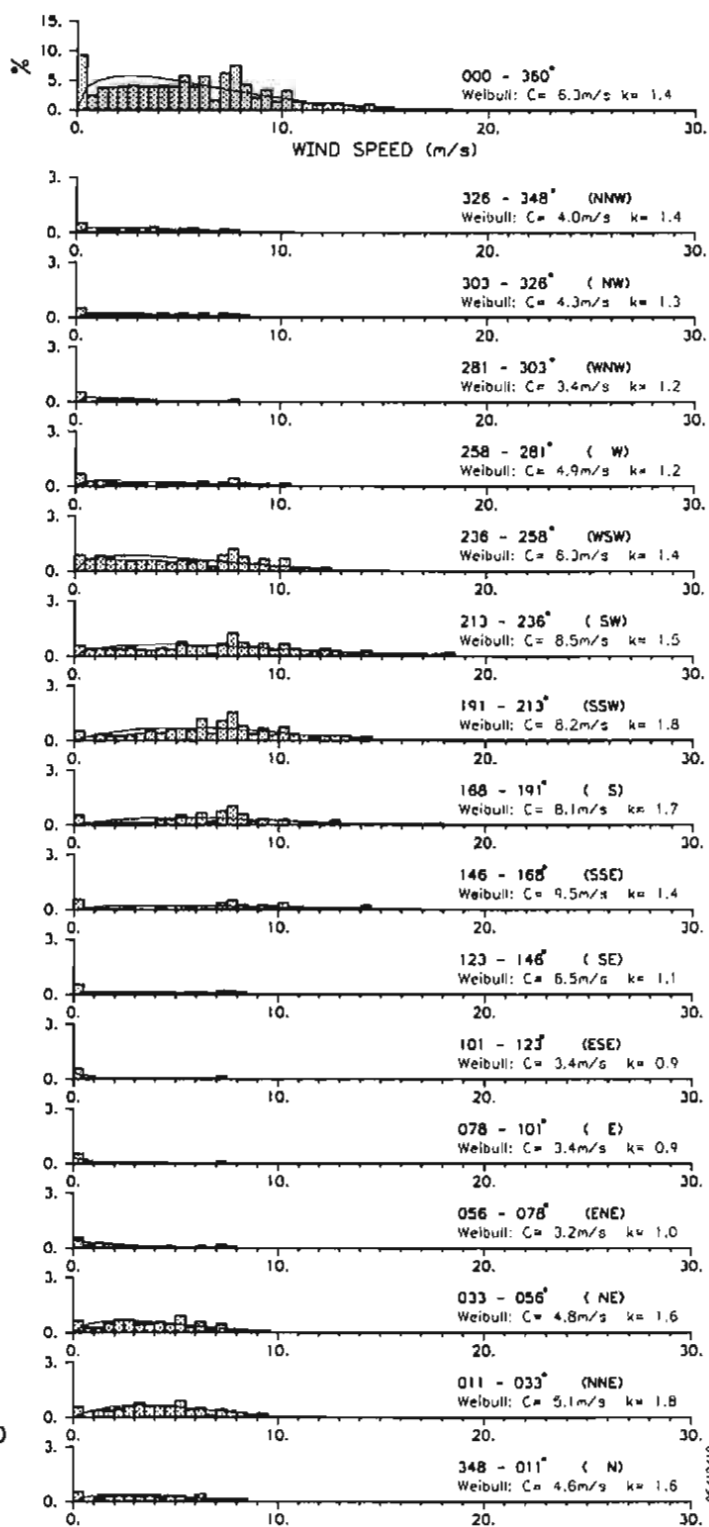
Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00
 Station: Quaqtaq (1)
 Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

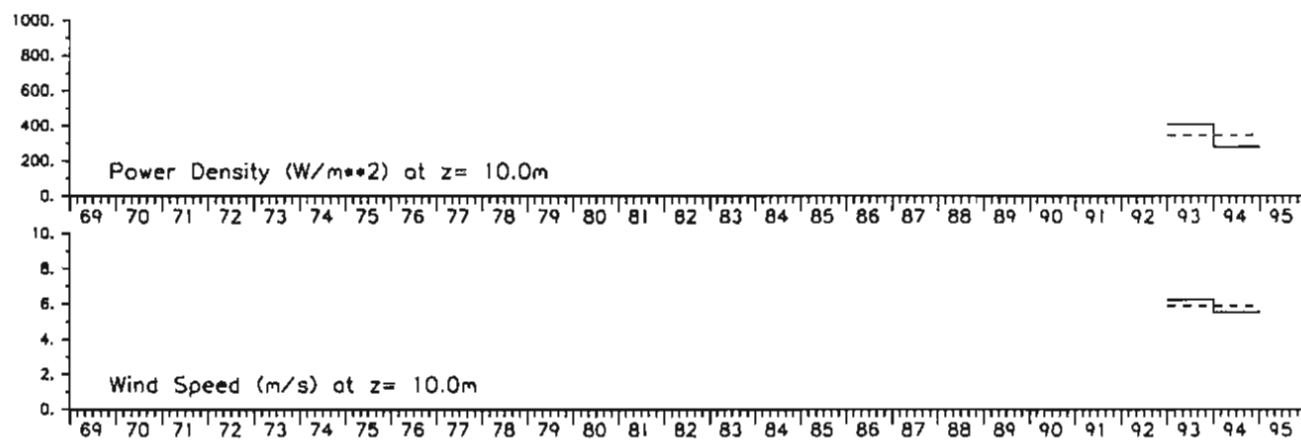


Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Salluit A (10)
 Wind Speed (m/s) at z= 10.0m
 Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Salluit A (10)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Salluit A (10)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.6	98.20	1.291	6.2	226.	24.3	-N/A-	411.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.5	98.25	1.291	5.5	229.	19.8	-N/A-	279.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->94/01/01	37.0	37.0	37.0	37.0	34.4	37.0	0.0	37.0	0.0	0.0	0.0
94/01/01->95/01/01	35.6	3.2	3.2	35.6	32.2	35.6	0.0	35.6	0.0	0.0	0.0

Period Average

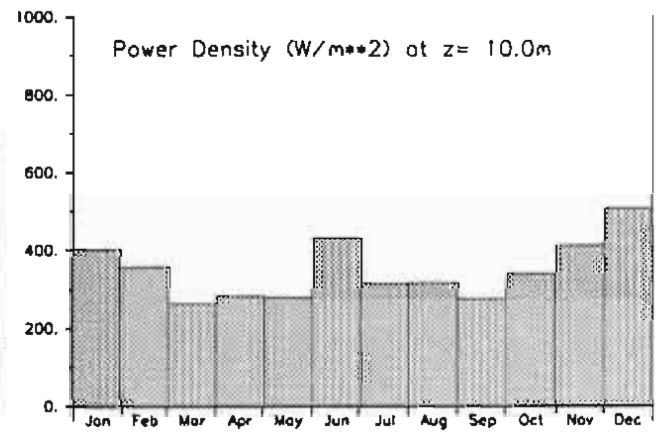
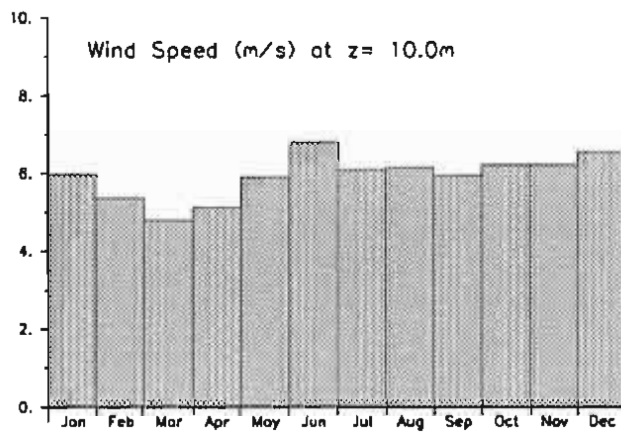
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.6	98.21	1.291	5.9	228.	24.3	-N/A-	346.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	36.3	20.1	20.1	36.3	33.3	36.3	0.0	36.3	0.0	0.0	0.0

95/10/20

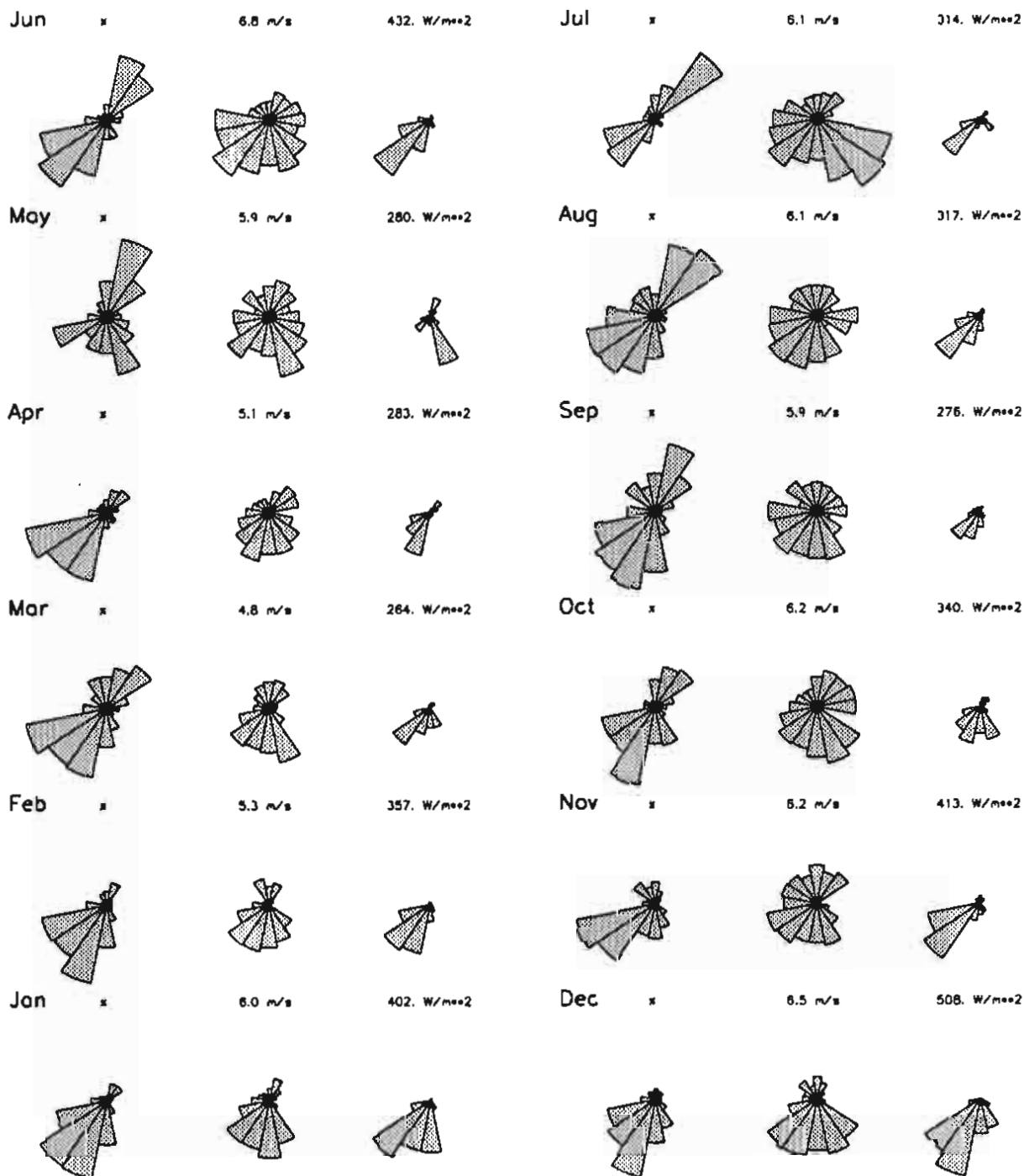
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
Station: Salluit A (10)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

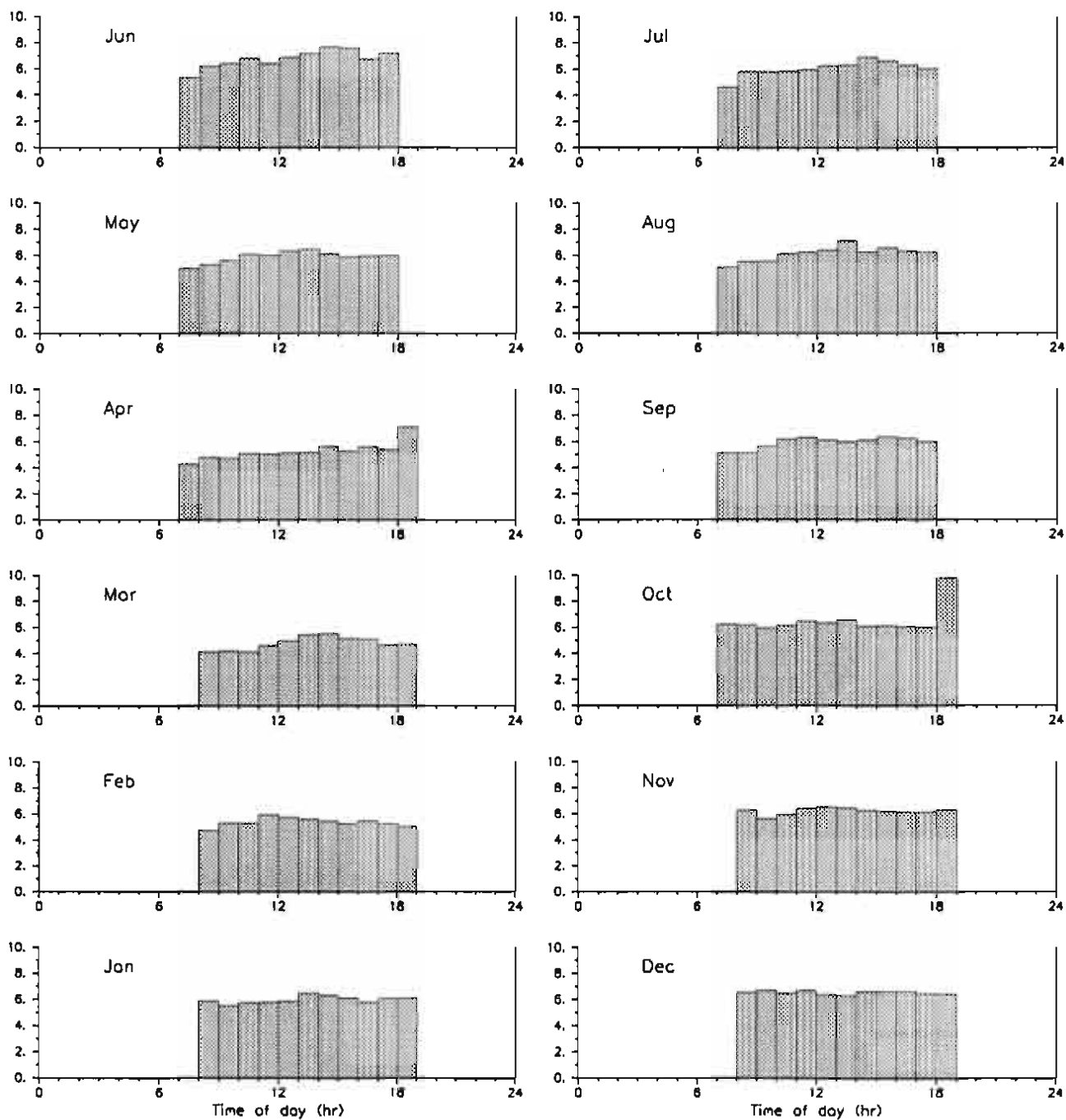
Station: Salluit A (10)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

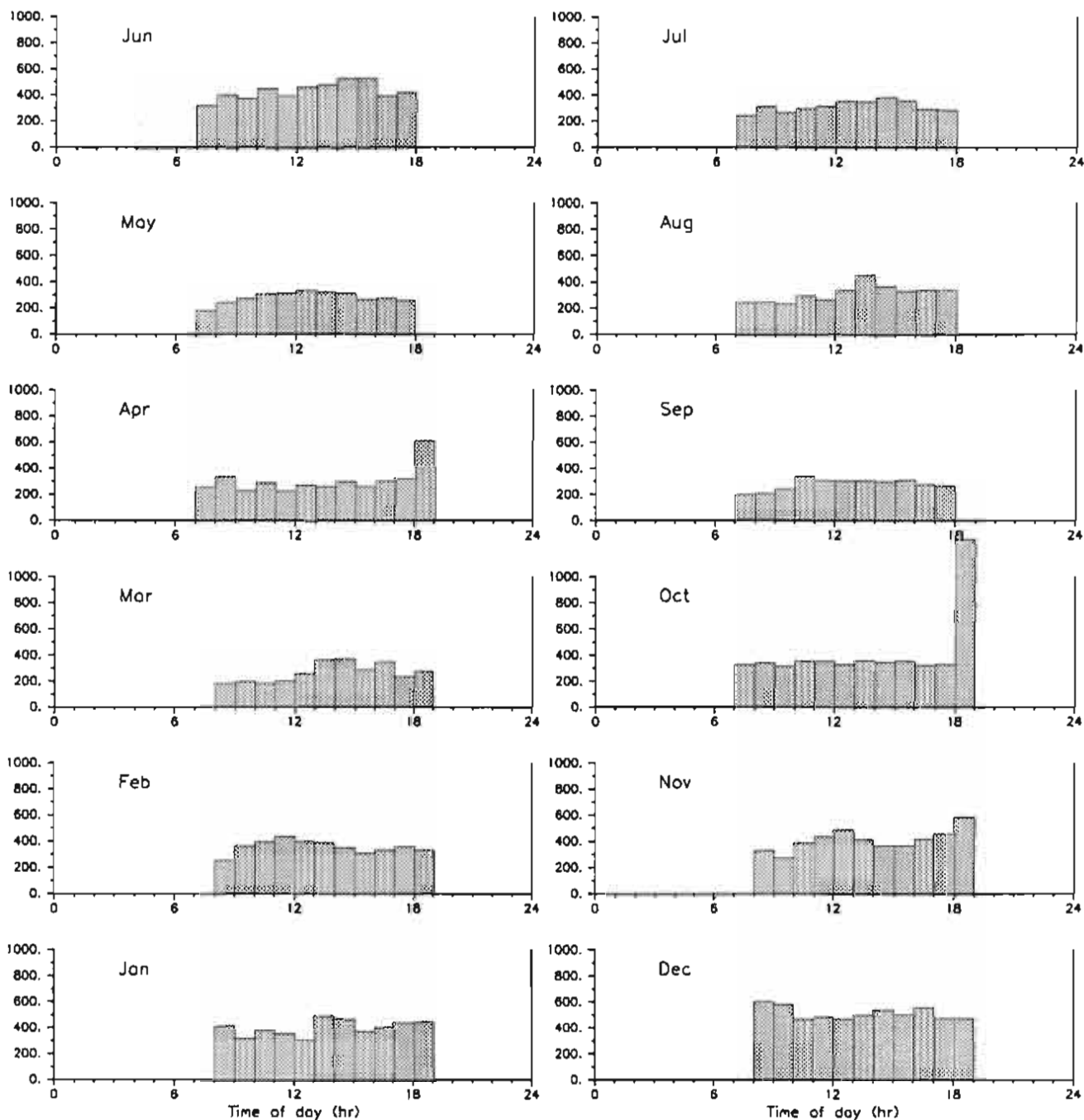
Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Station: Salluit A (10)
 Wind Speed (m/s) at z = 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

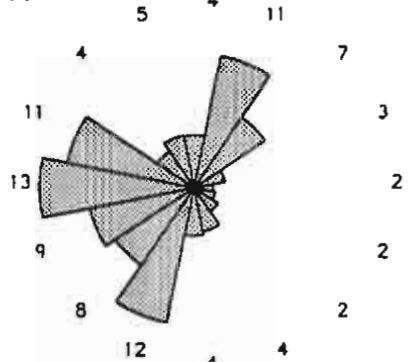
Station: Salluit A (10)

Power Density (W/m²) at z = 10.0m

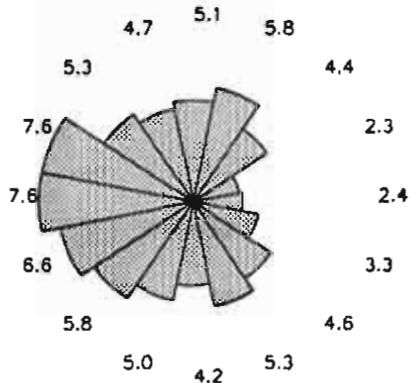
WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

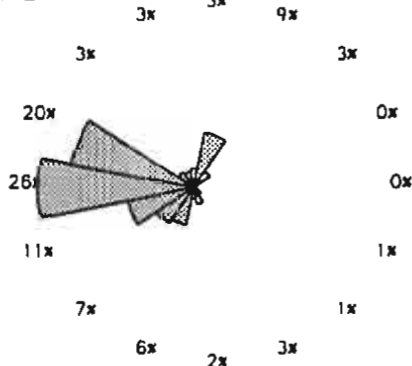
FREQUENCY (%)



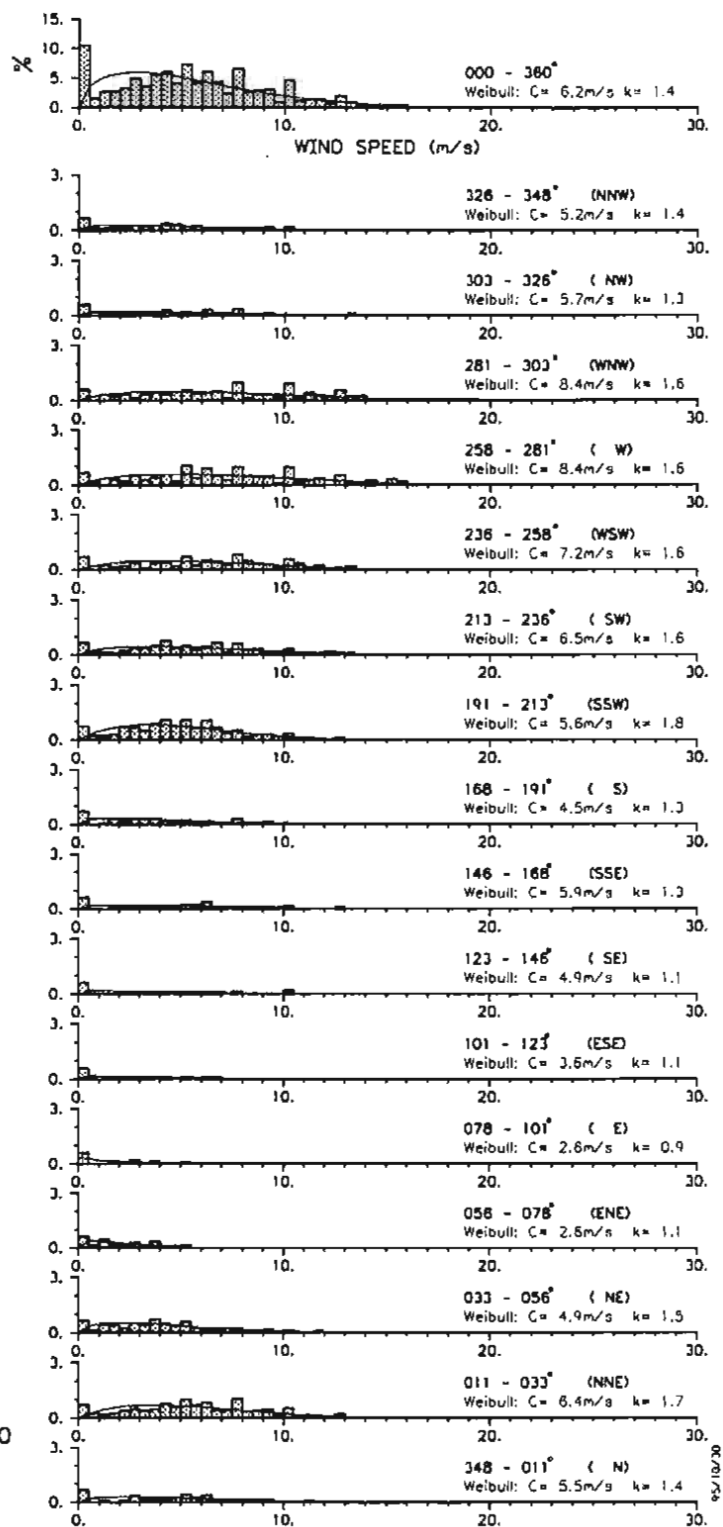
AVERAGE SPEED (m/s)
5.7m/s



POWER DENSITY (W/m²)
299.W/m²

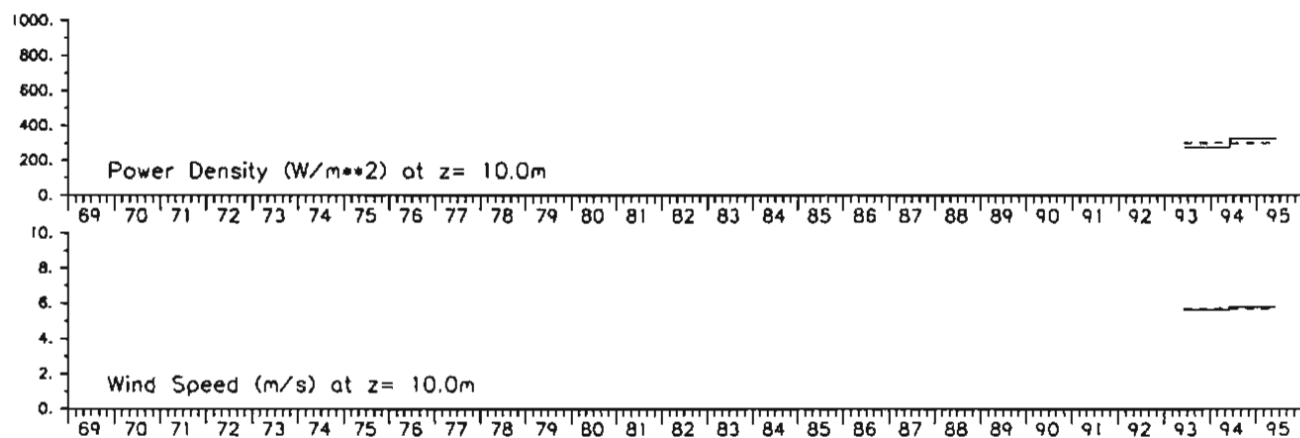


Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
Station: Tasiujaq A (9)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

Station: Tasiujaq A (9)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

 Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
 Tasiujaq A (9)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/06/01->94/06/01	-5.4	100.76	1.314	5.6	275.	17.2	-N/A-	275.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-5.0	100.76	1.312	5.8	276.	20.8	-N/A-	324.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->94/06/01	20.1	0.0	0.0	18.4	16.3	18.4	0.0	18.4	0.0	0.0	0.0
94/06/01->95/06/01	17.8	0.0	0.0	17.7	16.4	17.7	0.0	17.7	0.0	0.0	0.0

Period Average

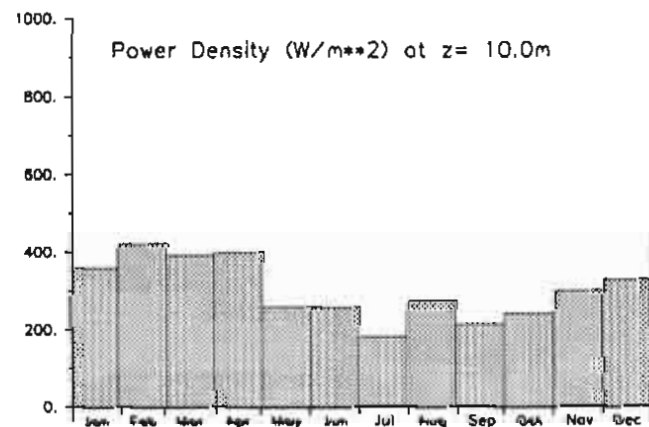
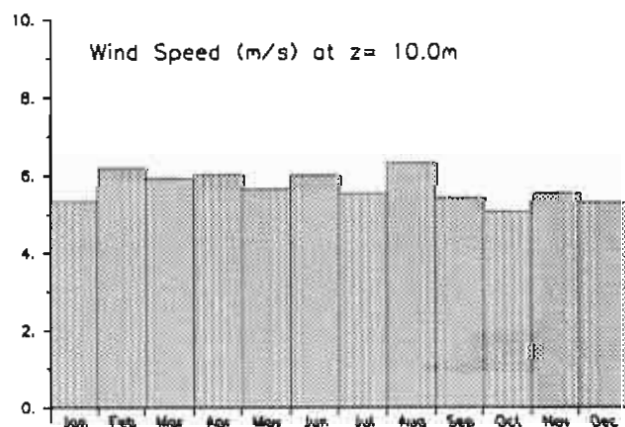
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-5.2	100.77	1.313	5.7	276.	20.8	-N/A-	299.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	19.0	0.0	0.0	18.1	16.4	18.1	0.0	18.1	0.0	0.0	0.0

95/10/30

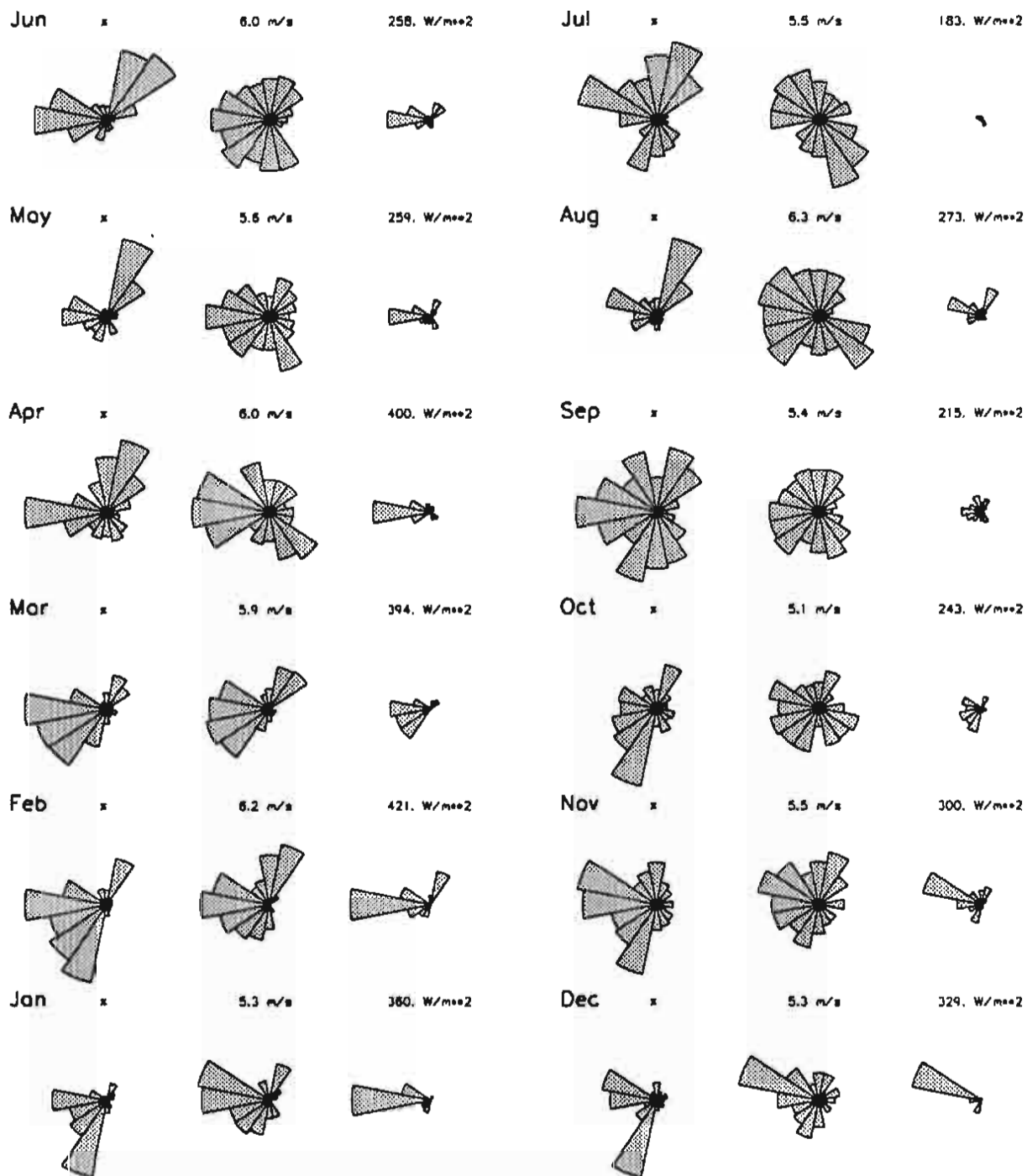
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
Station: Tasiujaq A (9)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

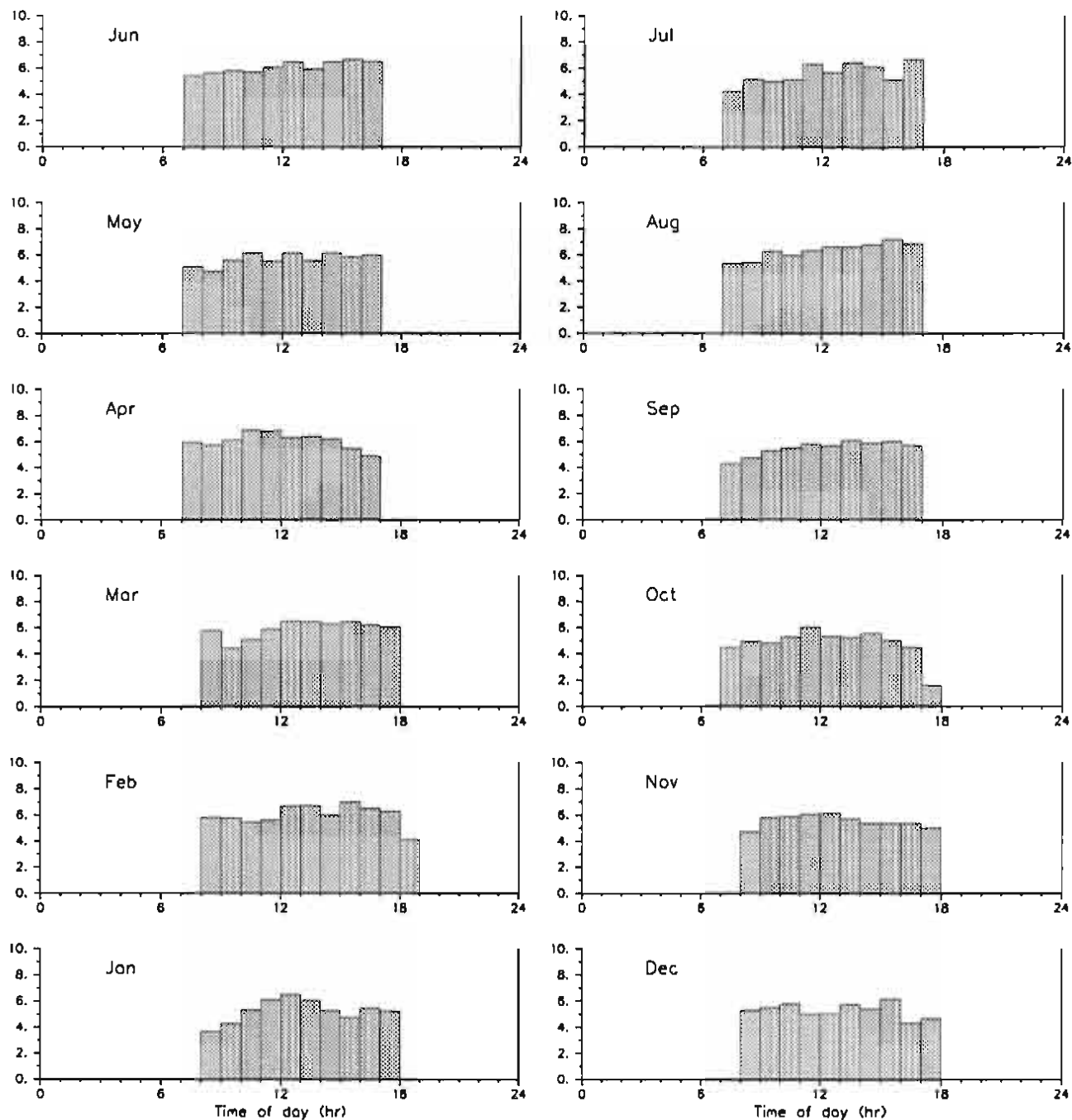
Station: Tasiujaq A (9)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

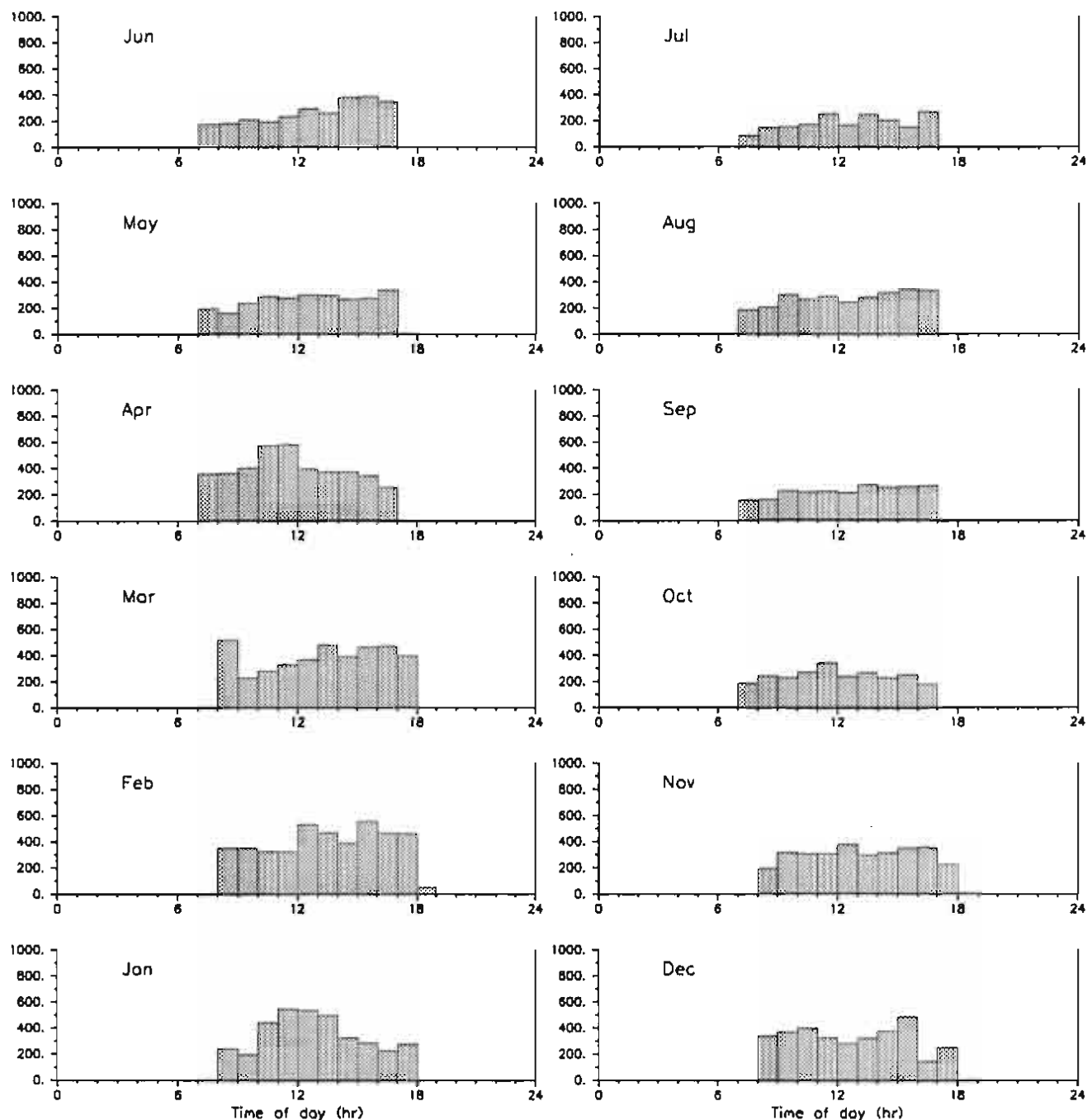


Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

Station: Tasiujaq A (9)

Wind Speed (m/s) at z= 10.0m

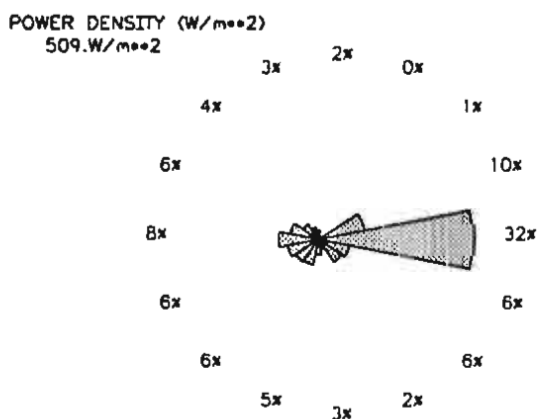
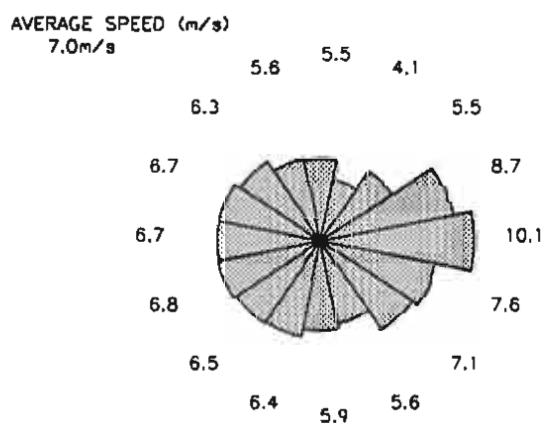
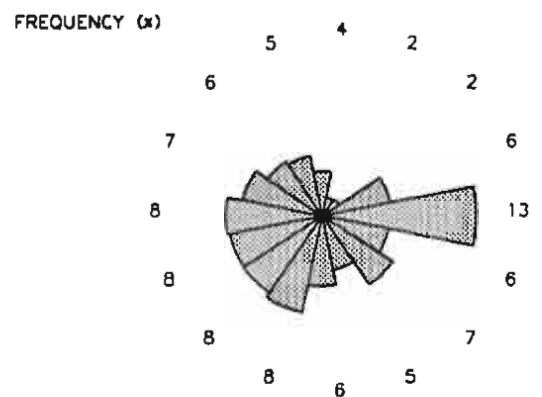
DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



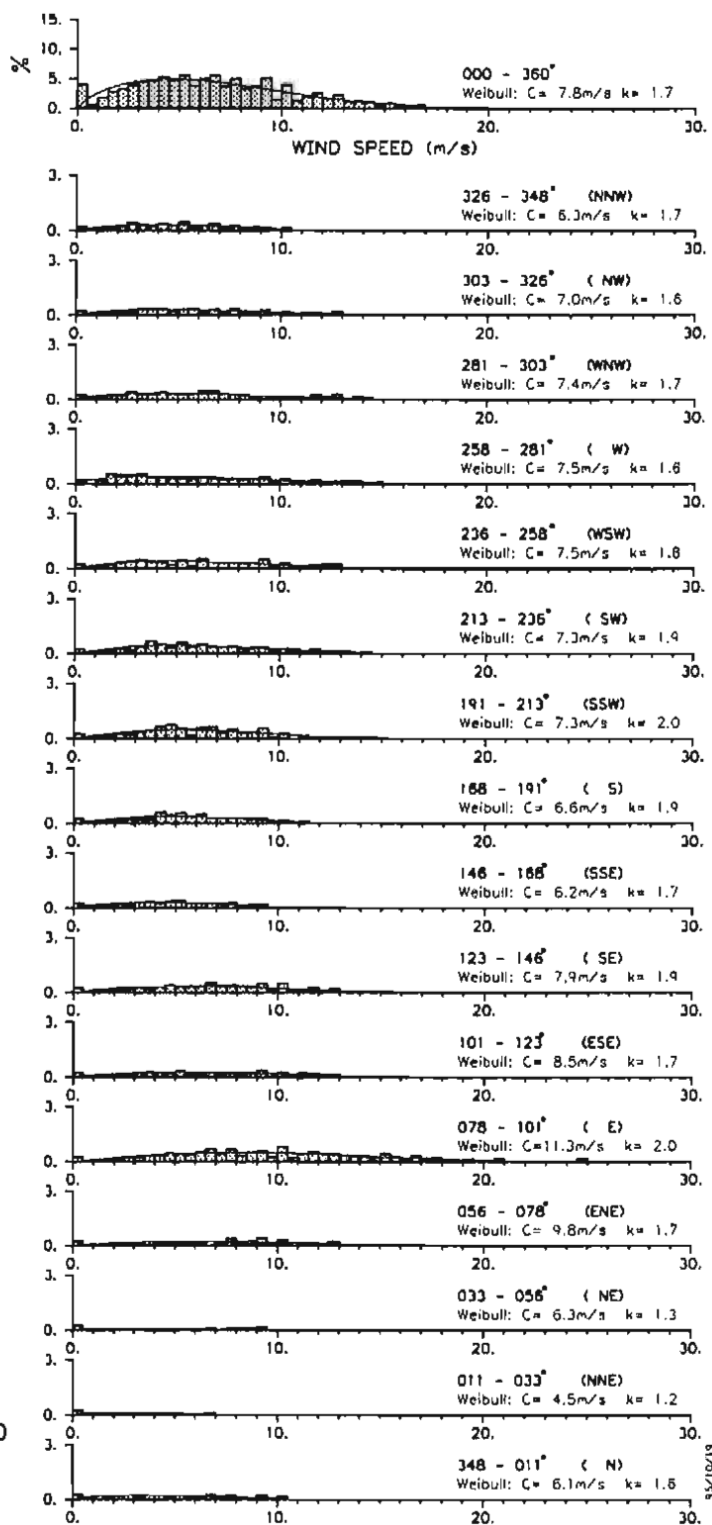
Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
 Station: Tasiujaq A (9)
 Power Density (W/m**2) at z= 10.0m

WIND DISTRIBUTION

Northern Quebec Wind Resource Study - AES Stations

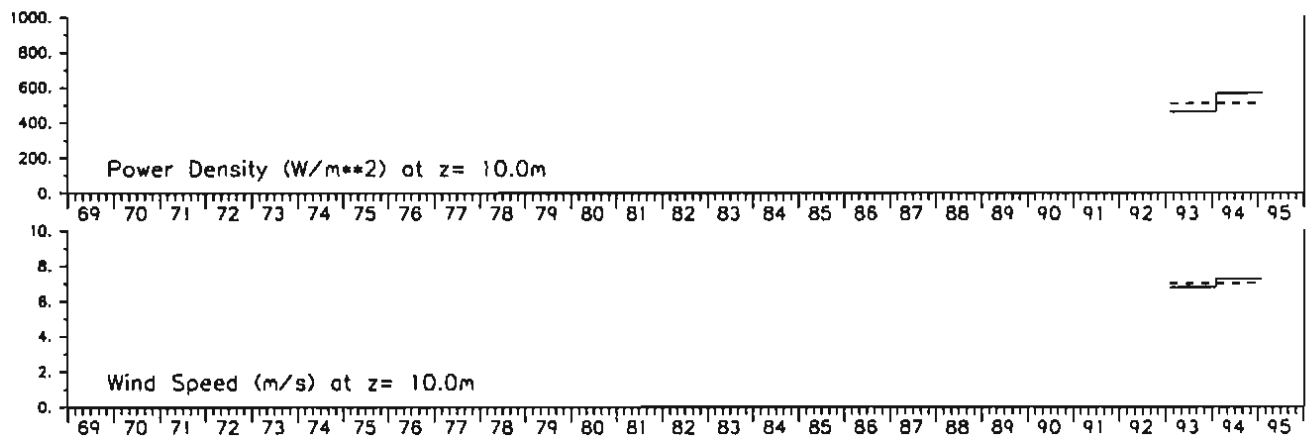


Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00
Station: Umiujaq A (B)
Wind Speed (m/s) at z = 10.0m
Wind Direction (degt) at z = 10.0m



ANNUAL AVERAGES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00
Station: Umiujaq A (B)

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00
 Umiujaq A (8)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	6.8	193.	27.7	-N/A-	461.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	7.3	203.	27.8	-N/A-	565.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->94/02/01	41.8	41.8	41.8	41.8	40.0	41.8	0.0	41.8	0.0	0.0	0.0
94/02/01->95/02/01	36.5	0.0	0.0	36.4	35.0	36.4	0.0	36.4	0.0	0.0	0.0

Period Average

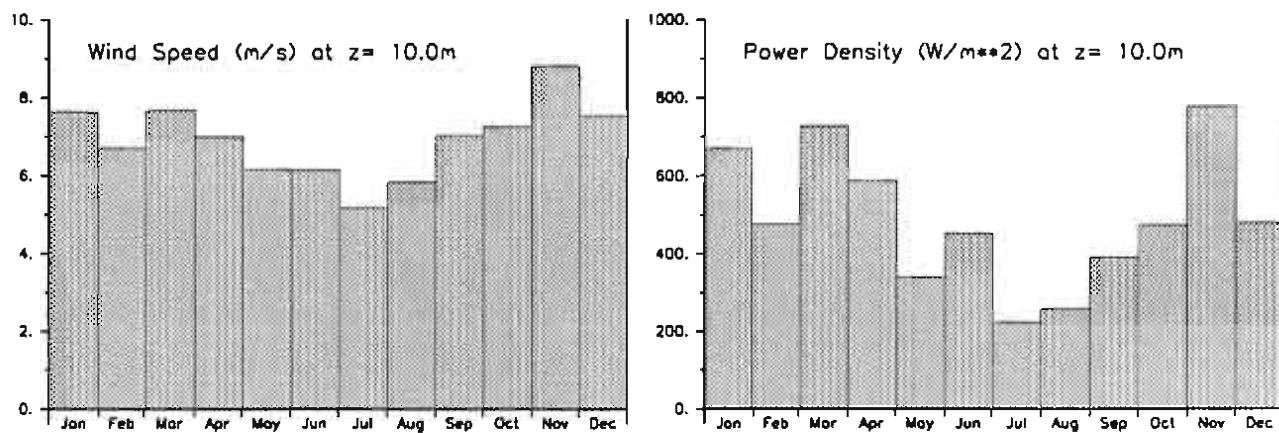
	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->95/02/01	-4.3	100.24	1.302	7.0	197.	27.8	-N/A-	509.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->95/02/01	39.1	20.9	20.9	39.1	37.5	39.1	0.0	39.1	0.0	0.0	0.0

95/10/20

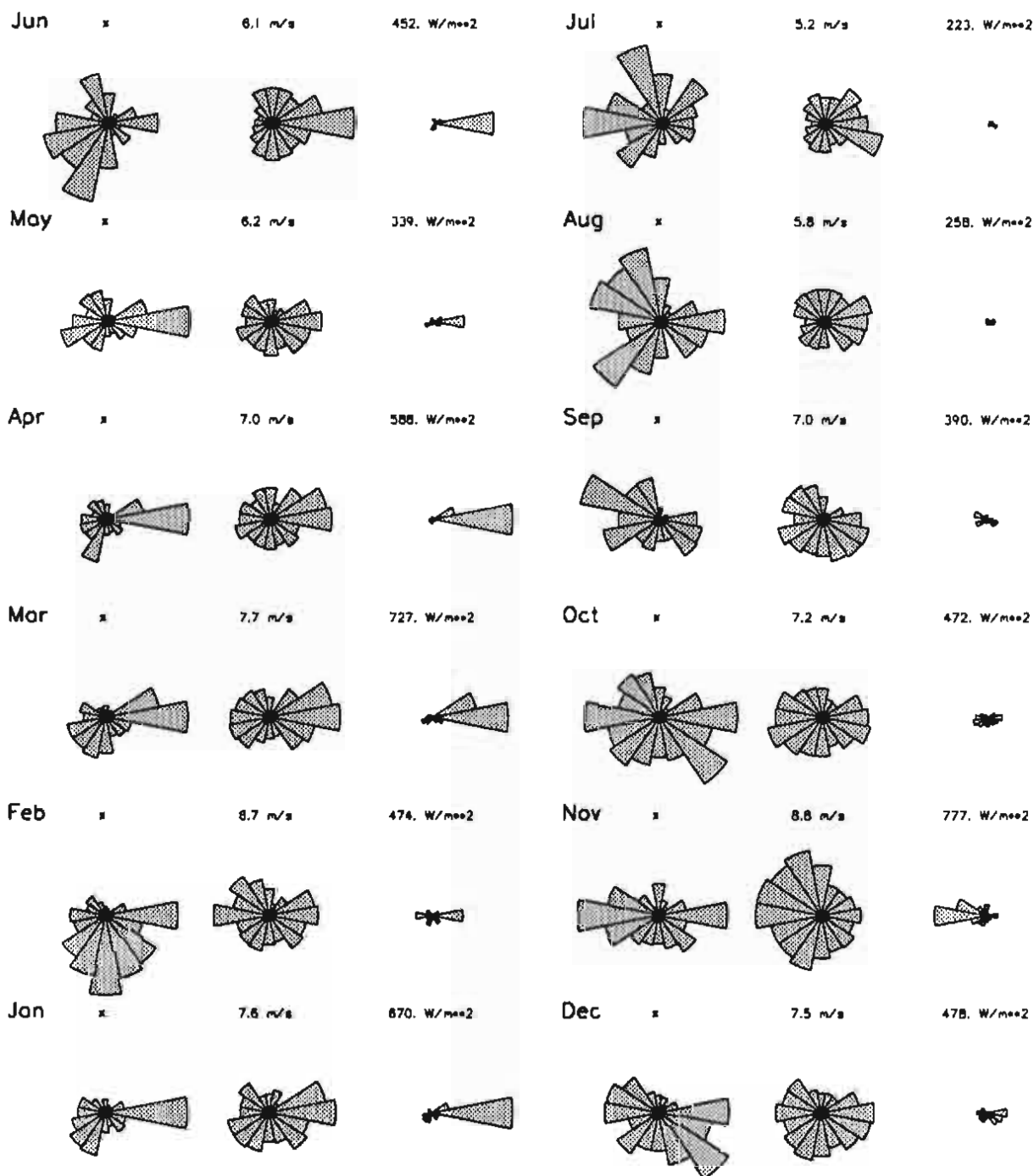
MONTHLY DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00
Station: Umiujaq A (8)

MONTHLY ROSES

Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00

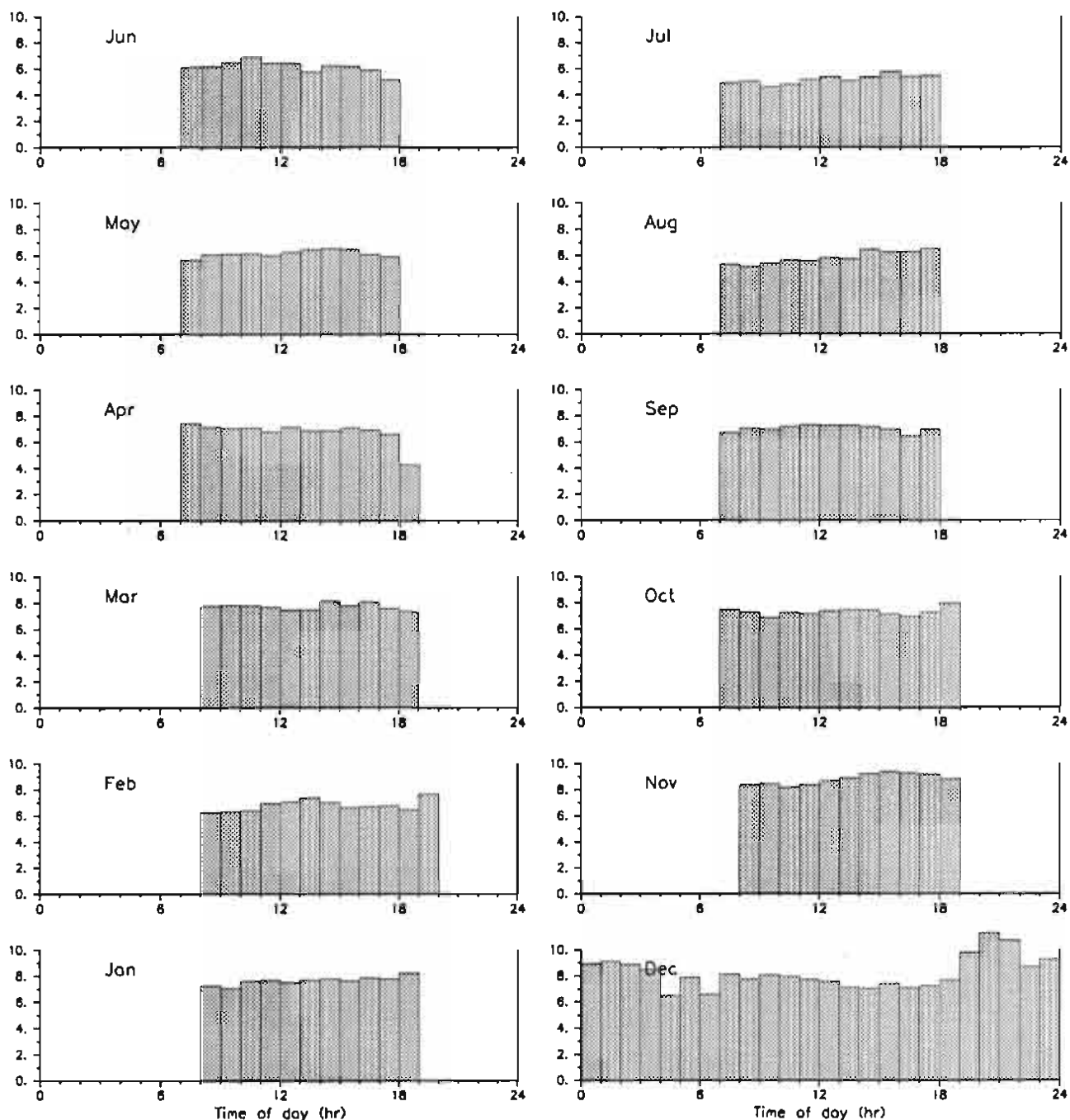
Station: Umiujaq A (8)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

Frequency (x) / Average speed (m/s) / x Power density (W/m²)

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations

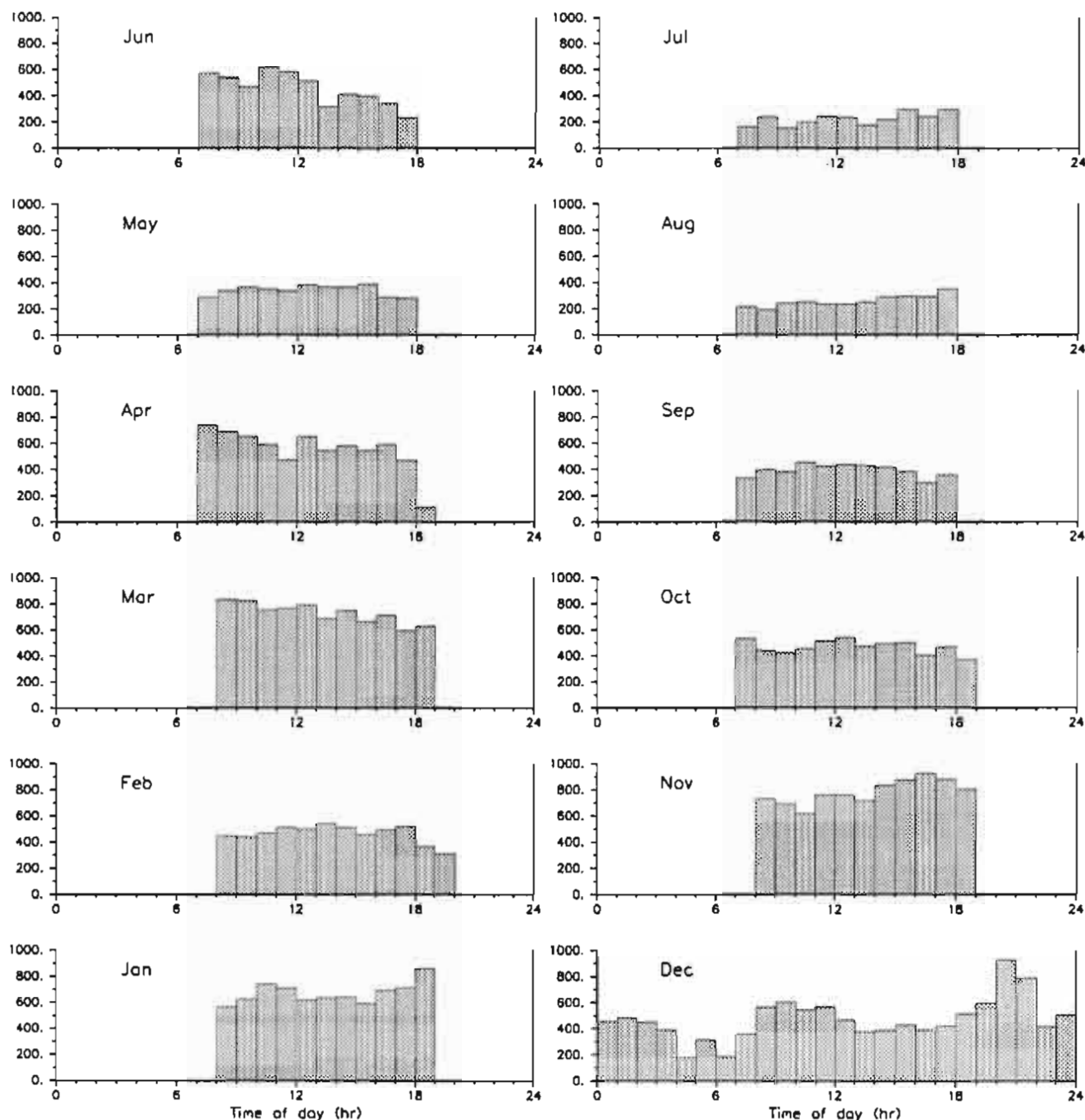


Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00

Station: Umiujaq A (8)

Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern Quebec Wind Resource Study - AES Stations



Period: 1993 Feb 01 00:00 to 1995 Feb 01 00:00
 Station: Umiujaq A (8)
 Power Density (W/m²) at z= 10.0m

13 APPENDIX E - WINDS AT STANDARD LEVELS

This appendix contains annual summary tables of estimated parameters for all stations at standard heights of 10 and 25m. Extrapolations of the wind speeds to the standard heights were carried out as described in Appendix A. All averages were also calculated as described in that appendix. The table format is described below.

13.1 Annual Averages (Table)

For each station, the data are averaged by year and total period of record. Where a specific data type was not measured, and where a climatological value could not be used in its place, it is listed as Not Available (N/A). The following data are output:

Column 1 - Average air temperature in degrees Celsius.

Where temperature data for the particular station were not available, climatological data from a nearby station were used instead. The observation height above ground level was taken as 1.5m in each case.

Column 2 - Average station barometric pressure in kiloPascals.

As noted for the air temperature, climatological data for a nearby station were

used (with adjustments for the difference in elevation) where station data were missing, or not measured. The observation height was taken as 1.5m.

Column 3 - Average air density in kilograms per cubic metre.

Density was computed from the hourly values of temperature and pressure as described in Appendix A, and then averaged.

Column 4 - Average wind speed in metres per second at the standard height.

Adjustment of the wind speed to the standard height was carried out according to the method described in Appendix A. The sector-dependent roughness lengths used are noted at the top of the table.

Column 5 - Average wind direction in degrees from true north.

The direction is not adjusted. It is taken from the original, measured wind direction.

Column 6 - Annual maximum value of the wind speed, in metres per second.

For example, in the case of AES stations using hourly data, this would be the maximum hourly wind speed during the year adjusted to the standard height.

Column 7 - Maximum gust speed in metres per second

The instantaneous gust speed was not determined at any of the stations.

Column 8 - Average wind power density in watts per square metre.

The wind power density is derived for each wind speed observation (which is adjusted to the standard height) and then averaged to produce the value in the table. The method of Appendix A is used to determine the power density.

Column 9 - Average turbulence intensity.

This is a non-dimensional measure of the short-term, turbulent fluctuations in the wind during the time of measurement. It is computed as the ratio of the standard deviation of wind speed, σ_u , during the measurement period to the mean wind speed during the period. Turbulent intensity was not measured at any of the stations.

Column 10 - Average Turbine Power

Turbine output characteristics were not determined for this table.

Column 11 - Annual Turbine Output

Turbine output characteristics were not determined for this table.

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

{0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300}

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Akulivik A (15)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-6.9	101.03	1.325	6.3	247.	19.7	-N/A-	318.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.1	101.07	1.327	6.0	72.	19.7	-N/A-	294.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	101.04	1.326	6.2	239.	19.7	-N/A-	306.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-6.9	101.03	1.325	7.3	247.	22.8	-N/A-	489.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.1	101.07	1.327	7.0	72.	22.8	-N/A-	453.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	101.04	1.326	7.1	239.	22.8	-N/A-	471.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

{0.0002,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0002,0.0002,0.0002,0.0002,0.0002}

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Aupaluk A (14)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.3	100.70	1.322	6.4	260.	20.6	-N/A-	337.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.70	1.320	6.3	285.	20.8	-N/A-	340.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	100.70	1.321	6.3	271.	20.8	-N/A-	338.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-7.3	100.70	1.322	7.1	260.	23.9	-N/A-	470.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.70	1.320	7.0	285.	24.0	-N/A-	464.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	100.70	1.321	7.1	271.	24.0	-N/A-	467.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

{0.0002,0.0002,0.0002,0.0002,0.0002,0.0002,0.0002,0.0300,0.0300,0.0300,0.0300,0.0300,0.0002,0.0002,0.0002,0.0002}

Period: 1969 Jan 01 00:00 to 1971 Jan 01 00:00

Cape Hopes Advance (13)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
69/01/01->70/01/01	-6.7	100.09	1.310	7.7	280.	31.1	-N/A-	642.	-N/A-	-N/A-	-N/A-
70/01/01->71/01/01	-7.0	100.06	1.312	8.0	281.	32.4	-N/A-	729.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
69/01/01->71/01/01	-6.9	100.07	1.311	7.9	281.	32.4	-N/A-	686.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
69/01/01->70/01/01	-6.7	100.09	1.310	8.5	280.	36.0	-N/A-	850.	-N/A-	-N/A-	-N/A-
70/01/01->71/01/01	-7.0	100.06	1.312	8.9	281.	35.2	-N/A-	968.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
69/01/01->71/01/01	-6.9	100.07	1.311	8.7	281.	36.0	-N/A-	909.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

10.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1977 Jan 01 00:00 to 1992 Jan 01 00:00

Inukjuak A (2)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
77/01/01->78/01/01	-5.2	101.14	1.318	5.7	349.	18.4	-N/A-	252.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-8.1	101.33	1.335	5.7	328.	20.6	-N/A-	229.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-6.8	101.21	1.327	6.0	263.	18.5	-N/A-	278.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-5.8	101.07	1.320	6.1	319.	17.8	-N/A-	291.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-5.4	101.08	1.318	5.6	318.	18.1	-N/A-	240.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-7.0	101.03	1.326	5.7	295.	20.0	-N/A-	289.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-7.3	101.28	1.332	5.2	316.	18.5	-N/A-	197.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-6.2	101.08	1.323	5.4	306.	23.4	-N/A-	231.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-5.4	101.05	1.319	5.5	349.	19.9	-N/A-	254.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-7.3	101.06	1.328	5.7	298.	19.9	-N/A-	253.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.6	101.13	1.320	5.4	355.	18.3	-N/A-	217.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.9	101.01	1.320	5.5	338.	22.2	-N/A-	227.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-8.1	101.01	1.331	5.9	291.	21.4	-N/A-	285.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-7.9	100.92	1.329	5.8	254.	20.0	-N/A-	279.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.5	101.05	1.325	5.6	294.	20.7	-N/A-	252.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
77/01/01->92/01/01	-6.6	101.10	1.325	5.7	311.	23.4	-N/A-	251.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
77/01/01->78/01/01	-5.2	101.14	1.318	6.6	349.	21.3	-N/A-	391.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-8.1	101.33	1.335	6.6	328.	23.9	-N/A-	355.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-6.8	101.21	1.327	7.0	263.	21.4	-N/A-	431.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-5.8	101.07	1.320	7.0	319.	20.6	-N/A-	451.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-5.4	101.08	1.318	6.5	318.	21.0	-N/A-	373.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-7.0	101.03	1.326	6.6	295.	23.1	-N/A-	448.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-7.3	101.28	1.332	6.0	316.	21.4	-N/A-	306.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-6.2	101.08	1.323	6.3	306.	27.1	-N/A-	358.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-5.4	101.05	1.319	6.4	349.	23.1	-N/A-	395.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-7.3	101.06	1.328	6.6	298.	23.0	-N/A-	393.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.6	101.13	1.320	6.3	355.	21.2	-N/A-	337.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.9	101.01	1.320	6.4	338.	25.7	-N/A-	352.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-8.1	101.01	1.331	6.8	291.	24.8	-N/A-	442.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-7.9	100.92	1.329	6.7	254.	23.2	-N/A-	433.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.5	101.05	1.325	6.4	294.	24.0	-N/A-	390.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
77/01/01->92/01/01	-6.6	101.10	1.325	6.5	311.	27.1	-N/A-	390.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300
 Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00
 Ivujivik A (3)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.1	100.60	1.320	5.9	195.	21.5	-N/A-	302.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.60	1.319	5.6	198.	21.6	-N/A-	266.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	100.60	1.320	5.7	196.	21.6	-N/A-	286.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-7.1	100.60	1.320	6.8	195.	24.9	-N/A-	468.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.60	1.319	6.5	198.	25.1	-N/A-	412.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.0	100.60	1.320	6.7	196.	25.1	-N/A-	444.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

{0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300}
 Period: 1993 Jan 01 00:00 to 1994 Jan 01 00:00
 Kangiqsualujuaq A (12)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-5.2	100.38	1.308	4.9	198.	18.3	-N/A-	139.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-5.2	100.38	1.308	4.9	198.	18.3	-N/A-	139.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-5.2	100.38	1.308	5.7	198.	21.2	-N/A-	216.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-5.2	100.38	1.308	5.7	198.	21.2	-N/A-	216.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Z₀ used (in 16 directions) was:

{0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300}

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Kangiqsujuag A (5)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.2	99.03	1.300	5.8	285.	24.7	-N/A-	363.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	99.01	1.298	5.6	313.	21.9	-N/A-	331.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	99.01	1.299	5.7	298.	24.7	-N/A-	347.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-7.2	99.03	1.300	6.7	285.	28.6	-N/A-	563.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	99.01	1.298	6.5	313.	25.4	-N/A-	514.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/01/01->95/01/01	-7.1	99.01	1.299	6.6	298.	28.6	-N/A-	539.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Kangirsuk A (6)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.5	99.51	1.308	6.2	301.	20.1	-N/A-	331.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.0	99.49	1.305	6.0	309.	21.8	-N/A-	337.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->95/01/01	-7.3	99.50	1.306	6.1	304.	21.8	-N/A-	334.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-7.5	99.51	1.308	7.2	301.	23.3	-N/A-	514.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.0	99.49	1.305	6.9	309.	25.2	-N/A-	523.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->95/01/01	-7.3	99.50	1.306	7.1	304.	25.2	-N/A-	518.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

(0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300)

Period: 1980 Jan 01 00:00 to 1995 Jan 01 00:00

Kuujuaq A (7)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	3.8	278.	17.2	-N/A-	108.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.0	286.	19.7	-N/A-	115.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	4.7	266.	20.4	-N/A-	180.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-5.9	100.91	1.320	4.2	283.	18.6	-N/A-	112.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	4.4	272.	22.9	-N/A-	140.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	4.3	284.	19.1	-N/A-	142.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	4.6	264.	23.5	-N/A-	164.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.1	284.	17.7	-N/A-	128.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.0	268.	15.6	-N/A-	105.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	4.5	271.	19.3	-N/A-	143.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	4.4	261.	16.9	-N/A-	138.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	3.9	265.	21.7	-N/A-	102.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.2	271.	18.5	-N/A-	129.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.3	265.	27.4	-N/A-	138.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.78	1.316	4.7	273.	21.5	-N/A-	181.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->95/01/01	-5.7	100.69	1.316	4.3	272.	27.4	-N/A-	135.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	4.4	278.	20.0	-N/A-	168.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.6	286.	22.9	-N/A-	178.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	5.4	266.	23.6	-N/A-	279.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-5.9	100.91	1.320	4.9	283.	21.5	-N/A-	174.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	5.1	272.	26.5	-N/A-	217.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	5.0	284.	22.1	-N/A-	220.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	5.3	264.	27.2	-N/A-	255.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.8	284.	20.5	-N/A-	199.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.6	268.	18.1	-N/A-	163.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	5.2	271.	22.4	-N/A-	222.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	5.1	261.	19.5	-N/A-	214.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	4.5	265.	25.1	-N/A-	158.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.9	271.	21.4	-N/A-	200.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.9	265.	31.7	-N/A-	214.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.78	1.316	5.5	273.	24.9	-N/A-	281.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
80/01/01->95/01/01	-5.7	100.69	1.316	4.9	272.	31.7	-N/A-	210.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1980 Jan 01 00:00 to 1990 Jan 01 00:00

Kuujuaupik A (4)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.3	101.01	1.313	4.8	226.	19.6	-N/A-	157.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-2.8	101.06	1.305	4.1	227.	18.1	-N/A-	102.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-4.6	101.06	1.315	5.0	236.	18.7	-N/A-	182.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-4.2	101.22	1.315	4.1	199.	15.6	-N/A-	110.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-3.8	101.08	1.311	4.4	232.	18.1	-N/A-	134.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-3.9	100.99	1.310	4.5	214.	17.1	-N/A-	136.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-5.2	101.06	1.318	4.3	237.	18.6	-N/A-	126.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-2.8	101.07	1.305	4.6	231.	15.5	-N/A-	132.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-3.8	100.97	1.310	4.7	195.	15.7	-N/A-	137.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-5.9	101.08	1.322	4.3	252.	16.6	-N/A-	127.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->90/01/01	-4.1	101.06	1.312	4.5	229.	19.6	-N/A-	134.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
80/01/01->81/01/01	-4.3	101.01	1.313	5.5	226.	22.7	-N/A-	234.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-2.8	101.06	1.305	4.6	227.	19.7	-N/A-	151.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-4.6	101.06	1.315	5.7	236.	21.6	-N/A-	272.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-4.2	101.22	1.315	4.7	199.	18.1	-N/A-	163.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-3.8	101.08	1.311	5.0	232.	21.0	-N/A-	196.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-3.9	100.99	1.310	5.1	214.	19.8	-N/A-	201.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-5.2	101.06	1.318	5.0	237.	21.5	-N/A-	186.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-2.8	101.07	1.305	5.3	231.	18.0	-N/A-	197.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-3.8	100.97	1.310	5.3	195.	18.2	-N/A-	203.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-5.9	101.08	1.322	5.0	252.	19.0	-N/A-	187.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->90/01/01	-4.1	101.06	1.312	5.1	229.	22.7	-N/A-	199.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

(0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300)

Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00

Povungnituk A (11)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/06/01->94/06/01	-7.0	100.87	1.324	6.2	231.	19.5	-N/A-	317.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-6.6	100.90	1.322	5.7	233.	21.3	-N/A-	267.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-6.8	100.89	1.323	6.0	232.	21.3	-N/A-	291.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m deg	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/06/01->94/06/01	-7.0	100.87	1.324	7.2	231.	22.6	-N/A-	492.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-6.6	100.90	1.322	6.6	233.	24.7	-N/A-	414.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-6.8	100.89	1.323	6.9	232.	24.7	-N/A-	451.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(g). Upstream Z₀ used (in 16 directions) was:

0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300, 0.0300
 Period: 1972 Jan 01 00:00 to 1981 Jan 01 00:00
 Quaqtaq (1)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m ³	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m ²	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
72/01/01->73/01/01	-8.2	100.70	1.326	6.2	282.	26.6	-N/A-	392.	-N/A-	-N/A-	-N/A-
73/01/01->74/01/01	-6.9	100.70	1.320	6.8	304.	27.0	-N/A-	476.	-N/A-	-N/A-	-N/A-
74/01/01->75/01/01	-7.2	100.70	1.321	6.6	296.	26.6	-N/A-	494.	-N/A-	-N/A-	-N/A-
75/01/01->76/01/01	-7.0	100.70	1.321	6.3	277.	24.3	-N/A-	421.	-N/A-	-N/A-	-N/A-
76/01/01->77/01/01	-7.4	100.70	1.322	6.8	280.	24.3	-N/A-	466.	-N/A-	-N/A-	-N/A-
77/01/01->78/01/01	-6.7	100.70	1.318	6.5	285.	24.8	-N/A-	450.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-7.6	100.70	1.323	6.3	285.	20.8	-N/A-	373.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-7.0	100.70	1.320	6.8	279.	23.7	-N/A-	515.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-6.9	100.70	1.320	6.7	297.	22.5	-N/A-	426.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
72/01/01->81/01/01	-7.2	100.71	1.321	6.5	286.	27.0	-N/A-	445.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m ³	WSpd 25.0m m/s	WDir 25.0m deg	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m ²	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
72/01/01->73/01/01	-8.2	100.70	1.326	7.1	282.	30.8	-N/A-	604.	-N/A-	-N/A-	-N/A-
73/01/01->74/01/01	-6.9	100.70	1.320	7.9	304.	31.2	-N/A-	735.	-N/A-	-N/A-	-N/A-
74/01/01->75/01/01	-7.2	100.70	1.321	7.7	296.	30.8	-N/A-	763.	-N/A-	-N/A-	-N/A-
75/01/01->76/01/01	-7.0	100.70	1.321	7.3	277.	28.1	-N/A-	648.	-N/A-	-N/A-	-N/A-
76/01/01->77/01/01	-7.4	100.70	1.322	7.8	280.	28.1	-N/A-	718.	-N/A-	-N/A-	-N/A-
77/01/01->78/01/01	-6.7	100.70	1.318	7.5	285.	28.7	-N/A-	694.	-N/A-	-N/A-	-N/A-
78/01/01->79/01/01	-7.6	100.70	1.323	7.2	285.	24.1	-N/A-	575.	-N/A-	-N/A-	-N/A-
79/01/01->80/01/01	-7.0	100.70	1.320	7.8	279.	27.4	-N/A-	794.	-N/A-	-N/A-	-N/A-
80/01/01->81/01/01	-6.9	100.70	1.320	7.7	297.	26.1	-N/A-	657.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
72/01/01->81/01/01	-7.2	100.71	1.321	7.5	286.	31.2	-N/A-	686.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Z₀ used (in 16 directions) was:

{0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300}

Period: 1993 Jan 01 00:00 to 1995 Jan 01 00:00

Salluit A (10)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->94/01/01	-7.6	98.20	1.291	6.2	226.	24.3	-N/A-	411.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.5	98.25	1.291	5.5	229.	19.8	-N/A-	279.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/01/01->95/01/01	-7.6	98.21	1.291	5.9	228.	24.3	-N/A-	346.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->94/01/01	-7.6	98.20	1.291	7.2	226.	28.2	-N/A-	637.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-7.5	98.25	1.291	6.4	229.	22.9	-N/A-	432.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/01/01->95/01/01	-7.6	98.21	1.291	6.8	228.	28.2	-N/A-	537.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Z₀ used (in 16 directions) was:
 (0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300)
 Period: 1993 Jun 01 00:00 to 1995 Jun 01 00:00
 Tasiujaq A (9)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/06/01->94/06/01	-5.4	100.76	1.314	5.6	275.	17.2	-N/A-	275.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-5.0	100.76	1.312	5.8	276.	20.8	-N/A-	324.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-5.2	100.77	1.313	5.7	276.	20.8	-N/A-	299.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/06/01->94/06/01	-5.4	100.76	1.314	6.5	275.	19.9	-N/A-	427.	-N/A-	-N/A-	-N/A-
94/06/01->95/06/01	-5.0	100.76	1.312	6.7	276.	24.1	-N/A-	503.	-N/A-	-N/A-	-N/A-

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/06/01->95/06/01	-5.2	100.77	1.313	6.6	276.	24.1	-N/A-	464.	-N/A-	-N/A-	-N/A-

95/11/03

ANNUAL AVERAGES Northern Quebec Wind Resource Study - AES Stations

Adjusted to elevation(s). Upstream Z₀ used (in 16 directions) was:

10.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1993 Feb 01 00:00 To 1995 Feb 01 00:00

Umiujaq A (8)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	6.8	193.	27.7	-N/A-	461.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	7.3	203.	27.8	-N/A-	565.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/02/01->95/02/01	-4.3	100.24	1.302	7.0	197.	27.8	-N/A-	509.	-N/A-	-N/A-	-N/A-

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	7.9	193.	32.1	-N/A-	715.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	8.4	203.	32.1	-N/A-	876.	-N/A-	-N/A-	-N/A-

Period Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/02/01->95/02/01	-4.3	100.24	1.302	8.1	197.	32.1	-N/A-	790.	-N/A-	-N/A-	-N/A-

95/11/03

14 APPENDIX F - MS-MICRO INPUT AND RESULTS

This appendix contains maps and tables related to the numerical modelling of the wind flow over the complex terrain at each of the fourteen villages studied. Note that all horizontal coordinates are in metres in the UTM coordinate system in zones 17 to 20. Zones are marked on the maps. Vertical coordinates are in metres.

There is one set of maps and a table for each of the villages. They are described briefly below. Note that the last four maps correspond to the same domain and can be overlaid for comparisons.

Topographic Relief Map

This map shows the 'master grid' used to generate the gridded topographic data used by the model. Note that the vertical scale is exaggerated.

Topographic Contour Map

This map displays topographic contours (in metres above sea level) in an 8km x 8km area surrounding the station. This area corresponds exactly to the central quarter of the numerical model domain (which is 16km x 16km).

Surface Roughness Map

On this map, the colours correspond to the type of surface defined by the surface roughness grid input to the MS-Micro. The colours can be related to the actual roughness lengths used through the roughness class listing in the 'MS-Micro MASTER PARAMETER SUMMARY' table for each station.

'MS-Micro MASTER PARAMETER SUMMARY' Table

This table lists the parameters used for the MS-Micro model run for each of the villages.

Wind Speed Isotach Map

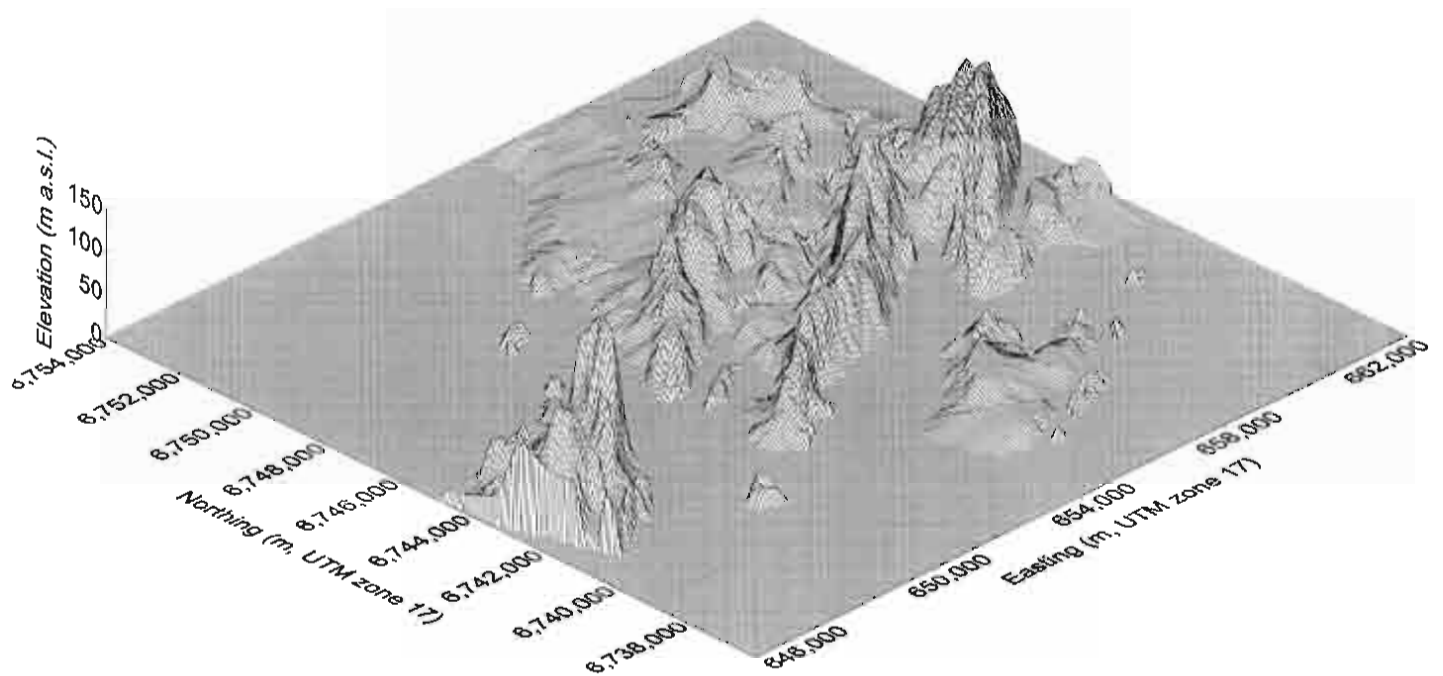
This map displays isotachs of the predicted wind speed over the central area of the model domain.

Turbine Output Isodyne Map

This map shows isodynes of the predicted output from the AOC 15/50 turbine (in average kW) for the central portion of the model domain. This map can be used for siting turbines for optimum performance.

MS-Micro MODEL INPUT

Zephyr North

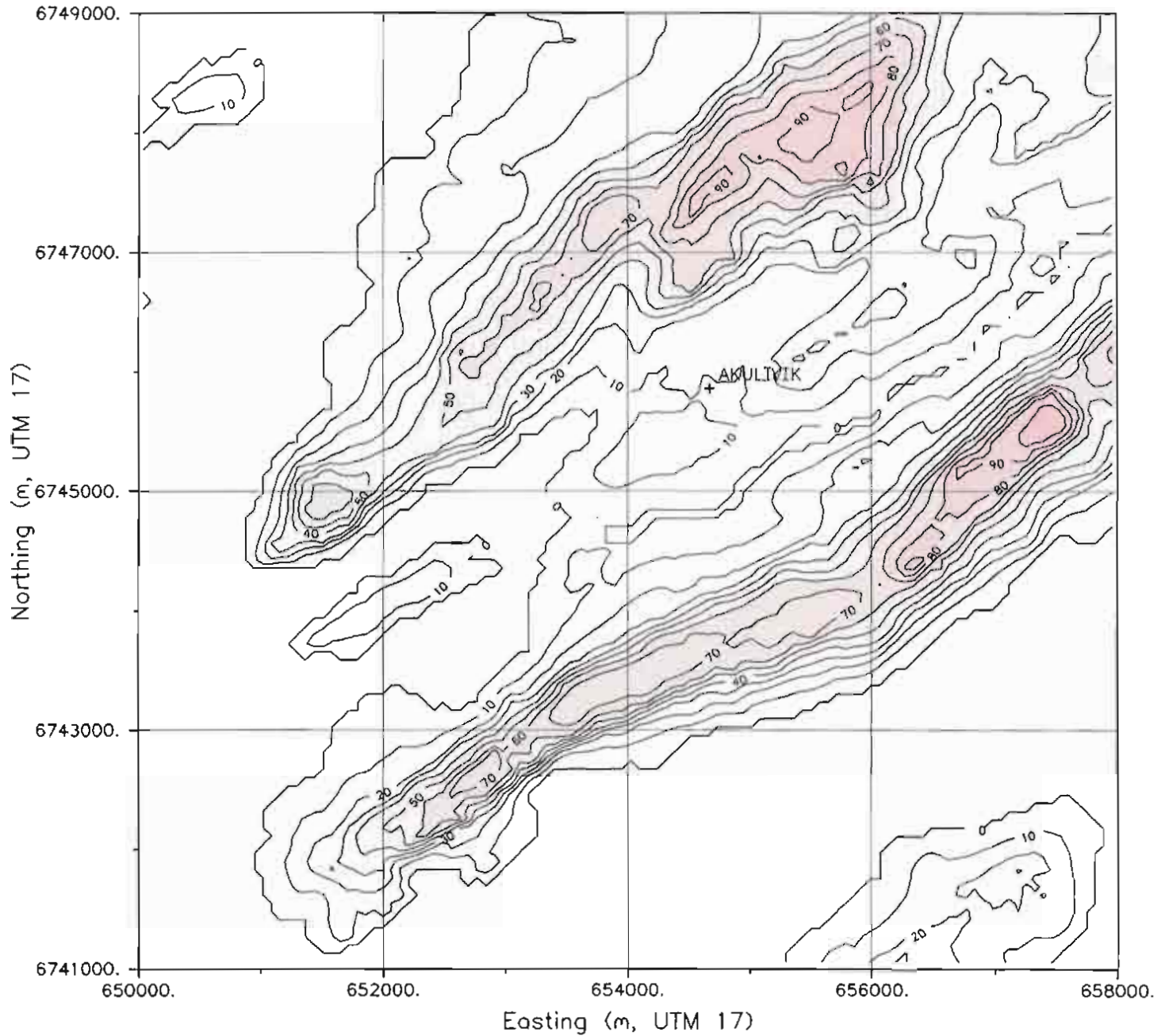


Akulivik

Topography Relief from Master Grid
Master grid file: AKULIVIK.TMG

MS-Micro MODEL INPUT

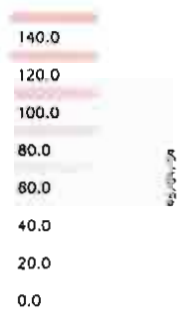
Zephyr North



AKULIVIK-UPS1 95/09/09 10:44:07

Topography from Master Grid (m) (Central quarter)

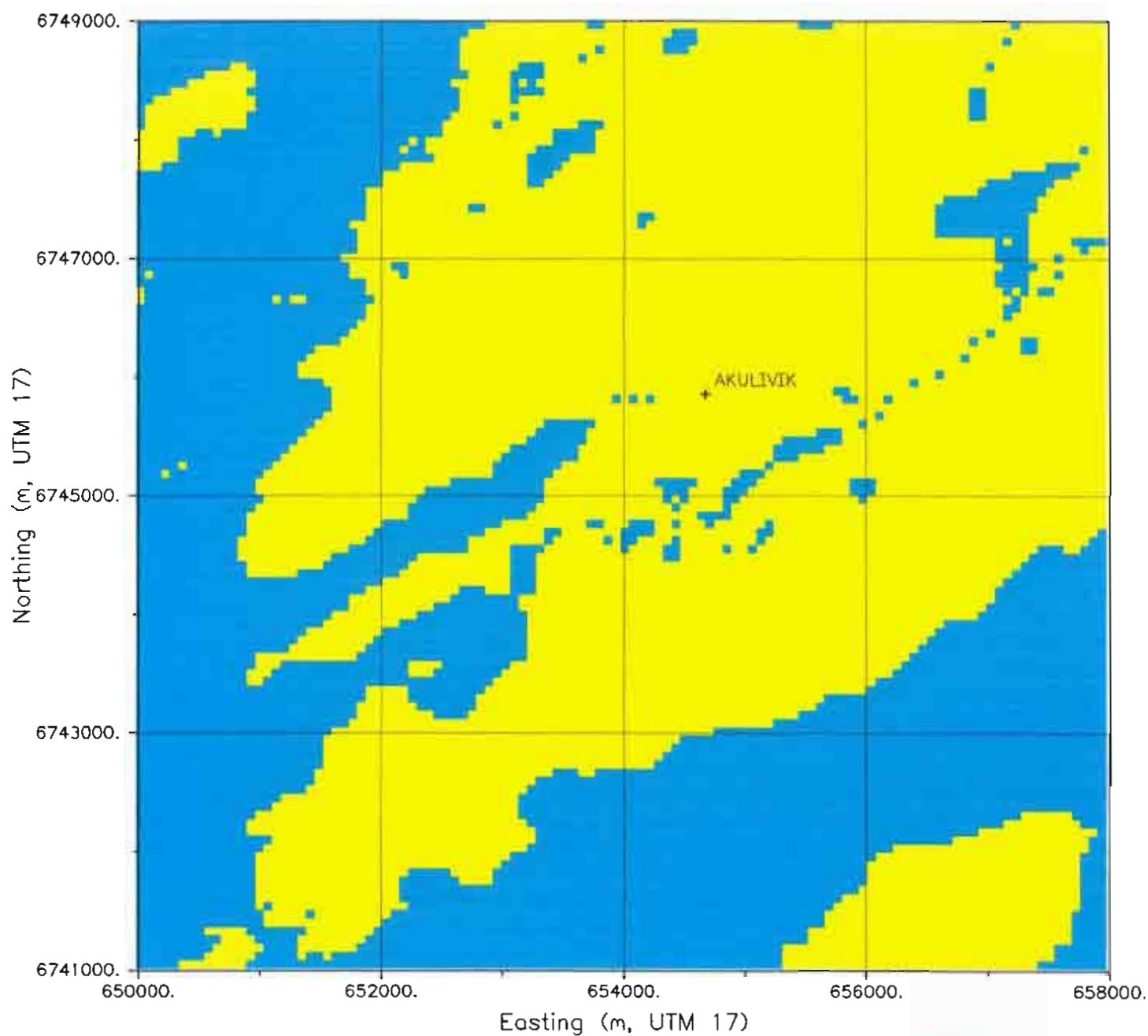
Master grid file: AKULIVIK.TMG



65/09/95

MS-Micro MODEL INPUT

Zephyr North



AKULIVIK-UPS1 95/09/09 10:44:07

Roughness from Master Grid (Central Quarter)

Master grid file: AKULIVIK.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: AKULIVIK-1 95/09/09 17:45:21

UTM zone, X-centre, Y-centre (m): 17 654000. 6745000.

Master topography file: AKULIVIK.TMG

Master roughness file: AKULIVIK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	1
9	180	0.	1
10	202	0.	1
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

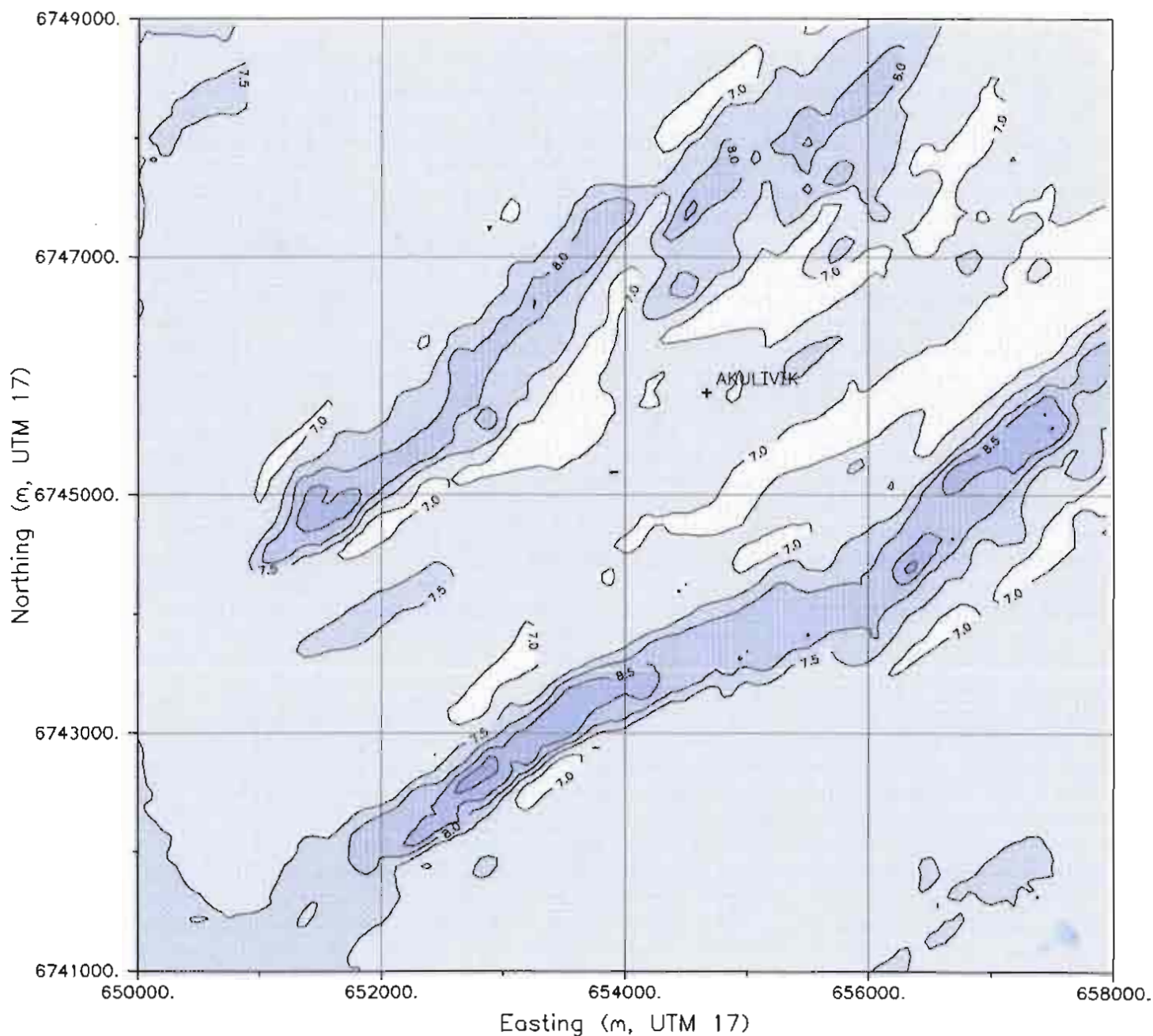
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

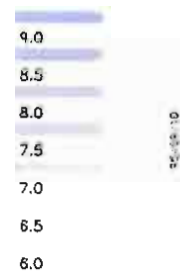


AKULIVIK-1 95/09/09 17:45:21

Wind Speed (m/s)

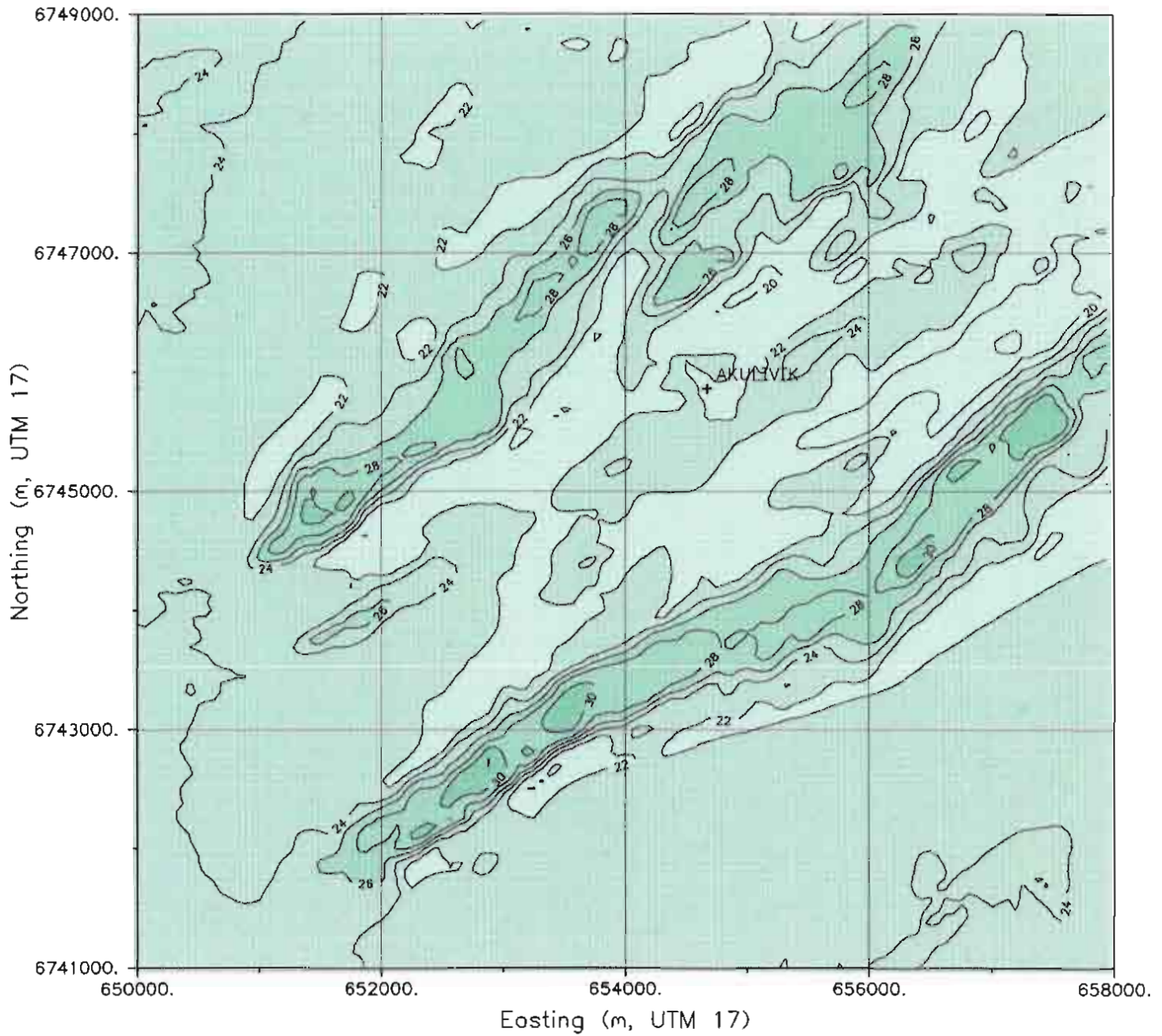
Level: 25.00m

Wind Distribution: AKULIVIK.RJF



MS-Micro MODEL OUTPUT

Zephyr North



AKULIVIK-1 95/09/09 17:45:21

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: AKULIVIK.RJF

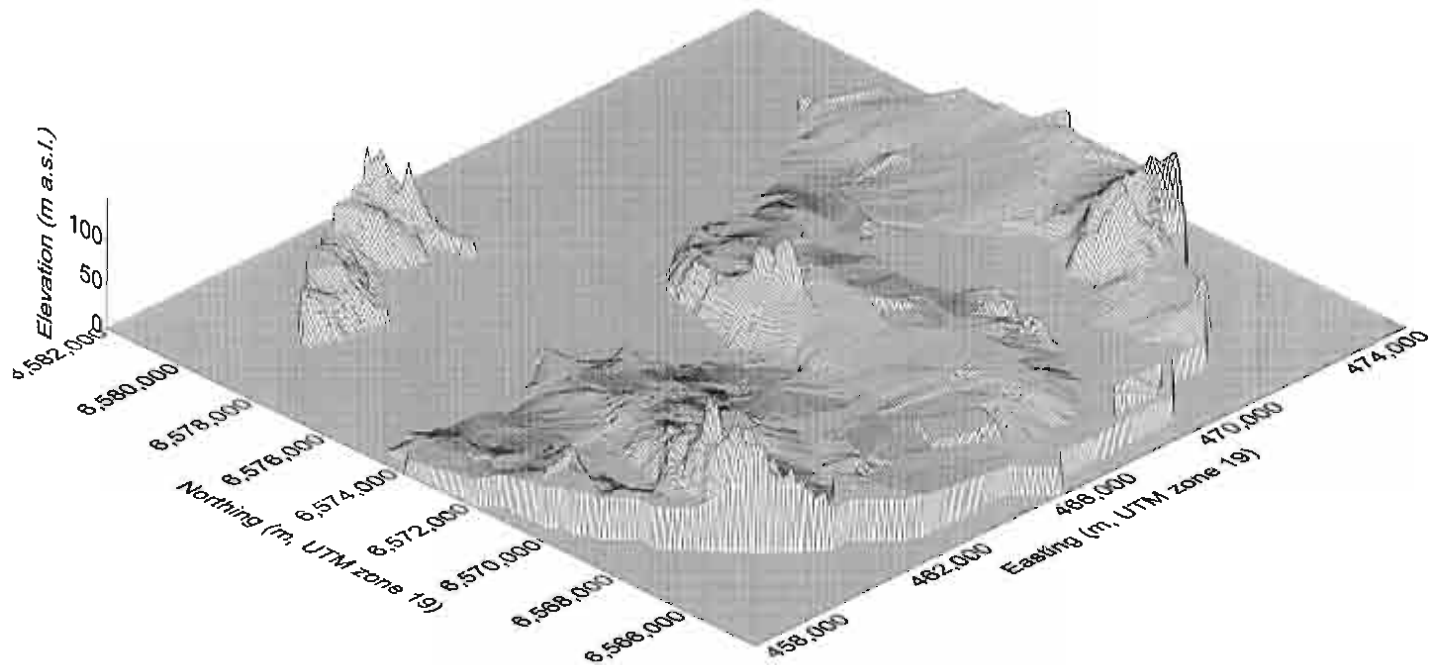
Temperature: -7.0C Pressure: 101.04kPa

30.0
28.0
22.0
18.0
14.0
10.0

95/09/09 17:45:21

MS-Micro MODEL INPUT

Zephyr North

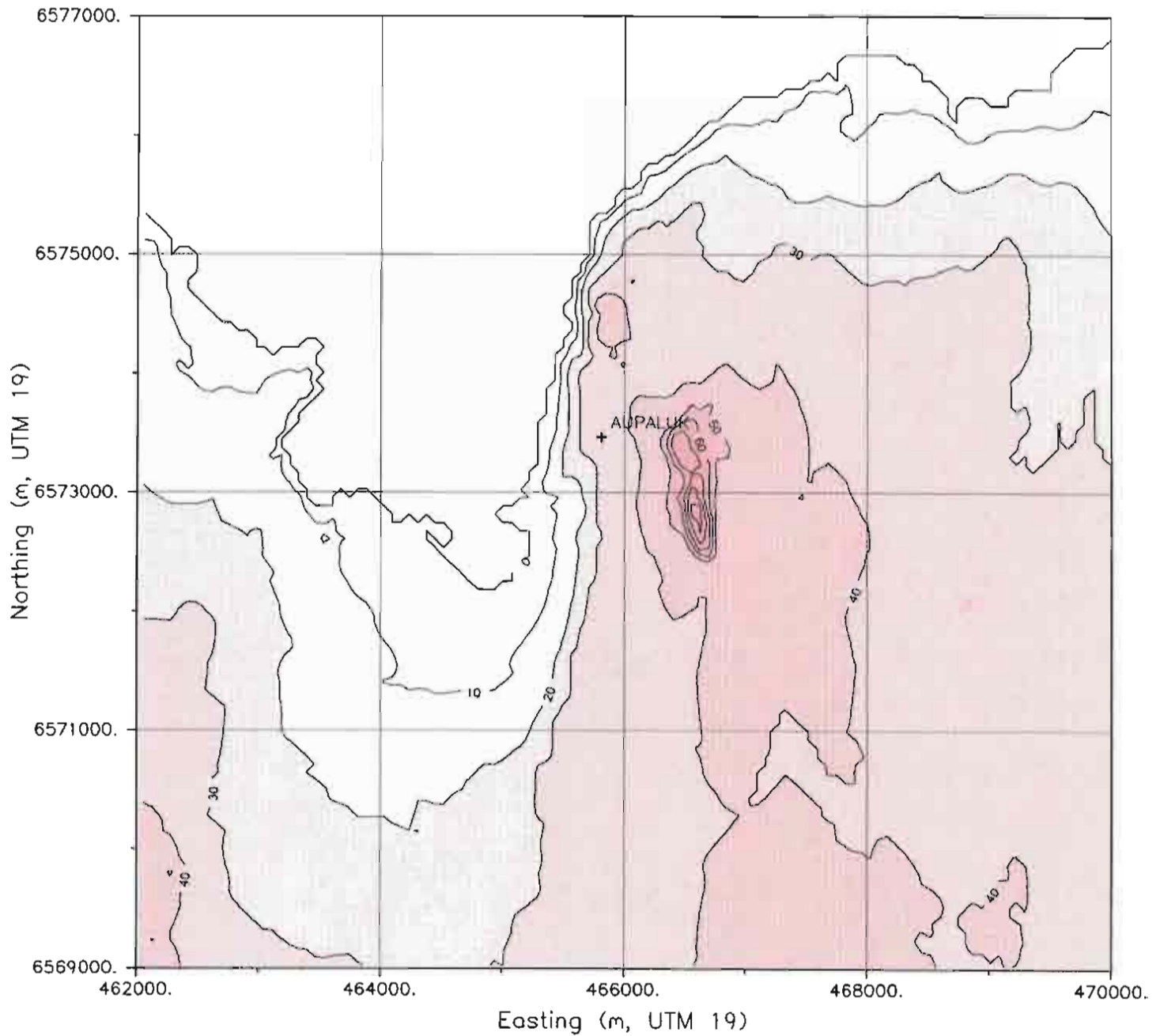


Aupaluk

Topography Relief from Master Grid
Master grid file: AUPALUK.TMG

MS-Micro MODEL INPUT

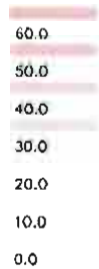
Zephyr North



AUPALUK-UPS1 95/09/11 09:40:39

Topography from Master Grid (m) (Central quarter)

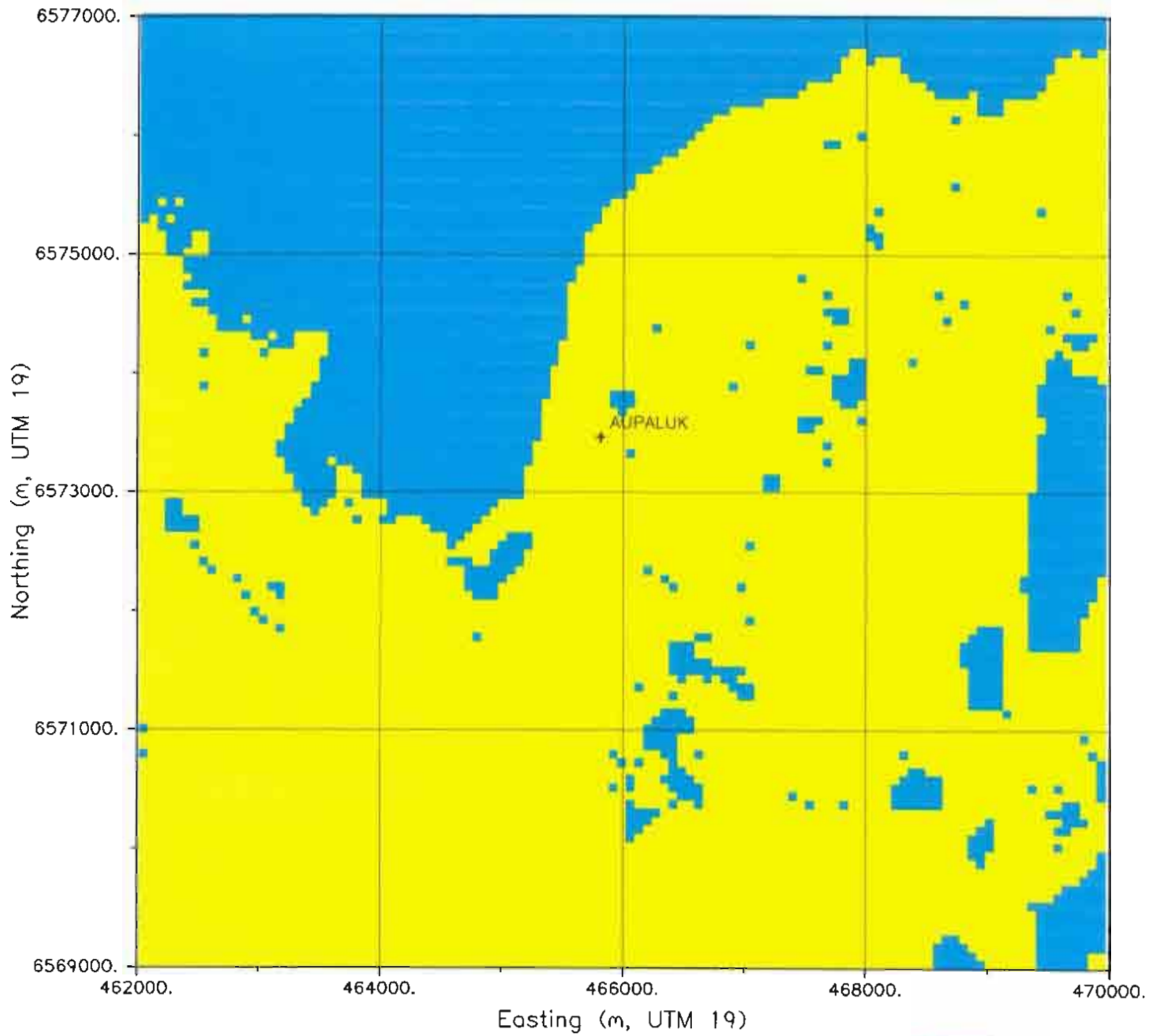
Master grid file: AUPALUK.TMG



95/09/11

MS-Micro MODEL INPUT

Zephyr North



AUPALUK-UPS1 95/09/11 09:40:39
 Roughness from Master Grid (Central Quarter)
 Master grid file: AUPALUK.RMG

- 8. Chaotic
- 7. Closed
- 6. Very Rough
- 5. Rough
- 4. Roughly Open
- 3. Open
- 2. Smooth
- 1. Sea

95/09/11

MS-Micro MASTER PARAMETER SUMMARY

Project Name: AUPALUK-1 95/09/11 10:40:32

UTM zone, X-centre, Y-centre (m): 19 466000. 6573000.

Master topography file: AUPALUK.TMG

Master roughness file: AUPALUK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	1
4	067	0.	1
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

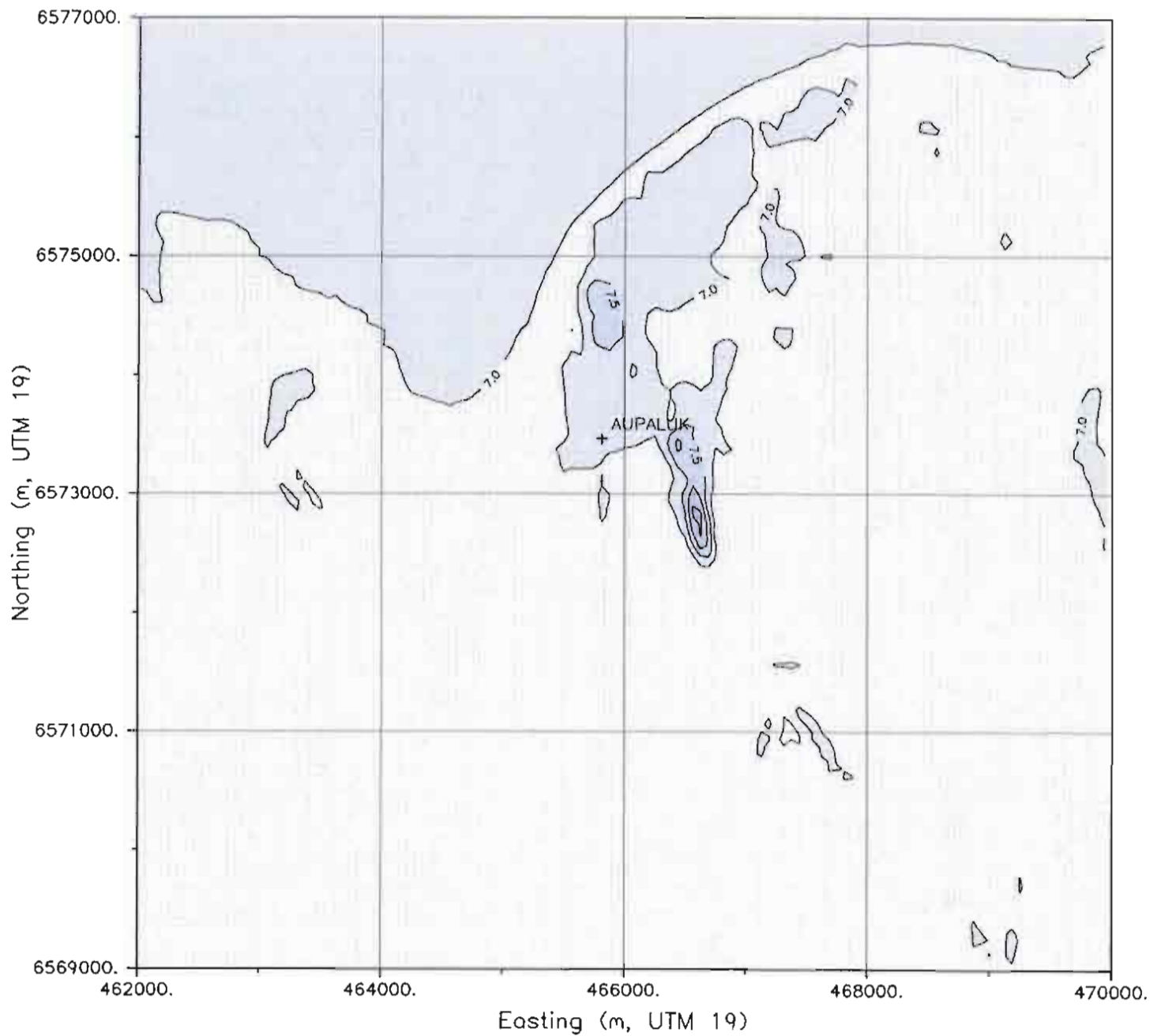
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

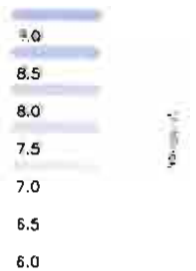


AUPALUK-1 95/09/11 10:40:32

Wind Speed (m/s)

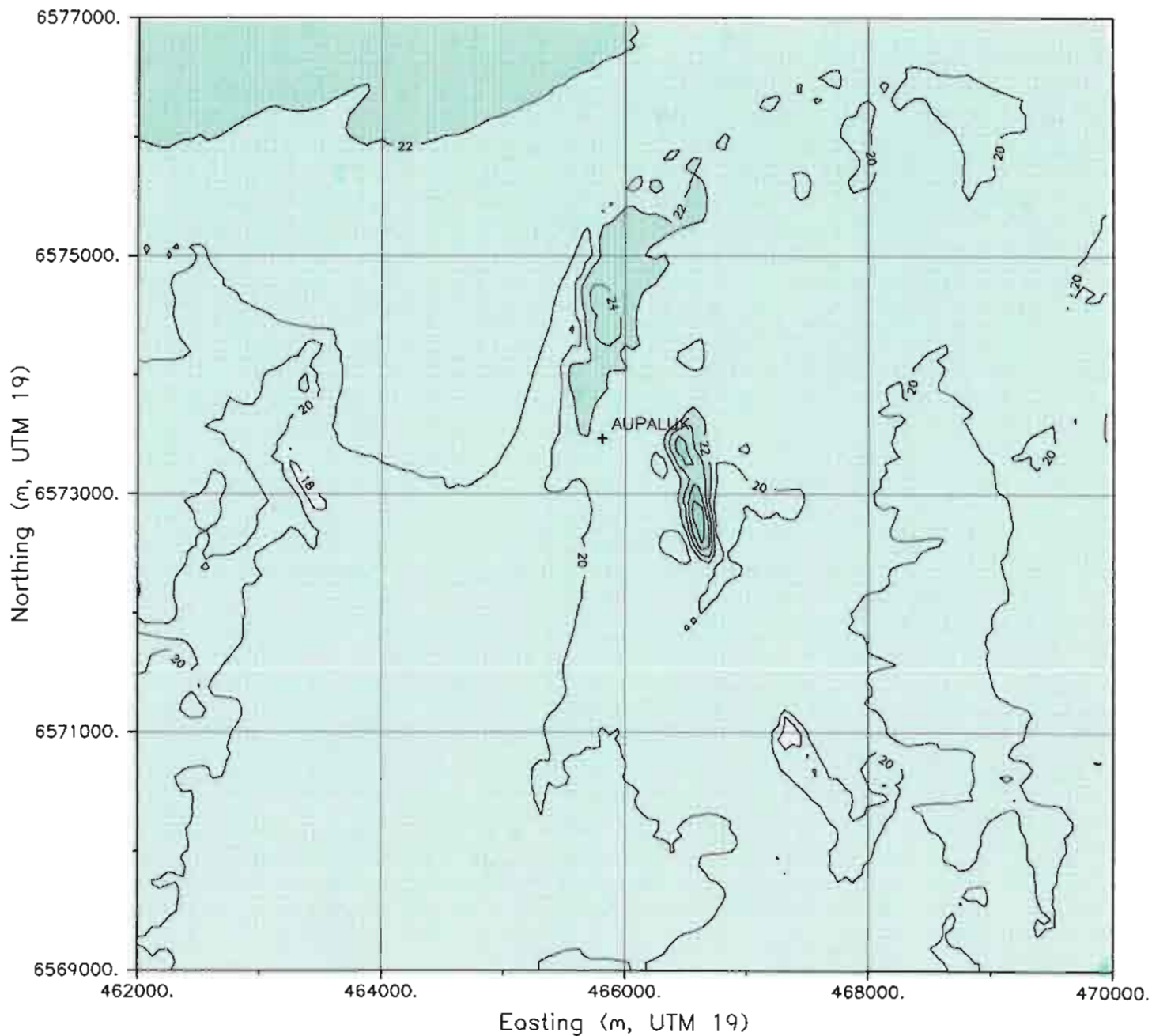
Level: 25.00m

Wind Distribution: AUPALUK.RJF



MS-Micro MODEL OUTPUT

Zephyr North



AUPALUK-1 95/09/11 10:40:32

AOC 15/50 Turbine Power (kW)

Level: 25.00m

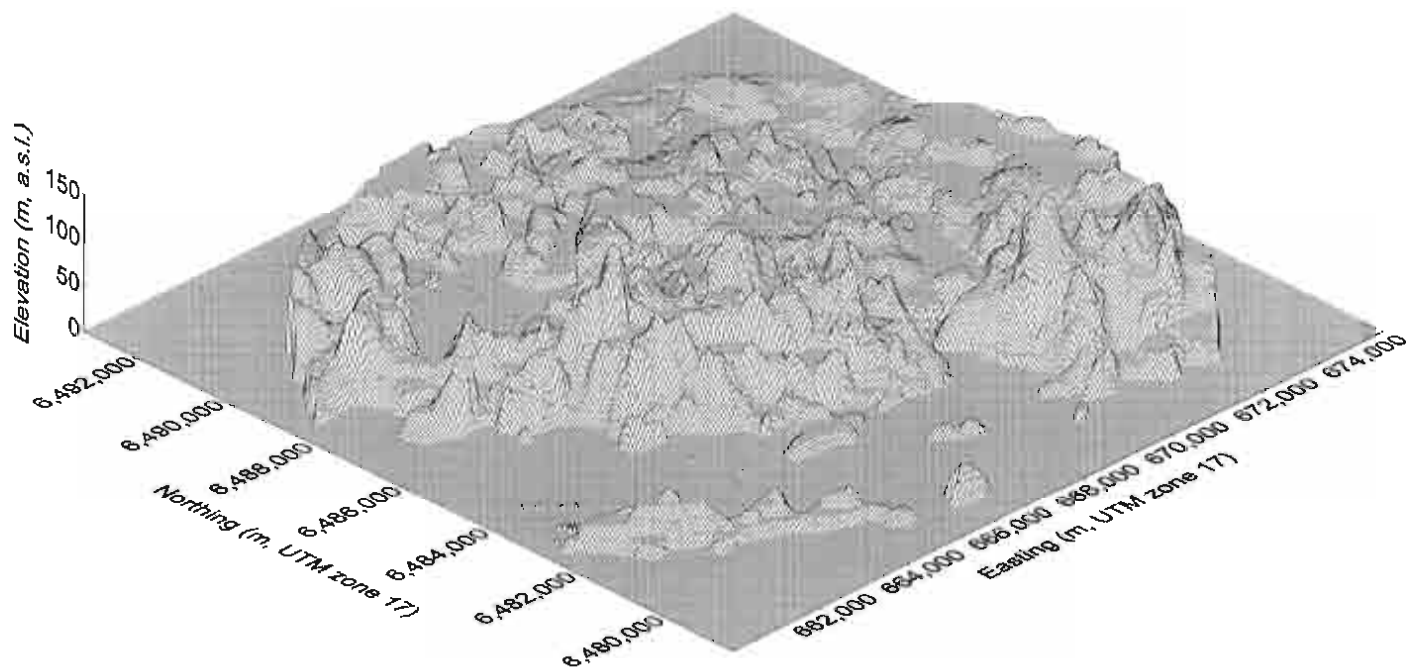
Wind Distribution: AUPALUK.RJF

Temperature: -7.1C Pressure: 100.70kPa

30.0
26.0
22.0
18.0
14.0
10.0

MS-Micro MODEL INPUT

Zephyr North

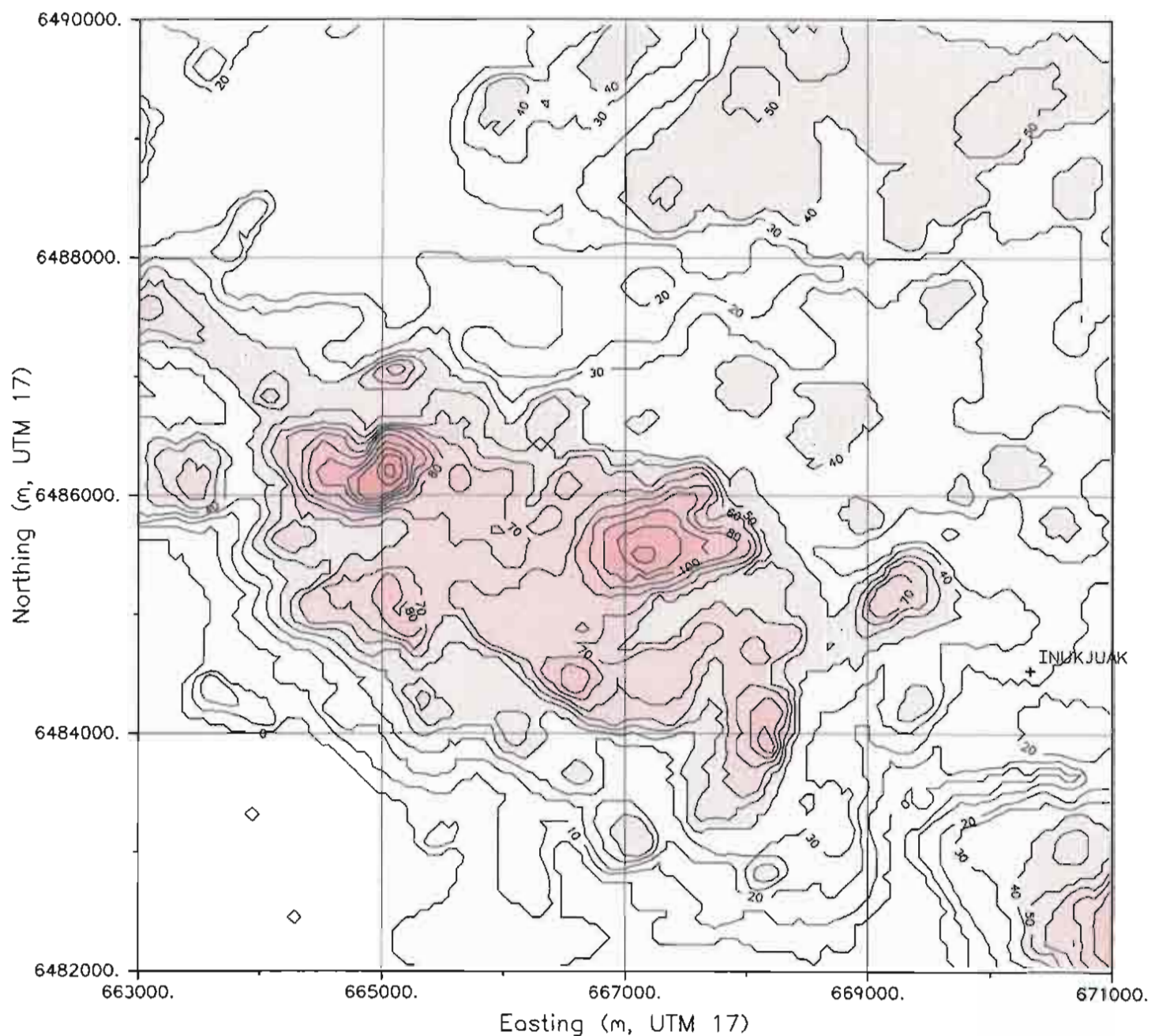


Inukjuak

Topography relief from Master Grid
Master grid file: INUKJUAK.TMG

MS-Micro MODEL INPUT

Zephyr North



INUKJUAQ-1 95/08/27 15:25:17

Topography from Master Grid (m) (Central quarter)

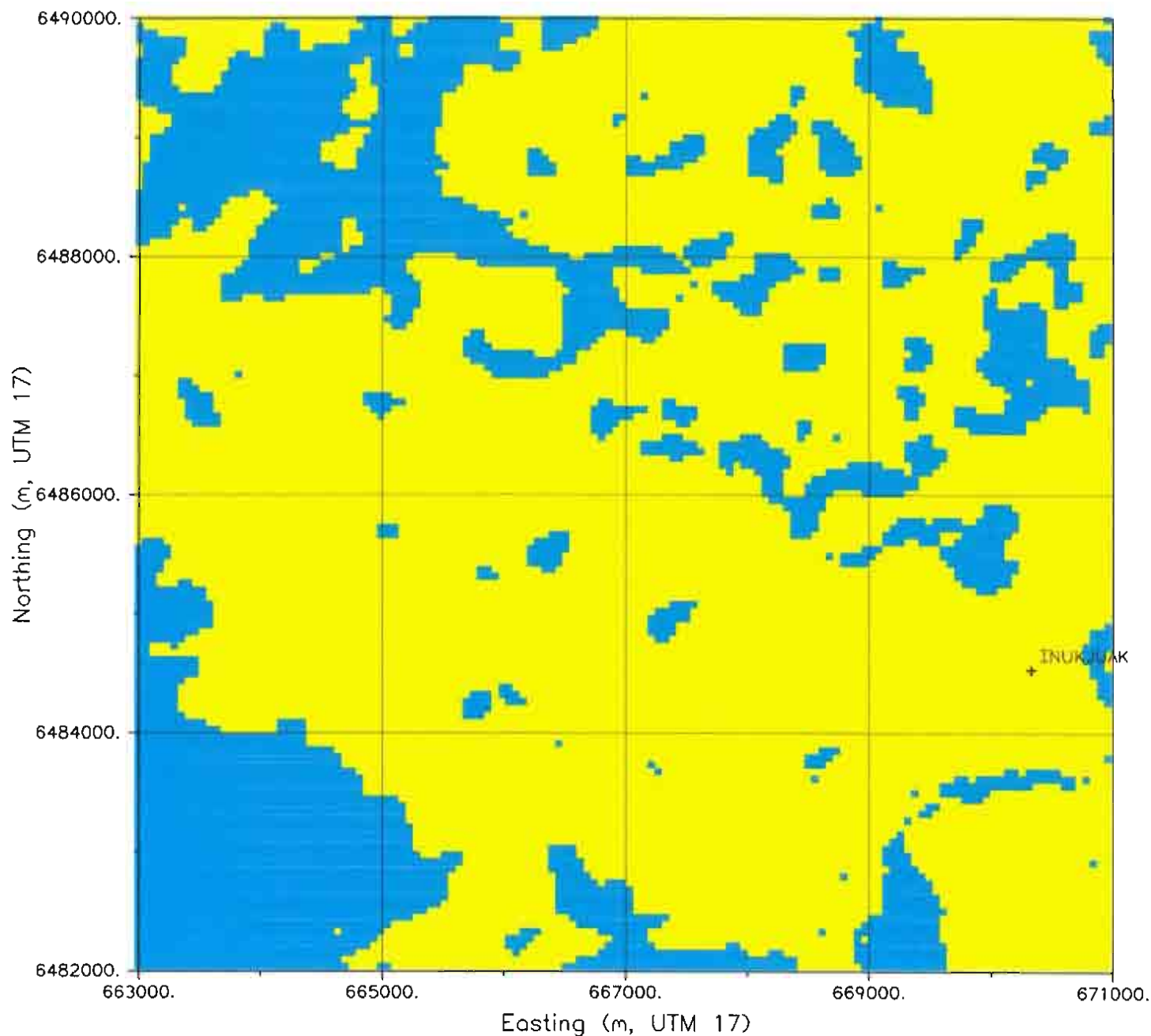
Master grid file: INUKJUAQ.TMG

120.1
100.1
80.1
60.0
40.0
20.0
0.0

MS-Micro 1.2

MS-Micro MODEL INPUT

Zephyr North



INUKJUAK-1 95/08/27 15:25:17

Roughness from Master Grid (Central Quarter)

Master grid file: INUKJUAK.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: INUKJUAK-1 95/09/12 08:47:47

UTM zone, X-centre, Y-centre (m): 17 667000. 6486000.

Master topography file: INUKJUAK.TMG

Master roughness file: INUKJUAK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	1
9	180	0.	1
10	202	0.	1
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

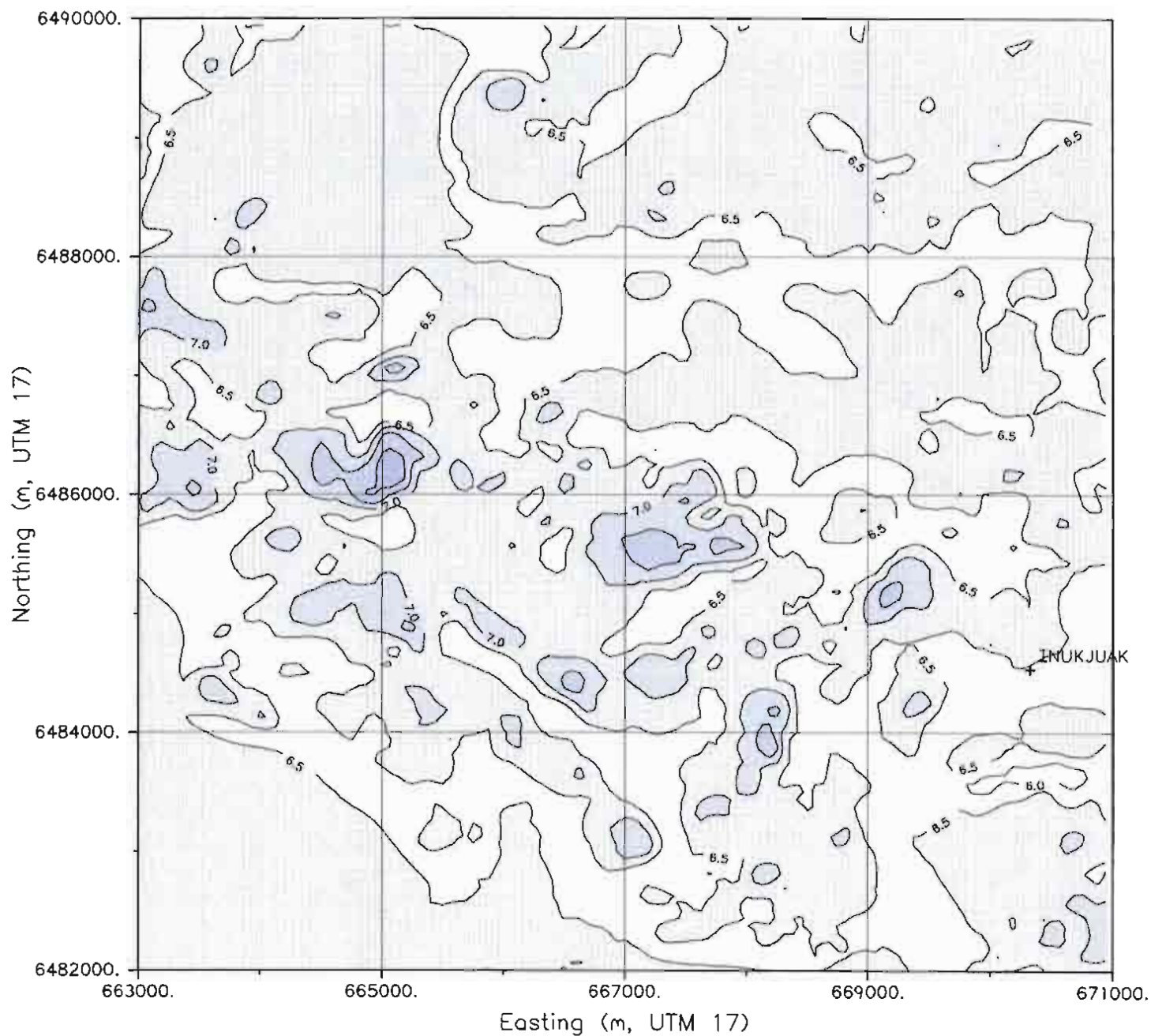
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

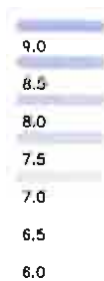


INUKJUA-1 95/09/12 08:47:47

Wind Speed (m/s)

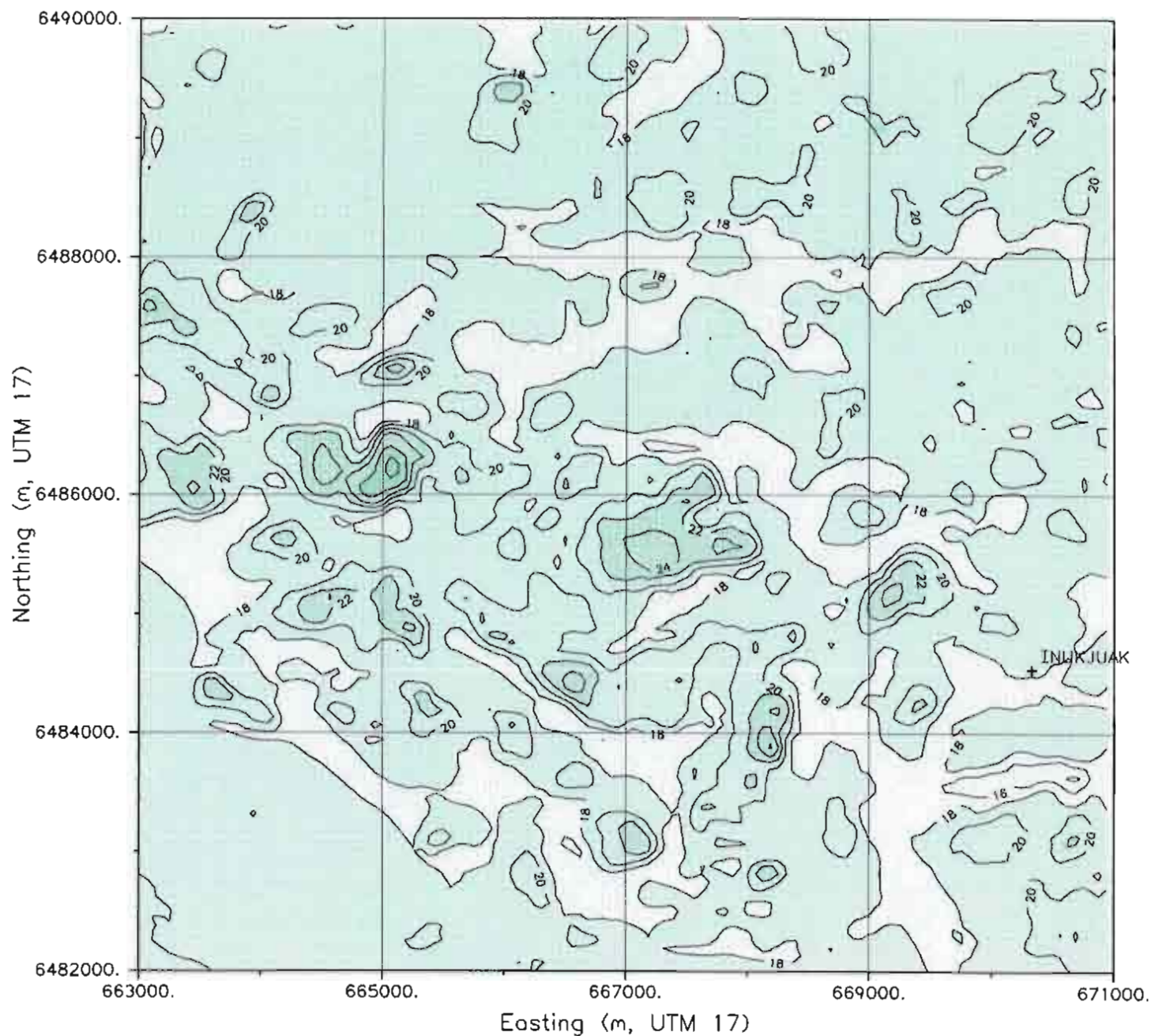
Level: 25.00m

Wind Distribution: INUKJUA.RJF



MS-Micro MODEL OUTPUT

Zephyr North



INUKJUAK-1 95/09/12 08:47:47

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: INUKJUAK.RJF

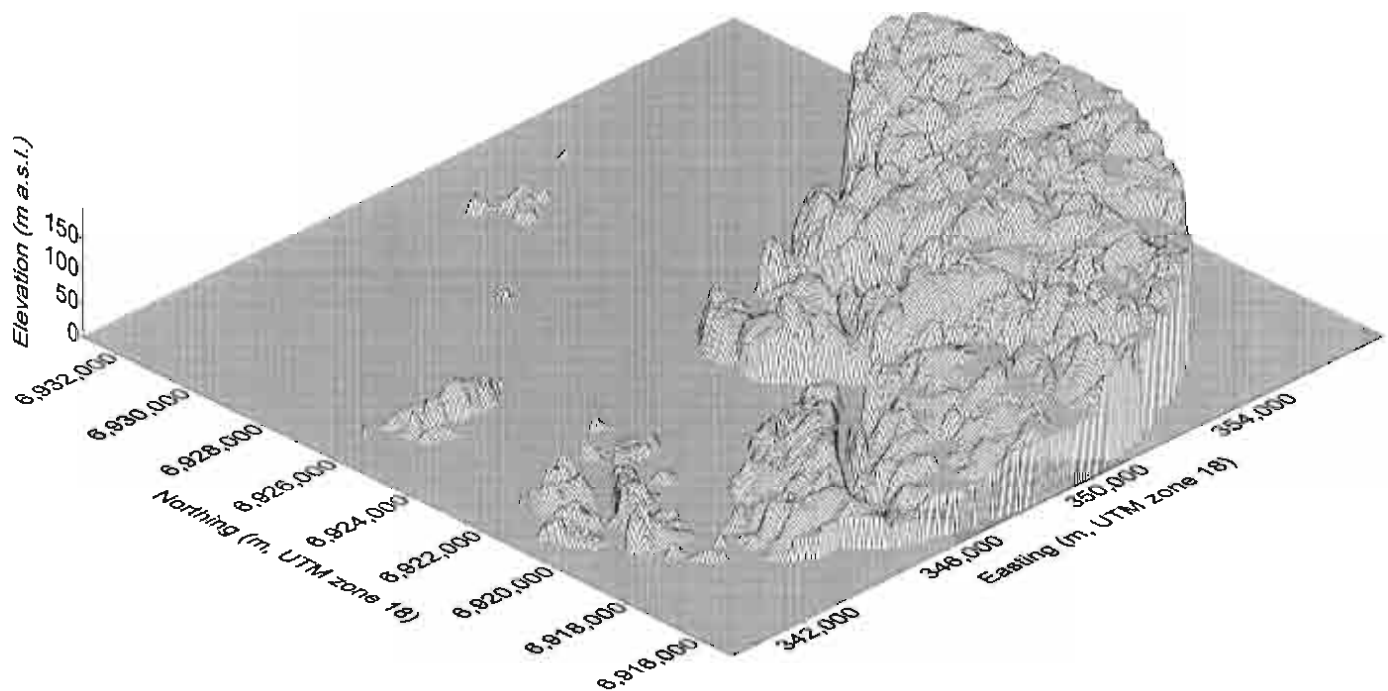
Temperature: -6.6C Pressure: 101.10kPa

30.0
25.0
22.0
18.0
14.0
10.0

95/09/12

MS-Micro MODEL INPUT

Zephyr North

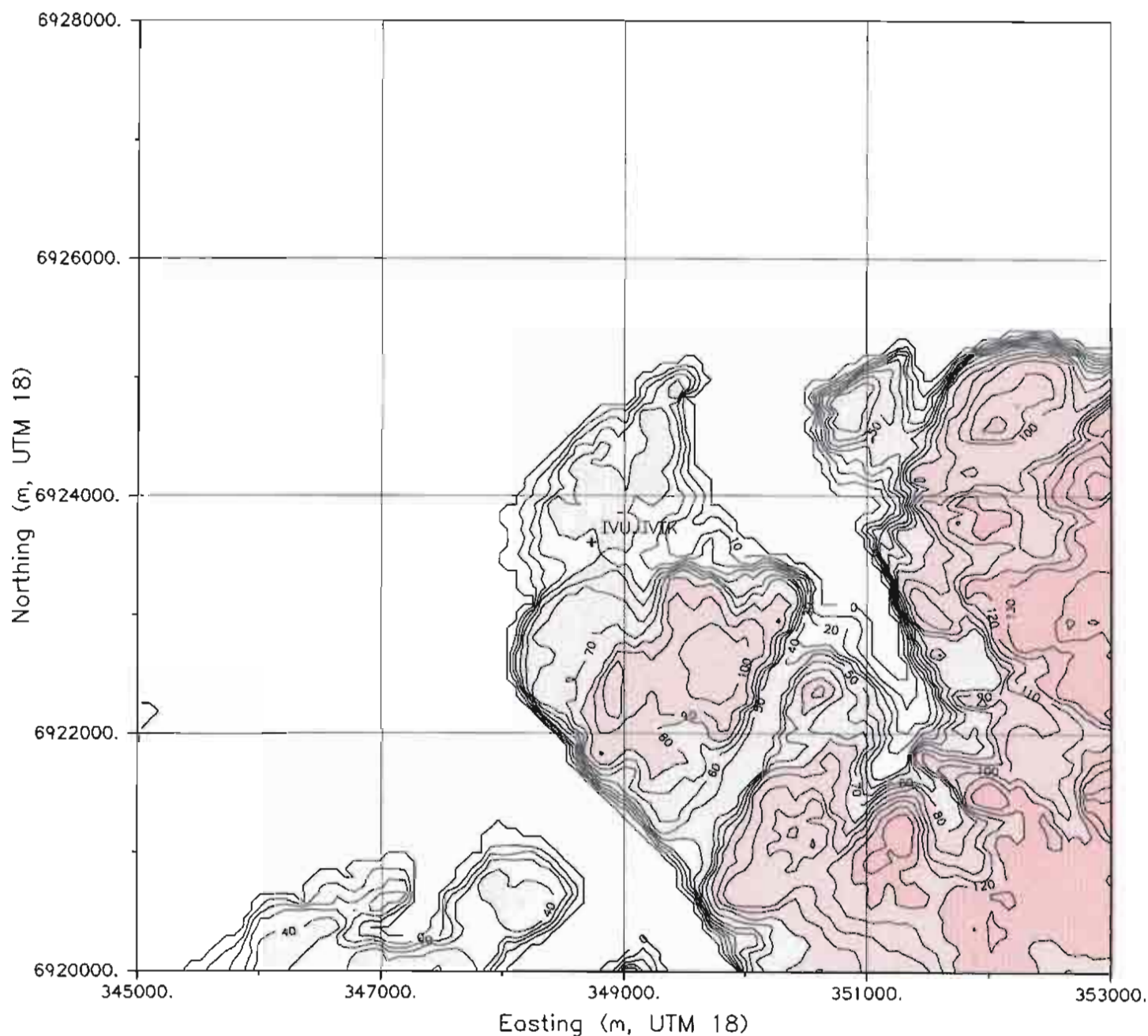


Ivujivik

Topography relief from Master Grid
Master grid file: IVUJIVIK.TMG

MS-Micro MODEL INPUT

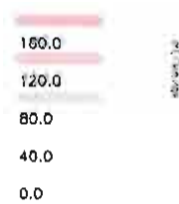
Zephyr North



IVUJIVIK-UPS1 95/09/12 13:03:36

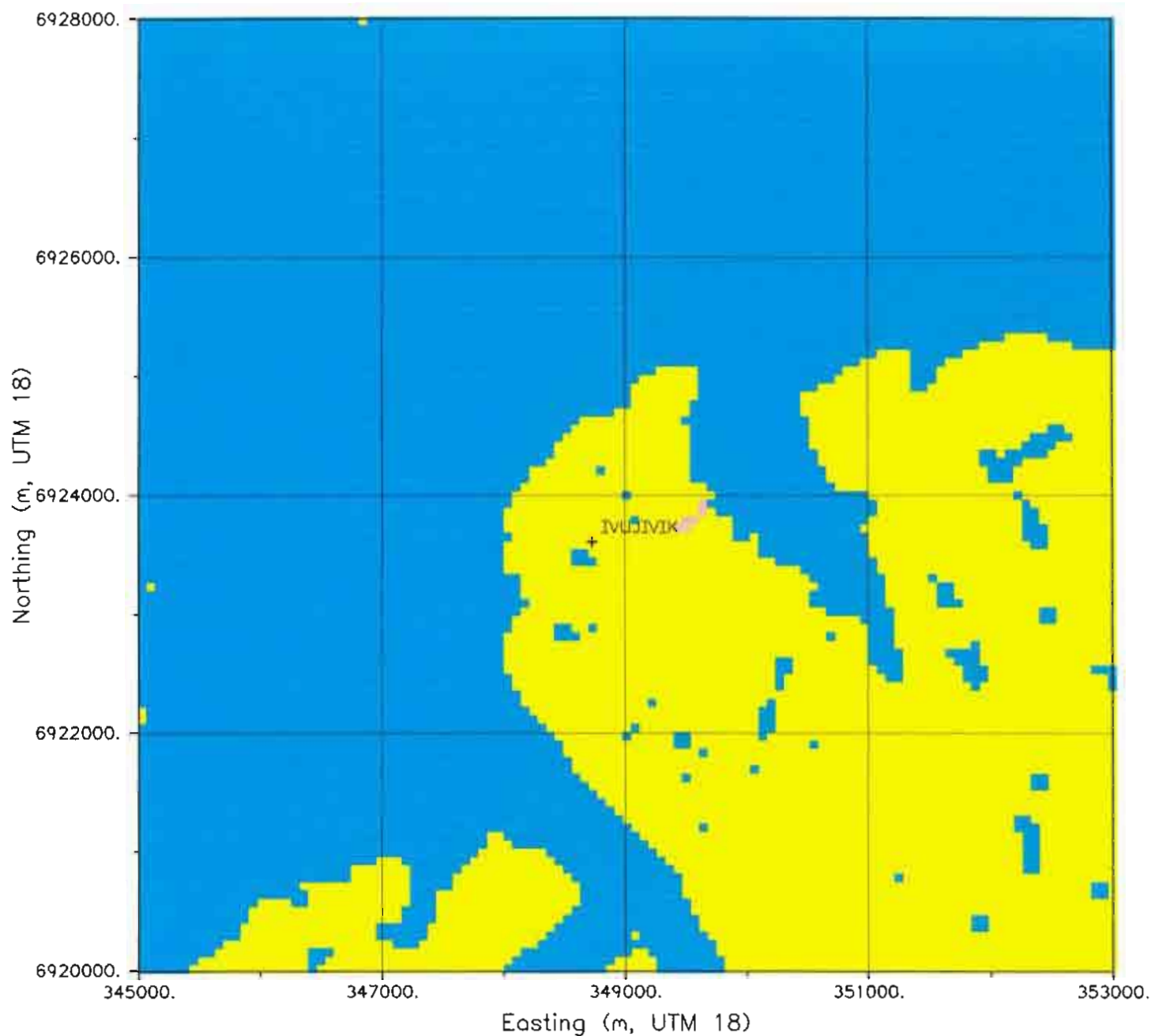
Topography from Master Grid (m) (Central quarter)

Master grid file: IVUJIVIK.TMG



MS-Micro MODEL INPUT

Zephyr North



IVUJIVIK-UPS1 95/09/12 13:03:36

Roughness from Master Grid (Central Quarter)

Master grid file: IVUJIVIK.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: 1VUJIVIK-1 95/09/12 14:50:16

UTM zone, X-centre, Y-centre (m): 18 349000. 6924000.

Master topography file: 1VUJIVIK.TMG

Master roughness file: 1VUJIVIK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	1
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

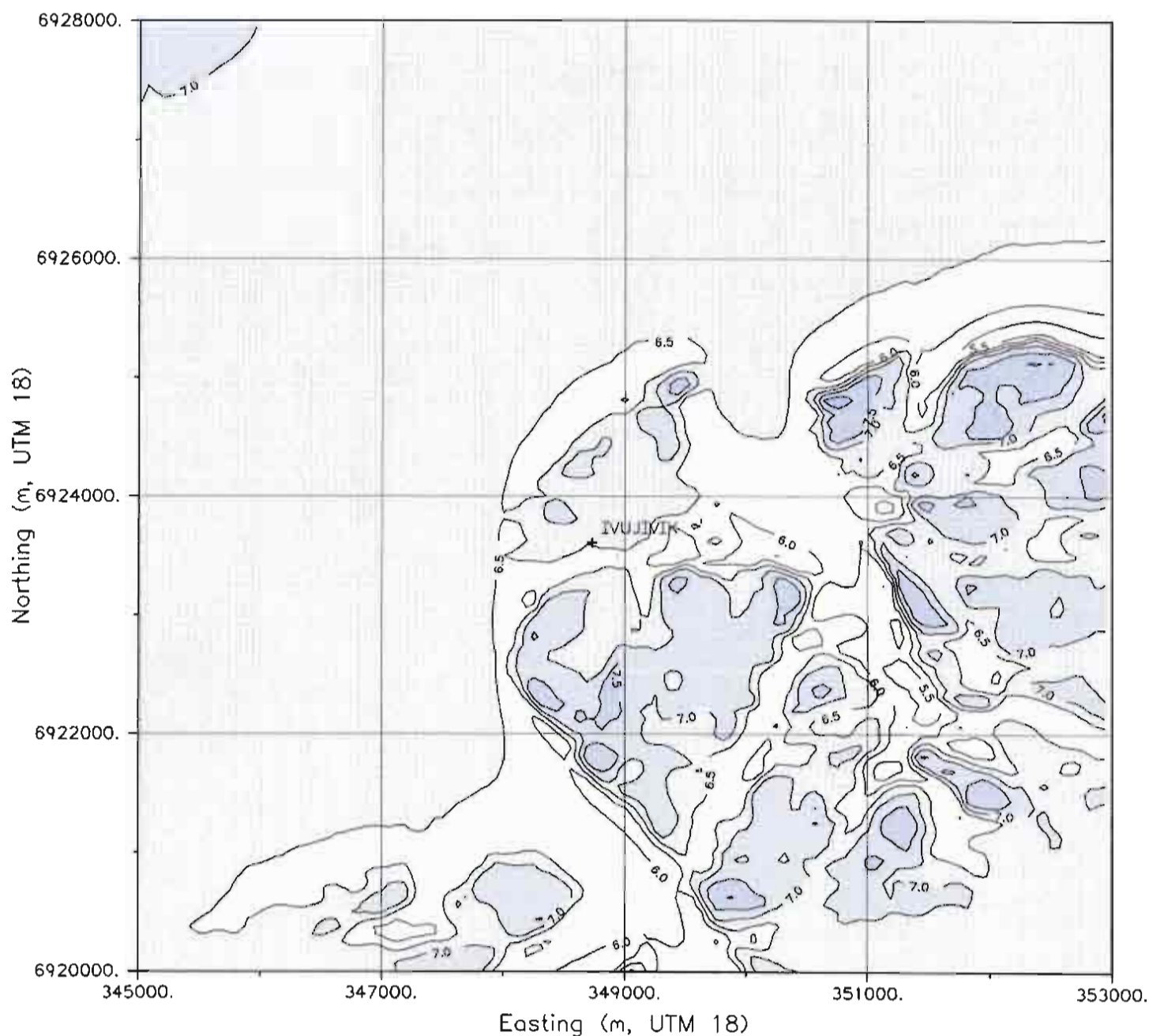
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

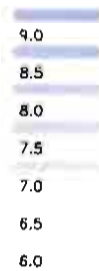


IVUJIVIK-1 95/09/12 14:50:16

Wind Speed (m/s)

Level: 25.00m

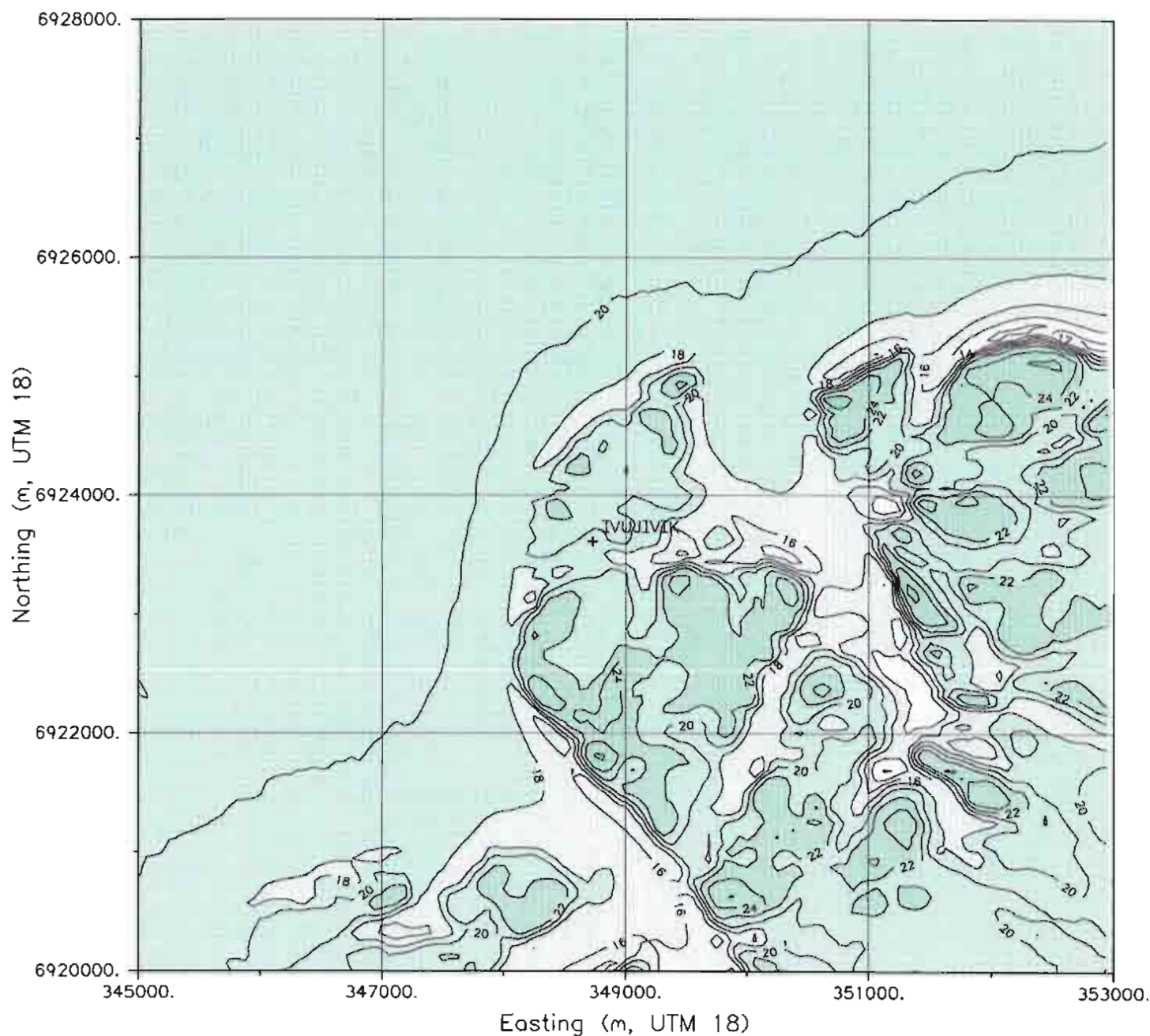
Wind Distribution: IVUJIVIK.RJF



95/09/12

MS-Micro MODEL OUTPUT

Zephyr North



IVUJIVIK-1 95/09/12 14:50:16

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: IVUJIVIK.RJF

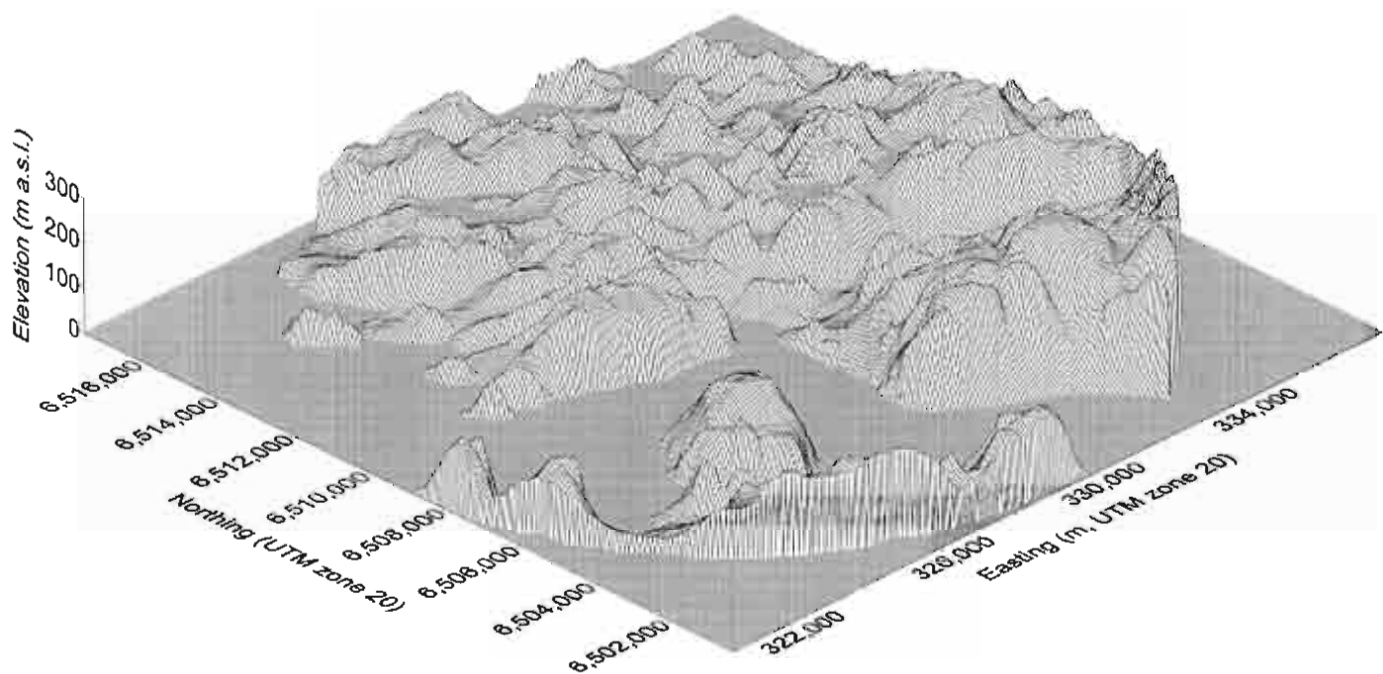
Temperature: -7.0C Pressure: 100.60kPa

30.0
26.0
22.0
18.0
14.0
10.0

0.000000

MS-Micro MODEL INPUT

Zephyr North

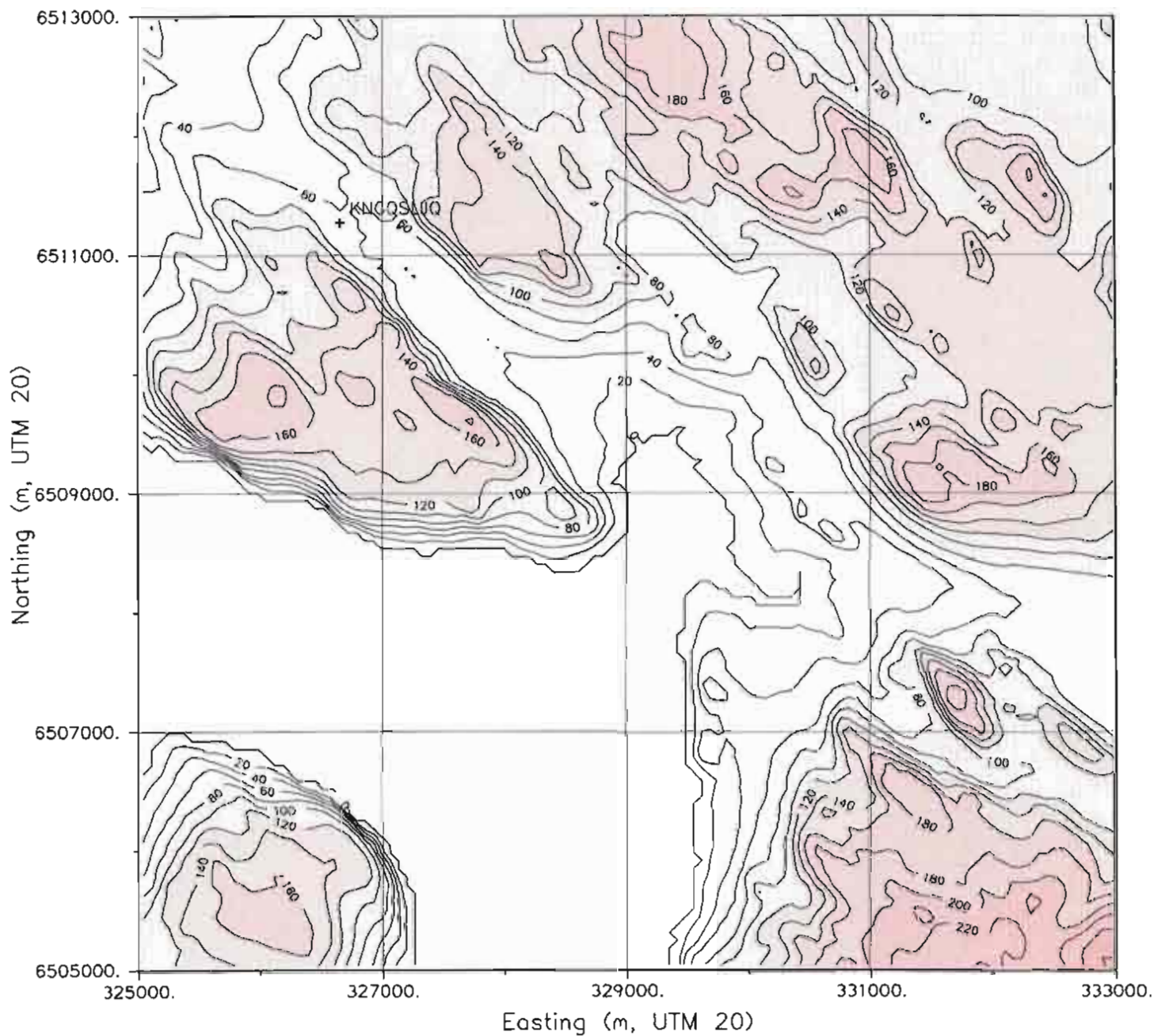


Kangiqsualujuaq

Topography Relief from Master Grid
Master grid file: KNGQSLJQ.TMG

MS-Micro MODEL INPUT

Zephyr North



KNGQSLJQ-UPS1 95/09/07 11:59:39

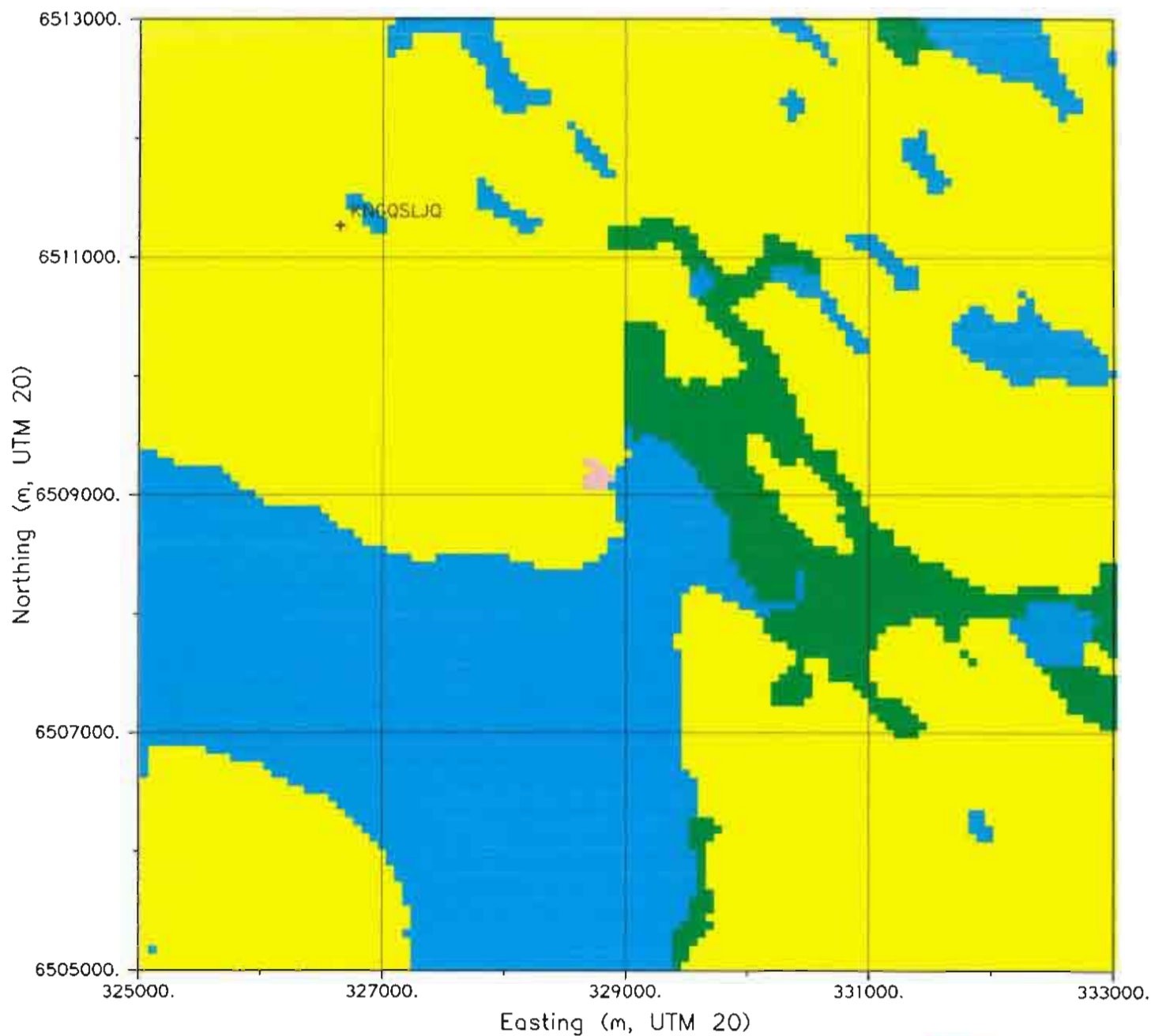
Topography from Master Grid (m) (Central quarter)

Master grid file: KNGQSLJQ.TMG

280.0
240.0
200.0
160.0
120.0
80.0
40.0
0.0

MS-Micro MODEL INPUT

Zephyr North



KNGQSLJQ-UPS1 95/09/07 11:59:39

Roughness from Master Grid (Central Quarter)

Master grid file: KNGQSLJQ.RMG

- 8. Chotic
- 7. Closed
- 6. Very Rough
- 5. Rough
- 4. Roughly Open
- 3. Open
- 2. Smooth
- 1. Sea

MS-Micro MASTER PARAMETER SUMMARY

Project Name: KNGQSLJQ-1 95/09/07 13:39:27

UTM zone, X-centre, Y-centre (m): 20 329000. 6509000.

Master topography file: KNGQSLJQ.TMG

Master roughness file: KNGQSLJQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 4000. 6000.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

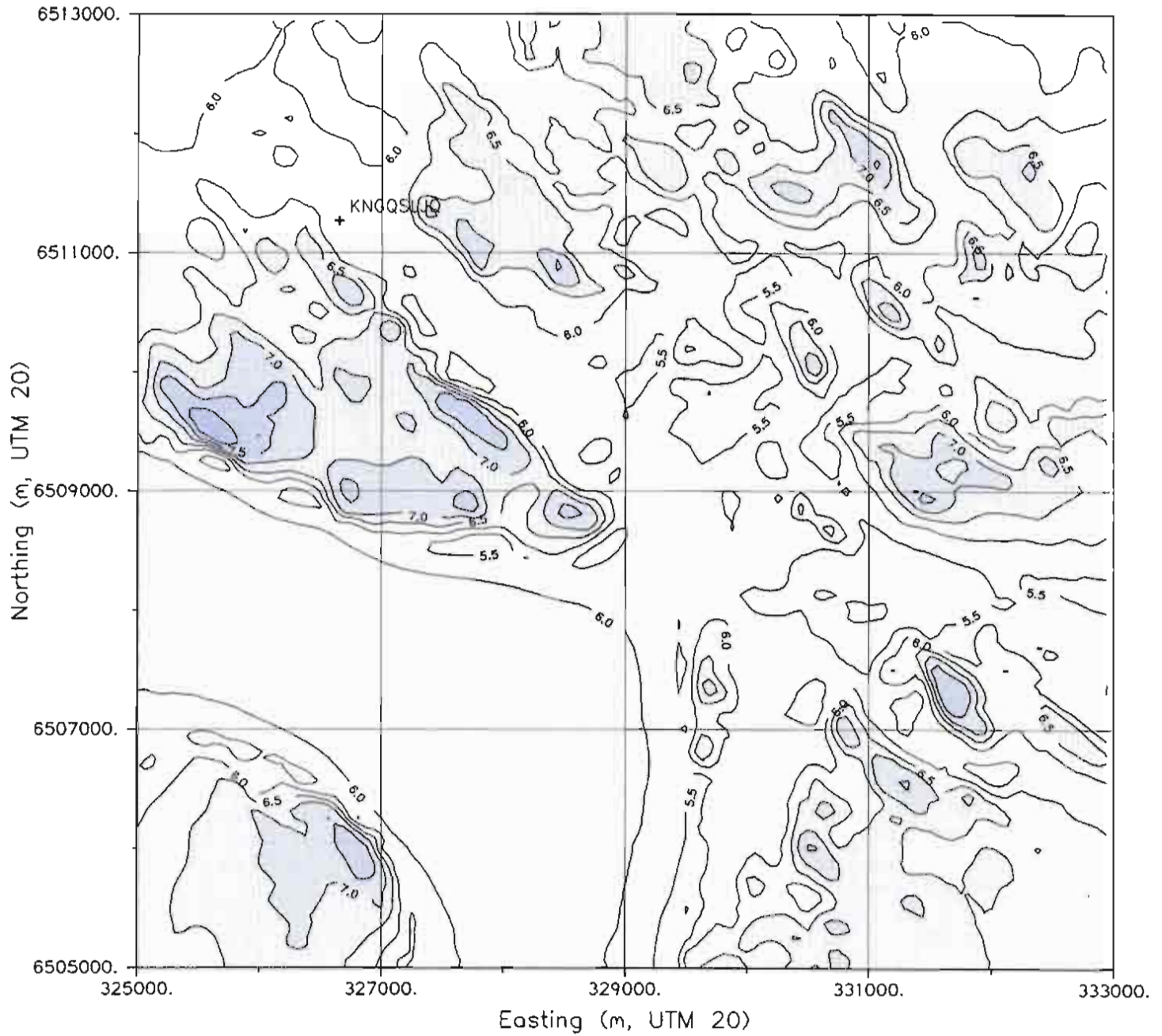
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



KNGQSLJQ-1 95/09/07 13:39:27

Wind Speed (m/s)

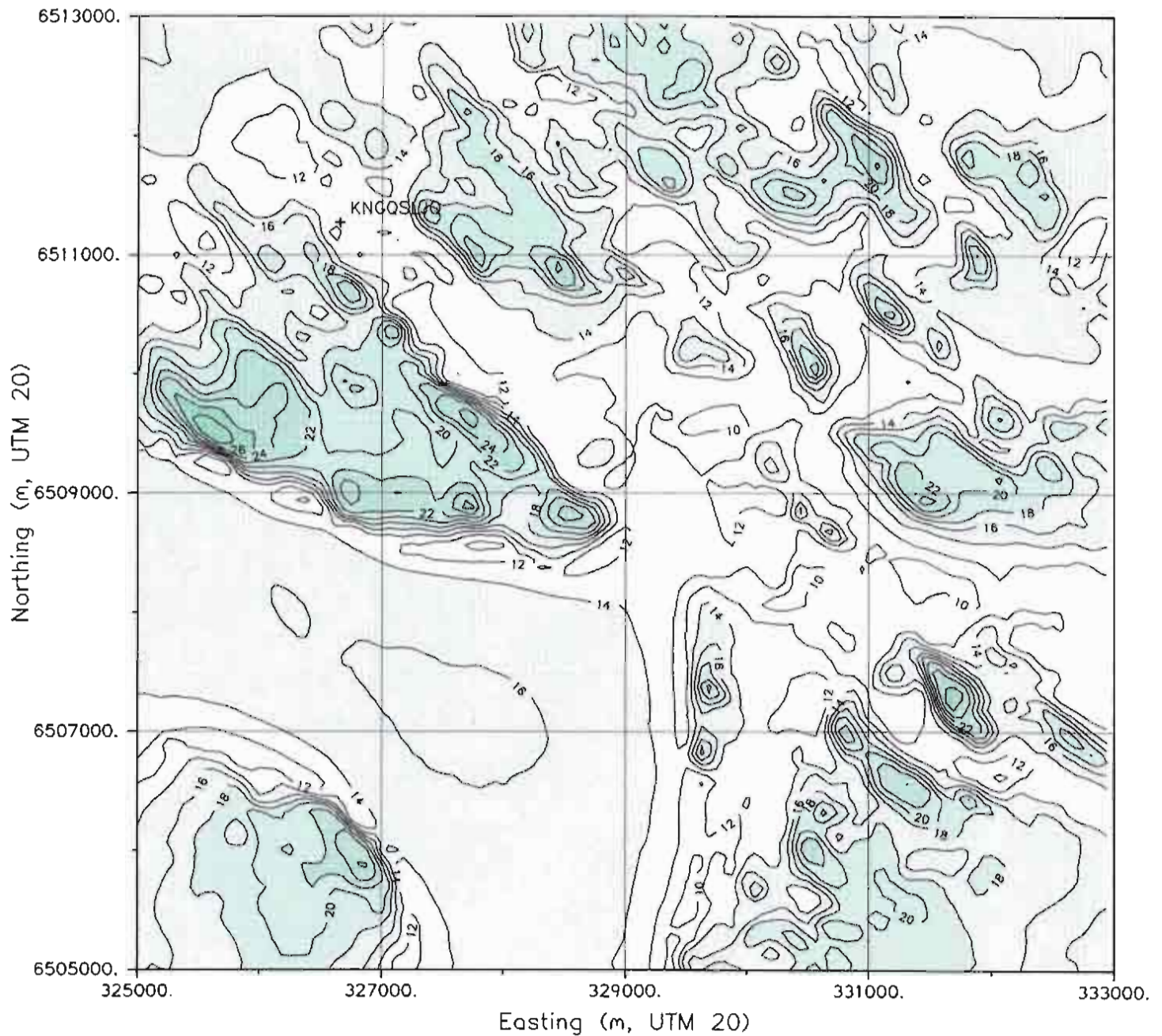
Level: 25.00m

Wind Distribution: KNGQSLJQ.RJF



MS-Micro MODEL OUTPUT

Zephyr North



KNGQSLJQ-1 95/09/07 13:39:27

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: KNGQSLJQ.RJF

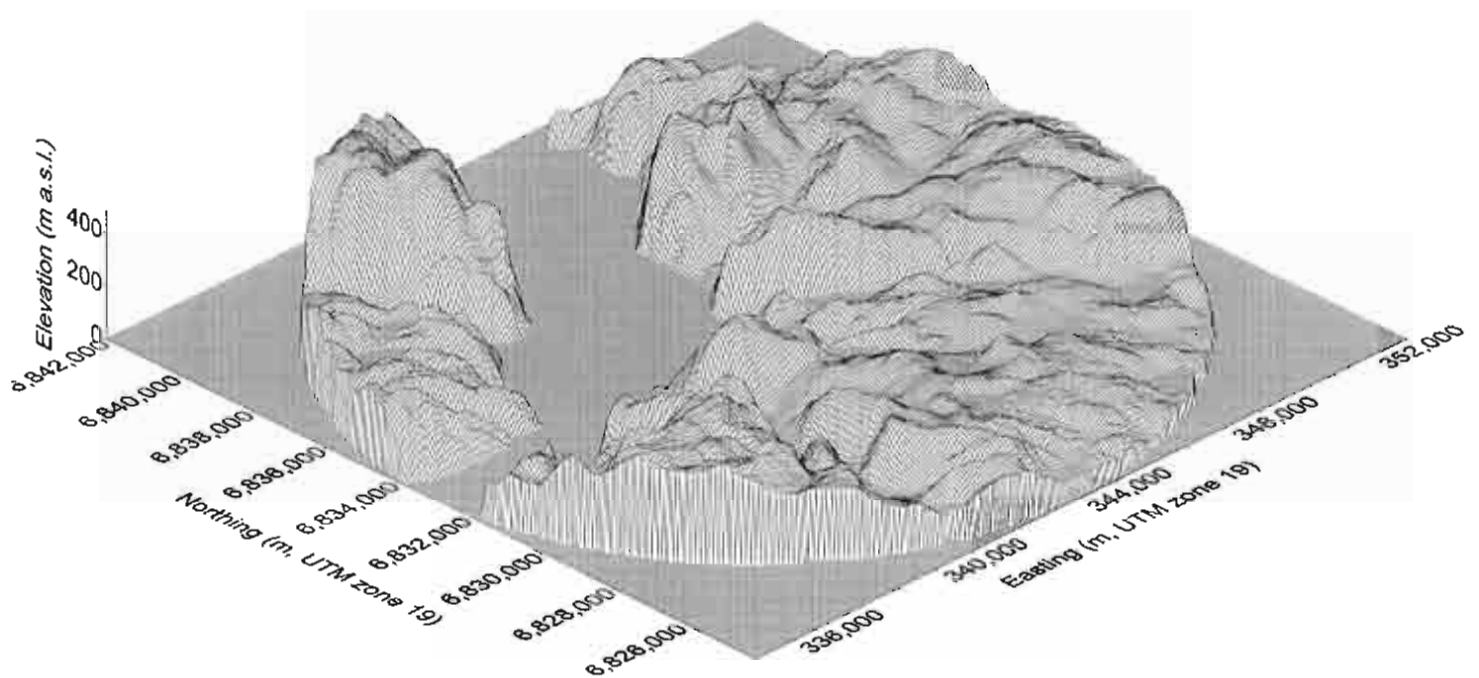
Temperature: -5.2C Pressure: 100.38kPa

30.0
26.0
22.0
18.0
14.0
10.0

40/09/12

MS-Micro MODEL INPUT

Zephyr North

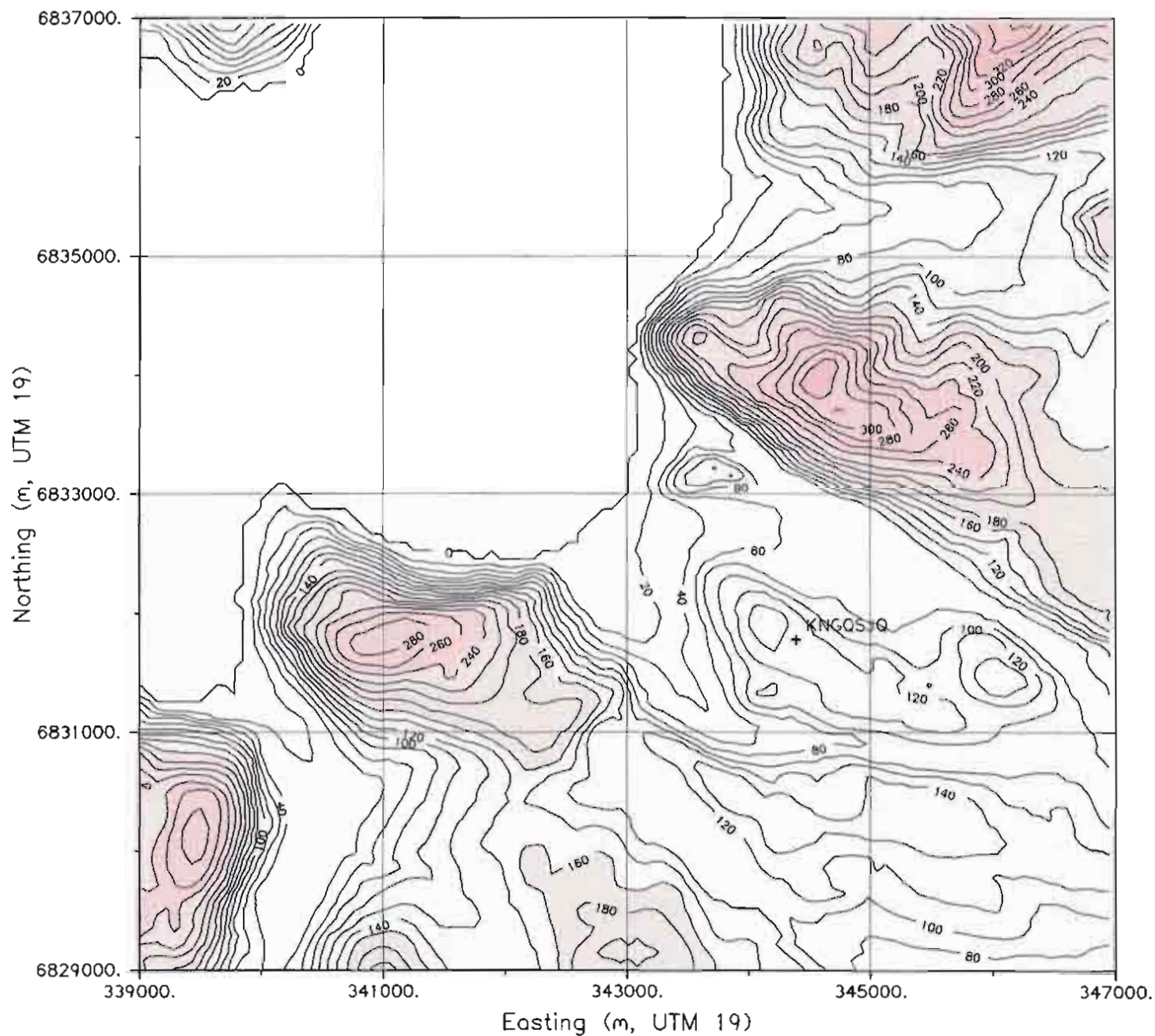


Kangiqsujaq

Topography Relief from Master Grid
Master grid file: KNGQJSJQ.TMG

MS-Micro MODEL INPUT

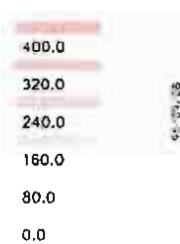
Zephyr North



KANGIQSUJUAQ-UPS1 95/09/08 13:16:05

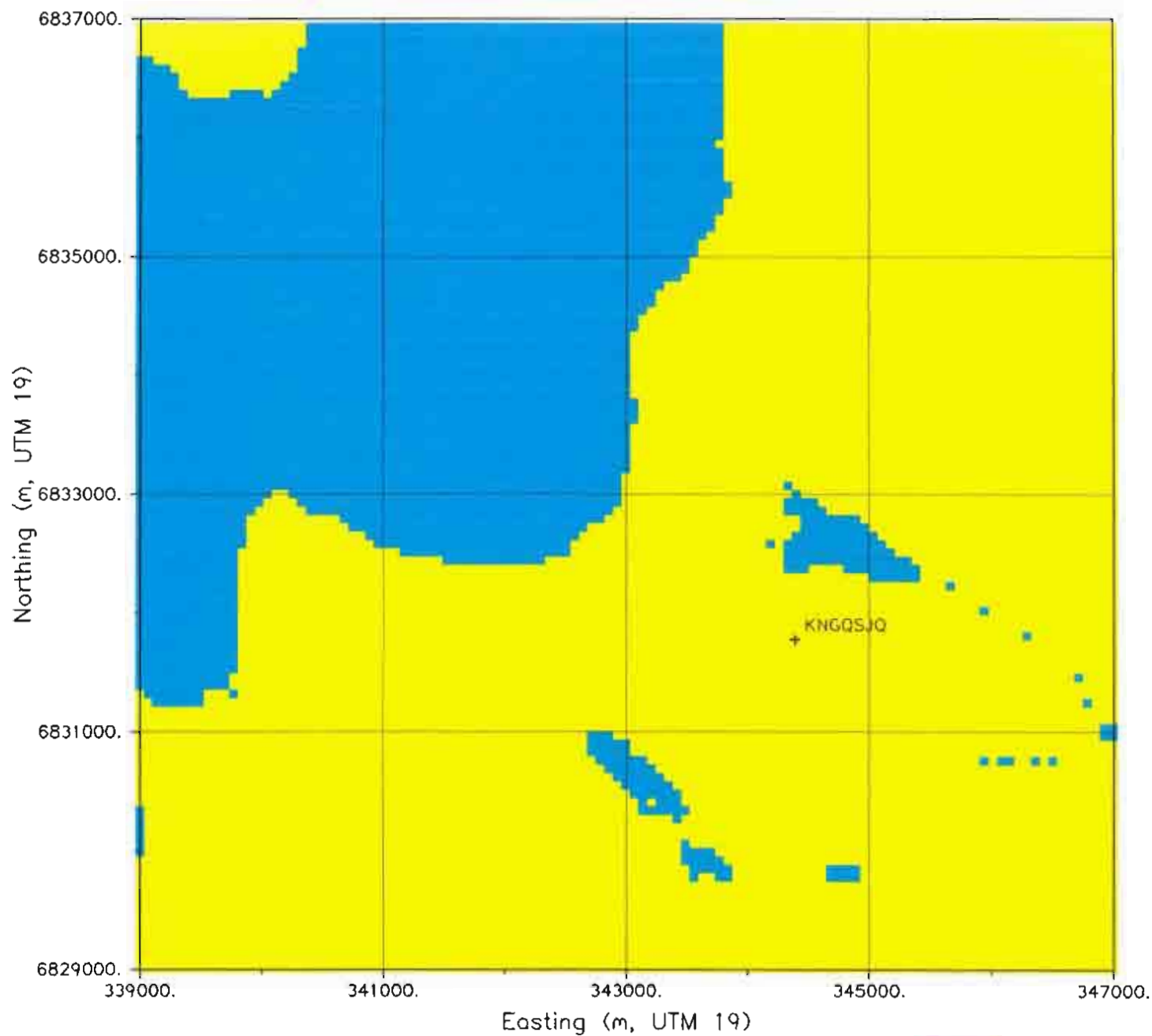
Topography from Master Grid (m) (Central quarter)

Master grid file: KNGQ5JQ.TMG



MS-Micro MODEL INPUT

Zephyr North



KANGIQSUJUAQ-UPS1 95/09/08 13:16:05

Roughness from Master Grid (Central Quarter)

Master grid file: KNGQSJO.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: KANGIQSUJUAQ-1 95/09/08 16:14:12

UTM zone, X-centre, Y-centre (m): 19 343000. 6833000.

Master topography file: KNGQJSJQ.TMG

Master roughness file: KNGQJSJQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

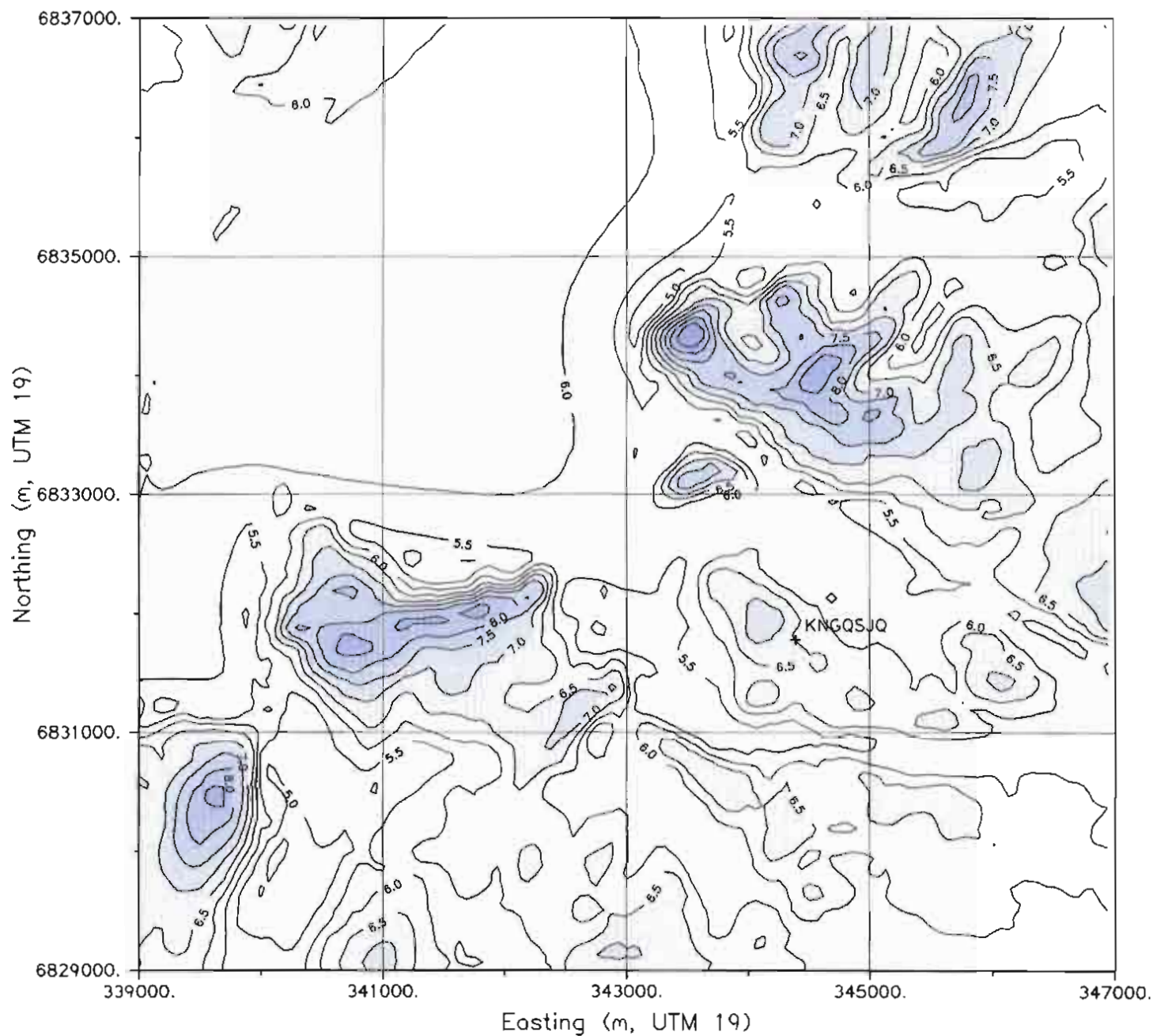
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

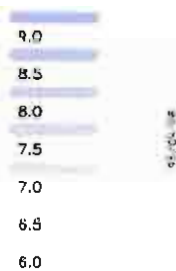


KANGIQSUJUAQ-1 95/09/08 16:14:12

Wind Speed (m/s)

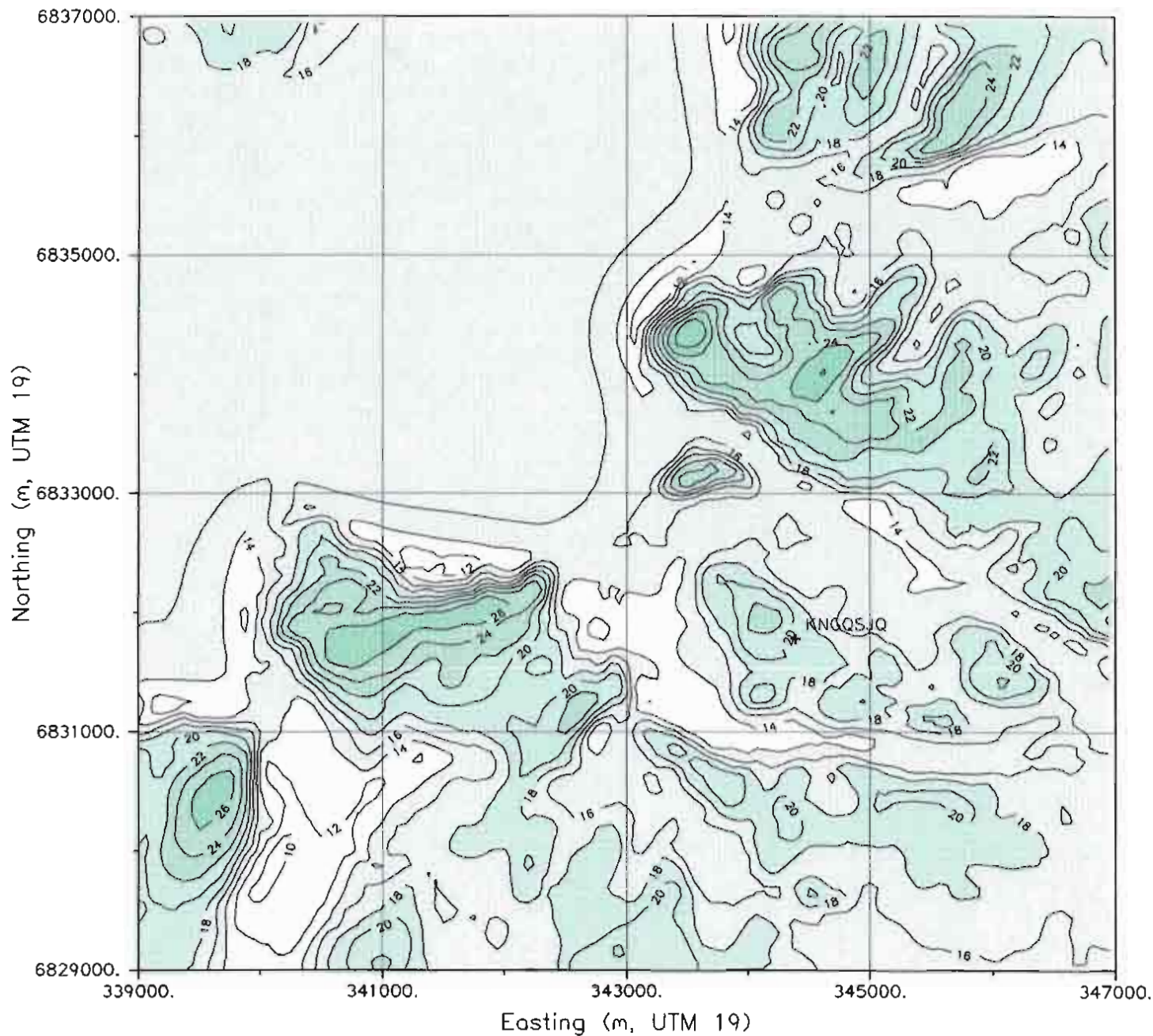
Level: 25.00m

Wind Distribution: KNGQSJQ.RJF



MS-Micro MODEL OUTPUT

Zephyr North



KANGIQSUJUAQ-1 95/09/08 16:14:12

AOC 15/50 Turbine Power (kW)

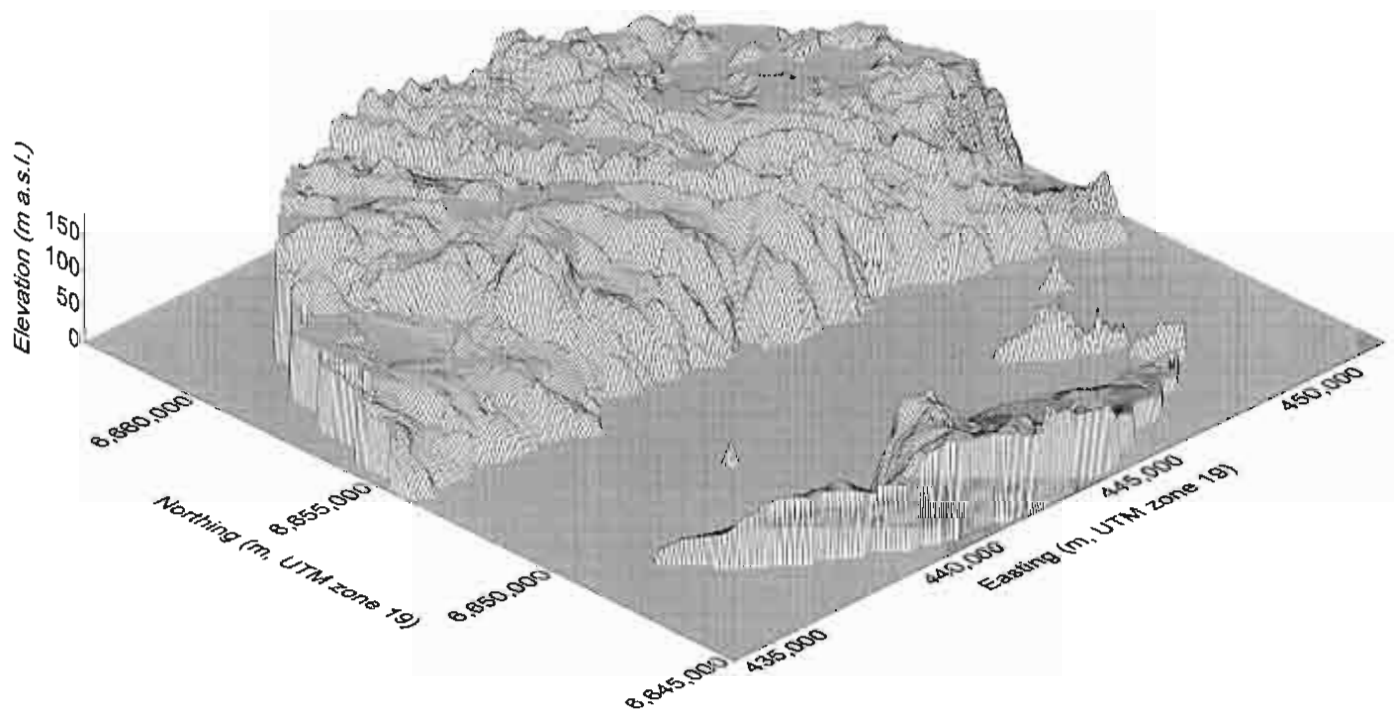
Level: 25.00m

Wind Distribution: KNGQSJQ.RJF

Temperature: -7.1C Pressure: 99.01kPa

30.0
26.0
22.0
18.0
14.0
10.0

45.0/10.0/25.0

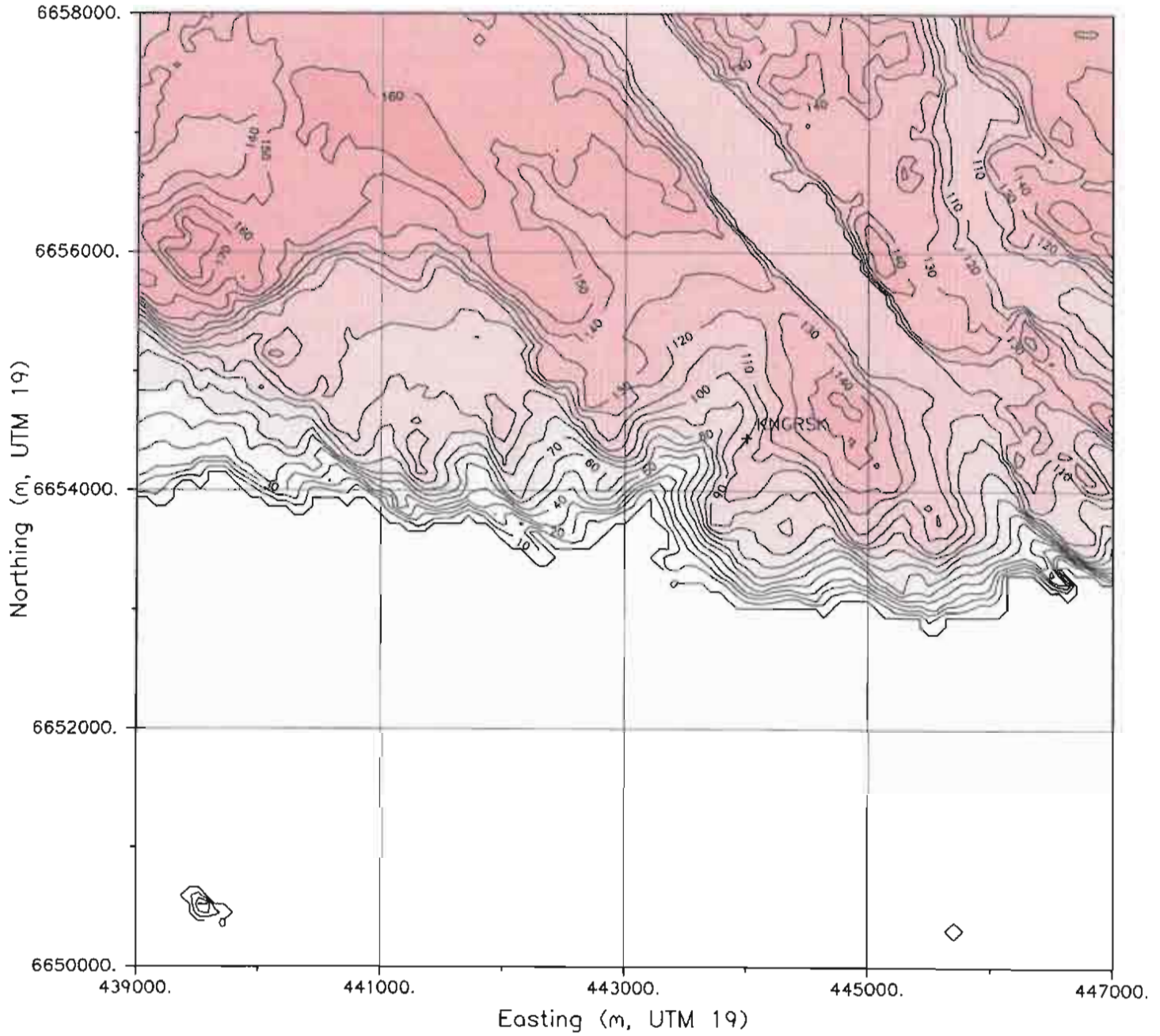


Kangirsuk

Topography Relief from Master Grid
Master grid file: KNGRSK.TMG

MS-Micro MODEL INPUT

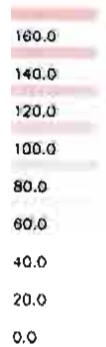
Zephyr North



KANGIRSUK-UPS1 95/09/09 13:09:03

Topography from Master Grid (m) (Central quarter)

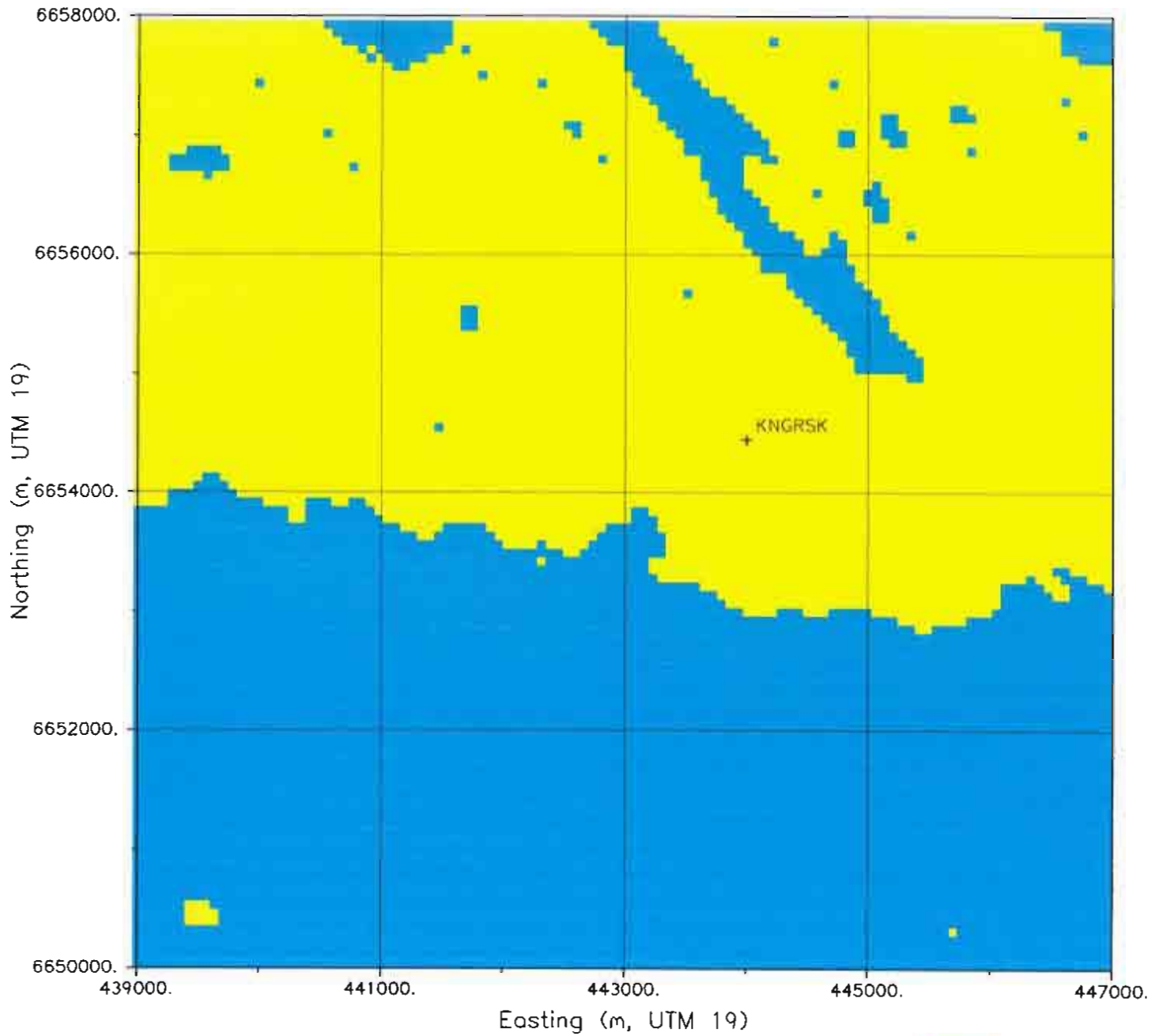
Master grid file: KNGRSK.TMG



95-09-09

MS-Micro MODEL INPUT

Zephyr North



KANGIRSUK-UPS1 95/09/09 13:09:03

Roughness from Master Grid (Central Quarter)

Master grid file: KNGRSK.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: KANGIRSUK-1 95/09/09 14:27:32

UTM zone, X-centre, Y-centre (m): 19 443000. 6654000.

Master topography file: KNGRSK.TMG

Master roughness file: KNGRSK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	1
5	090	0.	1
6	112	0.	1
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

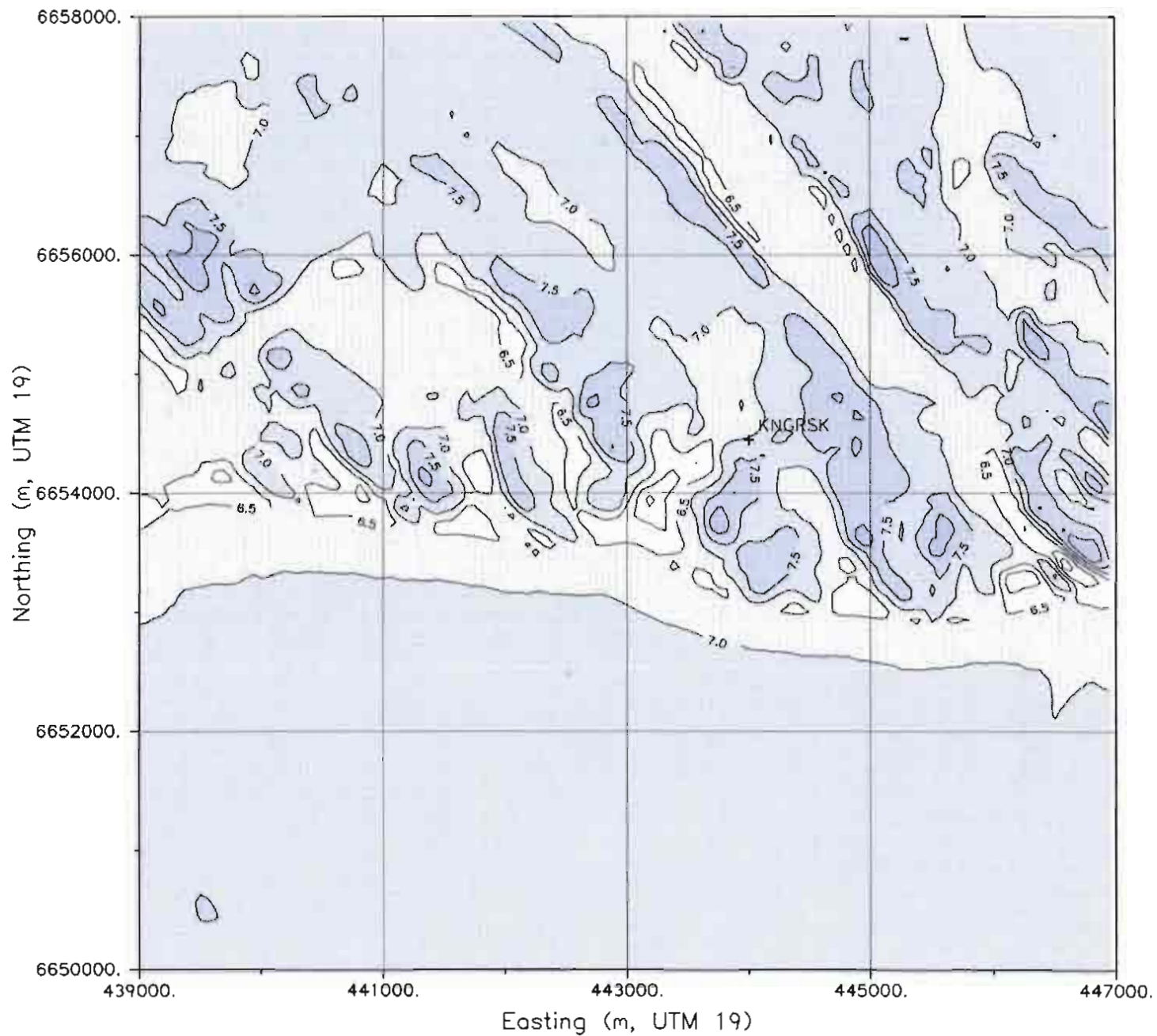
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North

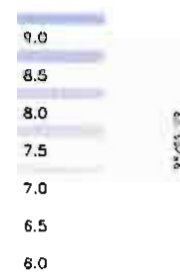


KANGIRSUK-1 95/09/09 14:27:32

Wind Speed (m/s)

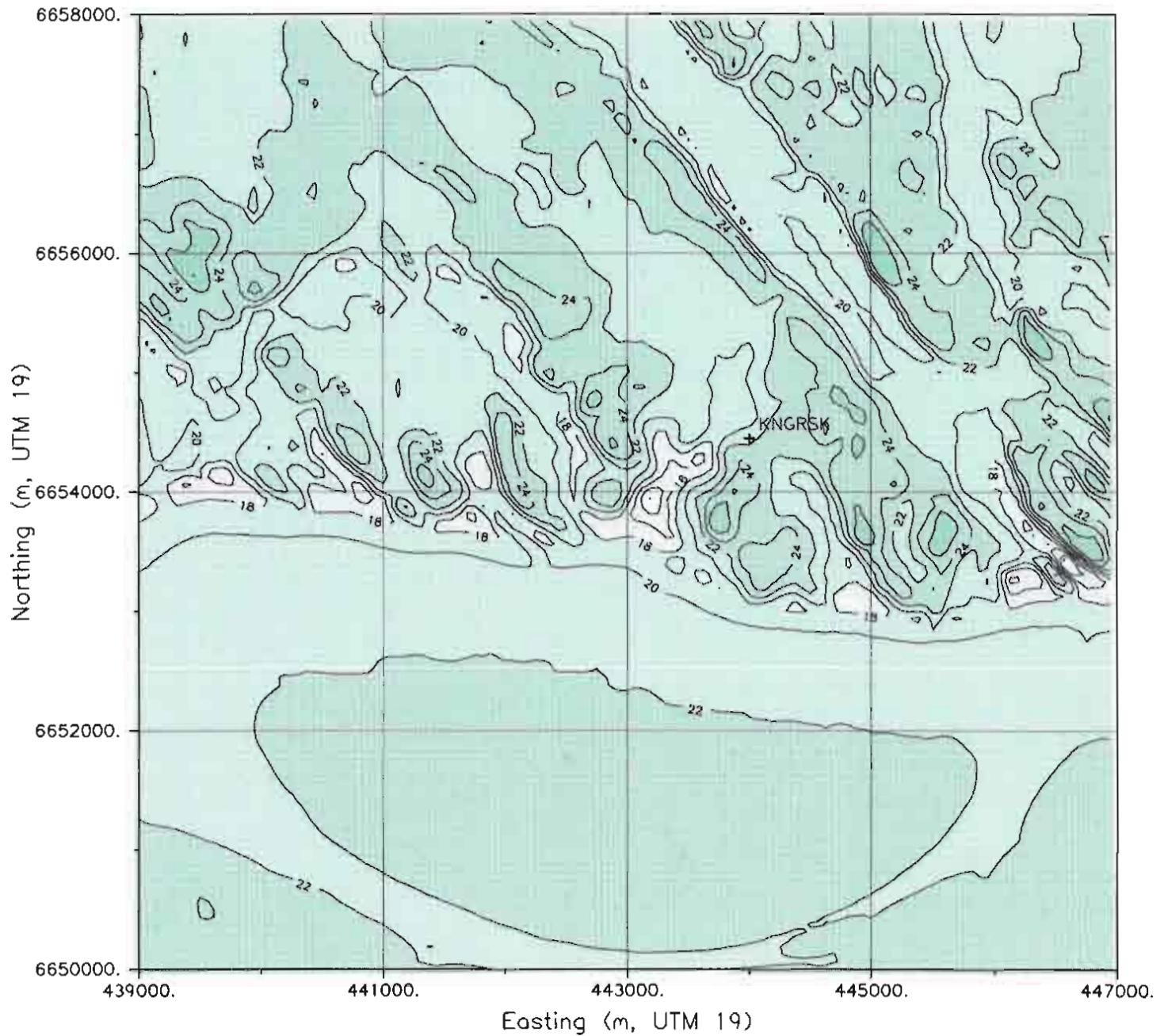
Level: 25.00m

Wind Distribution: KNGRSK.RJF



MS-Micro MODEL OUTPUT

Zephyr North



KANGIRSK-1 95/09/09 14:27:32

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: KNGRSK.RJF

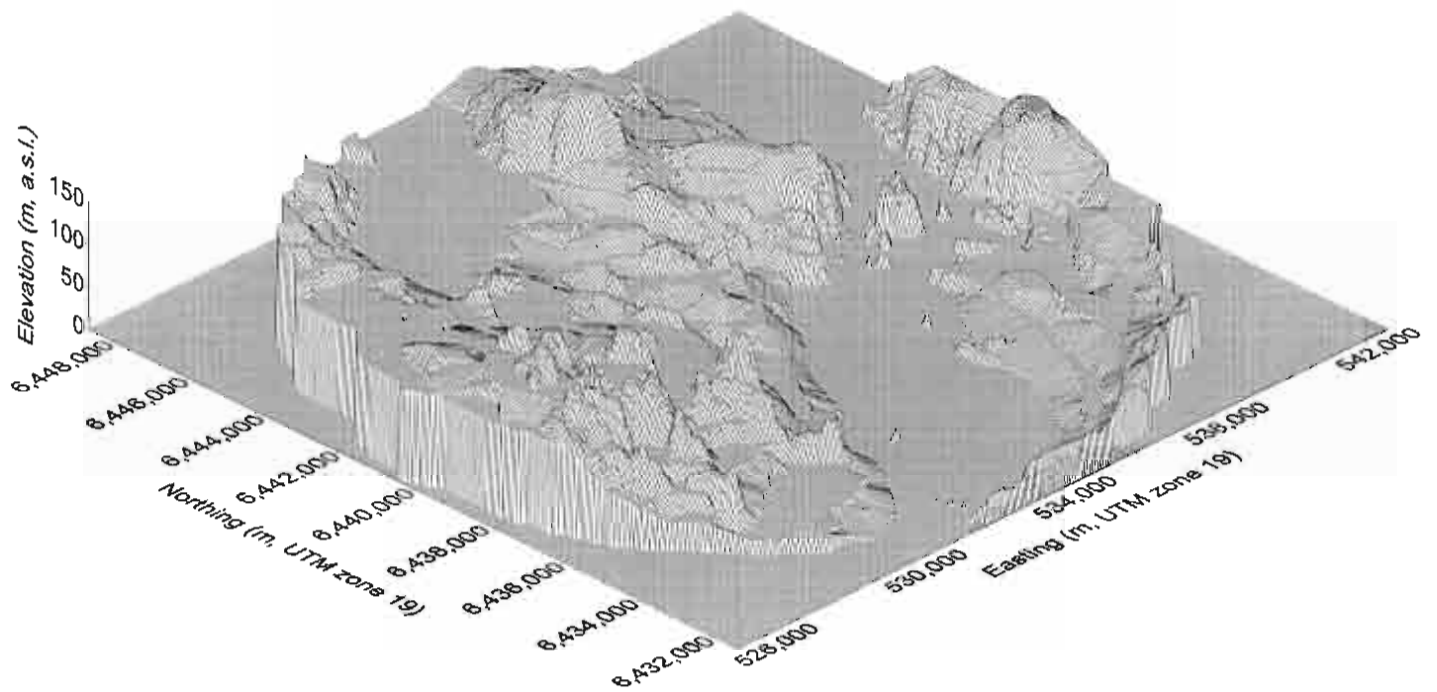
Temperature: -7.3C Pressure: 99.50kPa

30.0
26.0
22.0
18.0
14.0
10.0

45/10/10

MS-Micro MODEL INPUT

Zephyr North

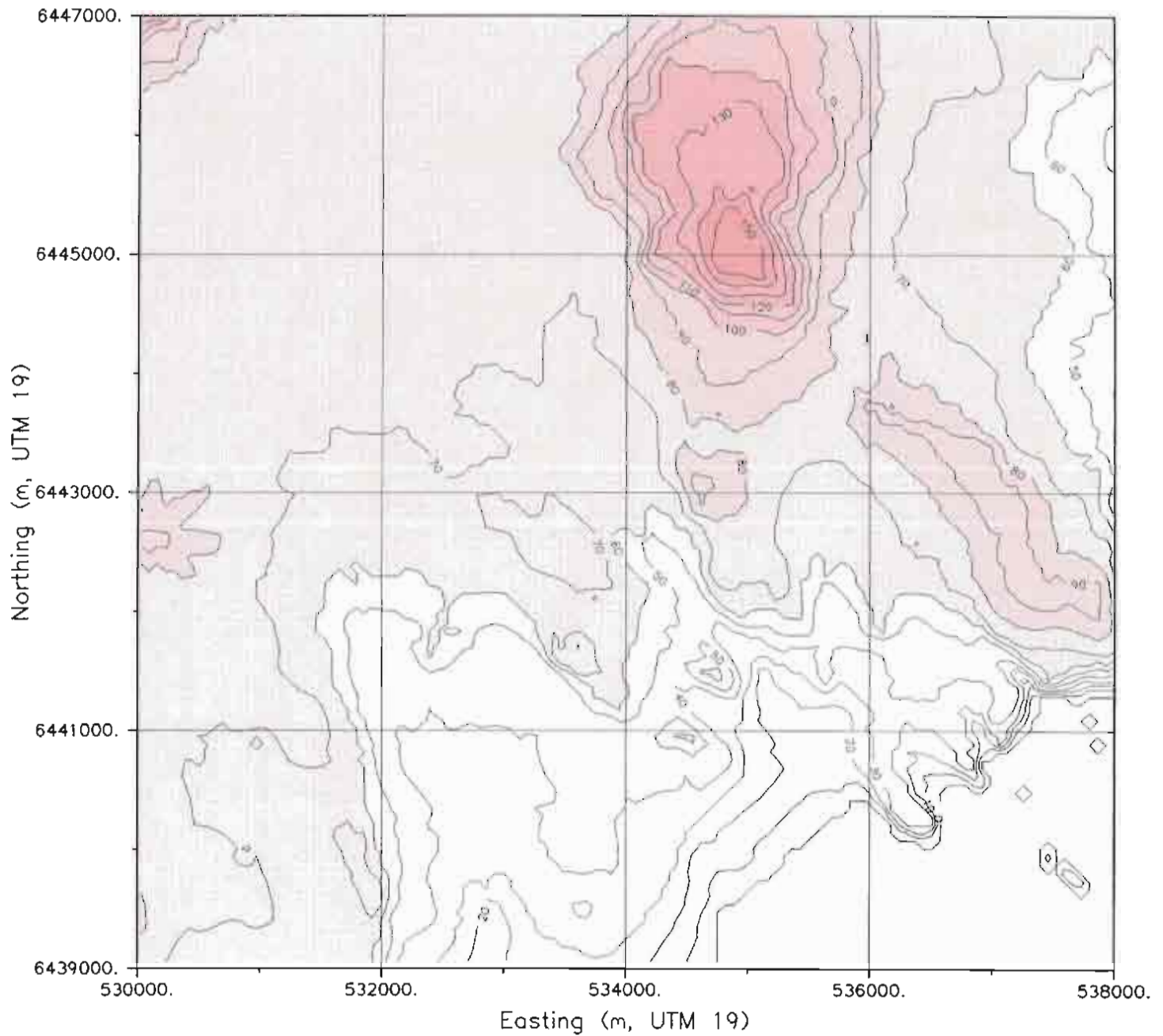


Kuujuaq

Topography Relief from Master Grid
Master grid file: KUUJJUAQ.TMG

MS-Micro MODEL INPUT

Zephyr North



KUUJJUAQ-2 95/09/07 10:14:30

Topography from Master Grid (m) (Central quarter)

Master grid file: KUUJJUAQ.TMG

140.0
120.0
100.0
80.0
60.0
40.0
20.0

95/09/07

Zephyr North



MS-Micro MASTER PARAMETER SUMMARY

Project Name: KUJJJUAQ-2 95/09/07 10:14:30

UTM zone, X-centre, Y-centre (m): 19 534000. 6443000.

Master topography file: KUJJJUAQ.TMG

Master roughness file: KUJJJUAQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

Level No. / Level (m)

1	25.00

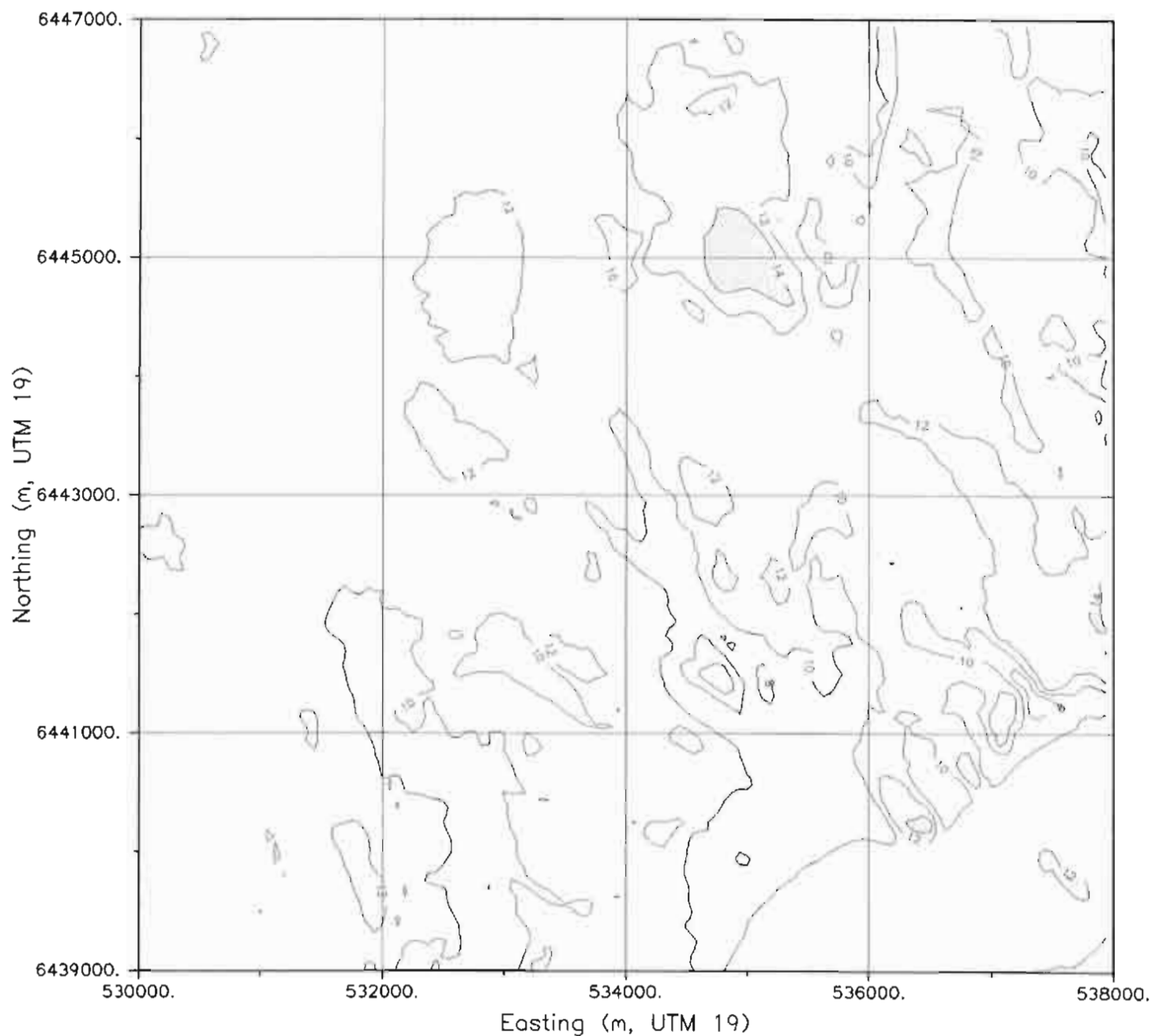
End of master parameter summary

Zephyr North



MS-Micro MODEL OUTPUT

Zephyr North



KUUJJUAQ-2 95/09/07 10:14:30

AOC 15/50 Turbine Power (kW)

Level: 25.00m

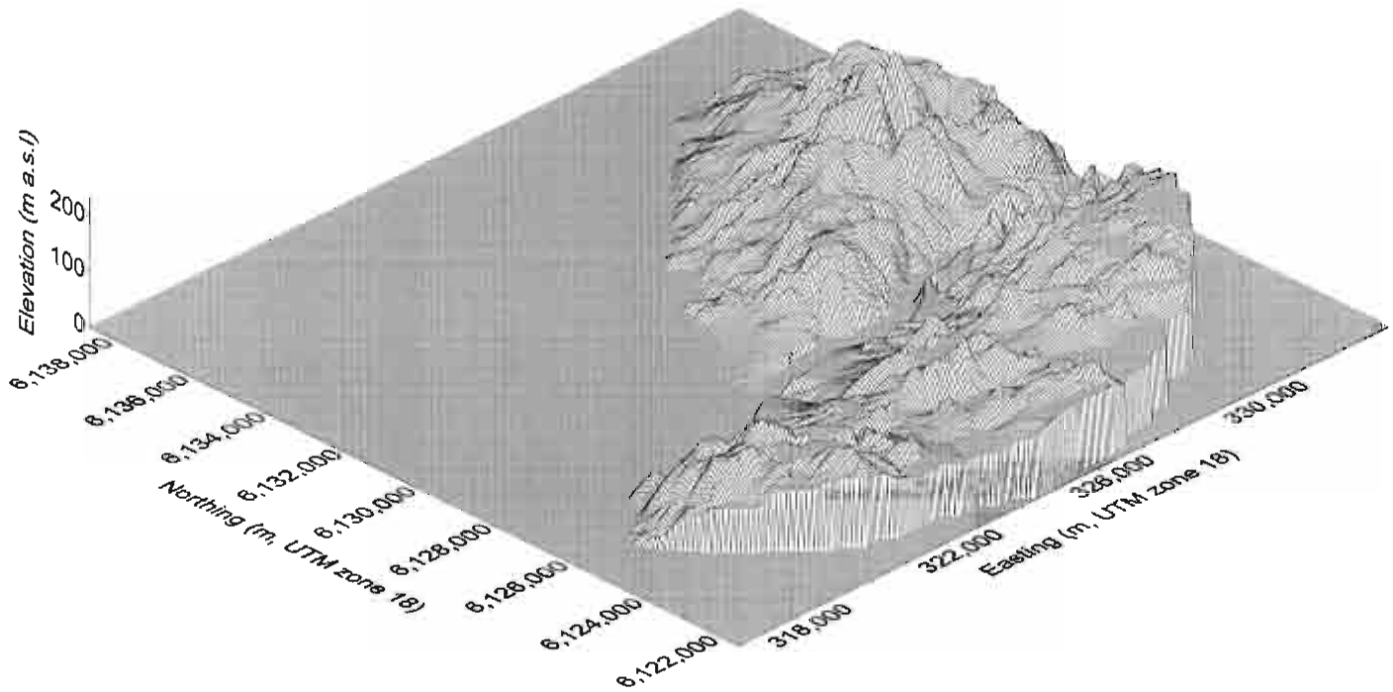
WInd Distribution: KUUJJUAQ.RJF

Temperature: -5.7C Pressure: 100.69kPa



MS-Micro MODEL INPUT

Zephyr North

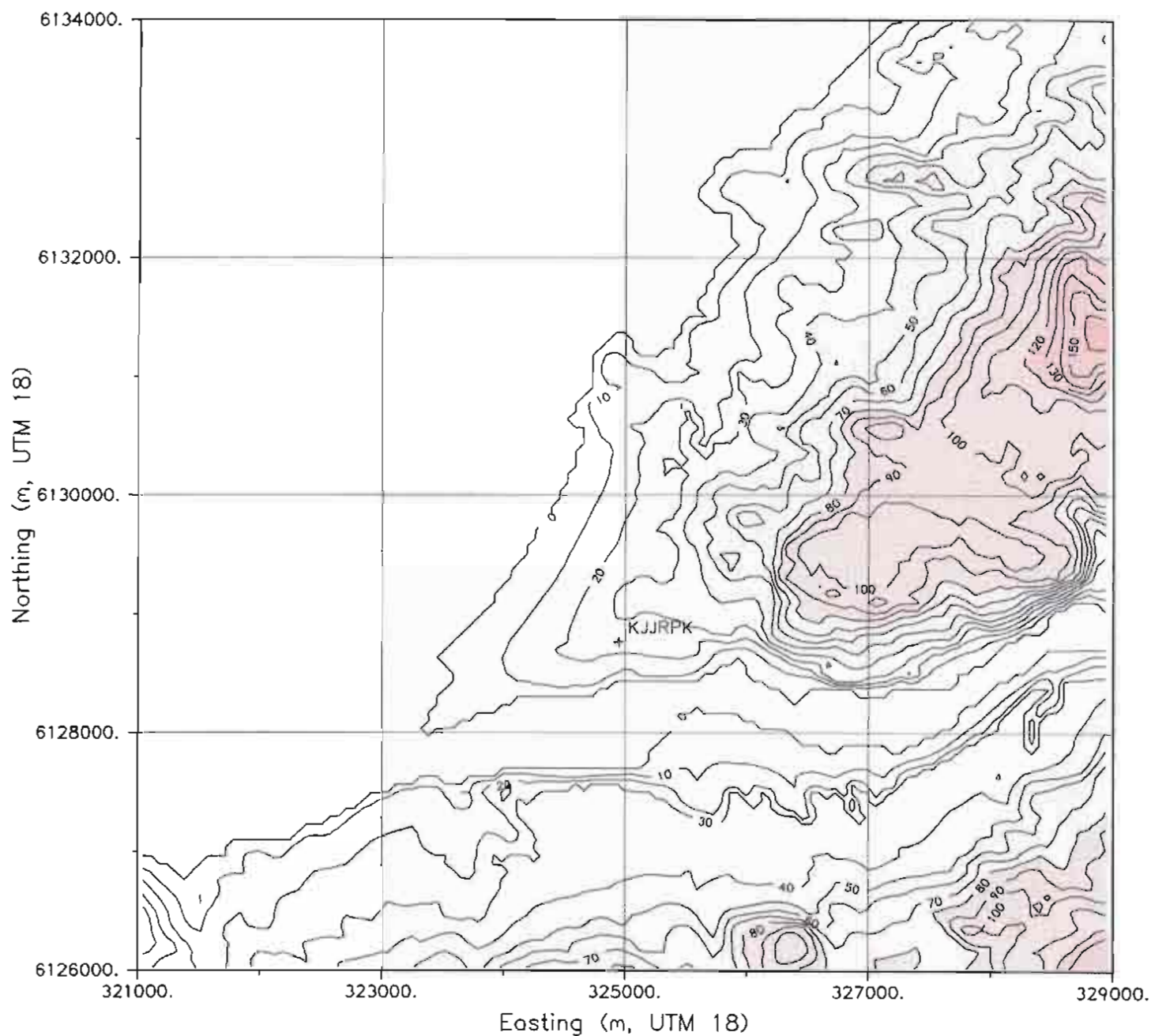


Kuujjuarapik

Topography Relief from Master Grid
Master grid file: KJJRPK.TMG

MS-Micro MODEL INPUT

Zephyr North



KUJJUARAPIK-1 95/09/06 14:00:14

Topography from Master Grid (m) (Central quarter)

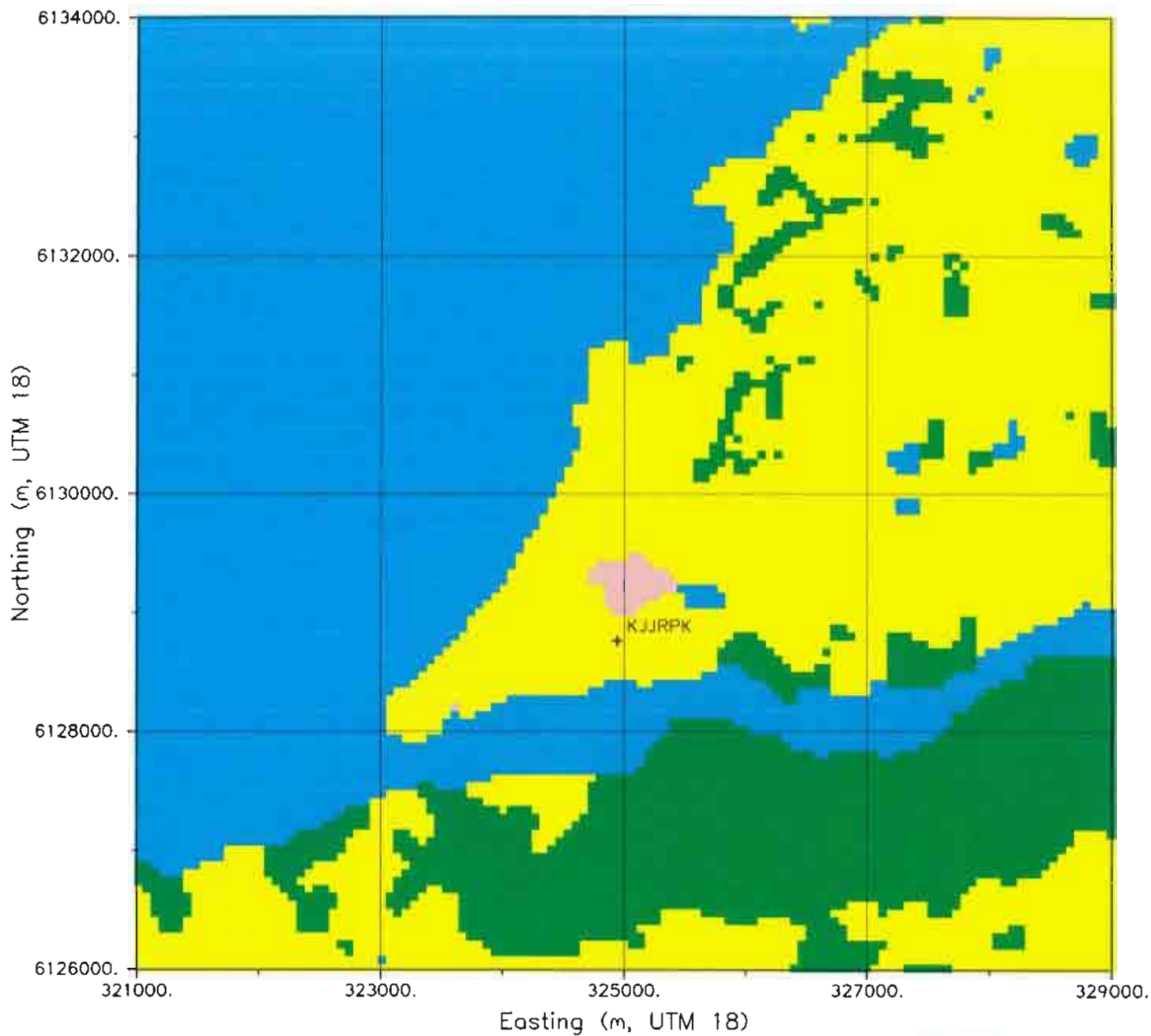
Master grid file: KJJRPK.TMG

200.0
160.0
120.0
80.0
40.0
0.0

45/04/06

MS-Micro MODEL INPUT

Zephyr North



KUJJUARAPIK-1 95/09/06 14:00:14

Roughness from Master Grid (Central Quarter)

Master grid file: KJJRPK.RMG

- 8. Chotic
- 7. Closed
- 6. Very Rough
- 5. Rough
- 4. Roughly Open
- 3. Open
- 2. Smooth
- 1. Sea

95/09/06

MS-Micro MASTER PARAMETER SUMMARY

Project Name: KUJJUARAPIK-1 95/09/06 14:00:14

UTM zone, X-centre, Y-centre (m): 18 325000. 6130000.

Master topography file: KJJRPK.TMG

Master roughness file: KJJRPK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

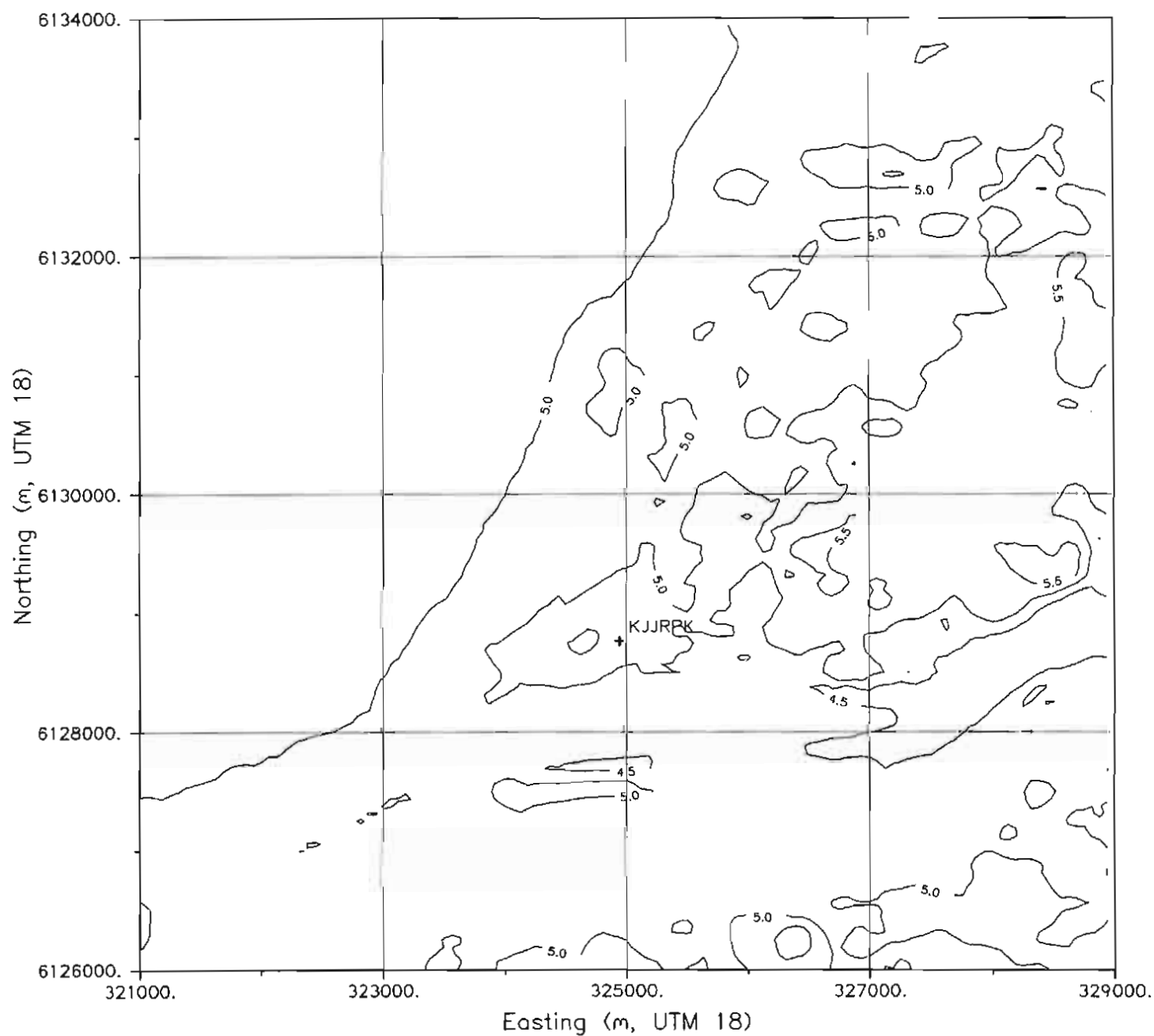
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



KUJJUARAPIK-1 95/09/06 14:00:14

Wind Speed (m/s)

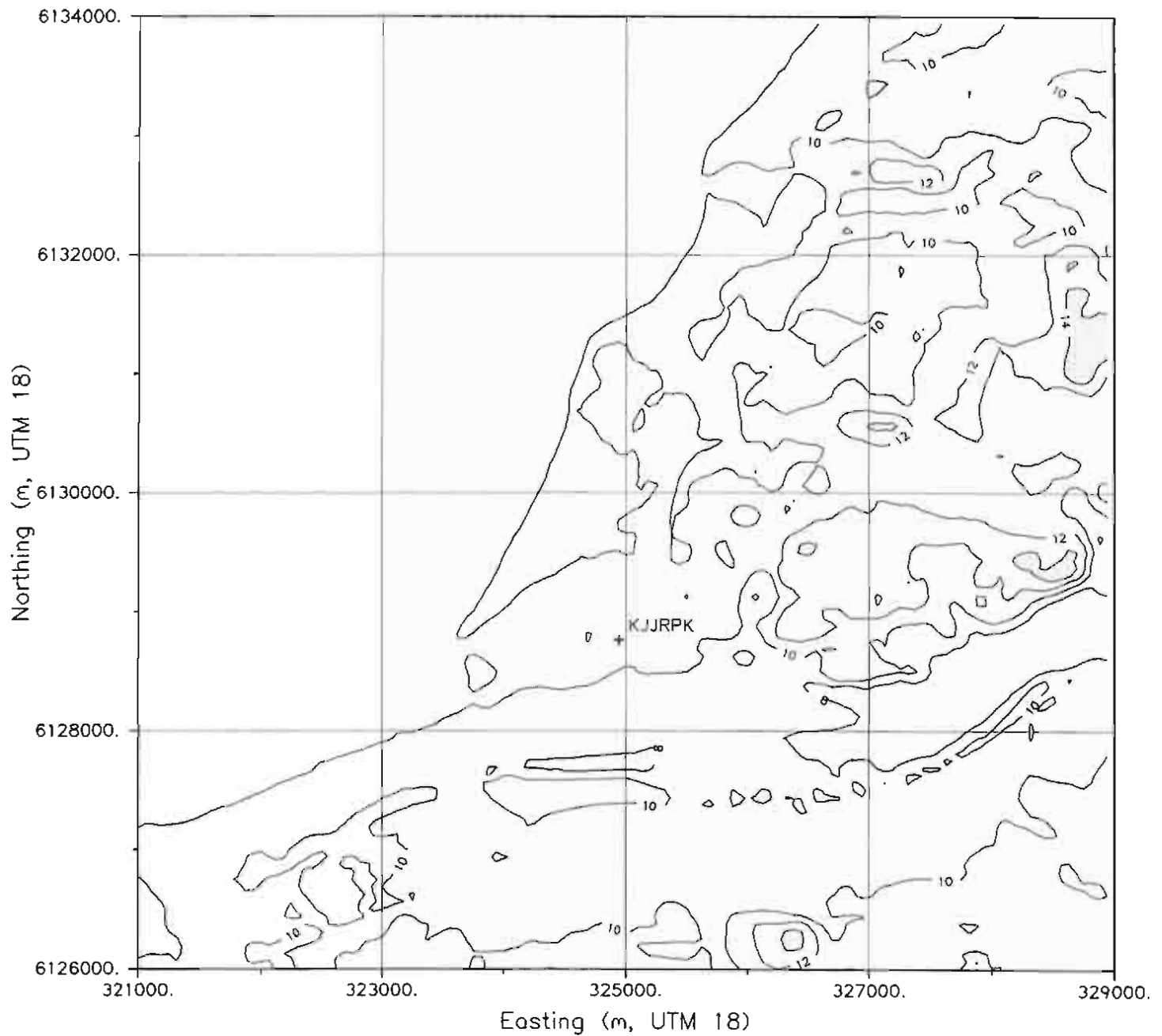
Level: 25.00m

Wind Distribution: KJJRPK.RJF



MS-Micro MODEL OUTPUT

Zephyr North



KUJJUARAPIK-1 95/09/06 14:00:14

AOC 15/50 Turbine Power (kW)

Level: 25.00m

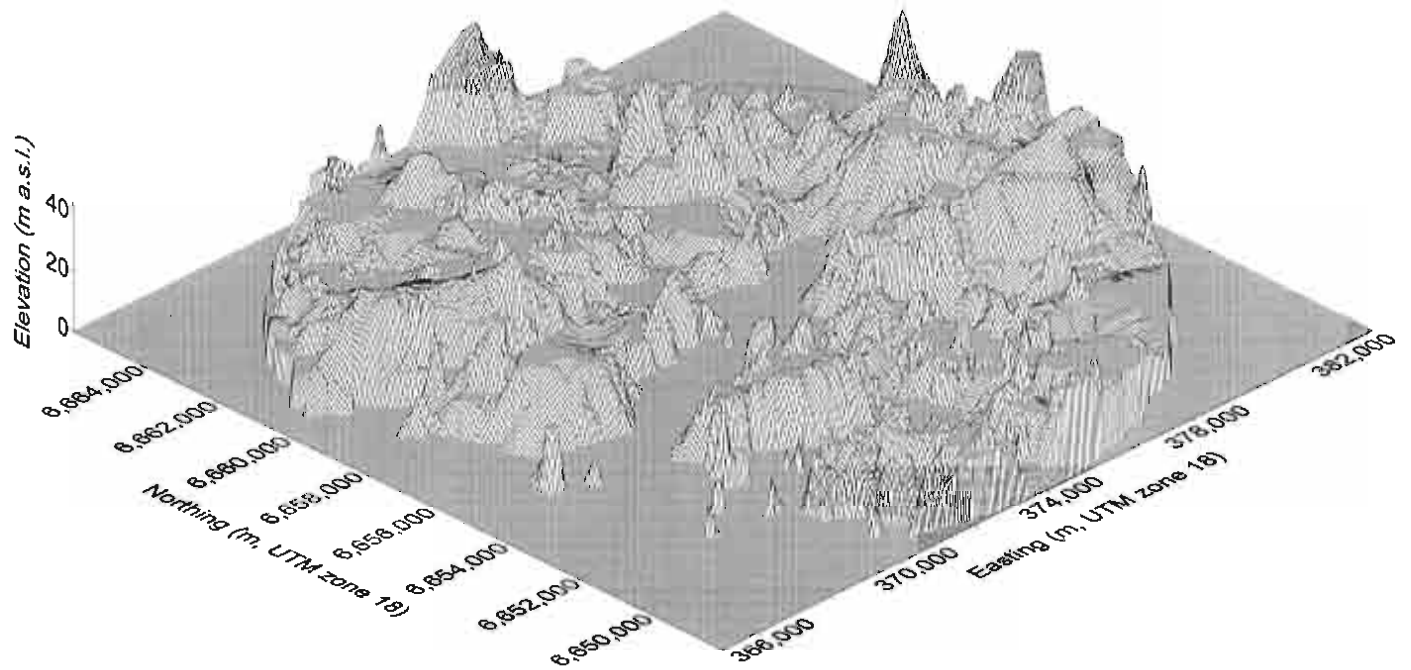
Wind Distribution: KJJRPK.RJF

Temperature: -4.1C Pressure: 101.06kPa



MS-Micro MODEL INPUT

Zephyr North

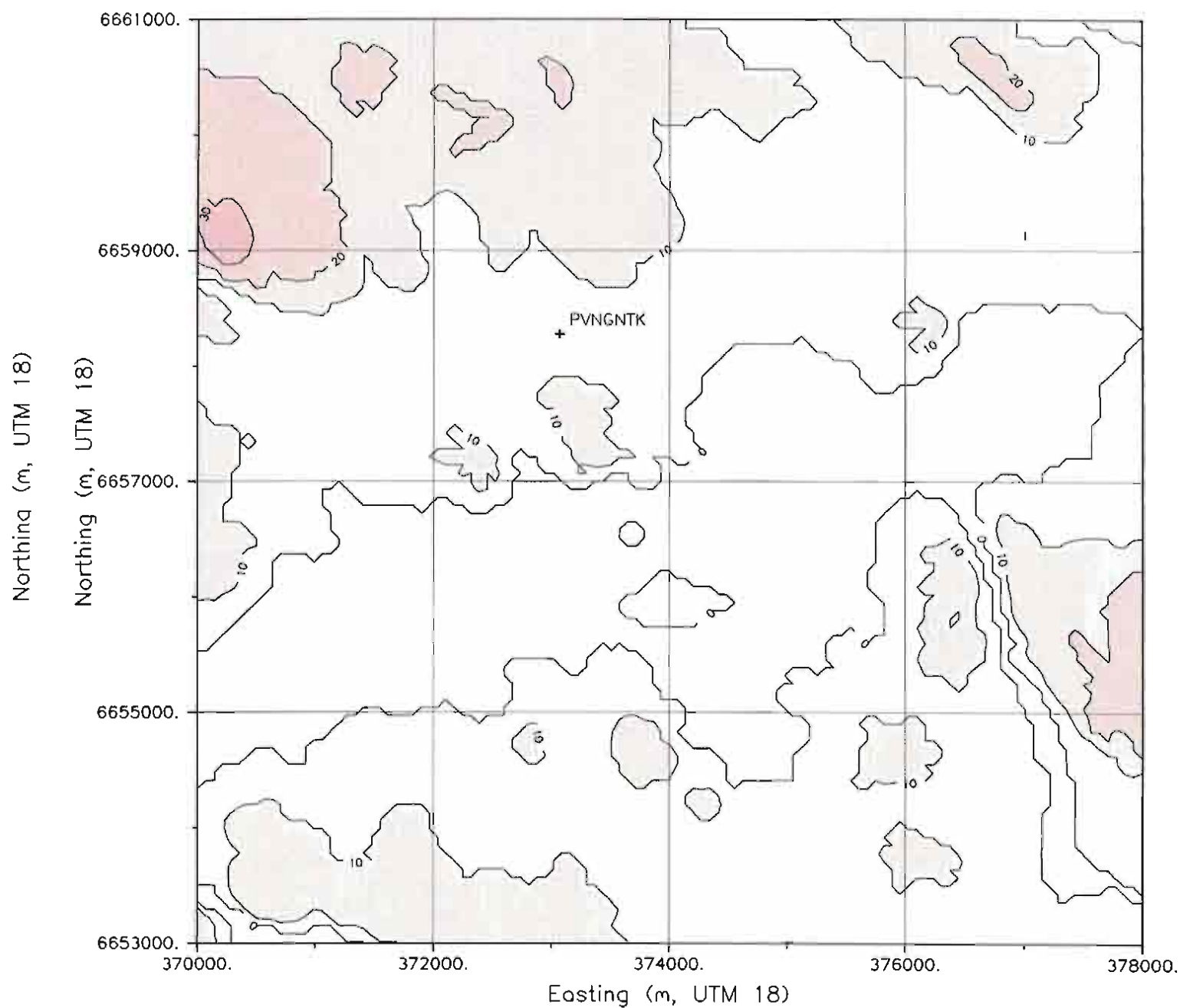


Povungnituk

Topography relief from Master Grid
Master grid file: POVUNGNITUK.TMG

MS-Micro MODEL INPUT

Zephyr North



POVUNGNTUK-UPS1 95/09/15 16:01:18

Topography from Master Grid (m) (Central quarter)

Master grid file: PVNGNTK.TMG

40.0
30.0
20.0
10.0
0.0

95/09/15

MS-Micro MASTER PARAMETER SUMMARY

Project Name: POVUNGNITUK-1 95/09/16 14:06:43

UTM zone, X-centre, Y-centre (m): 18 374000. 6657000.

Master topography file: PVNGNTK.TMG

Master roughness file: PVNGNTK.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	1
4	067	0.	1
5	090	0.	1
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	1
13	270	0.	1
14	292	0.	3
15	315	0.	3
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

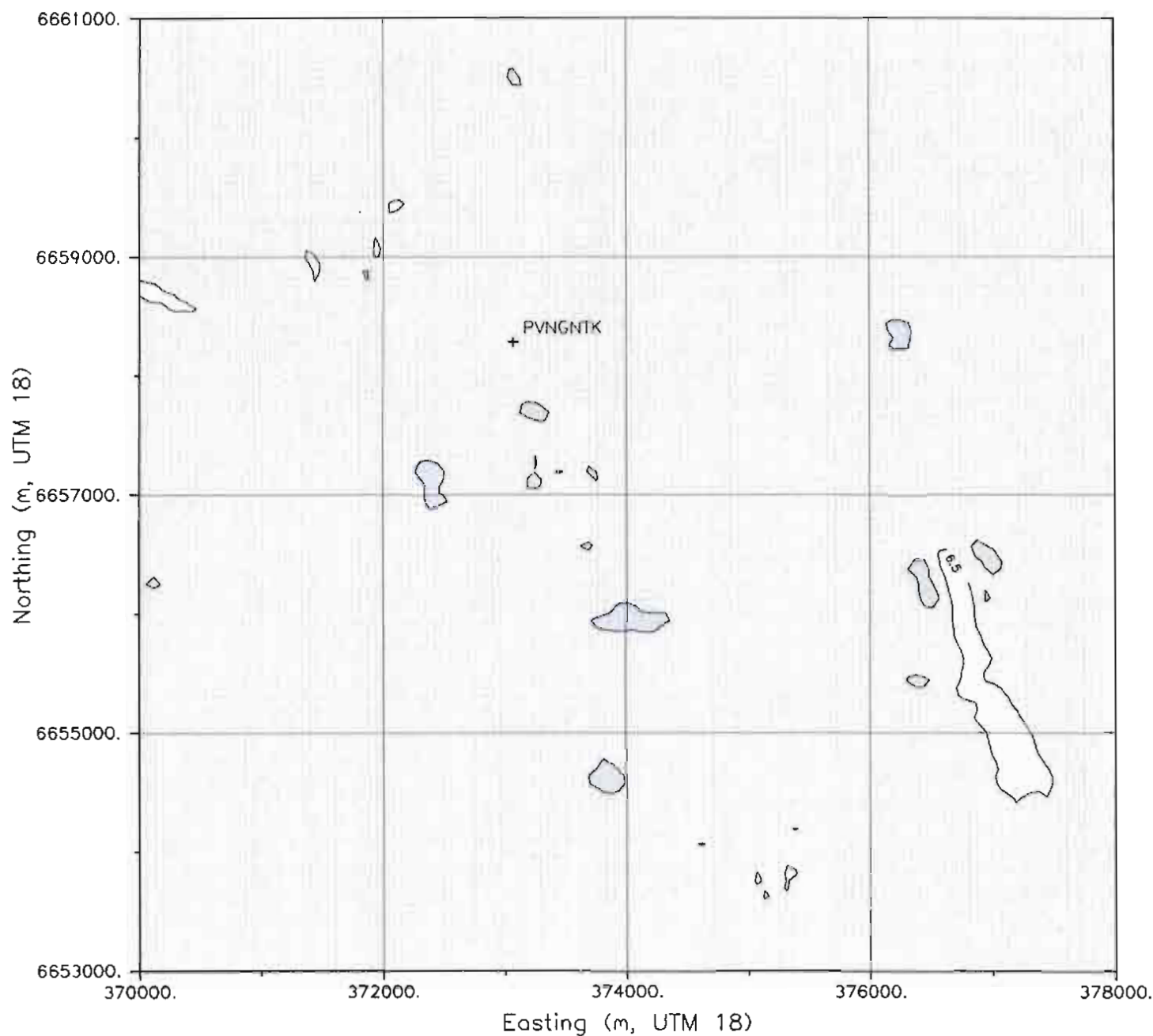
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



POVUNGNTUK-1 95/09/16 14:06:43

Wind Speed (m/s)

Level: 25.00m

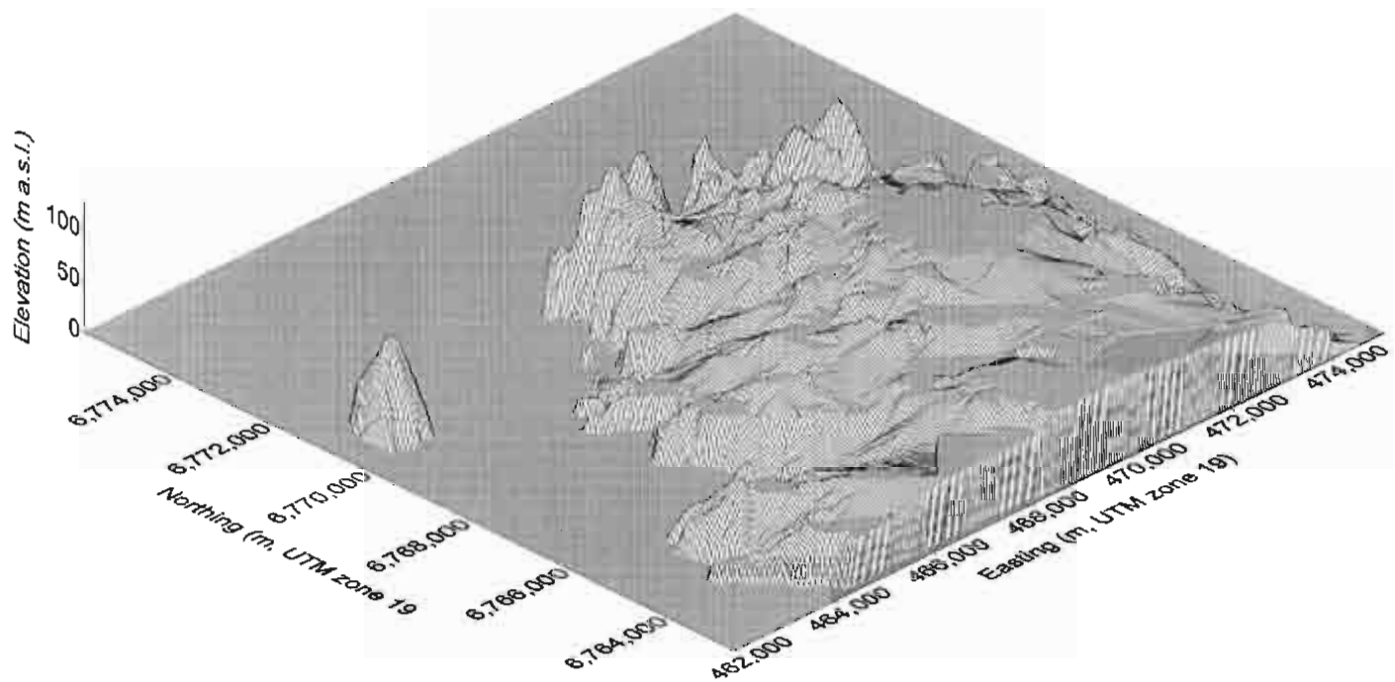
Wind Distribution: PVNGNTK.RJF

Zephyr North



MS-Micro MODEL INPUT

Zephyr North

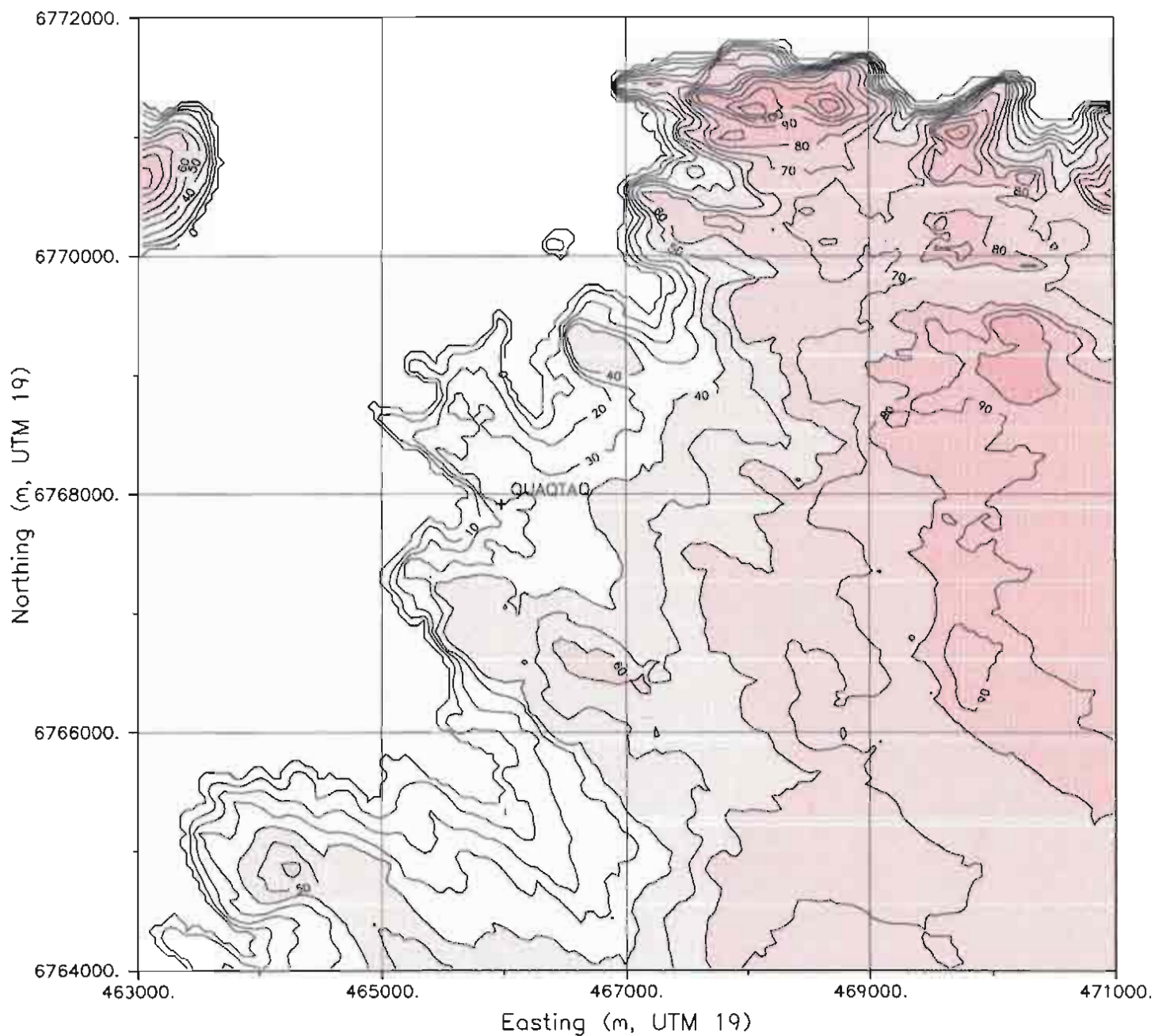


Quaqtaq

Topography Relief from Master Grid
Master grid file: QUAQTAQ.TMG

MS-Micro MODEL INPUT

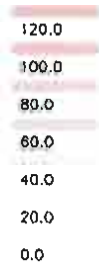
Zephyr North



QUAQTAQ-UPS1 95/09/07 14:39:17

Topography from Master Grid (m) (Central quarter)

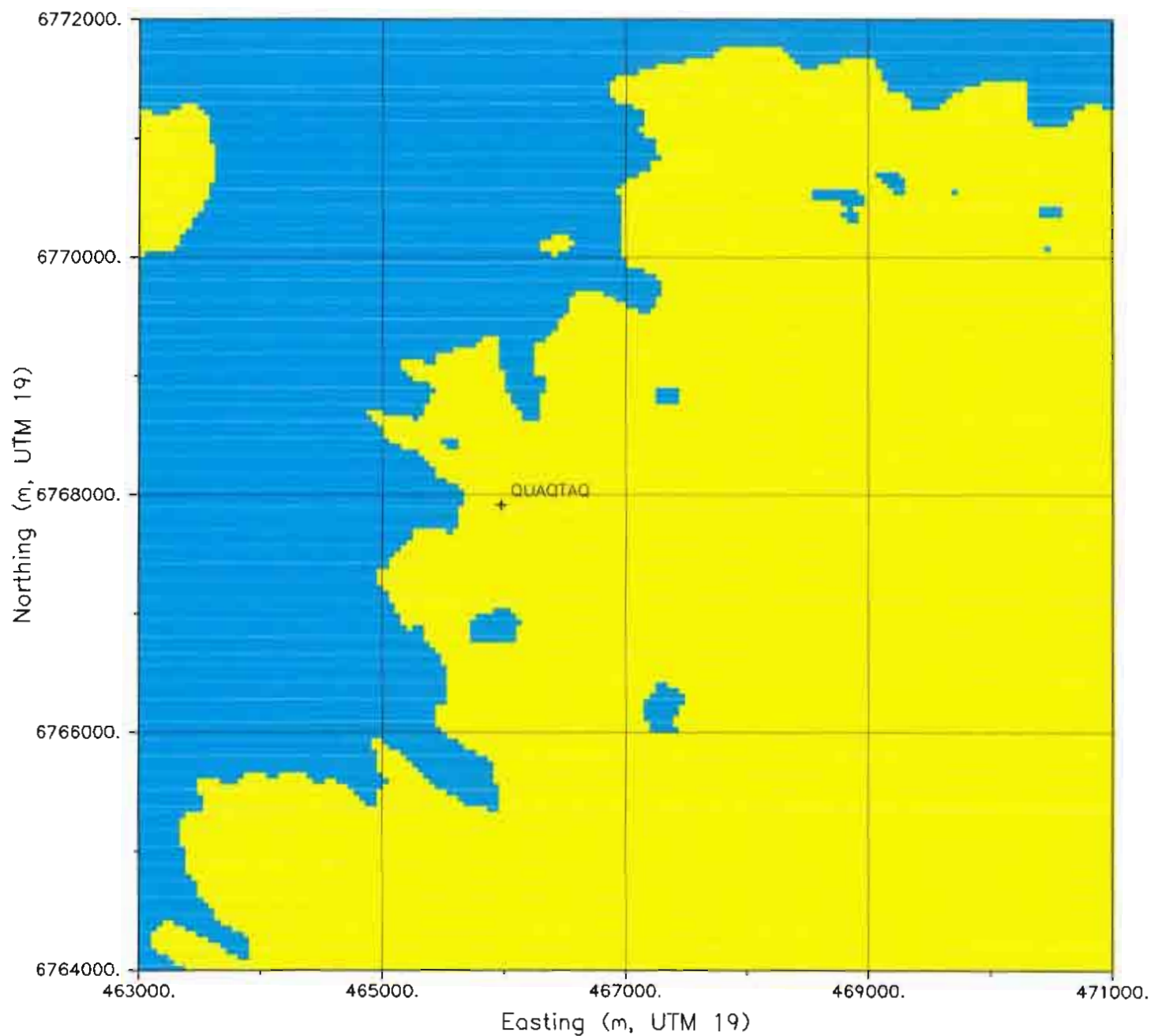
Master grid file: QUAQTAQ.TMG



0.0
20.0
40.0
60.0
80.0
100.0
120.0

MS-Micro MODEL INPUT

Zephyr North



QUAQTAQ-UPS1 95/09/07 14:39:17

Roughness from Master Grid (Central Quarter)

Master grid file: QUAQTAQ.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: QUAQTAQ-1 95/09/07 16:27:56

UTM zone, X-centre, Y-centre (m): 19 467000. 6768000.

Master topography file: QUAQTAQ.TMG

Master roughness file: QUAQTAQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

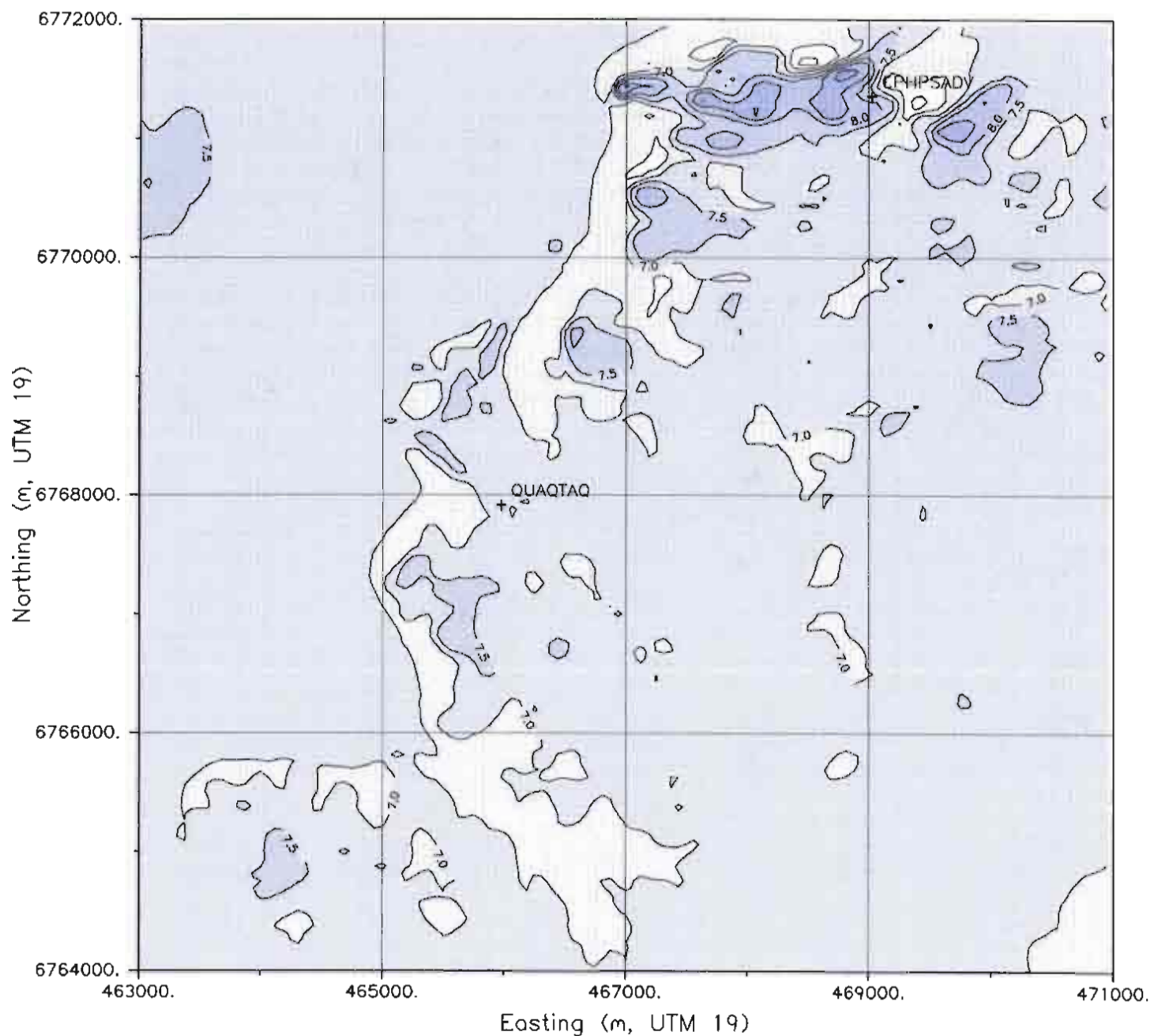
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



QUAQTAQ-1 95/09/07 16:27:56

Wind Speed (m/s)

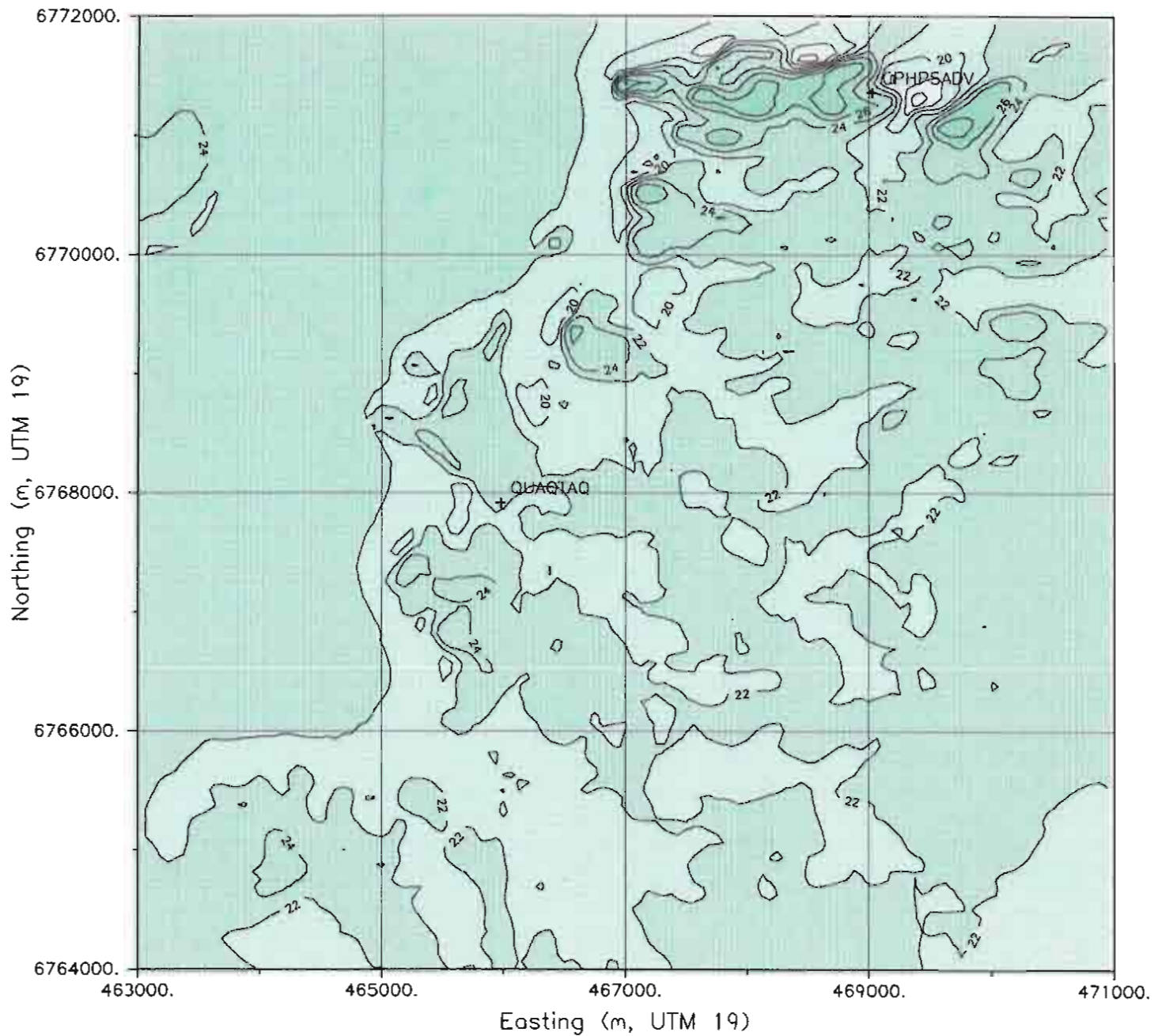
Level: 25.00m

Wind Distribution: QUAQTAQ.RJF



MS-Micro MODEL OUTPUT

Zephyr North



QUAQTAQ-1 95/09/07 16:27:56

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: QUAQTAQ.RJF

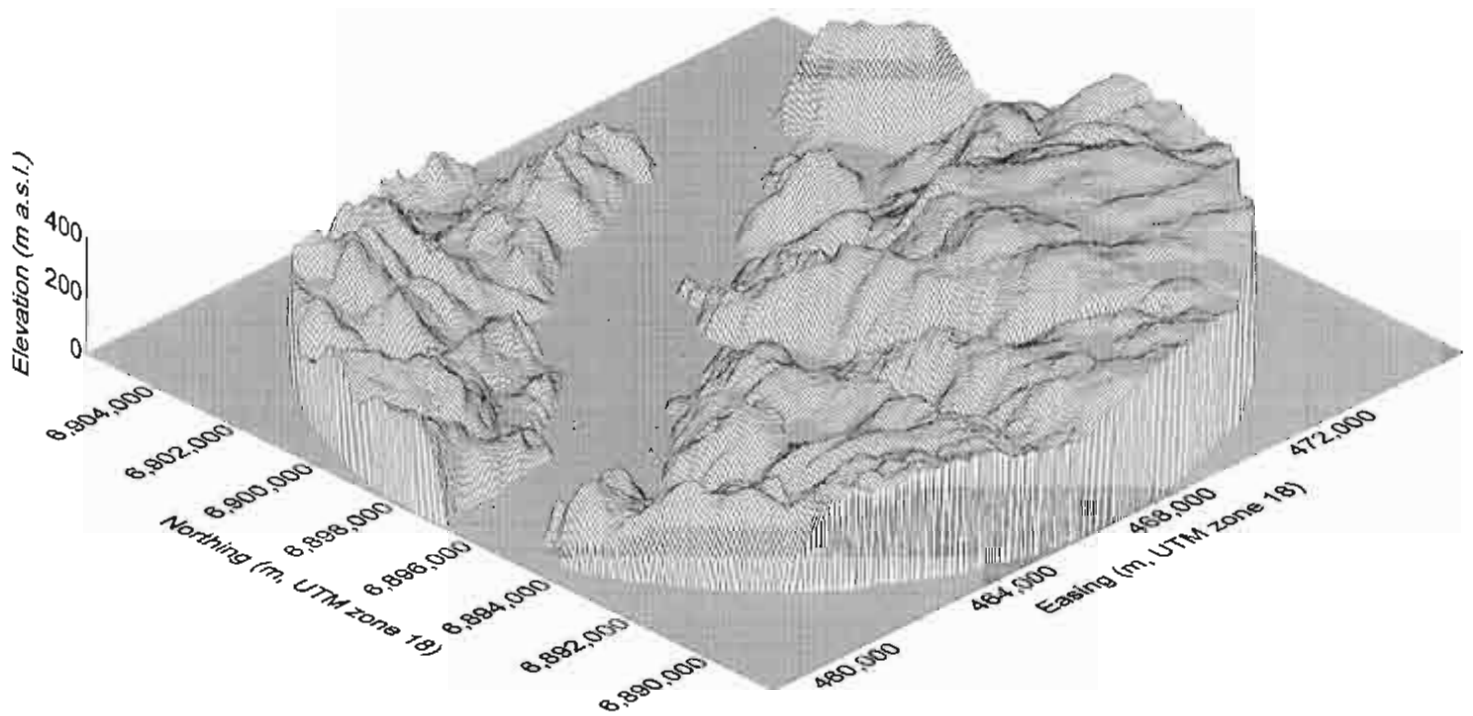
Temperature: -7.2C Pressure: 100.71kPa

30.0
26.0
22.0
18.0
14.0
10.0

0.1/0.0/0.0

MS-Micro MODEL INPUT

Zephyr North

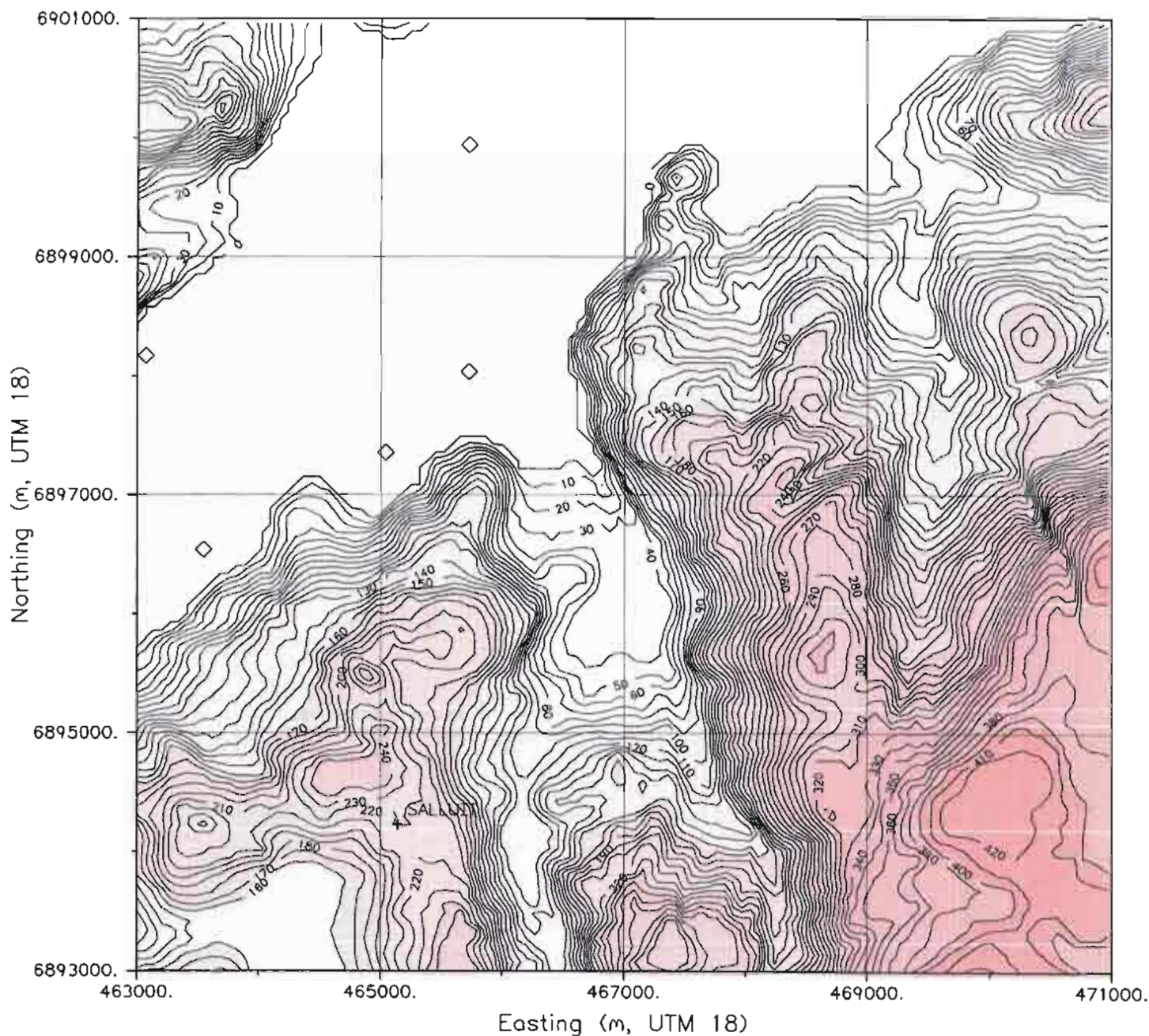


Salluit

Topography Relief from Master Grid
Master grid file: SALLUIT.TMG

MS-Micro MODEL INPUT

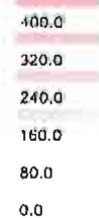
Zephyr North



SALLUIT-1 95/08/27 17:04:14

Topography from Master Grid (m) (Central quarter)

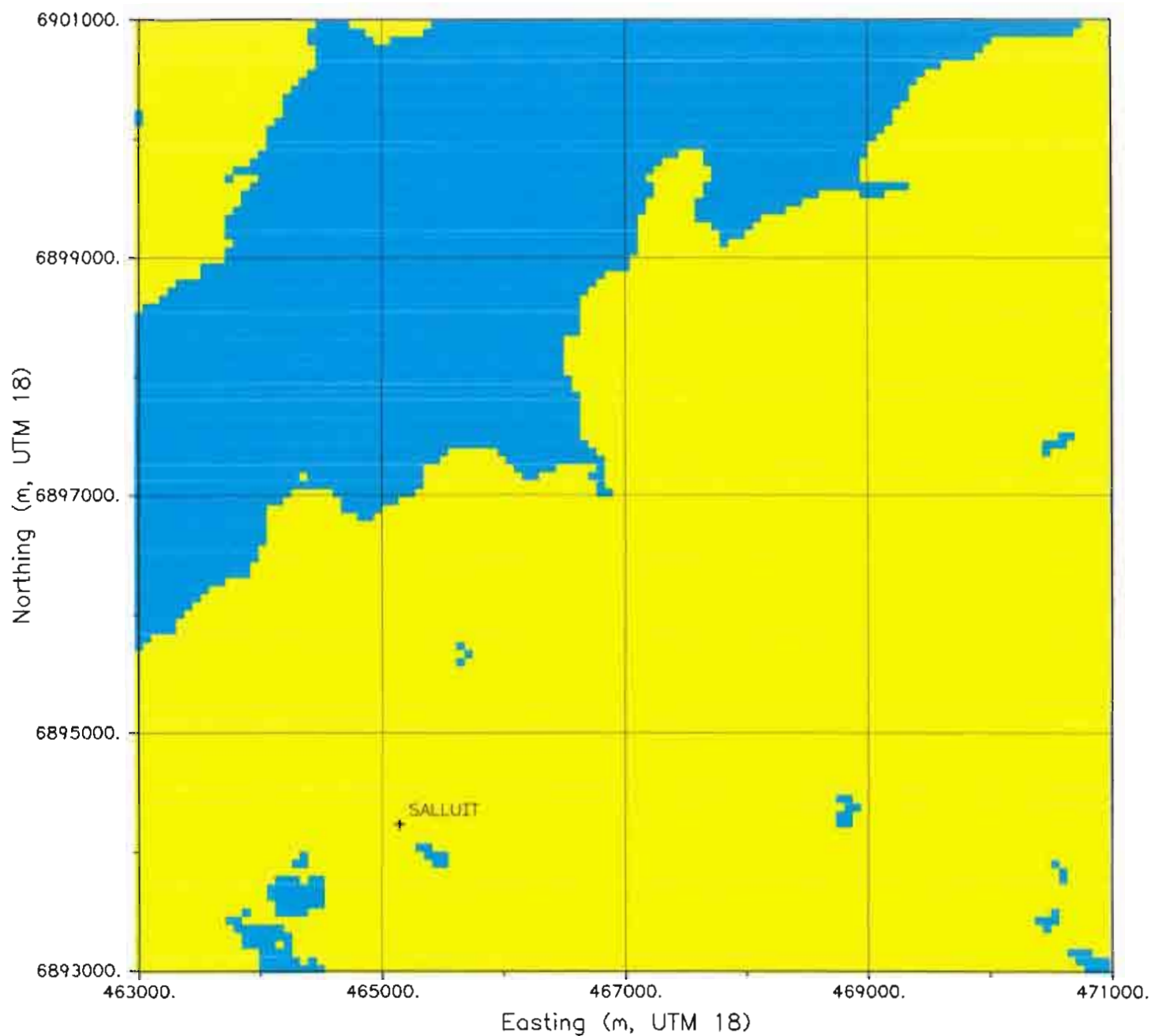
Master grid file: SALLUIT.TMG



45/08/12

MS-Micro MODEL INPUT

Zephyr North



SALLUIT-1 95/08/27 17:04:14

Roughness from Master Grid (Central Quarter)

Master grid file: SALLUIT.RMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: SALLUIT-1 95/08/27 17:04:14

UTM zone, X-centre, Y-centre (m): 18 467000. 6897000.

Master topography file: SALLUIT.TMG

Master roughness file: SALLUIT.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

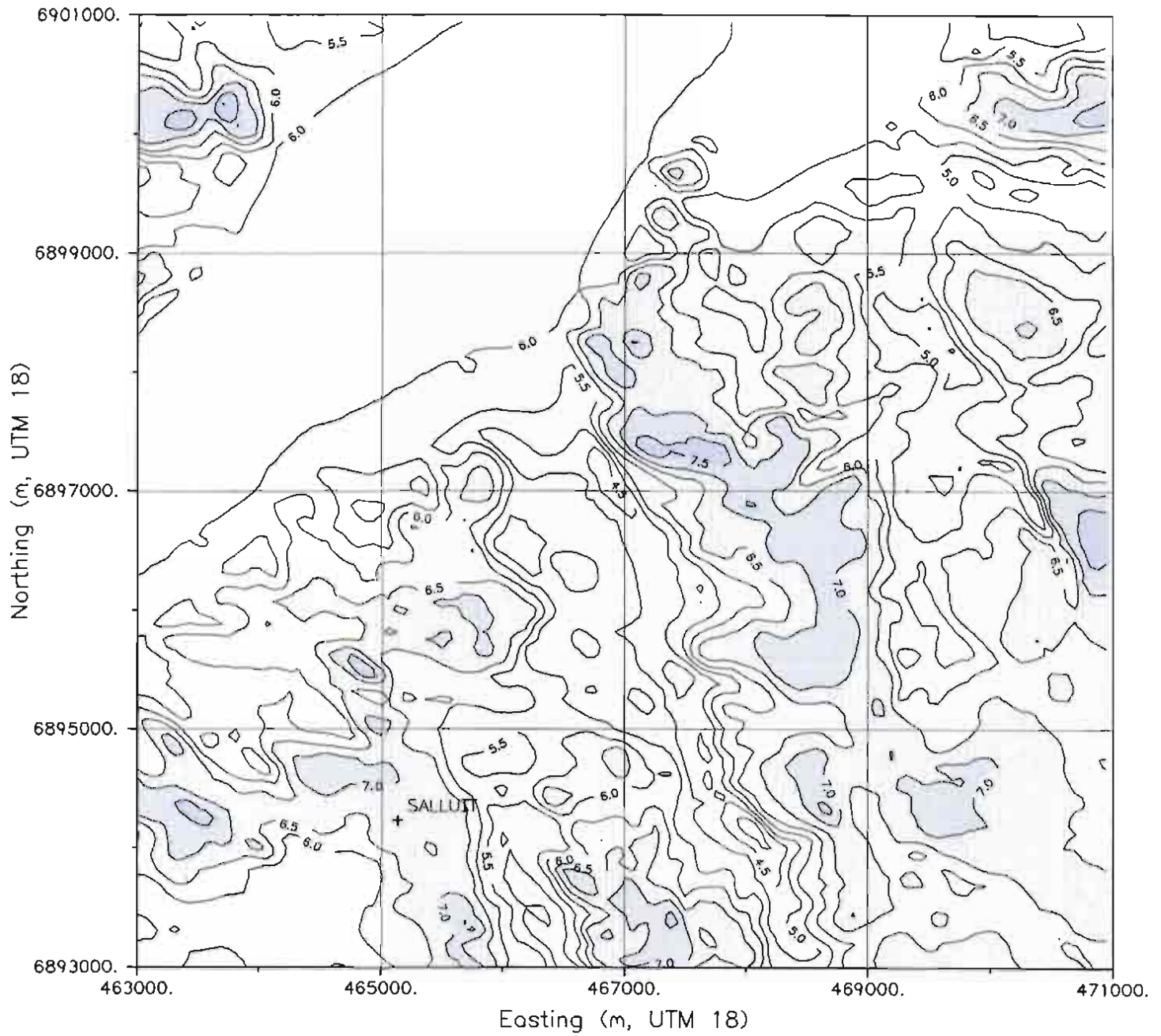
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



SALLUIT-1 95/08/27 17:04:14

Wind Speed (m/s)

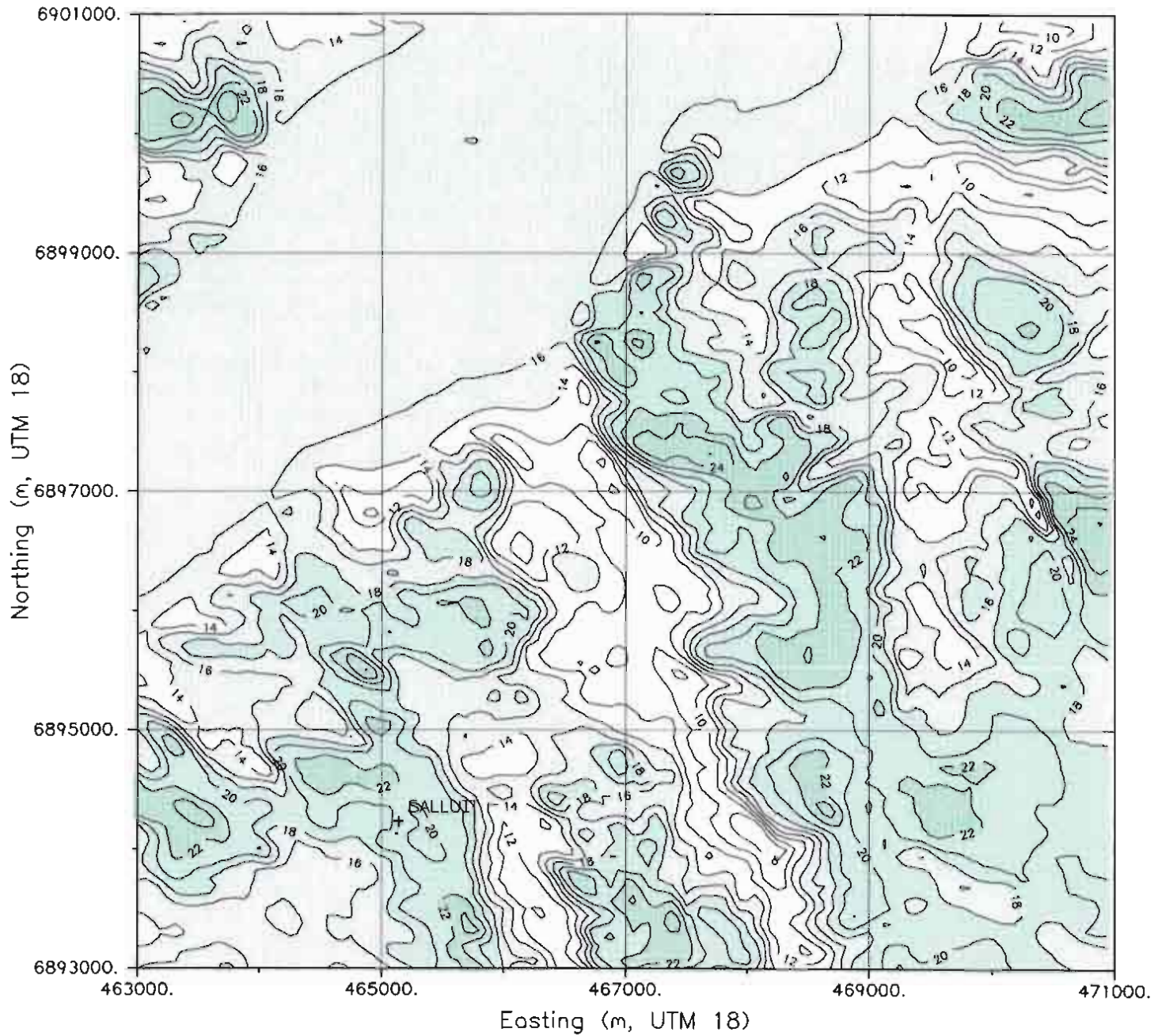
Level: 25.00m

Wind Distribution: SALLUIT.RJF



MS-Micro MODEL OUTPUT

Zephyr North



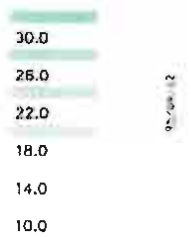
SALLUIT-1 95/08/27 17:04:14

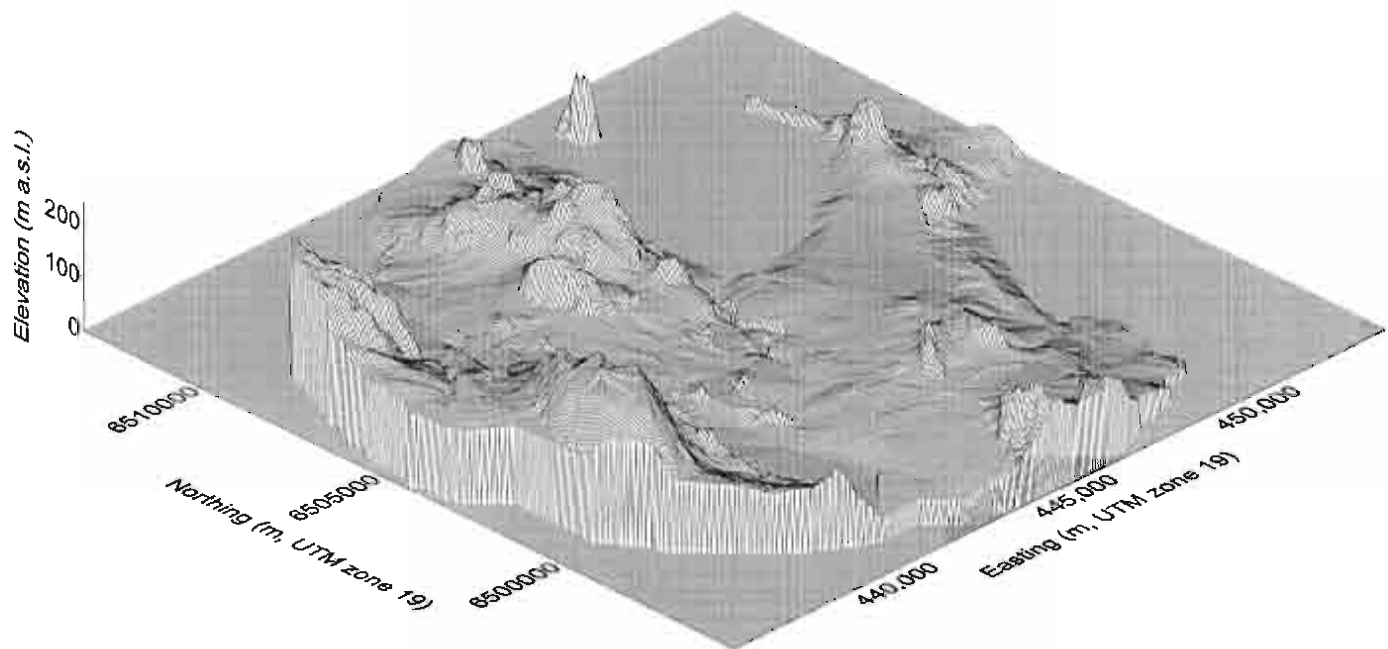
AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: SALLUIT.RJF

Temperature: -7.6C Pressure: 98.21kPa



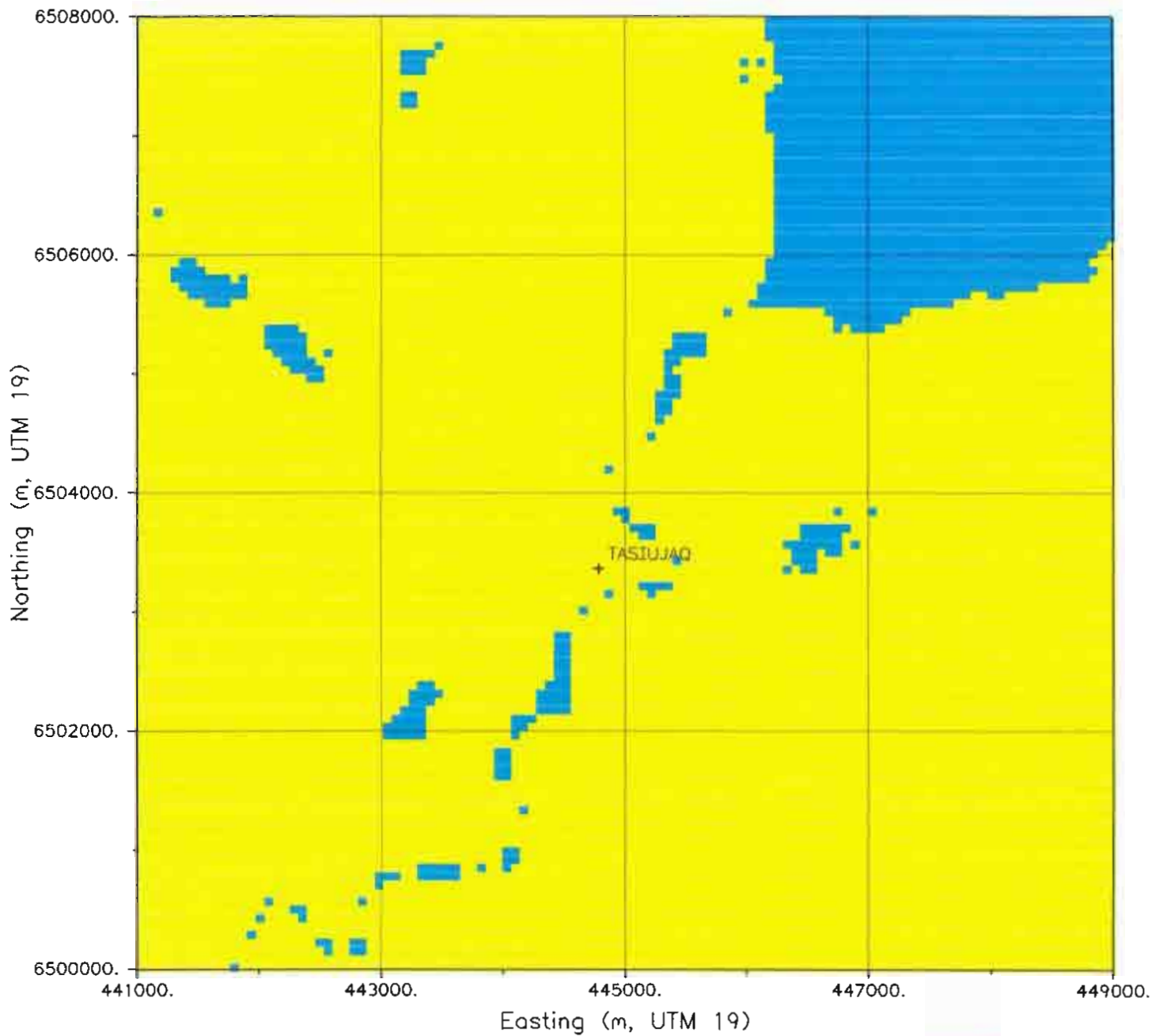


Tasiujaq

Topography Relief from Master Grid
Master grid file: TASIUJAQ.TMG

MS-Micro MODEL INPUT

Zephyr North



TASIUAQ-UPS1 95/09/10 14:58:24

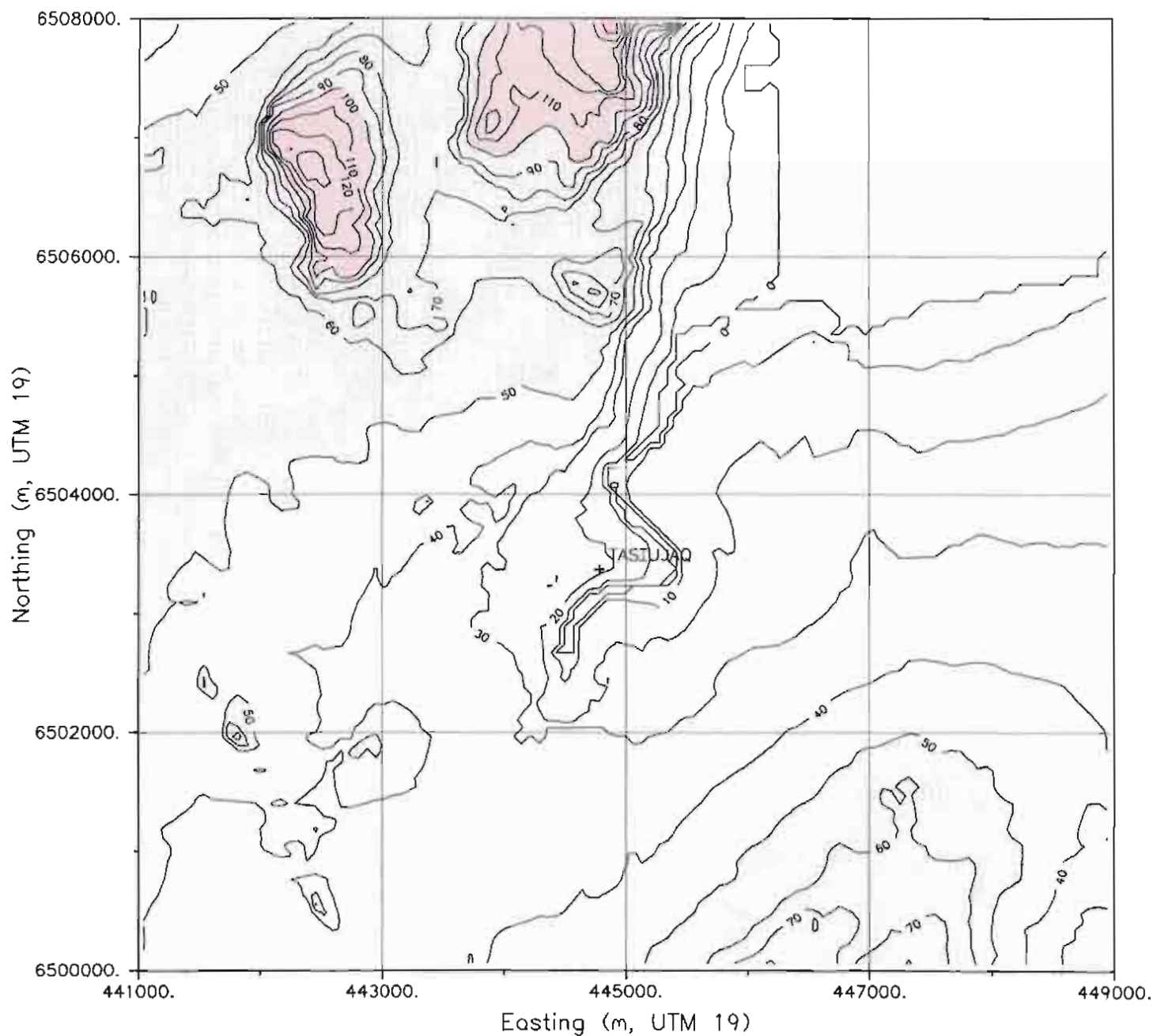
Roughness from Master Grid (Central Quarter)

Master grid file: TASIUAQ.RMG



MS-Micro MODEL INPUT

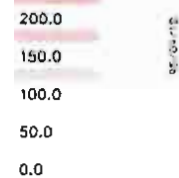
Zephyr North



TASIQUAQ-UPS1 95/09/10 14:58:24

Topography from Master Grid (m) (Central quarter)

Master grid file: TASIQUAQ.TMG



MS-Micro MASTER PARAMETER SUMMARY

Project Name: TASIUJQA-1 95/09/10 16:07:57

UTM zone, X-centre, Y-centre (m): 19 445000. 6504000.

Master topography file: TASIUJQA.TMG

Master roughness file: TASIUJQA.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	1
3	045	0.	1
4	067	0.	1
5	090	0.	1
6	112	0.	1
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

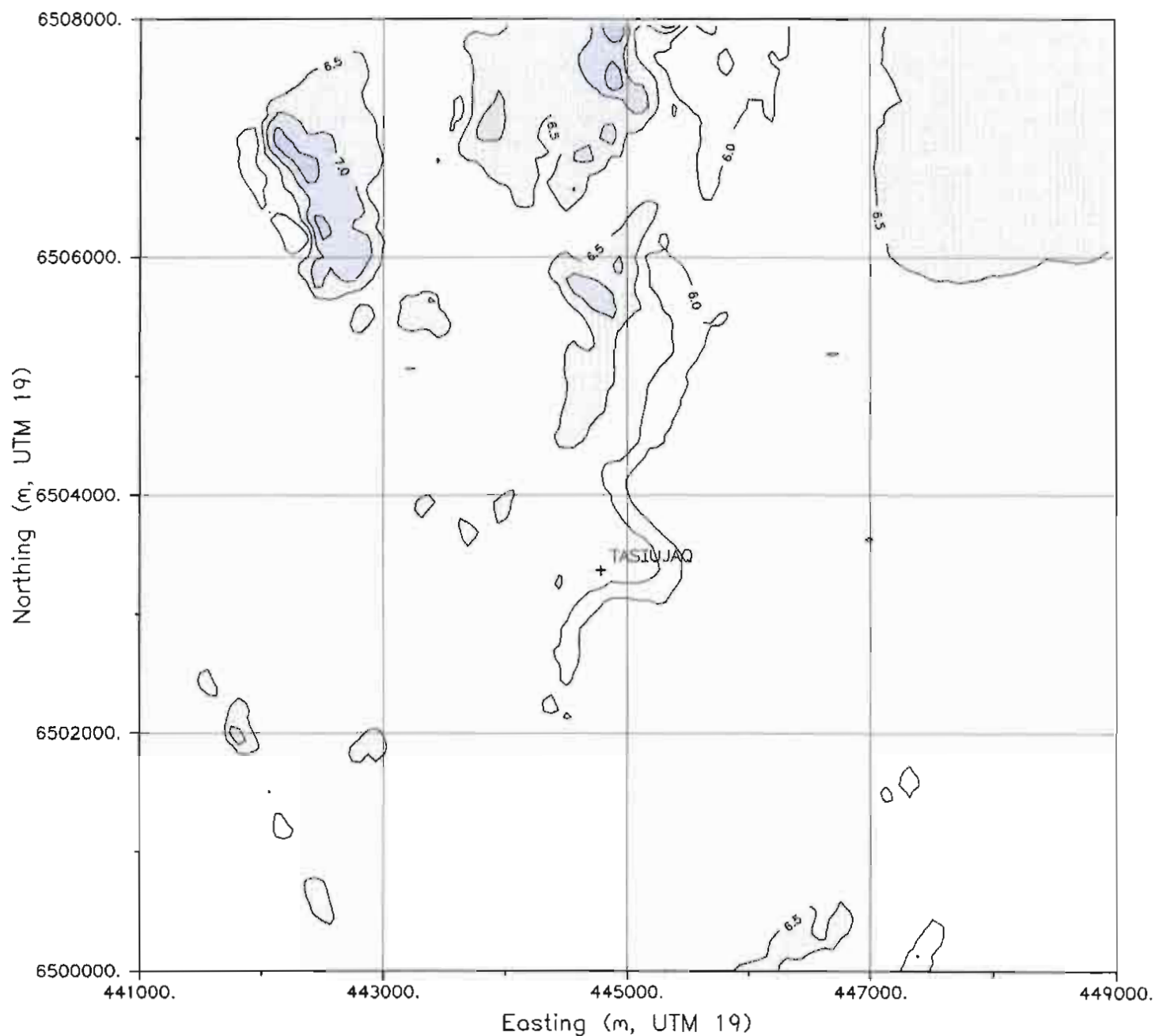
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



TASIUJAJ-1 95/09/10 16:07:57

Wind Speed (m/s)

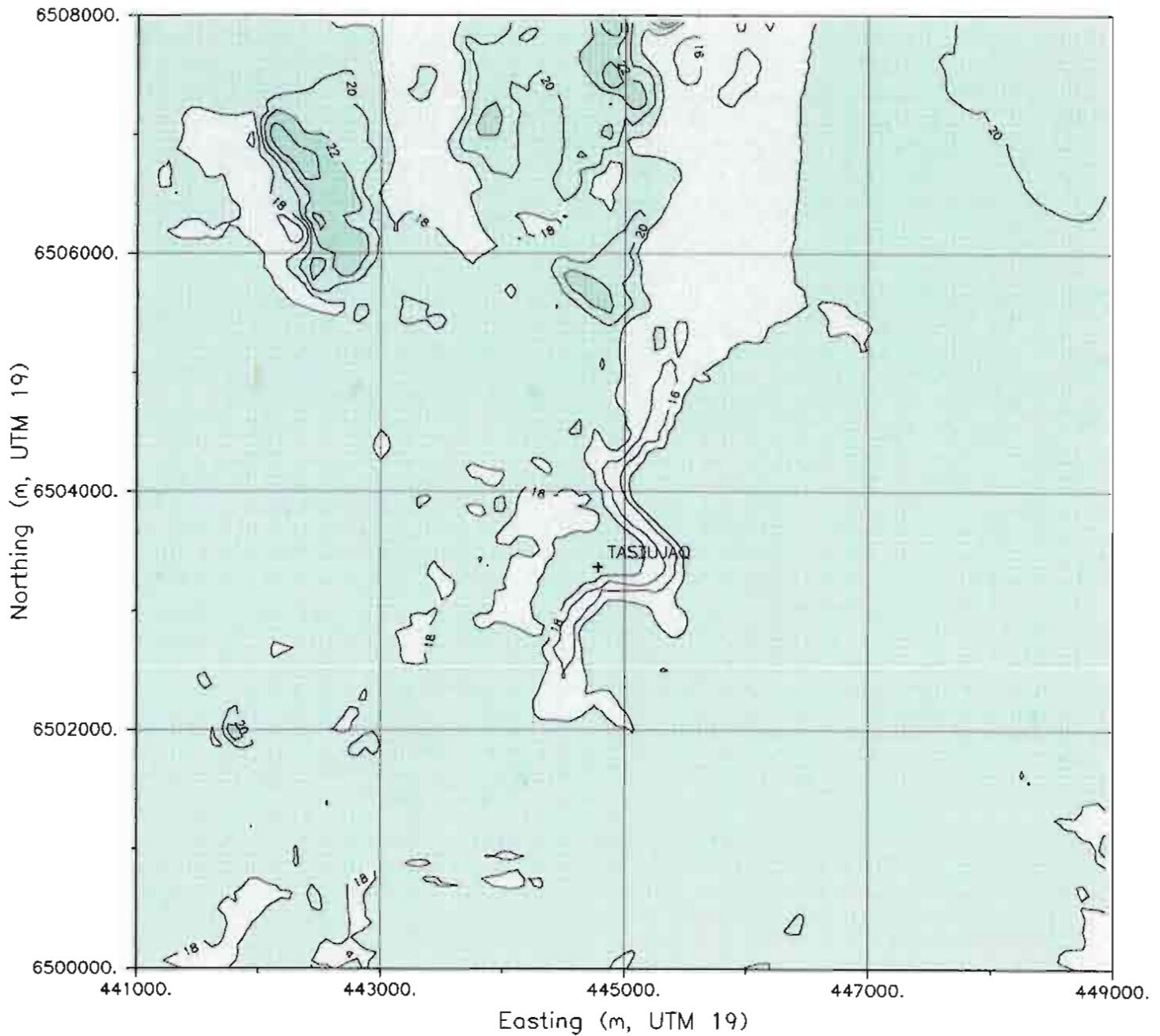
Level: 25.00m

Wind Distribution: TASIUJAJ.RJF



MS-Micro MODEL OUTPUT

Zephyr North



TASIUJAQ-1 95/09/10 16:07:57

AOC 15/50 Turbine Power (kW)

Level: 25.00m

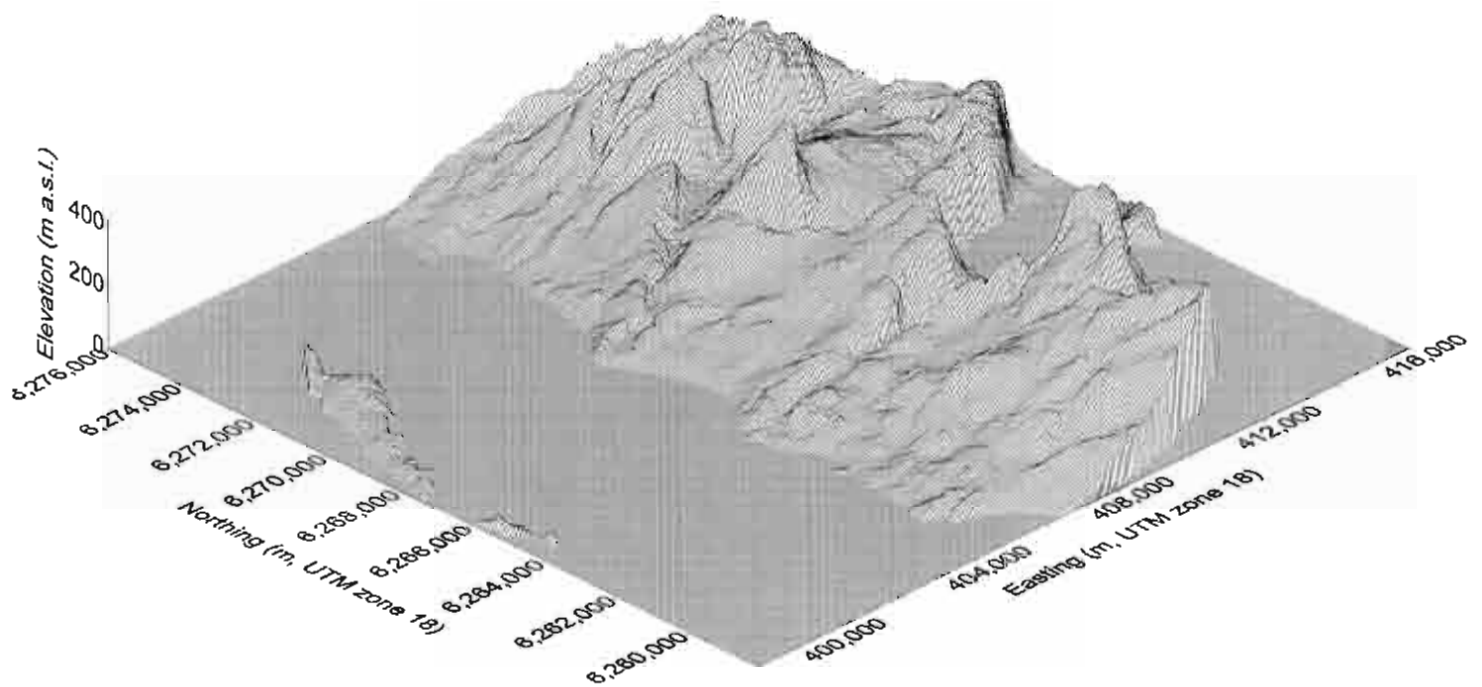
Wind Distribution: TASIUJAQ.RJF

Temperature: -5.2C Pressure: 100.77kPa



MS-Micro MODEL INPUT

Zephyr North

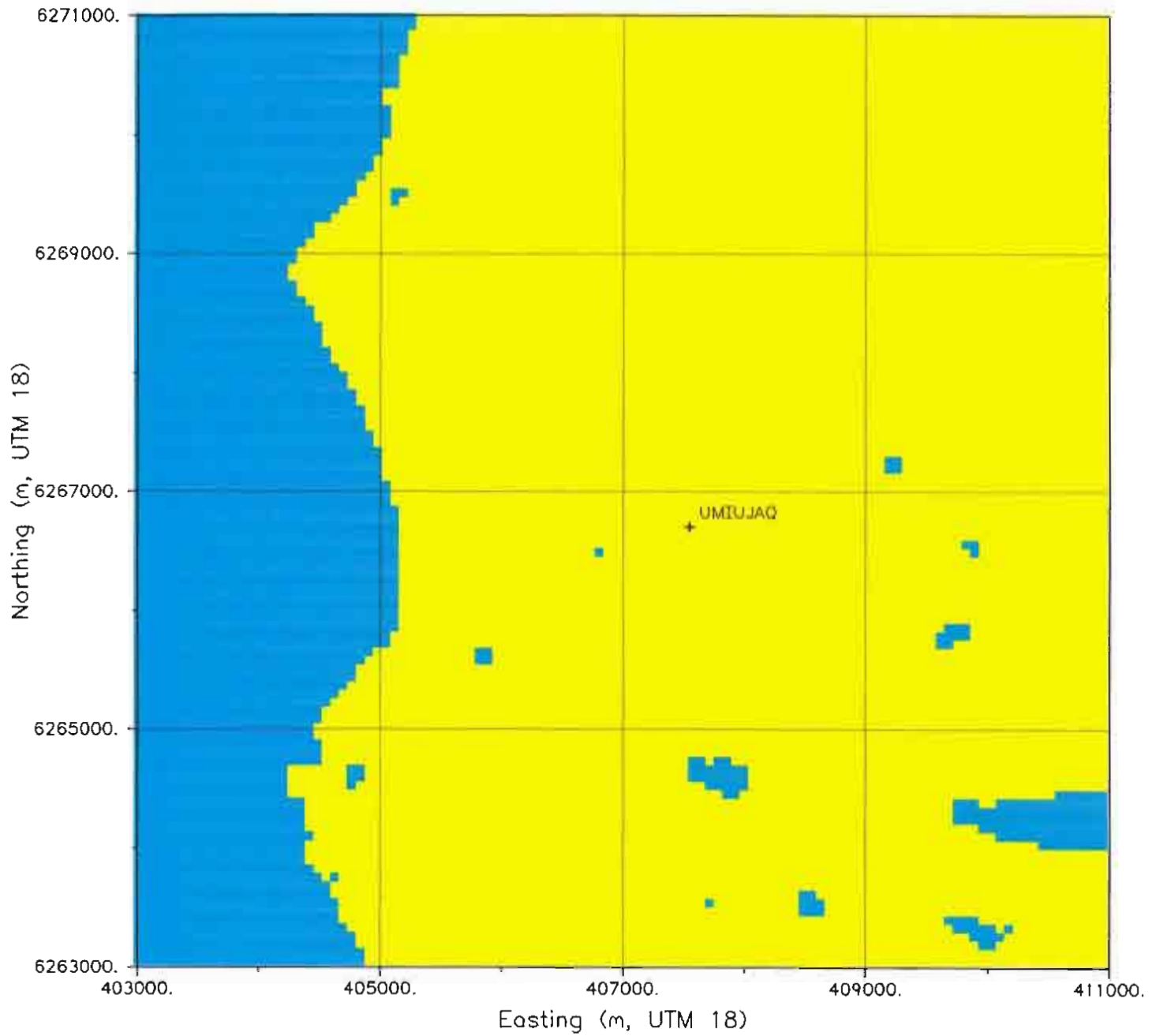


Umiujaq

Topography Relief from Master Grid
Master grid file: UMIUJAQ.TMG

MS-Micro MODEL INPUT

Zephyr North



MS-Micro MASTER PARAMETER SUMMARY

Project Name: UMIUJAQ-1 95/09/10 18:30:17

UTM zone, X-centre, Y-centre (m): 18 407000. 6267000.

Master topography file: UMIUJAQ.TMG

Master roughness file: UMIUJAQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	1
8	157	0.	1
9	180	0.	3
10	202	0.	3
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

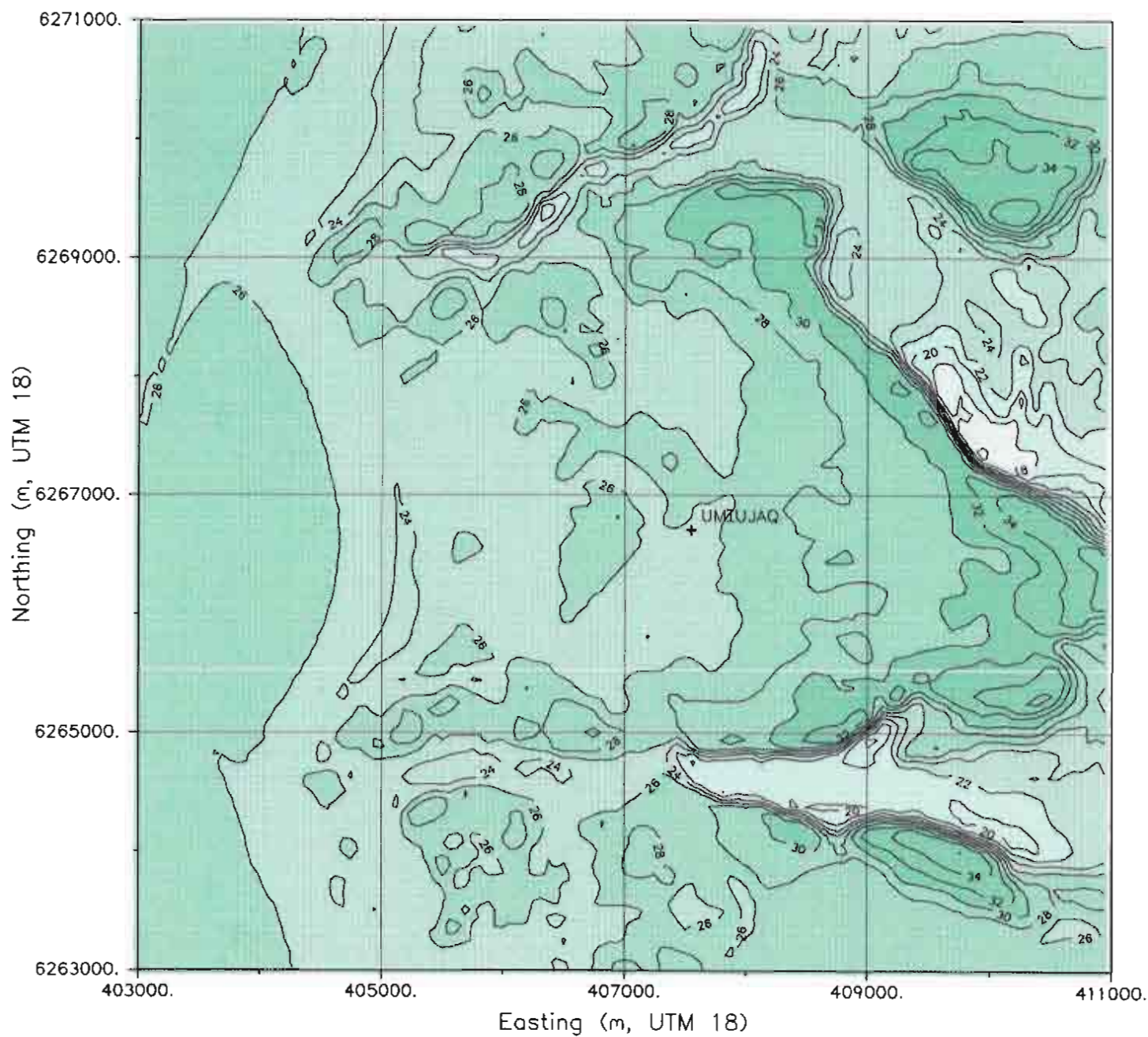
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT

Zephyr North



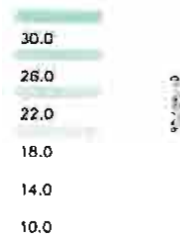
UMIUJQAQ-1 95/09/10 18:30:17

AOC 15/50 Turbine Power (kW)

Level: 25.00m

Wind Distribution: UMIUJQAQ.RJF

Temperature: -4.3C Pressure: 100.25kPa

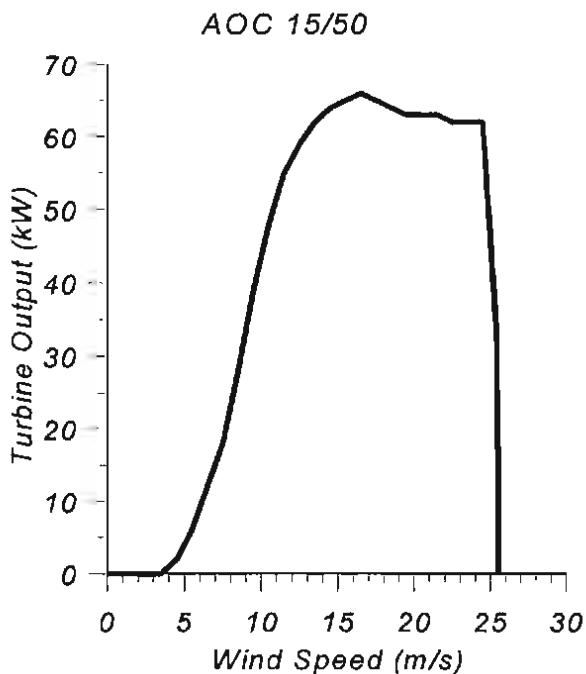


Further information from the turbine manufacturer follows.

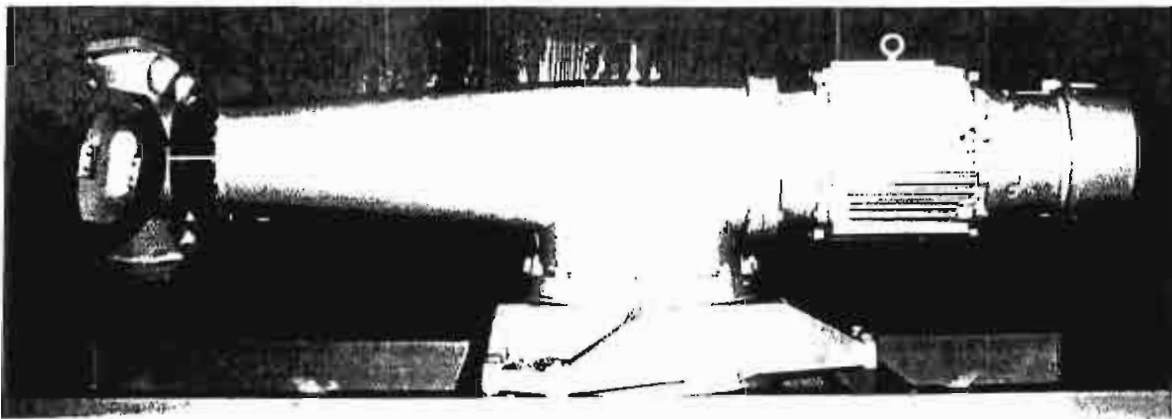
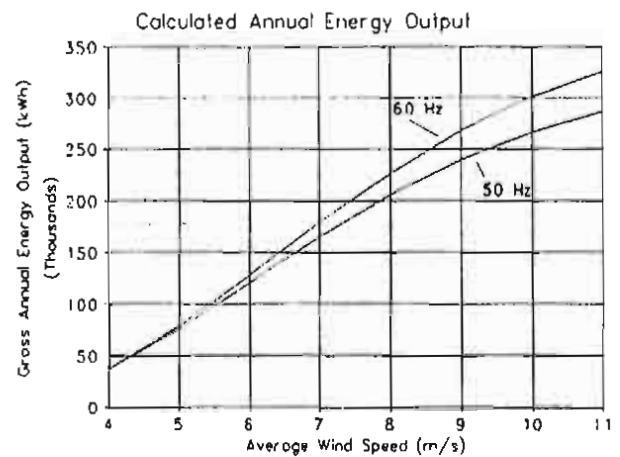
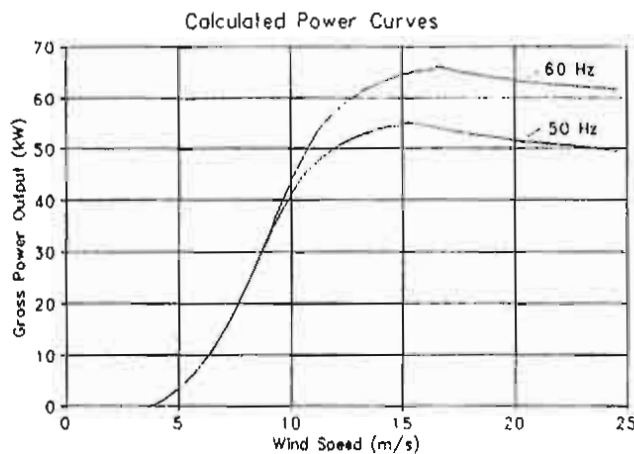
15 APPENDIX G - AOC 15/50

The Atlantic Orient AOC 15/50 wind turbine is manufactured by the Atlantic Orient Corporation. It is a stall-regulated 50kW (nameplate) horizontal axis wind turbine with a 15m (diameter) downwind, 3-bladed rotor located at 25m above the ground.

The power curve used for the MS-Micro model analysis (Appendix F) is shown below. It applies to standard conditions.



Performance Characteristics of the AOC 15/50 Wind Turbine



The AOC 15/50 Drivetrain assembly

Research and Development

The AOC 15/50 wind turbine was developed with a series of R & D cost-shared contracts administered by the National Renewable Energy Laboratory to comply with International Electro-Technical Commission standards. The Dutch Laboratory ECN has conducted a Failure Modes Effects Analysis (FMEA) on the 15/50 wind turbine. Field Testing continues in several locations in the United States and Canada, as well as component qualification testing in our Norwich, Vermont test facility.

One of the most important safety criteria in the design of the AOC 15/50 is the ability to safely control the wind turbine in normal and extreme conditions. This has lead to the development of redundant failsafe control mechanisms. The ultimate goal above and beyond low cost and high reliability is the protection and safe operation of the wind turbine in all specified conditions.



(For information requests)
Atlantic Orient Corporation
P.O. Box 1097
Farrell Farm Road, Rte 5N
Norwich, Vermont 05055 USA
Phone (802) 649-5446
FAX (802) 649-5404

Atlantic Orient Canada Inc.
One Moore Rd.
Dartmouth, Nova Scotia
B3B 1J1 CANADA
Phone (902) 468-1621
FAX (902) 468-2424

European Orient, Ltd
NEL Technology Park
108 Whitworth Building
East Kilbride
Glasgow G750QU
UNITED KINGDOM

DESIGN SPECIFICATIONS FOR THE ATLANTIC ORIENT 15/50 (60 HZ & 50 HZ) 50 kW WIND TURBINE

SYSTEM

Type	Utility Interface
Configuration	Horizontal axis
Rotor diameter	15 m (49.2 ft)
Centerline hub height	25 m (82 ft)

PERFORMANCE PARAMETERS 60 HZ

Rated electrical power	50 kW at 11.0 m/s (24.5 mph)
Windspeed	@ hub height 25 m (82 ft)
cut-in	3.7 m/s (8.2 mph)
shut-down (high wind)	22.4 m/s (50 mph)
peak (survival)	59.5 m/s (133 mph)
Annual output	
100% avail.	5.4 m/s (12 mph) 98,700 kWh
(Hub height wind speed)	6.7 m/s (15 mph) 165,000 kWh
	8.0 m/s (18 mph) 228,800 kWh

PERFORMANCE PARAMETERS 50 HZ

Rated electrical power	50 kW at 12.0 m/s (26.8 mph)
Windspeed	@ hub height 25 m (82 ft)
cut-in	3.8 m/s (8.6 mph)
shut-down (high wind)	25.0 m/s (55 mph)
peak (survival)	59.5 m/s (133 mph)
Calculated Annual Output	
100% avail	5.4 m/s (12 mph) 92,000 kWh
(Hub height wind speed)	6.7 m/s (15 mph) 152,300 kWh
	8.0 m/s (18 mph) 207,000 kWh

ROTOR

Type of hub	Fixed pitch
Rotor diameter	15 m (49.2 ft)
Swept area	177 m ² (1902 ft ²)
Number of blades	3
Rotor solidity	0.077
Rotor speed at rated power	65 rpm at 60 HZ, 62 rpm at 50 HZ
Location relative to tower	Downwind
Cone angle	8 degrees
Tilt angle	0 degrees
Rotor tip speed	50.7 m/s (113 mph) at 60 HZ; 48.6 m/s (109 mph) at 50 HZ
Design tip speed ratio	6.1

BLADE

Length	7.2 m (23.7 ft)
Material	Wood/epoxy laminate
Airfoil (type)	NREL, Thick Series - modified
Twist	7° outer blade
Root chord	457 mm (18 in) @ 4% 279 mm (11 in)
Max chord	749 mm (29.5 in) @ 39% 2925 mm (115 in)
Tip chord	406 mm (16 in) @ 100% 7500 mm (295 in)
Chord taper ratio	-2 : 1
Overspeed device	Electro-magnetic Tip Brake
Hub attachment	Embedded female ball receptacle
Blade weight	143 kg (315 lbs)

TRANSMISSION

Type	Planetary
Housing	Ductile Iron - Integrated casting
Ratio (rotor speed to generator speed)	1 to 28.25 (60 Hz); 1 to 24.57 (50 Hz)
Rating, output hp.	88
Lubrication	Synthetic Gear Oil
Filtration	Positive, pump with filter cartridge
Heater (option)	Cold weather version, electric

GENERATOR

Type	3-phase induction
Frequency (Hz)	60 & 50 HZ
Voltage (V)	480, 3-phase at 60 HZ 380, 3-phase at 50 HZ
kW at rated windspeed	50 kW
kW at peak continuous	66 kW at 60 HZ; 55 kW at 50 HZ
Speed rpm (nominal)	1800 at 60 HZ; 1500 at 50 HZ
Winding configuration	wye
Insulation	Class F (class H option)
Enclosure	Totally Enclosed Air Over (TEAO)
Frame size	365 TC
Mounting	Direct mount to transmission
Options	Arctic and Tropical Versions

YAW SYSTEM

Normal	Free, rotates 360 degrees
Option	Yaw damping - required when conditions exceed 50 degrees yaw rate per second

DRIVE TRAIN TOWER INTERFACE

Structural	Yaw bearing mounted on tower top casting
Electrical	Twist Cable

TOWER

Type	Galvanized 3-legged, bolted lattice, self supporting
Tower height	24 m (80 ft)
Options	30 m (100 ft), 37 m (120 ft)

FOUNDATION

Type	Concrete or special
Anchor bolts	Certified ASTM A-193 G.B7

CONTROL SYSTEM

Type	PLC based
Control inputs	Wind Speed, Generator shaft speed, Generator temperature
Control outputs	Line Interconnection, brake deployment, winding heaters
Communications (option)	Serial link to Central Computer for Energy Monitor and Maintenance Dispatch

ROTOR SPEED CONTROL

Production	Blade stall increases with increased wind velocity
Normal start-up	Aerodynamic. Electrical boost if necessary
Shut-down	Control system simultaneously applies dynamic brake and deploys tip brakes. Parking brake brings rotor to a standstill.
Back-up overspeed	Centrifugally activated tip brakes deploy

BRAKE SYSTEM CONTROL

Fail-safe brakes automatically deploy when grid failure occurs.

SYSTEM DESIGN WEIGHTS kg (lbs)

Tower	3,007 kg (6,630 lbs)
Rotor & Drive Train	2,404 kg (5,300 lbs)
Weight on foundation	5,411 kg (11,930 lbs)

DESIGN LIFE

30 Years

SCHEDULED MAINTENANCE

Semi-annual, or after severe events

DOCUMENTATION

Installation, Operation Service & Maintenance manual.

DESIGN STANDARDS

Applicable Standards AWEA, EIA, IEC, and CEC

NOTE 1: Atlantic Orient Corporation and its affiliates are constantly working to improve its products, therefore, specifications are subject to change without notice.

NOTE 2: Energy production is dependent upon actual wind resources and site conditions, and will vary with wind turbine maintenance, altitude, temperature, topography and the proximity to other structures.

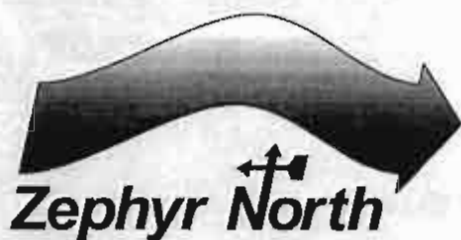
NOTE 3: For design options to accommodate severe climates or unusual circumstances, please contact the corporate office in Norwich, Vermont.

NORTHERN QUÉBEC WIND RESOURCE STUDY

for



**HISTORICAL WIND DATA
AND NUMERICAL
MODELLING UPDATE:
Kuujuaq, Quaqtaq and
Umiujuq**



J. R. Salmon

2001 June 7

*Originals printed on
Recycled 20% post-consumer content*



DISCLAIMER OF WARRANTIES AND LIMITATION OF LIABILITIES

This Report was prepared by Zephyr North of Burlington, Ontario, Canada as an account of work sponsored by Hydro-Québec. Neither Zephyr North nor any person acting on its behalf:

- (a) Makes any warranty or representation whatsoever, express or implied, (i) with respect to the use of any information, apparatus, method, process, or similar item disclosed in this report, including merchantability and fitness for a particular purpose, or (ii) that such use does not infringe on or interfere with privately owned rights, including any party's intellectual property, or (iii) that this report is suitable to any particular user's circumstance, or
- (b) Assumes responsibility for any damages or other liability whatsoever (including any consequential damages, even if Zephyr North or its representatives have been advised of the possibility of such damages) resulting from your selection or use of this report or any information, apparatus, method, process or similar item disclosed in this report.

EXECUTIVE SUMMARY

This report is an update of a previous study, “Northern Québec Wind Resource Study: Historical Wind Data and Numerical Modelling” published in October of 1995. It is limited to the re-assessment of three of the sites, Kuujjuaq, Quaqtaq and Umiujaq, using more recent meteorological data collected since 1995. In addition, the area examined around Quaqtaq was expanded to the northwest.

In all three cases, the mean wind speed at the observation sites was lower than reported previously. At two of the sites, this seems to be due to climatic variability. At Quaqtaq there seems to be a possibility of some type of change to the observations and/or site characteristics in about 1984. This was not investigated further.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Location and Purpose	1
2	HISTORICAL WIND DATA	1
2.1	Introduction	1
2.2	Atmospheric Environment Service Stations	1
3	DATA TREATMENT	2
3.1	Introduction	2
3.2	Data Completeness	2
3.3	Data Accuracy	3
3.4	Anemometer Height Adjustments	3
3.5	Treatment of Binning Biases	3
3.6	Adjustment for Obstacles	3
3.7	Adjustment for Complex Terrain	3
4	DATA SUMMARIES AND DISCUSSION	3
4.1	Introduction	3
4.2	Long-Term Average Wind Speed and Power Density	4
4.3	Directional Distribution of Long-Term Average Power Density	6
4.4	Weibull Shape Factors	6
4.5	Temporal Trends in Wind Speed and Power Density	6
4.6	Monthly Variation in Power Density	6
4.7	Diurnal Variation in Power Density	7
5	NUMERICAL MODEL ESTIMATES OF TURBINE POWER PRODUCTION	7
5.1	Introduction	7
5.2	Model Background	8
5.3	Topography Data	8
5.4	Surface Roughness Data	8
5.5	Model Run Details and Results	9
6	CONCLUSIONS	10
6.1	Data Quality	10
6.2	The Wind Resource	10
6.3	Kuujuaq Site Selection	10

7	ACKNOWLEDGEMENTS	11
8	REFERENCES	11
9	APPENDIX A - See 1995 report.	12
10	APPENDIX B - See 1995 report.	13
11	APPENDIX C - STATION DATA	14
12	APPENDIX D - WIND DATA SUMMARIES	18
12.1	Wind Distribution (Table)	18
12.2	Wind Distribution (Graph)	18
12.3	Annual Averages (Table)	19
12.4	Annual Averages (Graph)	19
12.5	Seasonal Distribution (Table)	19
12.6	Seasonal Distribution (Graph)	19
12.7	Monthly Roses (Graph)	19
12.8	Monthly Distribution (Table)	19
12.9	Monthly Distribution (Graph)	19
12.10	Diurnal Distribution (Table)	19
12.11	Diurnal Distribution (Graph)	19
13	APPENDIX E - WINDS AT STANDARD LEVELS . . .	20
13.1	Annual Averages (Table)	20
14	APPENDIX F - MS-MICRO INPUT AND RESULTS . .	22
15	APPENDIX G - AOC 15/50	24

TABLES

Table 1	Station averages for wind speed and power density (PD) at several heights.	7

FIGURES

1 INTRODUCTION

1.1 Location and Purpose

This project was initiated in 1995 to study the wind energy resources for fourteen remote villages in the northern part of the province of Québec. The original study is described in the report by Salmon and Stalker (1995) hereinafter referred to as “the 1995 report”. The original study area (shown in Figure 1 of the 1995 report) extended roughly from Hudson Bay east to eastern Ungava Bay and from Kuujjuarapik north to the northern tip of the province. This report describes an update to the 1995 report but is limited to examining three of the original stations — Kuujjuaq, Quaqtaq and Umiujaq. For Kuujjuaq, the study area was expanded to the northwest.

2 HISTORICAL WIND DATA

2.1 Introduction

The 1995 report includes meteorological data collected until mid 1995 (as available). Since then, additional data have been collected on a

regular basis at all three stations studied in this report. The characteristics of the data at the stations (listed in Appendix C) have remained essentially the same as those described in the 1995 report with the exception of Quaqtaq where the daily observing interval was reduced and the frequency of observations was increased (see below).

2.2 Atmospheric Environment Service Stations

As in the previous work, this study is based on data recorded by the Meteorological Service of Canada (MSC, formerly the Atmospheric Environment Service — AES), a division of Environment Canada. A summary of some of the characteristics of the data collected is available in the *Canadian Climate Normals, Volume 5, Wind* (1982). The ultimate source of wind data and information pertaining to these data is the data archive of MSC.

For this study, we obtained additional wind speed, wind direction, dry bulb air temperature and station barometric pressure data from MSC data covering the 1995 to 1999 inclusive period for Kuujjuaq Airport, Quaqtaq, and Umiujaq Airport.

Appendix C (repeated and updated from the 1995 report for the three stations) provides brief physical descriptions for each station. This information is derived from archived station reports. In addition, the appendix includes graphs of data availability, which are derived from the data themselves.

It should be noted that since 1995 MSC has modified its procedure for cataloguing instrument and site information for its

stations. This has made it difficult to access station reports to determine whether any of the instrument site details have changed since the 1995 report. In a personal communication with the station inspector (for all three stations), it has been learned that no substantial changes have been made to the meteorological equipment at any of the stations, nor have the surroundings changed significantly at Kuujuaq and Umiujaq. At Quaqtaq, M Réal Reid of Hydro-Québec reports that a diesel power plant is under construction about 50 m from the anemometer. The direction to the power plant is not known.

3 DATA TREATMENT

3.1 Introduction

The meteorological data were treated as described in Appendix B of the 1995 report with the goal of extracting the maximum amount of correct, appropriate and useful information from them. A summary of the results of the data treatment is presented in the following sections.

3.2 Data Completeness

The stations had annual blocks of contiguous data (*i.e.*, no long missing sections) for periods of 7 years (Umiujaq Airport, 1993 to 1999 inclusive), 10 years (Quaqtaq, 1990 to 1999) and 20 years (Kuujuaq Airport, 1980

to 1999). Data availability graphs are shown in Appendix C.

Within the contiguous blocks of data used for the analysis, there were shorter, randomly-distributed blocks of missing data. These blocks were deemed to be short enough that they would have only a minor effect on the the long-term averages and so they were ignored in the analysis. The missing blocks of data are described in the following paragraphs.

Data were very complete at Kuujuaq Airport.

Data were missing at Quaqtaq for two periods of about four to five weeks each during December 1991/January 1992 and March 1992. A longer period of data (about nine weeks) was missing during the spring/summer of 1996.

Umiujaq had one extended block (about 4 weeks) of data missing in July 1994.

Table 1 lists the data coverage showing the year and month at the beginning and end of the observations, the number of complete years of observations, the hours per day and the days per week that observations were taken.

The observation regimes broke down into three types:

1. Hourly, full day, seven days a week (Kuujuaq A);
2. Hourly, daytime only, seven days a week (Quaqtaq, Umiujaq A);
3. Hourly, daytime only, five days (Monday to Friday) a week (Quaqtaq, Umiujaq A)

Note that data from Quaqtaq and Umiujaq Airport fell categories 2 or 3 — depending on the period of observation.

3.3 Data Accuracy

As these data were provided by the Meteorological Service of Canada, it was assumed that the maintenance and data quality-control procedures followed by this organization continued to be adequate to ensure reasonable data accuracy.

3.4 Anemometer Height Adjustments

All three stations had anemometers located at the WMO (World Meteorological Organization) standard height of 10m.

3.5 Treatment of Binning Biases

All data were treated for binning biases as described in Appendix B of the 1995 report.

Minor binning biases in wind speed distributions seemed to occur in the higher speeds recorded at Quaqtaq and Umiujaq. Since these were reasonably small, no further action was taken. (Without further analysis, it is not clear what effect these biases would have on the results, although it is assumed to be minor in this case. Note, also, that further analysis might not resolve this question.)

There were no bias problems evident in the wind direction distributions.

3.6 Adjustment for Obstacles

As described in the previous report, no corrections were made for sheltering of the anemometers due to obstacles. Because of the remoteness of these sites, it seems unlikely that there would be significant corrections required at any of the stations.

3.7 Adjustment for Complex Terrain

A numerical model analysis of the effect of the local topography and surface roughness on the wind flow at each of the three stations is contained in Section 5.

4 DATA SUMMARIES AND DISCUSSION

4.1 Introduction

In this section, summaries of the data and discussions of these summaries will be presented. Note that the data are already summarized to some extent in the graphs and tables of the appendices.

Appendix C contains station information. It includes tables describing meteorological measurement parameters, data availability graphs, geographic, terrain and siting information. In addition, graphs showing the data availability are presented. These can be used to determine the data collection regime (full day, daylight hours, *etc.*) in effect at any specific time in the data record.

In Appendix D, the graphs for each station summarize the data at the original level of measurement, *i.e.*, the anemometer level on the measurement tower. The graphs and tables available for each station in the appendix are as follows.

1. Joint-frequency table of wind speed v. wind direction (analyzed over the complete station period).

2. Polar graphs of wind frequency by 16 direction sectors, average wind speed by 16 sectors, average wind power density by 16 sectors; histograms of wind speed distribution by sector for 16 sectors with sector-wise Weibull parameters, and overall wind speed distribution for all direction sectors with overall Weibull parameters (averaged over the complete station period).

3. Table of the year-by-year variation in temperature, barometric pressure, air density, wind speed, wind direction, power density, and other parameters.

4. Histograms of wind speed and power density year by year for the period 1980 to 1999 inclusive (where data are available).

5. Table of the seasonal variation of wind speed, wind power density, and other parameters (averaged over the complete station period).

6. Histograms of the seasonal variation of wind speed and wind power density (averaged over the complete station period).

7. Polar graphs of the monthly directional distribution of wind frequency, average wind speed and power density (averaged over the complete station period).

8. Table of the monthly variation of wind speed, wind power density, and other parameters (averaged over the complete station period).

9. Histograms of the monthly variation of wind speed and wind power density (averaged over the complete station period).

10. Monthly tables of the diurnal variation of wind speed and power density (averaged over the complete station period).

11. Monthly histograms of the diurnal variation of wind speed and power density (averaged over the complete station period).

In Appendix E, the tables summarize the annual averages at the station for two of 'standard levels' — the anemometer height (10 m) and the turbine hub height (25 m). These extrapolations use Equation 1 of Appendix B of the 1995 report with the direction-dependent roughness lengths, z_0 , shown at the top of the table. Values of z_0 used in this study were:

0.0002 m (Sea)
- open water

0.03 m (Open)
- unobstructed landscape with widely separated obstacles (tundra)

0.10 m (Roughly Open)
- open landscape, low vegetation, occasional obstacles (low tree coverage)

0.25 m (Rough)
- open landscape, variable height vegetation, scattered woods

1.0 m (Closed)
- full obstacle coverage with small open spaces (low-rise built-up areas, mature forests)

The tabulation at standard levels serves two purposes. One, it allows station-to-station comparison of wind speeds and power densities where the original measurement levels may have been at different heights, and two, it serves as a quick reference for the estimated wind speed (at the observation station) at a level close to the possible hub-height of the wind turbine under investigation. There is only one type of table in this appendix as the graphs of Appendix D are generally sufficient to provide a good understanding of the characteristics of the local wind regime. The format of the tables in this appendix is as follows.

1. Table of annual averages of station temperature, barometric pressure, air density, wind speed, wind direction, maximum wind speed, maximum gust speed (if available), wind power density and turbulence intensity (if available). Wind speed, maximum wind speed, maximum gust speed, wind power density and turbulence intensity are adjusted to standard levels.

4.2 Long-Term Average Wind Speed and Power Density

Table 1 presents summaries of the wind speed and power density averages for the three stations. Three sets of averages are given. Each set consists of an average wind speed followed by the corresponding power density,

in brackets. The first set is the measured wind speed/power density at the anemometer height. The second and third sets are the extrapolated wind speed estimates/power densities at the 'standard' heights of 10 and 25 m.

Comparison of the wind speeds and power densities from the 1995 report reveals that they are all lower than measured previously. There are a number of possible reasons for this, including the normal statistical variation expected in meteorological elements. However, the changes in some cases are substantial, and interestingly they are all reductions in speed and power density. It was decided to briefly examine the data sets at each of the stations.

Kuujuaq

From the "Data Availability" graphs of Appendix C there appears to be no significant difference in data collection details between the 1995 report (1980 to 1994) period and this report period (1980 to 1999). Both periods show very complete data recovery 24 hours a day, 7 days a week. However, the "Annual Averages" graphs of Appendix D show that the wind speeds (and power densities) for the 1995 to 1999 period have all been below average. This accounts for the reduction in mean wind speed.

Quaqtaq

The "Data Availability" graphs of Appendix C show that for the period of this report (1990-1999) wind data have been collected at hourly intervals but only during the daylight hours. For some years (7 to 10 years total), the data were collected on 7 days of the week; for the remaining years, data were only collected on 5 out of 7 days. For the data analysis period of the 1995 report (1972 to 1980) "Data Availability" graphs (not

shown in the 1995 report) show that data were collected at 3-hourly intervals for 24 hours per day for 5 of the years and at 3-hourly intervals for 21 hours per day (one observation missing per day) for 4 of the years. Data were collected on all 7 days of the week.

The diurnal distribution graphs of the 1995 report suggests a very slight increase in wind speeds during the daylight hours. If this were a significant factor, it might be expected that the average wind speed calculated for the present period (1990 to 1999) would be higher than that of the previous period, since all the data from the present report occur during the daylight hours. This, however, is not the case.

An additional "Annual Averages" graph of the average wind speeds for the period spanning both reports (1972 to 1999, included in Appendix D after the 1980 to 1999 graph) interestingly shows that all annual average wind speeds up to 1984 are above the 1972-1999 long-term average wind speed, while all of the annual average wind speeds from 1990 to 1999 (except 1991 and 1999) are below the long-term average. This, of course, can account for the reduction in average wind speed from that determined in the 1995 report. It is possible that this reduction is due to climatic variation or, perhaps, climate change. However, there are some additional possible causes:

1. Change in instrumentation.
2. Lack of instrument maintenance and calibration (not likely).
3. Change in instrument exposure (installation of a new building that obstructs the anemometer, etc.)
4. Change in anemometer elevation.

5. Change in anemometer location.
6. Change in observation procedures.

If interest warrants, it would be possible to investigate these further.

Umiujaq

Data collection at Umiujaq does not appear to have changed in the 1993 to 1999 period (Appendix C “Data Availability” graphs). Data are collected during the daylight hours, 7 days per week.

However, the “Annual Averages” graph of Appendix D shows that during the period used in the 1995 report (1993 to 1994) wind speeds were above the long-term (1993 to 1999) average for both years. This explains the higher wind speed average determined in the 1995 report and suggest that the long-term average wind speed is indeed lower.

4.3 Directional Distribution of Long-Term Average Power Density

Kuujuaq

The directional distribution of the power density is very similar to that determined in the 1995 report.

Quaqtaq

Despite the two different periods of analysis, the directional distribution at Quaqtaq is very similar to that measured previously.

Umiujaq

The addition of five years of observational data has not changed the directional distribution of power density to any substantial degree.

4.4 Weibull Shape Factors

The Weibull shape factor parameters, k , for all three stations varied very little from the previously examined data. It should be noted that the wind speed frequency distribution for Quaqtaq is better in the present data set in that there is much less evidence of large spikes at specific wind speeds.

4.5 Temporal Trends in Wind Speed and Power Density

The time-series histograms of Appendix D show that the wind speed and power density at the stations with longer records are reasonably consistent from year to year with the power density showing more variation than the wind speed (as would be expected from Equation 4 of Appendix A of the 1995 report).

Examination of the graphs and data from the longer-term stations (Kuujuaq A and Quaqtaq) suggest that, generally, the largest deviations from the average wind speed over the record period are in the $\pm 5\%$ to $\pm 10\%$ range.

As expected, the maximum power density excursions are larger, ranging from $\pm 15\%$ to $\pm 35\%$.

Note that there is a discussion of the wind speed trends for all three stations in Section 4.2.

4.6 Monthly Variation in Power Density

The monthly variations in power density at Kuujuaq and Umiujaq show the same pattern as determined in the 1995 report. However, at Quaqtaq the winter and spring winds seem to have weakened somewhat relative to the

Table 1 Station averages for wind speed and power density (PD) at several heights.

Station	Begin - End Record YY/MM	Years	Diurnal data coverage	Weekly data coverage	Anemo- meter height z_a (m)	Ave. speed (PD) at z_a ms^{-1} (Wm^{-2})	Est. speed (PD) at 10m ms^{-1} (Wm^{-2})	Est. speed (PD) at 25m ms^{-1} (Wm^{-2})
MSC Stations (HLY01 Data)								
Kuujuaq Airport	80/01 - 99/12	20	all day	7 days	10.0	4.1 (125)	4.1 (125)	4.8 (193)
Quaqtaq	90/01 - 99/12	10	daytime	7 days or M-F	10.0	5.8 (282)	5.8 (282)	6.6 (434)
Umiujaq Airport	93/02 - 99/01	7	daytime	7 days or M-F	10.0	6.7 (425)	6.7 (425)	7.7 (660)

daytime - data collected only during daytime hours

all day - data collected daytime and nighttime

PD - Power Density (Wm^{-2})

7 days - data collected 7 days per week

M - F - data collected Monday to Friday only

fall winds. This can be seen by comparing the “Monthly Distribution” graph from the present report with the graph in the 1995 report. It is not clear what the explanation for this might be.

graphs of Appendix C) and do not represent long-term averages.

4.7 Diurnal Variation in Power Density

For Kuujuaq there is little change in the diurnal variation in power density from that shown in the 1995 report. For Quaqtaq, information has been lost about the variation during non-daylight hours because of the change in the format of the data collection. It is difficult to draw any conclusions from the graphs for Umiujaq for either the present or the 1995 report period. It should be noted that for both Quaqtaq and Umiujaq, any data outside of daylight hours should be ignored, since they are the result of very infrequent data collection (see the “Data Availability”

5 NUMERICAL MODEL ESTIMATES OF TURBINE POWER PRODUCTION

5.1 Introduction

This section describes MS-Micro/3 model estimates of the average power for an Atlantic Orient Corporation AOC 15/50 wind turbine in the vicinity of the 3 villages under consideration. As for the 1995 report, the

results are presented as isoline (isotach or isodyne) maps of the estimated, long-term average output from this turbine over a small region surrounding the village. For Quaqtaq and Umiujaq, the local regions are identical to those used for the 1995 report. For Kuujjuaq, the region has been expanded a considerable distance to the northwest.

5.2 Model Background

The computer model used, MS-Micro/3, is described in the 1995 report.

5.3 Topography Data

For Quaqtaq and Umiujaq, the topographies used were identical to those used in the 1995 report. They are shown in Appendix F of that report.

For Kuujjuaq, the topography was obtained by interpolating from a Canadian Digital Elevation Data (CDED) model which is a Canadian variation of a Digital Elevation Model (DEM) and is very similar in format to USGS (United States Geological Survey) DEM's. Elevations were interpolated from CDED 24K onto a regular grid aligned with the local UTM (Zone 19) grid. This elevation grid was used as topographic input to the MS-Micro/3 model. Relief, shaded relief and contour maps of this grid are shown in Appendix F. Note that the relief map is characterized by an exaggerated vertical scale. It should also be noted that there is a small strip of topography missing from the southern end of the area. These data are not available in the 24K CDED. However, this does not effect the model calculations as the "inner area" of the model lies to the north of this strip.

5.4 Surface Roughness Data

For Quaqtaq and Umiujaq, roughness grids identical to those of the 1995 report were used for this report. They are shown in Appendix F of the 1995 report.

For Kuujjuaq, the surface roughness (roughness length) was estimated from NTS 1:250,000 map 24K (Kuujjuaq). Roughness lengths were assigned to the areas depicted on the map covered by water, clear land, forested land and built-up habitations.

In the case of the clear land, an ambiguity occurred that was not known to Zephyr North when the 1995 report was compiled. When examining the two NTS 1:250,000 topographic maps in the vicinity of Kuujjuaq (24K and 24F), it was noted that the area depicted as forest (coloured green on the 24F map) stopped suddenly at the 58th parallel of latitude. It required some subsequent investigation to determine that the Geological Survey of Canada treated forested areas differently on northern maps depending on whether they were south or north of 58°. Essentially, on the northern maps if the vegetation would not prevent a pedestrian from viewing the terrain (*i.e.*, to aid in determining where he or she was located) then the vegetation was not marked as forested. Therefore, it is possible on the northern maps to have vegetation (trees or otherwise) up to a height of about 1.5 m without being depicted by green shading.

This, of course, creates a problem for the present study. Previously, it was assumed that unshaded portions of the maps were characterized by tundra and assigned a roughness length, z_0 , of 3 cm. However, in this case, it is possible that there is 1.5 m vegetation covering the terrain, for which a roughness length of 3 cm would not be

appropriate. We handled this situation by carrying out two computer modelling runs - one using a roughness length of 3 cm and one using a roughness length of 10 cm. The results of both runs are summarized by the graphs in Appendix F. Of course, this solution does not cover the case in which there are portions of the study area covered by trees, and portions which are not.

Again, as for the topography, regular grids were generated from the surface-type regions of the maps and were used as input to MS-Micro/3. Maps depicting the surface roughness are shown in Appendix F.

5.5 Model Run Details and Results

Model runs for Quaqtaq and Umiujaq were made using local model domains of 16 km x 16 km with 256 x 256 grid lines for a grid point separation of 62.5 m horizontally. For Kuujjuaq, the local domain was 48 x 48 km with 512 x 512 grid lines for a grid point separation of 93.75 m. In addition to gridded topography and roughness length data, the model runs required a choice for the 'upstream roughness length' for each of the sixteen upstream directions used. These were provided by examining the surface types on the NTS maps for each of the upstream directions. (These were different for the two types of surface assumed for the Kuujjuaq runs.) For the required upstream topographic elevation, the model made its own calculation from the topography 'master grid'. The parameters chosen for each of the runs are presented in Appendix F in the tables labelled 'MS-Micro MASTER PARAMETER SUMMARY'.

One model run was carried out for each of Quaqtaq and Umiujaq, and two runs (for the

assuming two different local surface roughness types) for Kuujjuaq in order to determine the terrain influences at the anemometer location. This information was then used with the joint-frequency (wind speed v , wind direction) tables listed in Appendix D to generate a basis (or reference) joint frequency table that would represent the wind regime without the influence of the local topography and surface roughness. This synthesized joint-frequency table was then combined with model runs for the area to generate wind speed and AOC 15/50 turbine power output isoline maps.

The wind speed and turbine power isoline maps are shown in Appendix F. The latter can be used to estimate the average turbine output for any location in an 8 km x 8 km (24 x 24 km for Kuujjuaq) region in the vicinity of the village.

Note that the scales on the maps are in metres in the UTM coordinate system and that the villages are all located in UTM Zone 19.

It is worth noting that the resolution of the (input) terrain for the Kuujjuaq model runs is coarser than that of Quaqtaq and Umiujaq for two reasons. First, the CDED digital elevations are provided on 3 arc-second centres or about 60 m (east-west) by 100 m (north-south) centres. Second, the grid point separation was larger due to the choice of a larger computational domain. (This was compensated somewhat by the choice of 512 grid lines.) Both of these will have the effect of numerically smoothing the terrain, which will in turn smooth out some of the high frequency components of predicted wind speed and power density. As a consequence, if a wind turbine site is chosen from the Kuujjuaq isotach or isodyne maps presented in this report, it is recommended that some

consideration be given to modelling a smaller domain in the vicinity of that site using more detailed (1:50,000) topographic maps for input. Of course, it is always highly recommended that on-site wind monitoring for a minimum of one year be carried out on any candidate site.

Umiujaq, this appears to have been due to normal climatic variations. For Quaqtaq, this could be due to climatic variation but it seems unlikely that all annual average wind speeds before 1984 would be above the long-term average wind speed while all annual average wind speeds after this date would be below the long-term average. Some reasons for the discrepancy have been suggested, and this station may be a candidate for further investigation.

6 CONCLUSIONS

6.1 Data Quality

It is felt that observer bias (as described in Section 3 of the 1995 report) was not as evident in some the present data sets. This may be due to conversion of the stations to “automatic” but this is not definitely known at present.

Unfortunately, Quaqtaq and Umiujaq only have daytime observations and some of these are only taken Monday-to-Friday.

For this report Quaqtaq was characterized by daytime observations at hourly intervals. For the 1995 report, observations were taken at 3-hourly intervals for 21 or 24 hours of the day. It could not be determined what effect this might have had on data quality.

6.2 The Wind Resource

The wind resource appeared to have diminished at all three of the stations examined. In the case of Kuujjuaq and

6.3 Kuujjuaq Site Selection

As explained above, the resolution of the input data and model grid for the Kuujjuaq study was coarser than for Quaqtaq and Umiujaq. As a consequence, it is recommended that any potential Kuujjuaq wind turbine sites chosen from this modelling study be considered for finer detail modelling using finer resolution input data.

7 ACKNOWLEDGEMENTS

The author wishes to thank Hydro-Québec for the funding for this study.

8 REFERENCES

Atmospheric Environment Service, 1982:
Canadian Climate Normals, Volume 5, Wind, 1951-1980, Climatological Services Division, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4.

Atmospheric Environment Service, 1989:
Climatological Station Catalogue, Ontario, Climatological Services Division, Canadian Climate Centre, Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, M3H 5T4.

Salmon, J.R. and P.G. Stalker, 1995:
Northern Québec Wind Resource Study: Historical Wind Data and Numerical Modelling, prepared for Hydro-Québec by Zephyr North, 1995/10/31.

**9 APPENDIX A - See 1995
report.**

**10 APPENDIX B - See 1995
report.**

11 APPENDIX C - STATION DATA

This appendix contains station summaries with geographic, meteorological, terrain and station siting information. Also included are graphs showing the data availability for each of the stations for the complete station period.

Station: **Kuujuaq A**Abbreviation: **KUJJUAQ**Network ID: **7**Network: **MSC Regular (HLY01)**Network Abbr: **R4AE**Type: **MSC Synoptic and Auto Stations**Longitude: **-68.4281°E**Latitude: **58.0917°N**Elevation(amsl): **37m**Easting: **533,722m**Northing: **6,438,848m**UTM Zone: **19**NTS Map References: **24K/1, 24K/2, 24K (1:250,000)**Data start: **80/01**Data end: **99/12**Data archiving interval: **60min**

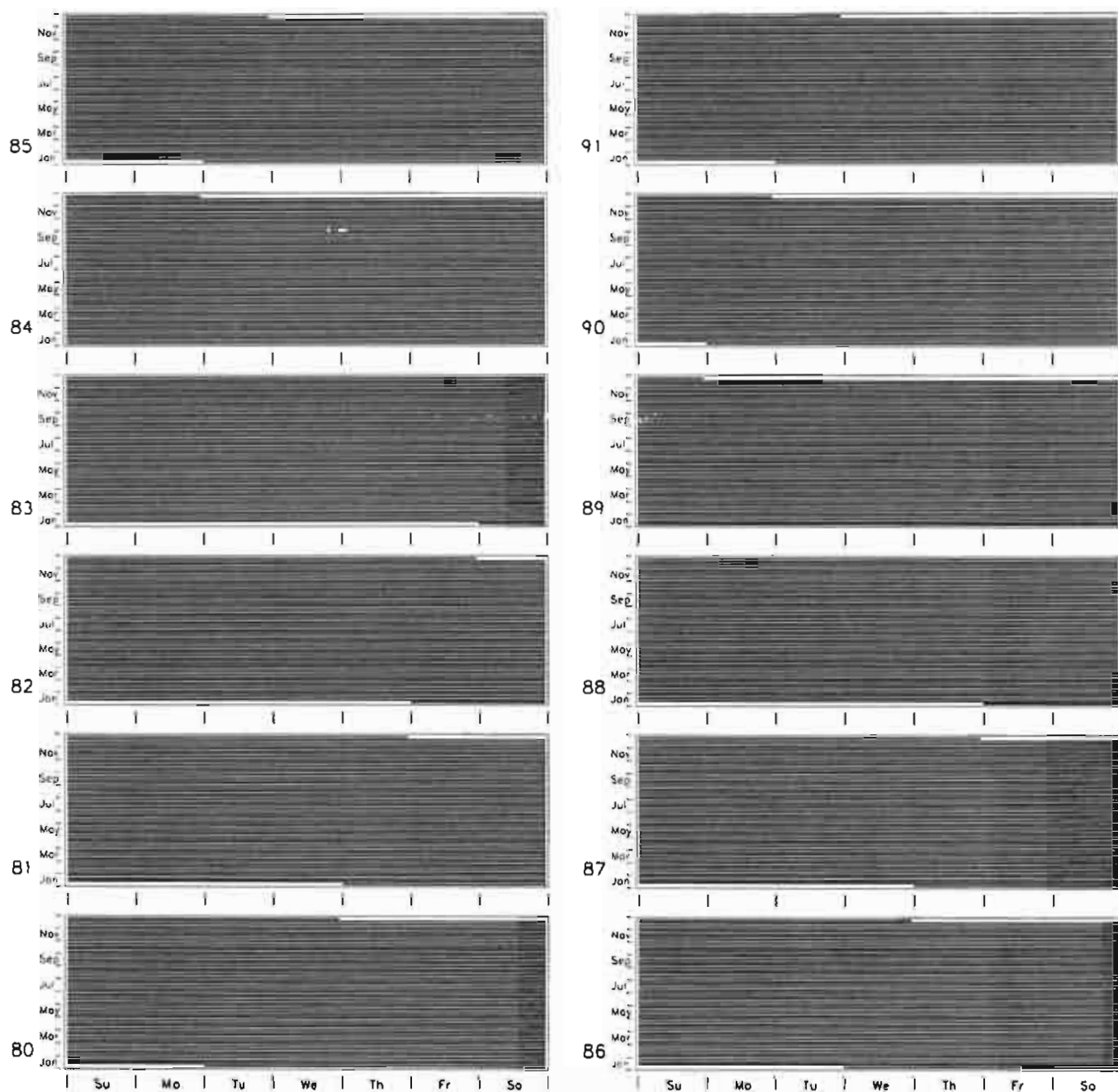
Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The instrument site is situated 55 meters to the south of the airport FSS tower. The site is covered with gravel and is slightly inclined for drainage. The nearby terrain is relatively flat and clear. The Koksoak River runs about 700 meters further south on an ENE-WSW axis. Mountains (about 500 meters elevation) rise in all cardinal directions at various distances. The closest are about 5 kilometers away. Everywhere, the ground is covered with lichens and rocks. The anemometer tower is situated on a cleared apron on the north side of runway 07-25 and about midway between the ends of the runway."
2. From photographs, the local terrain seems to be tundra.

DATA AVAILABILITY

Northern QC WRA II - AES Stations



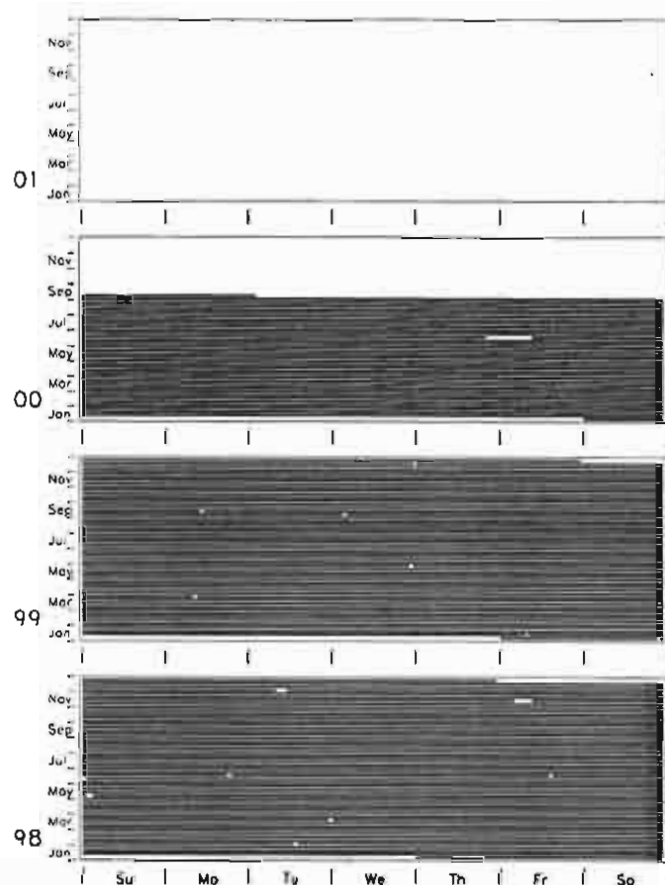
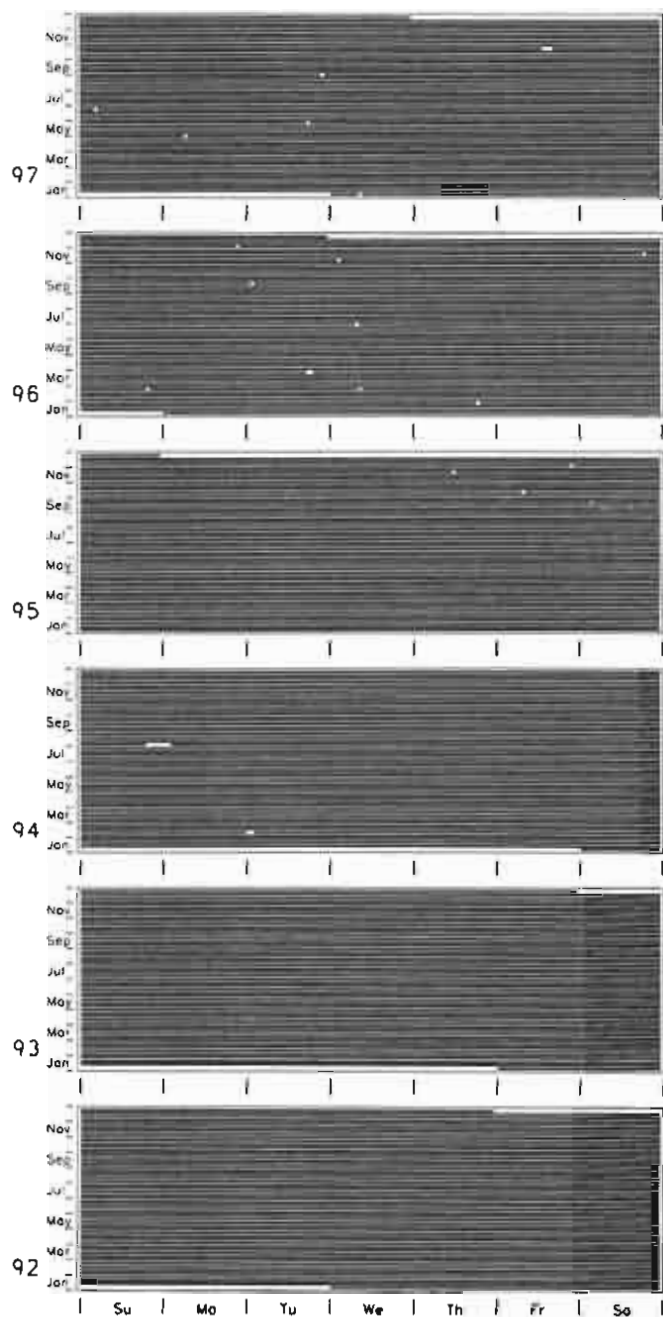
Period: 1980 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Kuujjuaq A (1)

Wind Speed (m/s) at z=-99.00 m

DATA AVAILABILITY

Northern QC WRA II - AES Stations



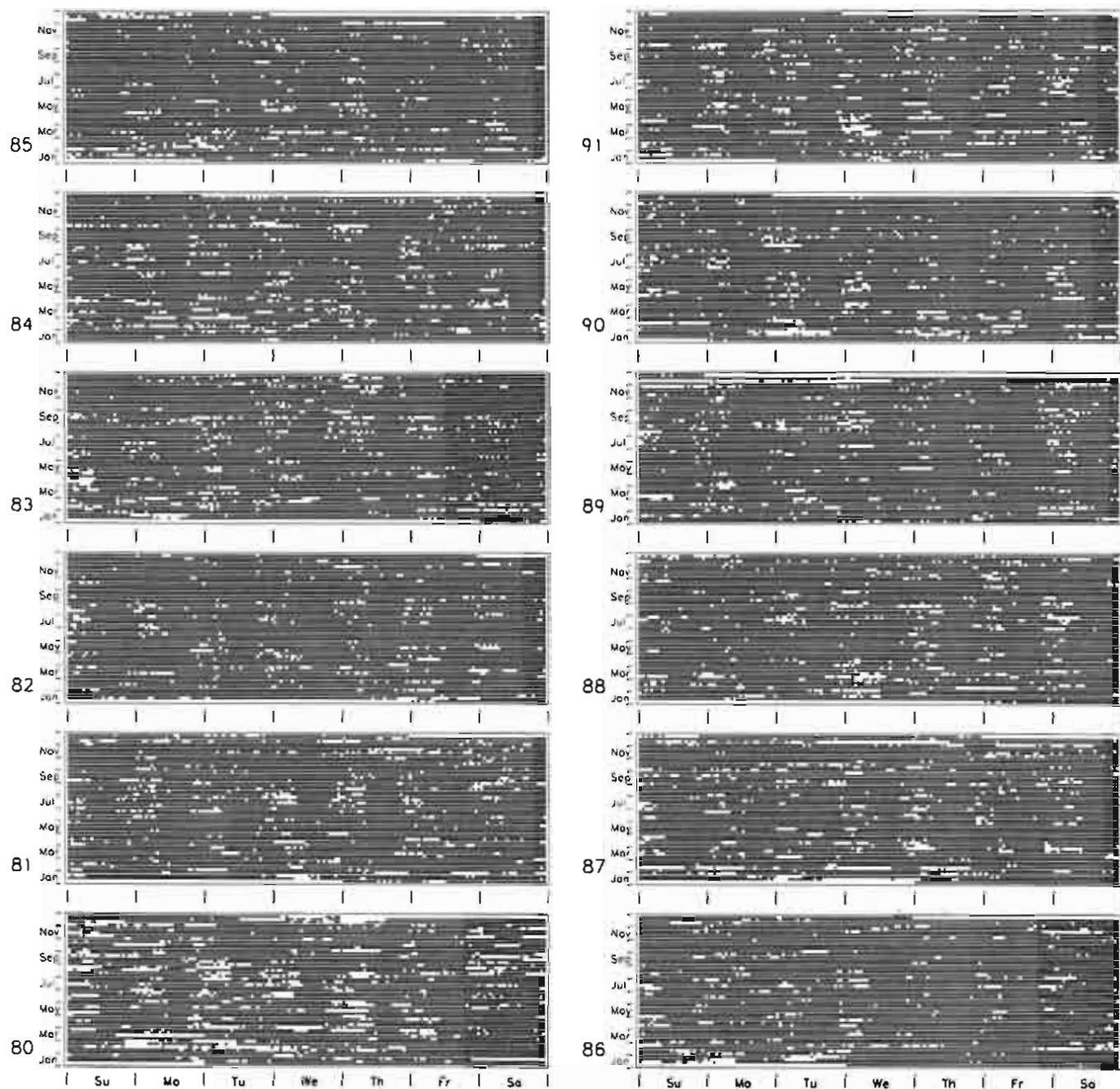
Period: 1980 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Kuujuaq A (1)

Wind Speed (m/s) at z=-99.00 m

DATA AVAILABILITY

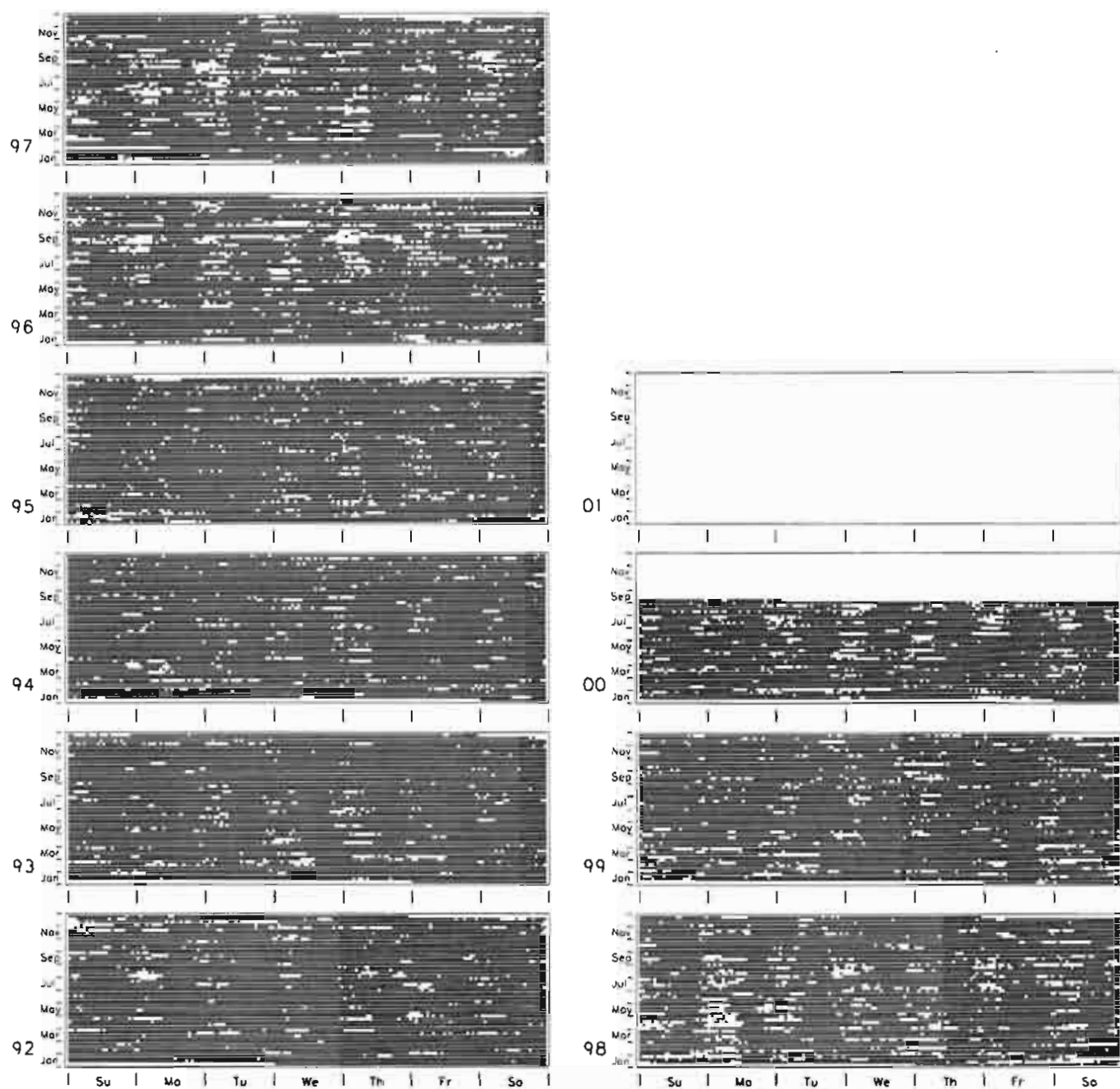
Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2001 Jan 01 00:00
 Station: Kuujuaq A (1)
 Wind Direction (degt) at z=-99.00 m

DATA AVAILABILITY

Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Kuujuaq A (1)

Wind Direction (degt) at z=-99.00 m

Station: **Quaqtaq**Abbreviation: **QUAQTAQ**Network ID: **1**Network: **MSC Regular (HLY01)**Network Abbr: **R4AE**Type: **MSC Synoptic and Auto Stations**Longitude: **-69.6300°E**Latitude: **61.0464°N**Elevation(amsl): **29m**Easting: **465,975m**Northing: **6,767,914m**UTM Zone: **19**NTS Map References: **25F/4, 25F/3, 25C/13, 25C/14**Data start: **90/01**Data end: **99/12**Data archiving interval: **60min**

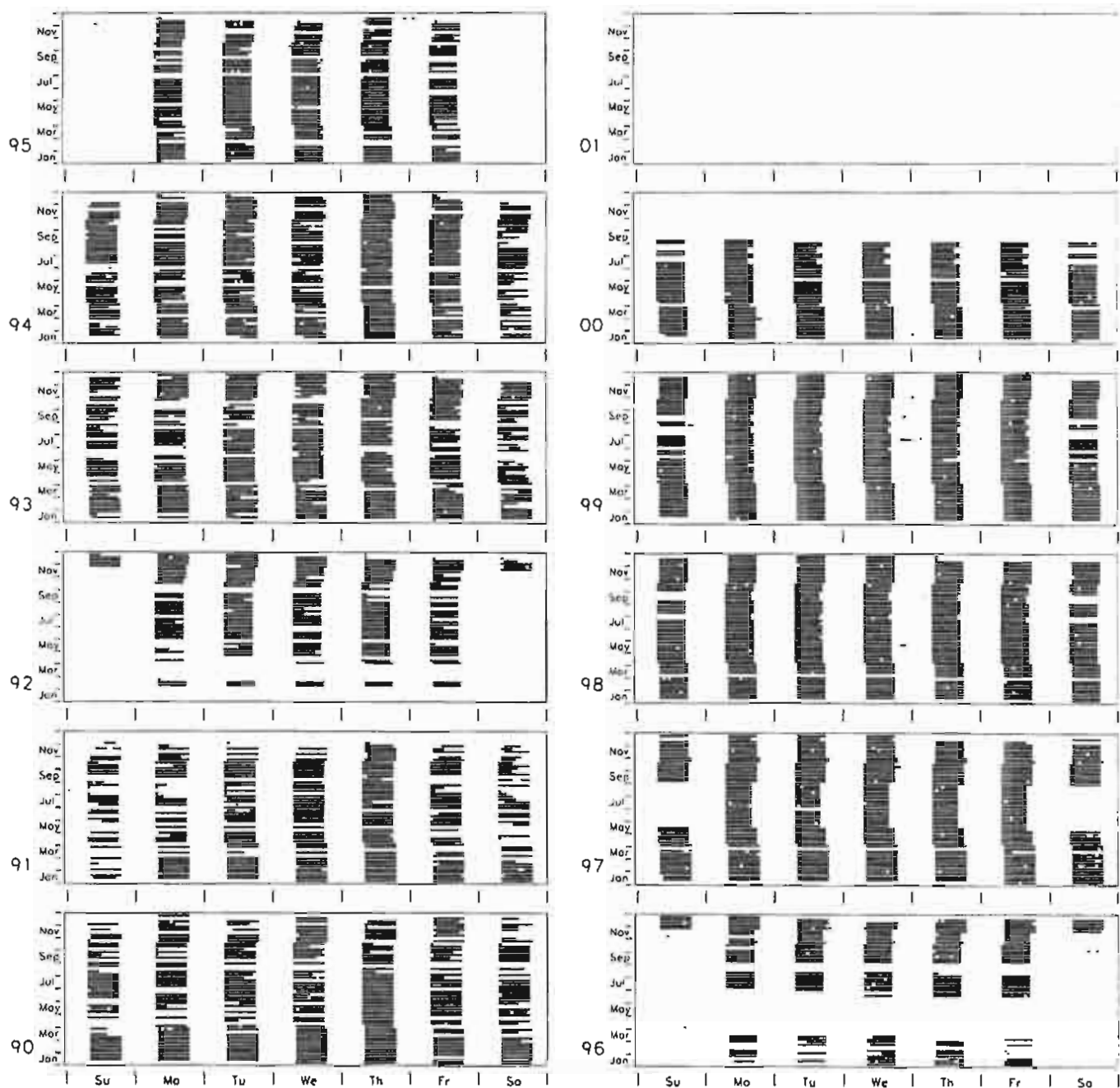
Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "The station is located at Quaqtaq Airport which is situated on the east coast of Diana Bay. The general topography is uneven with many small hills. The instrument site is on gravel...the ceiling projector and the anemometer tower are 300 meters south-east of the station."
2. From photographs, the surrounding terrain seems to be tundra.

DATA AVAILABILITY

Northern QC WRA II - AES Stations



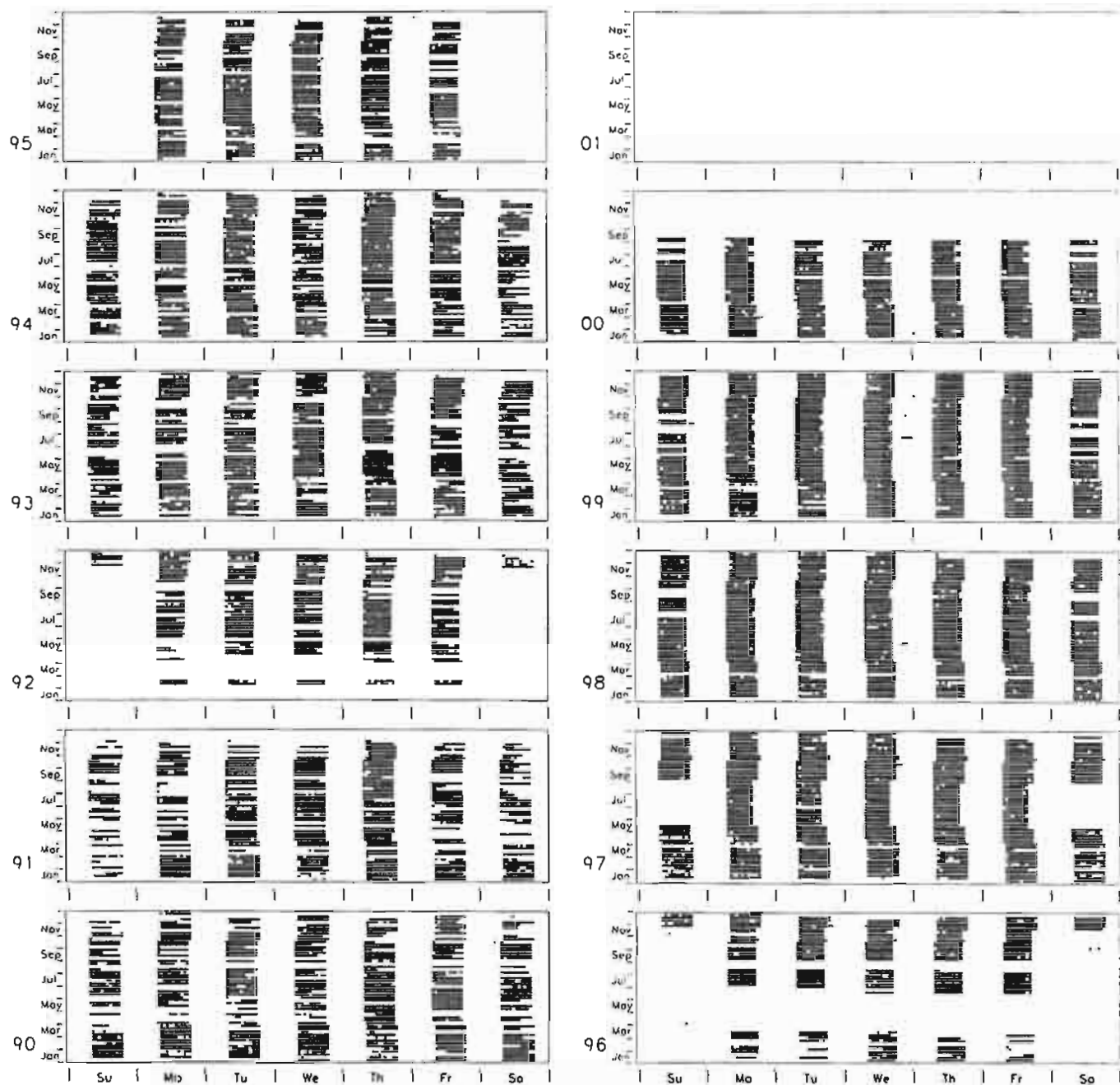
Period: 1990 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Quaqtaq (2)

Wind Speed (m/s) at z=-99.00 m

DATA AVAILABILITY

Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2001 Jan 01 00:00
 Station: Quaqtoq (2)
 Wind Direction (degt) at z=-99.00 m

Station: **Umiujaq A**Abbreviation: **UMIUJQAQ**Network ID: **8**Network: **MSC Regular (HLY01)**Network Abbr: **R4AE**Type: **MSC Synoptic and Auto Stations**Longitude: **-76.5033°E**Latitude: **56.5375°N**Elevation(amsl): **71m**Easting: **407,547m**Northing: **6,266,704m**UTM Zone: **18**NTS Map References: **34C/10, 34C/7, 34C/8, 34C/9,**Data start: **93/02**Data end: **00/01**Data archiving interval: **60min**

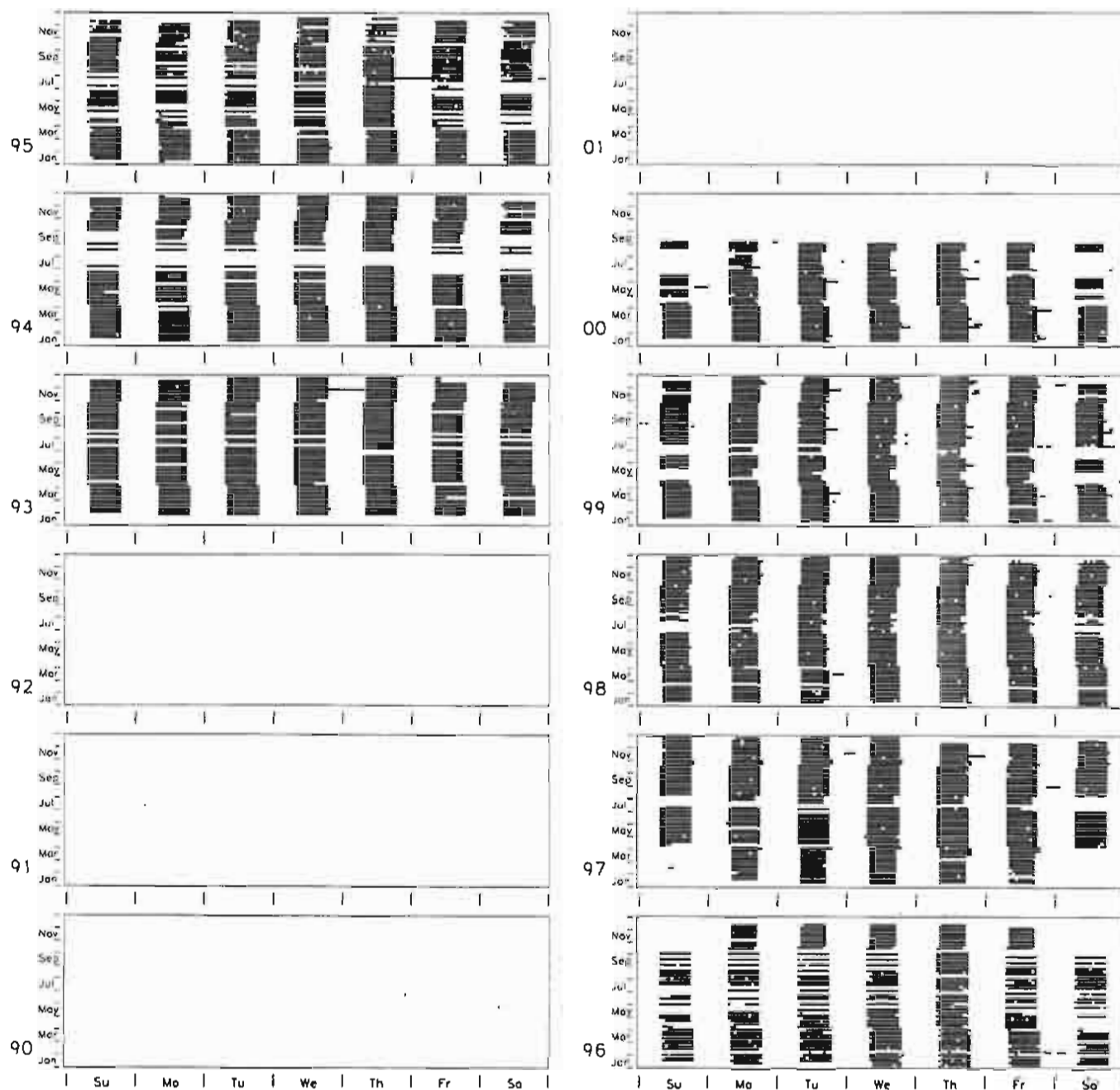
Parameters measured directly	Abbrev.	Units	Height	Interval
Wind Speed	WSpd	m/s	10.0m	60min
Wind Direction	WDir	°(true)	10.0	60
Air Temperature (dry bulb)	Temp	C	1.5	60
Station barometric pressure	BPress	kPa	1.5	60
Parameters derived by datalogger	Abbrev.	Units	Height	Interval
none				

	Topography	Roughness
N	see map	see map
NE	see map	see map
E	see map	see map
SE	see map	see map
S	see map	see map
SW	see map	see map
W	see map	see map
NW	see map	see map

1. "Umiujaq is located on the east shore of the Hudson Bay. The station is at the airport in the terminal building. It is surrounded by hills (so the visibility is limited to the south, east and north) with the sea to the west. The surface of the ground in general is covered by rocks, grass and little bushes...The anemometer tower with the projector are located 140 meters to the south of the station. The sites of those instruments are all filled with compact gravel from the runway. The instruments are all well exposed and within their standards."

DATA AVAILABILITY

Northern QC WRA II - AES Stations



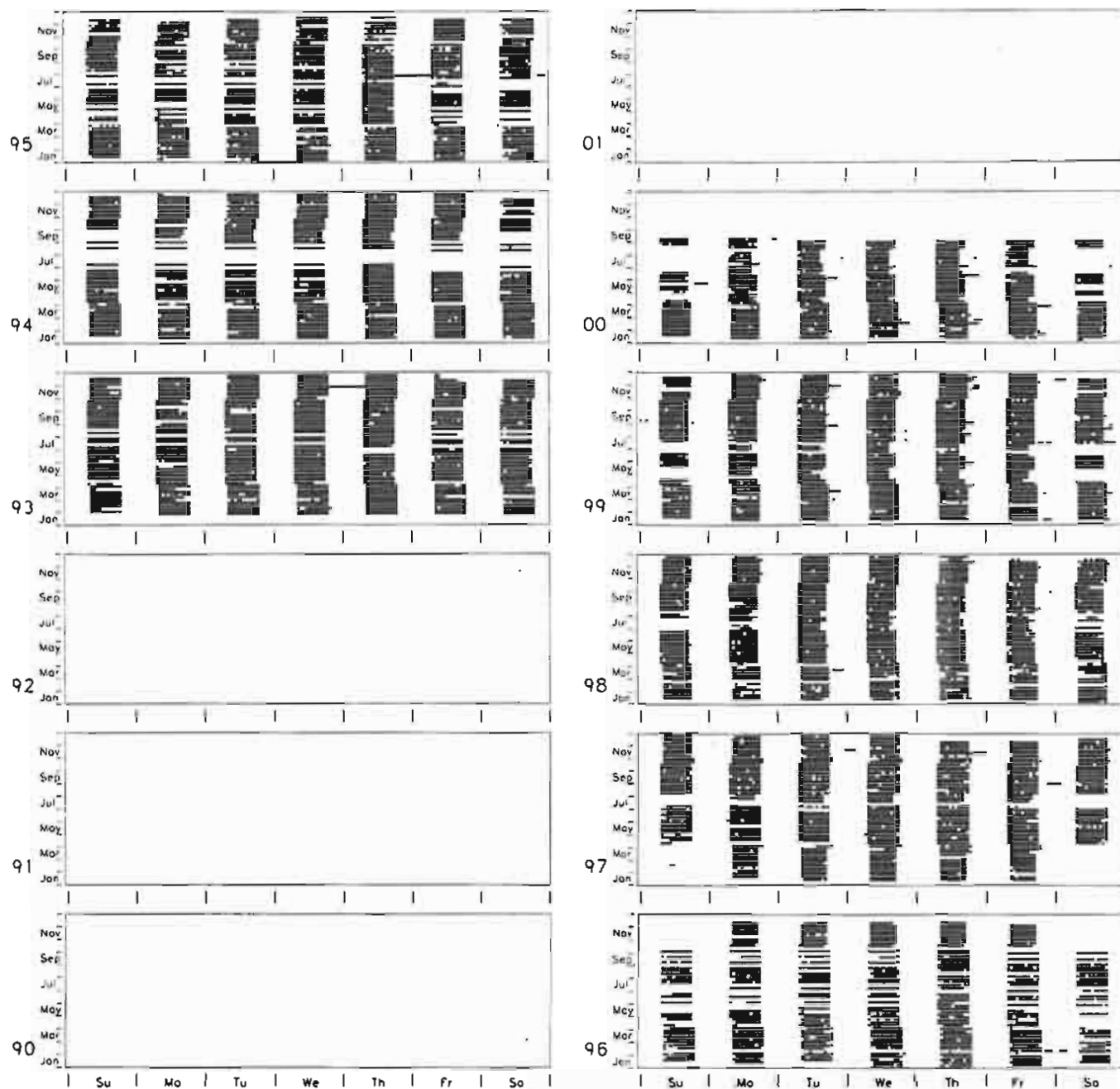
Period: 1990 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Umiujaq A (3)

Wind Speed (m/s) at z=-99.00 m

DATA AVAILABILITY

Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2001 Jan 01 00:00

Station: Umiujaq A (3)

Wind Direction (degt) at z=-99.00 m

12 APPENDIX D - WIND DATA SUMMARIES

This appendix contains graphs summarizing wind energy resource characteristics at all stations. The summarized data are presented for the anemometer height and are not corrected for obstructions to the anemometer and are not corrected for terrain influences. The following sections describe the graphs.

12.1 Wind Distribution (Table)

Joint-frequency table of wind speed v. wind direction (averaged over the complete station period).

12.2 Wind Distribution (Graph)

The multiple plots on this diagram are derived from binned data expressed as joint frequency distributions of wind speed or wind power density with wind direction sector. Sixteen wind direction sectors were used. There is one page for each measurement level.

Left Side - Wind Rose Plots

Top - Distribution by direction of frequency of occurrence of the wind.

Note that calms have been distributed equally throughout all directions.

Centre - Distribution by direction of average wind speed.

The average wind speed in each direction is shown along with the overall average wind speed. This includes calms distributed equally throughout all directions. Averages have been calculated as described in Appendix A.

Bottom - Distribution by direction of average wind power density.

The average wind power density in each direction is shown along with the overall average power density. This includes calms distributed equally throughout all directions. Note that it is the percentage of the overall power density that is shown in each sector.

Right Side - Frequency Histograms

Top - Percentage occurrence of wind speed v. wind speed for all directions.

Wind speed bins are 0.5m/s wide. Weibull parameters c and k are shown as well as the Weibull distribution represented by those parameters.

Below - Percentage occurrence of wind speed v. wind speed by direction bin.

Wind speed bins are 0.5m/s wide. Each histogram represents the distribution of the wind speed within the directions indicated on the graph. Weibull parameters c and k (for the particular direction plot) are shown as

well as the Weibull distribution represented by those parameters.

12.3 Annual Averages (Table)

This table lists the annual statistics (generally averages) for the station. The format of the table is described in Appendix E. The averages are calculated as described in Appendix A of the 1995 report.

12.4 Annual Averages (Graph)

These two graphs show the annual variation in mean wind speed and mean wind power density at the measurement level(s).

12.5 Seasonal Distribution (Table)

Table of the seasonal variation of wind speed, wind power density, and other parameters (averaged over the complete station period). The format of the table is described in Appendix E. The averages are calculated as described in Appendix A of the 1995 report.

12.6 Seasonal Distribution (Graph)

Histograms of the seasonal variation of wind speed and wind power density (averaged over the complete station period).

12.7 Monthly Roses (Graph)

This graph shows the monthly distribution by direction of the wind frequency, the average wind speed and the average power density. Note that for the power density, it is the percentage of the total power density (all

directions) that is displayed for each direction sector.

12.8 Monthly Distribution (Table)

Table of the monthly variation of wind speed, wind power density, and other parameters (averaged over the complete station period). The format of the table is described in Appendix E. The averages are calculated as described in Appendix A of the 1995 report.

12.9 Monthly Distribution (Graph)

Histograms of the monthly variation in mean wind speed and mean wind power density at the measurement level(s).

12.10 Diurnal Distribution (Table)

Monthly tables of the diurnal variation of wind speed and power density (averaged over the complete station period).

12.11 Diurnal Distribution (Graph)

Separate graphs of the variation in wind speed and wind power density with time of day, are provided for each month of the year. Averages are taken over the entire period of record.

• • • • •

Northern QC WRA II - AES Stations

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Kuujuung A (1)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Percentage of Observations per Bin

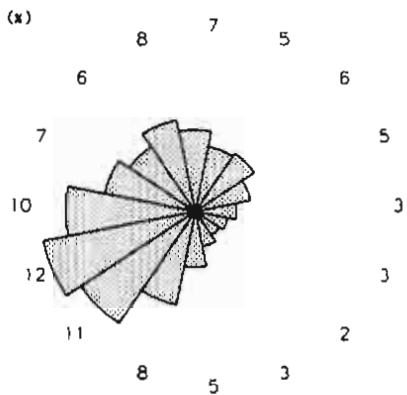
Weibull C (m/s)	4.9	4.7	4.7	4.0	3.3	3.1	2.9	3.0	3.5	3.8	4.5	5.3	5.8	5.4	4.7	4.6
Weibull k	1.5	1.5	1.6	1.5	1.4	1.3	1.2	1.3	1.5	1.6	1.7	1.7	1.6	1.5	1.5	1.5
Ave.Speed (m/s)	4.46	4.23	4.24	3.63	2.98	2.83	2.63	2.72	3.13	3.40	3.98	4.73	5.25	4.87	4.22	4.16
For all directions: Weibull C (m/s) = 4.6 k = 1.5 Ave.Speed (m/s) = 4.1																

Total Time Periods: 175321 Total Observations: 175263 100.0% Data Availability
Includes 13832 calms distributed evenly throughout direct~~ion~~ bins.
01/04/19

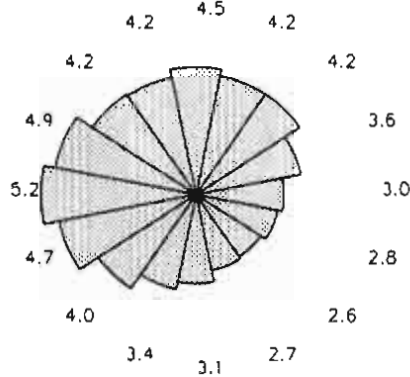
WIND DISTRIBUTION

Northern QC WRA II - AES Stations

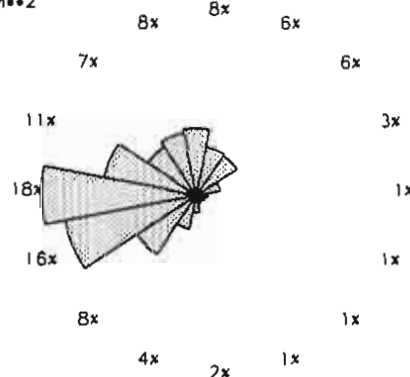
FREQUENCY (%)



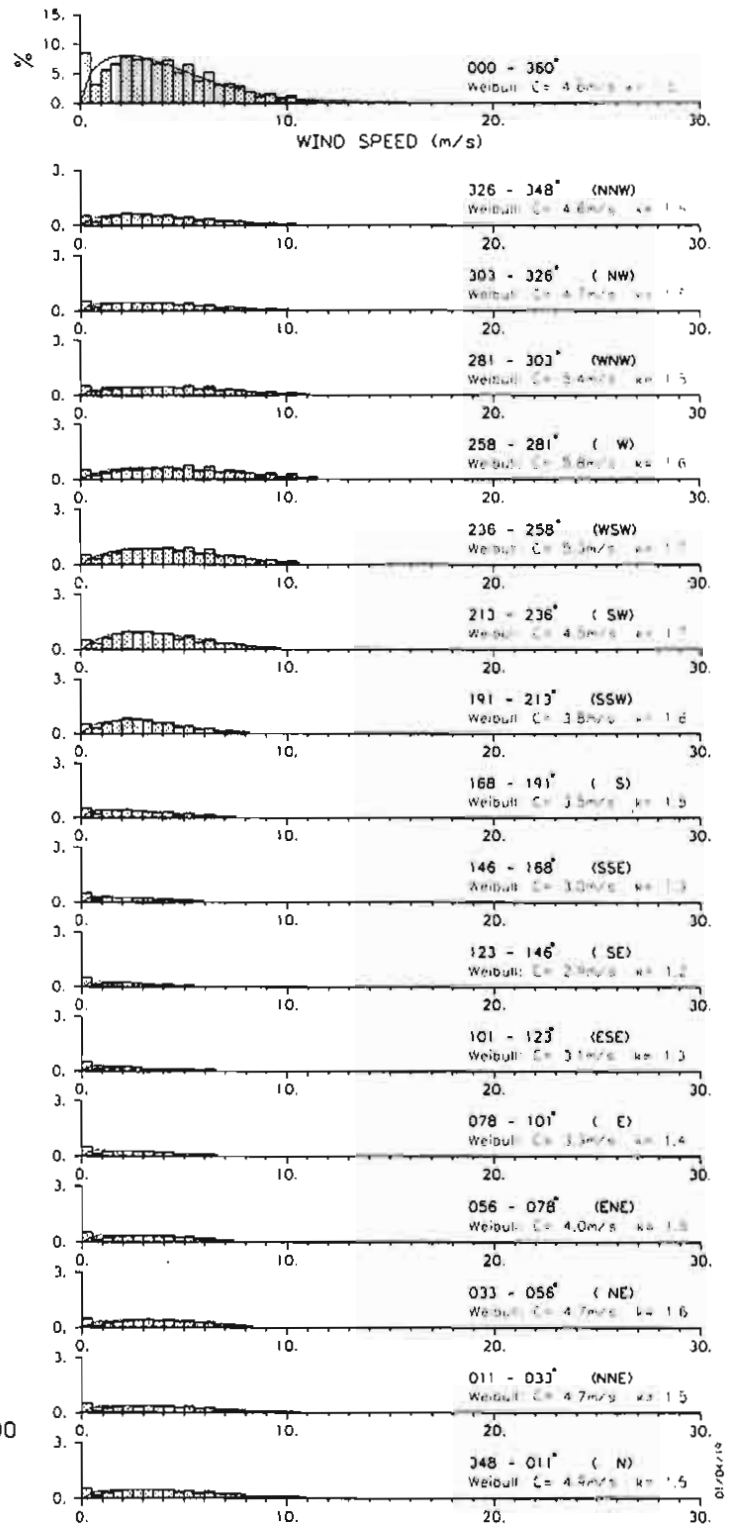
AVERAGE SPEED (m/s)
4.1m/s



POWER DENSITY (W/m²)
125.W/m²



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Kuujuaq A (1)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES Northern QC WRA II - AES Stations

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
 Kuujuaq A (1)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	3.8	278.	17.2	-N/A-	108.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.0	286.	19.7	-N/A-	115.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	4.7	266.	20.4	-N/A-	136.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	-5.9	100.91	1.320	4.2	283.	18.6	-N/A-	112.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	4.4	272.	22.9	-N/A-	140.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	4.3	284.	19.1	-N/A-	142.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	4.6	264.	23.5	-N/A-	164.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.1	284.	17.7	-N/A-	128.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.0	268.	15.6	-N/A-	105.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	4.5	271.	19.3	-N/A-	143.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	4.4	261.	16.9	-N/A-	138.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	3.9	265.	21.7	-N/A-	102.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.2	271.	18.5	-N/A-	129.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.3	265.	27.4	-N/A-	138.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.63	1.314	4.7	273.	21.5	-N/A-	180.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-4.4	100.82	1.311	3.8	261.	21.8	-N/A-	99.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-4.0	100.80	1.308	3.7	281.	23.1	-N/A-	109.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-5.0	100.57	1.310	3.7	290.	18.5	-N/A-	92.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-3.7	100.80	1.307	3.5	290.	20.5	-N/A-	76.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-3.1	100.71	1.302	3.9	289.	20.5	-N/A-	91.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->81/01/01	100.0	100.0	100.0	100.0	85.6	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	92.3	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	94.8	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	92.7	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	94.2	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	91.3	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	100.0	100.0	100.0	100.0	92.8	100.0	0.0	100.0	0.0	0.0	0.0
90/01/01->91/01/01	100.0	100.0	100.0	100.0	94.0	100.0	0.0	100.0	0.0	0.0	0.0
91/01/01->92/01/01	100.0	100.0	100.0	100.0	93.0	100.0	0.0	100.0	0.0	0.0	0.0
92/01/01->93/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
93/01/01->94/01/01	100.0	100.0	100.0	100.0	94.9	100.0	0.0	100.0	0.0	0.0	0.0
94/01/01->95/01/01	99.9	99.9	99.9	99.9	94.9	99.9	0.0	99.9	0.0	0.0	0.0
95/01/01->96/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
96/01/01->97/01/01	99.9	99.9	99.9	99.9	88.1	99.9	0.0	99.9	0.0	0.0	0.0
97/01/01->98/01/01	99.9	99.9	99.9	99.9	87.7	99.9	0.0	99.9	0.0	0.0	0.0
98/01/01->99/01/01	99.8	99.8	99.8	99.8	86.9	99.8	0.0	99.8	0.0	0.0	0.0
99/01/01->00/01/01	99.9	99.9	99.9	99.9	91.5	99.9	0.0	99.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->00/01/01	-5.3	100.70	1.314	4.1	274.	27.4	-N/A-	125.	-N/A-	-N/A-	-N/A-

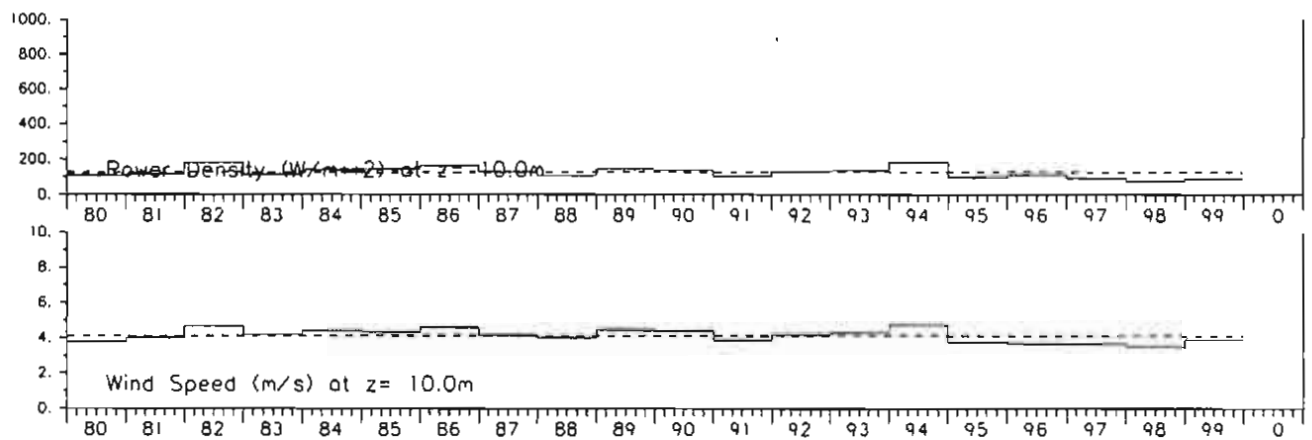
Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
80/01/01->00/01/01	100.0	100.0	100.0	100.0	92.1	100.0	0.0	100.0	0.0	0.0	0.0

01/04/19

ANNUAL AVERAGES

Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Kuujjuaq A (1)

SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Kuujuaq A (1)

Seasonal Average

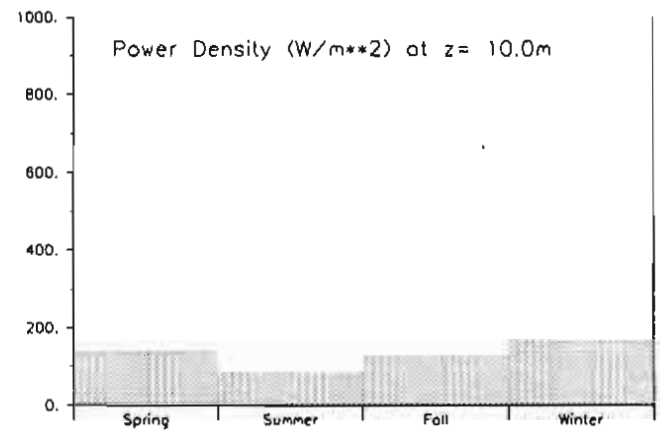
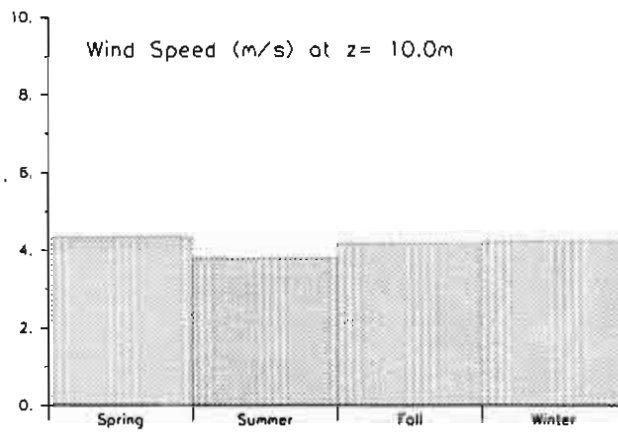
	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	Trbints 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Spring	-8.5	101.10	1.333	4.3	304.	18.5	-N/A-	135.	-N/A-	-N/A-	-N/A-
Summer	10.0	100.53	1.237	3.8	325.	17.3	-N/A-	82.	-N/A-	-N/A-	-N/A-
Fall	-0.8	100.55	1.287	4.2	260.	27.4	-N/A-	121.	-N/A-	-N/A-	-N/A-
Winter	-22.2	100.62	1.399	4.2	246.	23.1	-N/A-	162.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	Trbints	TrbnPwr	TrbnOut
Spring	100.0	100.0	100.0	100.0	92.6	100.0	0.0	100.0	0.0	0.0	0.0
Summer	100.0	100.0	100.0	100.0	92.7	100.0	0.0	100.0	0.0	0.0	0.0
Fall	100.0	99.9	99.9	100.0	93.3	100.0	0.0	100.0	0.0	0.0	0.0
Winter	100.0	100.0	100.0	100.0	89.6	100.0	0.0	100.0	0.0	0.0	0.0

01/05/20

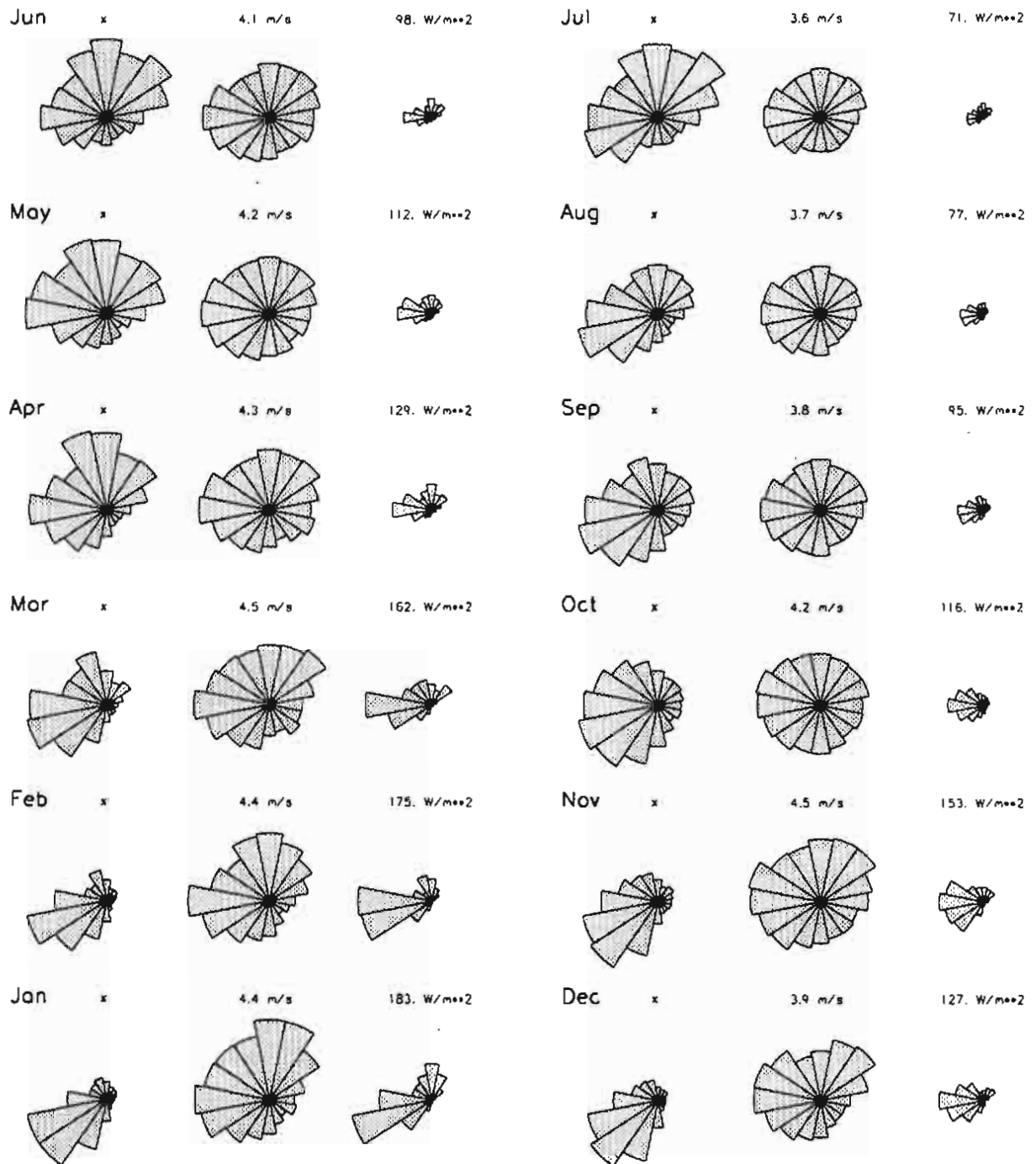
SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Kuujjuaq A (1)

MONTHLY ROSES

Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Kuujuaq A (1)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Frequency (x) | Average speed (m/s) | x Power density (W/m²)

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Kuujuuaq A (1)

Monthly Average

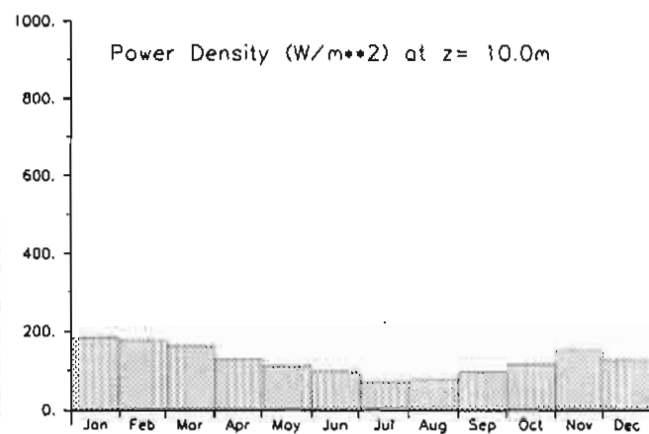
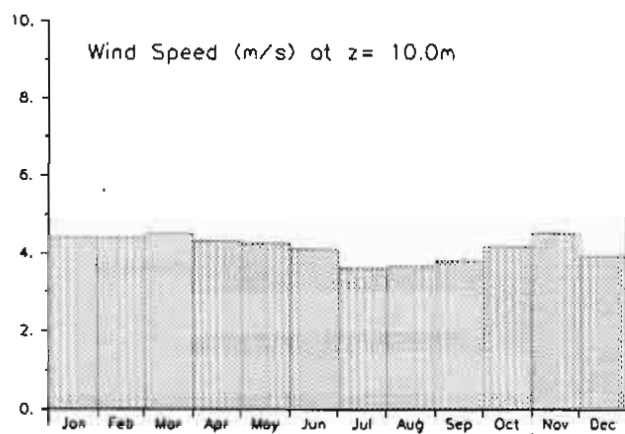
	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Jan	-24.0	100.50	1.407	4.4	243.	23.1	-N/A-	183.	-N/A-	-N/A-	-N/A-
Feb	-23.7	100.77	1.409	4.4	254.	21.8	-N/A-	175.	-N/A-	-N/A-	-N/A-
Mar	-17.5	101.06	1.379	4.5	278.	18.5	-N/A-	162.	-N/A-	-N/A-	-N/A-
Apr	-8.2	101.21	1.332	4.3	318.	16.0	-N/A-	129.	-N/A-	-N/A-	-N/A-
May	0.3	101.02	1.287	4.2	325.	17.7	-N/A-	113.	-N/A-	-N/A-	-N/A-
Jun	7.4	100.63	1.250	4.1	348.	17.2	-N/A-	95.	-N/A-	-N/A-	-N/A-
Jul	11.6	100.44	1.229	3.6	337.	16.2	-N/A-	71.	-N/A-	-N/A-	-N/A-
Aug	10.9	100.51	1.233	3.7	389.	17.3	-N/A-	77.	-N/A-	-N/A-	-N/A-
Sep	6.0	100.50	1.255	3.8	271.	17.5	-N/A-	95.	-N/A-	-N/A-	-N/A-
Oct	-0.2	100.64	1.285	4.2	261.	23.5	-N/A-	116.	-N/A-	-N/A-	-N/A-
Nov	-8.1	100.52	1.322	4.5	252.	27.4	-N/A-	151.	-N/A-	-N/A-	-N/A-
Dec	-19.0	100.60	1.381	3.9	241.	21.7	-N/A-	127.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
Jan	100.0	100.0	100.0	100.0	89.7	100.0	0.0	100.0	0.0	0.0	0.0
Feb	100.0	100.0	100.0	100.0	89.3	100.0	0.0	100.0	0.0	0.0	0.0
Mar	100.0	100.0	100.0	100.0	91.6	100.0	0.0	100.0	0.0	0.0	0.0
Apr	100.0	100.0	100.0	100.0	91.9	100.0	0.0	100.0	0.0	0.0	0.0
May	100.0	100.0	100.0	100.0	94.4	100.0	0.0	100.0	0.0	0.0	0.0
Jun	100.0	100.0	100.0	100.0	93.7	100.0	0.0	100.0	0.0	0.0	0.0
Jul	100.0	100.0	100.0	100.0	92.4	100.0	0.0	100.0	0.0	0.0	0.0
Aug	100.0	100.0	100.0	100.0	92.0	100.0	0.0	100.0	0.0	0.0	0.0
Sep	100.0	100.0	100.0	100.0	91.6	100.0	0.0	100.0	0.0	0.0	0.0
Oct	99.9	99.9	99.9	99.9	93.9	99.9	0.0	99.9	0.0	0.0	0.0
Nov	99.9	99.9	99.9	99.9	94.6	99.9	0.0	99.9	0.0	0.0	0.0
Dec	100.0	99.9	99.9	100.0	89.7	100.0	0.0	100.0	0.0	0.0	0.0

01/04/19

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Kuujuaq A (1)

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00
Kuuujuaq A (1)

Wind Speed (m/s) z= 10.0m

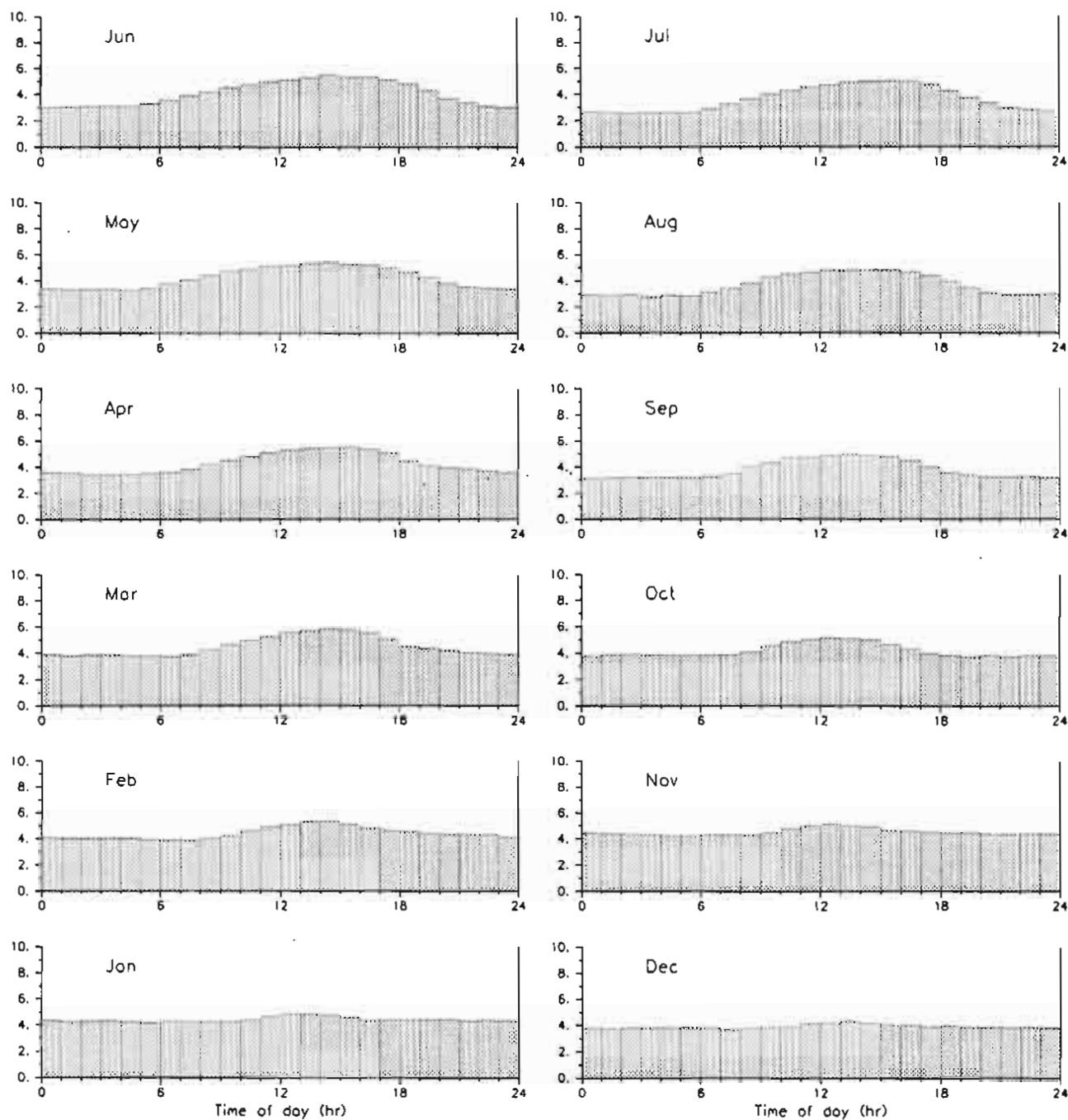
Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	4.3	4.1	3.9	3.6	3.4	3.0	2.7	2.9	3.1	3.7	4.4	3.8
1	4.2	4.0	3.8	3.5	3.3	3.1	2.6	2.9	3.1	3.9	4.4	3.8
2	4.3	4.0	3.9	3.4	3.3	3.1	2.6	2.9	3.2	3.9	4.4	3.8
3	4.3	4.0	3.9	3.4	3.4	3.1	2.6	2.7	3.2	3.8	4.3	3.8
4	4.2	4.0	3.8	3.5	3.3	3.1	2.6	2.8	3.2	3.8	4.3	3.8
5	4.1	3.9	3.8	3.5	3.4	3.3	2.6	2.8	3.1	3.8	4.2	3.9
6	4.3	3.9	3.7	3.6	3.8	3.5	2.9	3.1	3.2	3.8	4.3	3.8
7	4.3	3.8	3.9	3.8	4.1	3.9	3.2	3.4	3.5	3.8	4.3	3.7
8	4.2	4.0	4.2	4.2	4.5	4.2	3.6	3.8	4.1	4.1	4.3	3.8
9	4.3	4.2	4.6	4.5	4.8	4.5	4.0	4.3	4.3	4.6	4.4	3.9
10	4.4	4.6	5.0	4.8	4.9	4.7	4.3	4.5	4.7	4.8	4.8	3.9
11	4.7	4.9	5.2	5.1	5.1	4.9	4.5	4.6	4.7	5.0	5.0	4.1
12	4.9	5.0	5.5	5.3	5.2	5.1	4.7	4.8	4.9	5.1	5.1	4.2
13	4.9	5.3	5.6	5.4	5.3	5.3	4.8	4.8	5.0	5.1	5.0	4.3
14	4.7	5.3	5.8	5.5	5.4	5.5	4.9	4.8	4.9	5.0	4.9	4.2
15	4.6	5.1	5.7	5.5	5.3	5.3	5.0	4.8	4.8	4.6	4.7	4.1
16	4.4	4.8	5.5	5.4	5.2	5.3	4.9	4.7	4.5	4.3	4.6	4.0
17	4.4	4.6	5.0	5.1	5.0	5.1	4.7	4.3	4.0	3.9	4.5	3.9
18	4.4	4.5	4.5	4.5	4.7	4.8	4.2	3.9	3.6	3.8	4.4	4.0
19	4.4	4.4	4.3	4.1	4.2	4.3	3.7	3.4	3.4	3.7	4.5	3.9
20	4.4	4.3	4.2	4.0	3.8	3.6	3.3	3.1	3.2	3.8	4.4	3.8
21	4.3	4.3	4.0	3.8	3.5	3.3	2.9	2.9	3.2	3.7	4.4	3.8
22	4.3	4.3	4.0	3.7	3.4	3.1	2.8	2.9	3.3	3.8	4.4	3.9
23	4.3	4.1	3.9	3.6	3.4	3.0	2.7	3.0	3.2	3.8	4.4	3.8

Power Density (W/m**2) z= 10.0m

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	182.	152.	117.	94.	75.	50.	35.	52.	62.	98.	145.	114.
1	201.	151.	114.	92.	76.	56.	37.	46.	64.	101.	138.	114.
2	195.	152.	124.	87.	73.	54.	34.	47.	67.	106.	141.	114.
3	183.	151.	122.	87.	69.	60.	34.	41.	66.	106.	143.	120.
4	182.	153.	115.	89.	63.	57.	34.	44.	71.	105.	141.	118.
5	165.	146.	114.	91.	72.	66.	38.	46.	68.	103.	137.	123.
6	171.	133.	113.	101.	90.	75.	46.	61.	74.	101.	141.	120.
7	168.	128.	120.	110.	103.	93.	61.	68.	80.	99.	141.	119.
8	165.	144.	149.	132.	126.	103.	68.	80.	109.	107.	140.	120.
9	171.	157.	162.	145.	139.	117.	82.	101.	123.	135.	152.	136.
10	176.	185.	199.	159.	147.	127.	93.	113.	145.	150.	171.	135.
11	193.	209.	221.	176.	157.	137.	104.	113.	142.	164.	186.	139.
12	194.	213.	239.	196.	156.	145.	112.	127.	148.	176.	182.	143.
13	205.	233.	235.	198.	172.	156.	121.	122.	151.	169.	184.	144.
14	188.	239.	249.	196.	175.	172.	130.	122.	145.	161.	176.	135.
15	181.	210.	237.	196.	157.	145.	129.	122.	142.	130.	178.	132.
16	169.	205.	213.	180.	155.	151.	123.	111.	115.	113.	152.	127.
17	177.	184.	182.	159.	141.	137.	107.	102.	94.	92.	153.	125.
18	184.	188.	152.	120.	126.	120.	82.	79.	79.	91.	145.	128.
19	189.	189.	145.	107.	106.	97.	64.	58.	70.	86.	152.	126.
20	194.	180.	145.	101.	82.	69.	50.	50.	64.	94.	143.	129.
21	196.	178.	138.	97.	75.	57.	43.	46.	65.	92.	146.	129.
22	190.	164.	141.	96.	75.	51.	37.	46.	73.	101.	144.	131.
23	184.	160.	129.	89.	75.	48.	37.	48.	69.	99.	140.	132.

01/04/19

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations

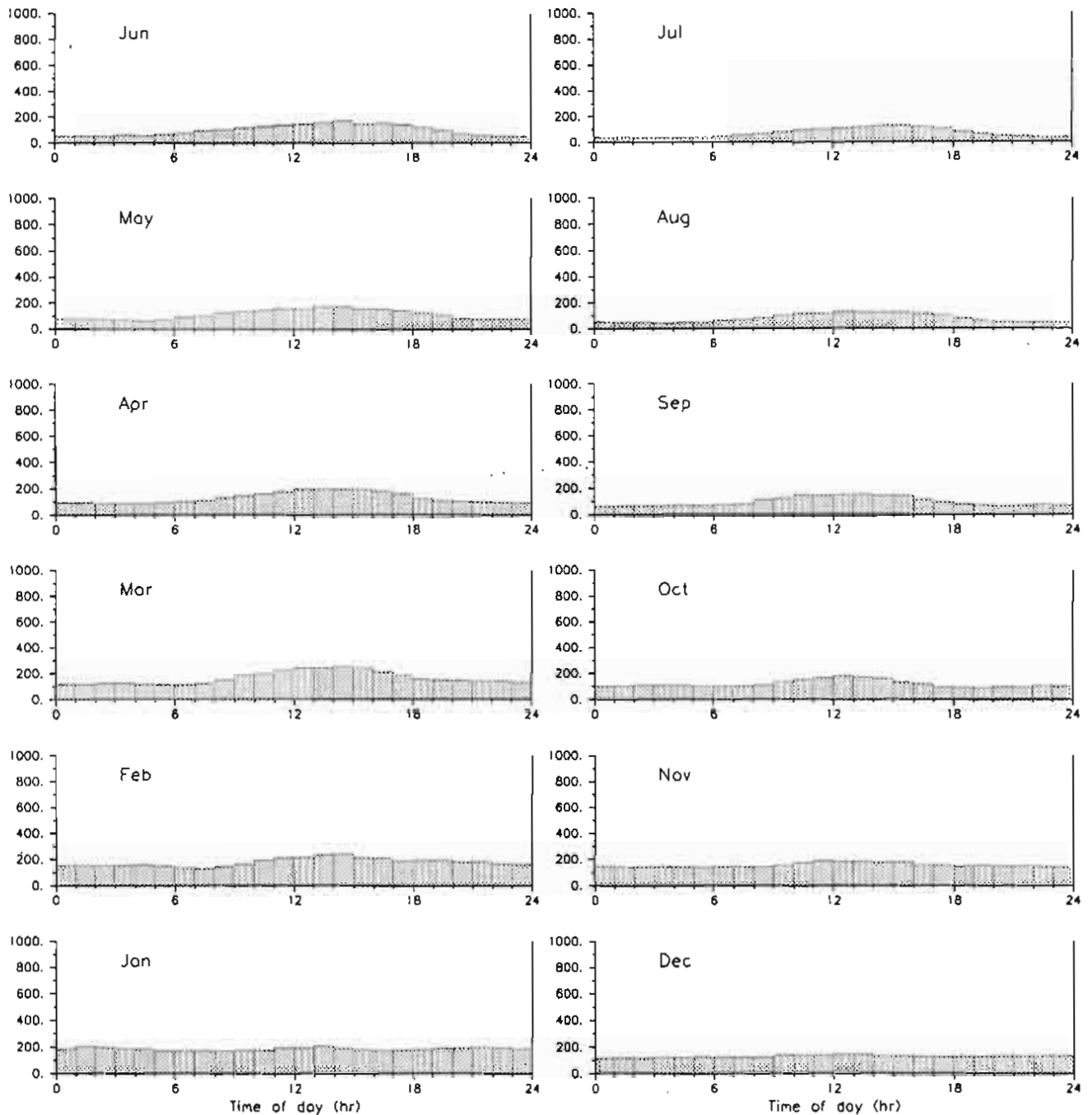


Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Kuujuaq A (1)

Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Kuujjuaq A (1)

Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00

Quaqtaq (2)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Percentage of Observations per Bin

WSpd(m/s)		WDir(degt)																	
		N		NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
		348.8	11.3	33.8	56.3	78.8	101.3	123.8	146.3	168.8	191.3	213.8	236.3	258.8	281.3	303.8	326.3		
		to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to		
		11.3	33.8	56.3	78.8	101.3	123.8	146.3	168.8	191.3	213.8	236.3	258.8	281.3	303.8	326.3	348.8		
0.0	to	0.5	0.36	0.35	0.35	0.34	0.35	0.35	0.36	0.38	0.37	0.36	0.36	0.35	0.37	0.36	0.36	0.37	5.74
0.5	to	1.0	0.05	0.04	0.01	0.01	0.01	0.03	0.11	0.17	0.18	0.11	0.05	0.12	0.17	0.13	0.06	0.12	1.38
1.0	to	1.5	0.14	0.06	0.03	0.04	0.04	0.05	0.29	0.28	0.28	0.30	0.19	0.31	0.36	0.30	0.17	0.26	3.09
1.5	to	2.0	0.13	0.07	0.08	0.06	0.08	0.07	0.25	0.30	0.24	0.34	0.21	0.38	0.42	0.44	0.27	0.41	3.74
2.0	to	2.5	0.19	0.13	0.10	0.11	0.11	0.14	0.19	0.31	0.38	0.42	0.34	0.28	0.47	0.59	0.39	0.58	4.71
2.5	to	3.0	0.26	0.15	0.12	0.13	0.16	0.12	0.26	0.32	0.44	0.48	0.35	0.34	0.46	0.63	0.55	0.71	5.44
3.0	to	3.5	0.24	0.12	0.12	0.11	0.11	0.19	0.19	0.22	0.36	0.40	0.21	0.22	0.38	0.57	0.50	0.57	4.49
3.5	to	4.0	0.20	0.14	0.14	0.19	0.19	0.19	0.20	0.31	0.44	0.50	0.27	0.23	0.39	0.72	0.64	0.59	5.32
4.0	to	4.5	0.24	0.13	0.16	0.17	0.14	0.19	0.22	0.31	0.42	0.46	0.34	0.20	0.27	0.85	0.83	0.44	5.38
4.5	to	5.0	0.17	0.05	0.11	0.17	0.18	0.22	0.18	0.24	0.34	0.29	0.31	0.24	0.24	0.65	0.52	0.34	4.27
5.0	to	5.5	0.30	0.27	0.23	0.28	0.37	0.39	0.36	0.56	0.65	0.56	0.54	0.39	0.39	1.46	1.27	0.55	8.56
5.5	to	6.0	0.11	0.07	0.11	0.13	0.19	0.11	0.09	0.17	0.23	0.24	0.17	0.14	0.16	0.50	0.61	0.30	3.33
6.0	to	6.5	0.16	0.16	0.19	0.30	0.28	0.26	0.26	0.28	0.40	0.39	0.38	0.27	0.22	0.98	1.20	0.40	6.10
6.5	to	7.0	0.08	0.11	0.12	0.15	0.18	0.20	0.15	0.18	0.23	0.17	0.17	0.15	0.12	0.49	0.79	0.32	3.59
7.0	to	7.5	0.09	0.08	0.11	0.17	0.26	0.20	0.16	0.29	0.22	0.21	0.23	0.18	0.16	0.56	0.94	0.28	4.17
7.5	to	8.0	0.20	0.15	0.25	0.37	0.44	0.43	0.26	0.52	0.44	0.29	0.39	0.23	0.30	1.17	1.71	0.64	7.81
8.0	to	8.5	0.09	0.05	0.08	0.17	0.25	0.23	0.18	0.19	0.22	0.13	0.07	0.09	0.08	0.39	0.77	0.22	3.20
8.5	to	9.0	0.09	0.04	0.12	0.15	0.23	0.16	0.12	0.26	0.19	0.12	0.09	0.09	0.08	0.36	0.70	0.24	3.03
9.0	to	9.5	0.06	0.07	0.12	0.15	0.31	0.20	0.13	0.25	0.16	0.13	0.11	0.07	0.09	0.43	0.73	0.21	3.23
9.5	to	10.0	0.03	0.02	0.04	0.05	0.15	0.11	0.04	0.05	0.04	0.03	0.05	0.02	0.00	0.14	0.21	0.16	1.13
10.0	to	10.5	0.07	0.05	0.11	0.21	0.44	0.28	0.13	0.23	0.20	0.13	0.07	0.09	0.08	0.48	0.86	0.28	3.73
10.5	to	11.0	0.01	0.01	0.04	0.10	0.14	0.09	0.05	0.04	0.02	0.02	0.02	0.04	0.03	0.12	0.21	0.06	1.00
11.0	to	11.5	0.04	0.02	0.01	0.11	0.26	0.10	0.06	0.05	0.04	0.02	0.01	0.03	0.01	0.17	0.25	0.12	1.30
11.5	to	12.0	0.01	0.01	0.04	0.07	0.15	0.05	0.05	0.06	0.03	0.00	0.02	0.01	0.03	0.11	0.20	0.09	0.93
12.0	to	12.5	0.01	0.02	0.03	0.06	0.13	0.08	0.01	0.05	0.01	0.01	0.01	0.01	0.01	0.08	0.20	0.05	0.78
12.5	to	13.0	0.01	0.01	0.05	0.11	0.25	0.11	0.07	0.06	0.05	0.04	0.02	0.01	0.07	0.21	0.38	0.11	1.54
13.0	to	13.5	0.00	0.00	0.03	0.04	0.09	0.04	0.03	0.03	0.03	0.01	0.01	0.02	0.00	0.09	0.16	0.05	0.65
13.5	to	14.0	0.00	0.00	0.01	0.01	0.09	0.04	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.05	0.09	0.02	0.36
14.0	to	14.5	0.00	0.00	0.01	0.03	0.05	0.05	0.02	0.01	0.01	0.00	0.01	0.01	0.00	0.04	0.08	0.02	0.36
14.5	to	15.0	0.01	0.00	0.00	0.01	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.04	0.19
15.0	to	15.5	0.00	0.00	0.03	0.02	0.05	0.03	0.01	0.02	0.00	0.00	0.01	0.00	0.03	0.07	0.08	0.04	0.39
15.5	to	16.0	0.00	0.01	0.03	0.04	0.07	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.03	0.06	0.02	0.30
16.0	to	16.5	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.01	0.10
16.5	to	17.0	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.08
17.0	to	17.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
17.5	to	18.0	0.00	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.02	0.15
18.0	to	18.5	0.00	0.00	0.02	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.14
18.5	to	19.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02
19.0	to	19.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
19.5	to	20.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
20.0	to	20.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.06
20.5	to	21.0	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.06
21.0	to	21.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
21.5	to	22.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.0	to	22.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
22.5	to	23.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
23.0	to	23.5	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
23.5	to	24.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24.0	to	24.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24.5	to	25.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
			3.39	2.39	2.97	4.17	5.93	4.70	4.46	6.18	6.63	6.19	5.03	4.54	5.43	13.27	16.02	8.69	
Weibull C (m/s)			5.0	5.1	6.5	7.6	8.7	7.3	5.6	5.9	5.5	5.1	5.3	4.8	4.7	6.7	7.8	6.2	
Weibull k			1.5	1.4	1.5	1.6	1.7	1.7	1.4	1.6	1.7	1.7	1.7	1.5	1.4	1.9	2.1	1.6	
Ave.Speed (m/s)			4.57	4.66	5.92	6.89	7.90	6.57	5.18	5.42	4.99	4.54	4.85	4.41	4.26	5.97	6.99	5.51	
For all directions: Weibull C (m/s) = 6.3 k = 1.6 Ave.Speed (m/s) = 5.8																			

Total Time Periods: 87649

Total Observations: 27439

31.3% Data Availability

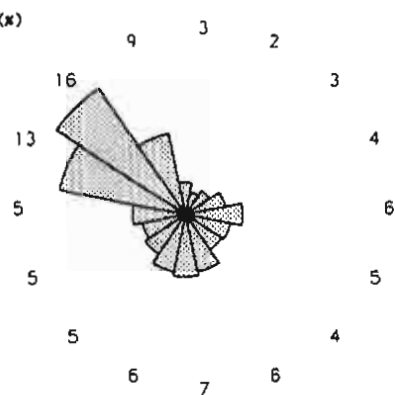
Includes 1505 calms distributed evenly throughout direction bins.

01/04/16

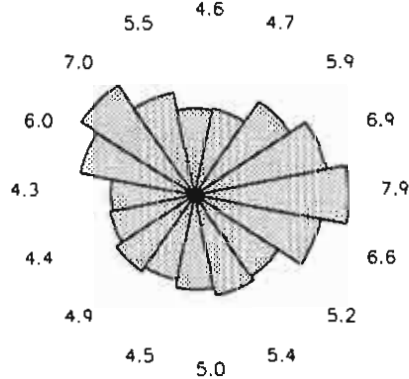
WIND DISTRIBUTION

Northern QC WRA II - AES Stations

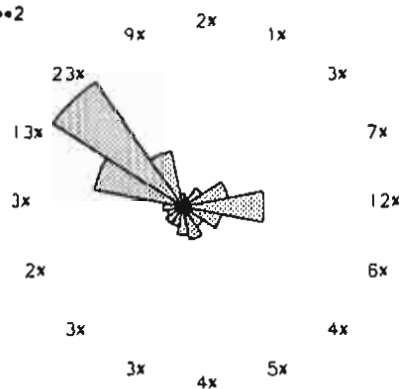
FREQUENCY (%)



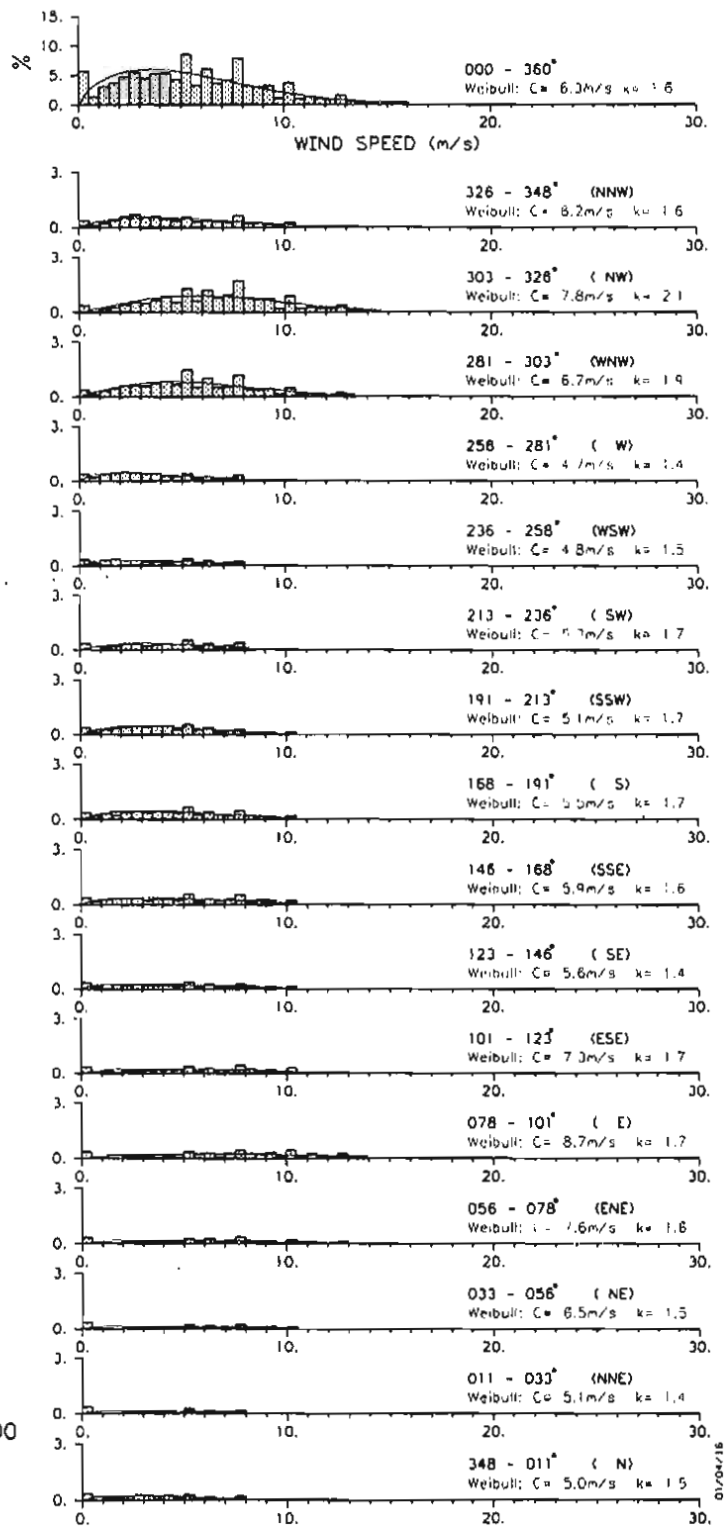
AVERAGE SPEED (m/s)
5.8m/s



POWER DENSITY (W/m**2)
282.W/m**2



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Quaqtaq (2)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES Northern QC WRA II - AES Stations

Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
 Quaqtaq (2)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
90/01/01->91/01/01	-7.4	100.65	1.322	5.7	285.	20.8	-N/A-	312.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-7.3	100.69	1.322	6.3	273.	20.8	-N/A-	365.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.70	1.323	5.7	274.	20.8	-N/A-	302.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-7.3	100.68	1.322	5.7	255.	23.7	-N/A-	281.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.64	1.319	5.5	287.	20.5	-N/A-	236.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-6.7	100.71	1.319	5.1	289.	23.3	-N/A-	232.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-6.8	100.74	1.320	5.6	289.	17.7	-N/A-	230.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-6.8	100.64	1.318	5.6	296.	19.7	-N/A-	249.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-6.4	100.73	1.318	5.9	300.	20.7	-N/A-	261.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-6.2	100.72	1.317	6.2	294.	23.0	-N/A-	331.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->91/01/01	34.5	34.5	34.5	34.5	30.9	34.5	0.0	34.5	0.0	0.0	0.0
91/01/01->92/01/01	29.7	29.7	29.7	29.7	28.0	29.7	0.0	29.7	0.0	0.0	0.0
92/01/01->93/01/01	19.7	19.7	19.7	19.7	18.1	19.7	0.0	19.7	0.0	0.0	0.0
93/01/01->94/01/01	36.1	36.1	36.1	36.1	33.8	36.1	0.0	36.1	0.0	0.0	0.0
94/01/01->95/01/01	36.9	36.9	36.9	36.9	34.5	36.9	0.0	36.9	0.0	0.0	0.0
95/01/01->96/01/01	23.8	23.8	23.8	23.8	22.6	23.8	0.0	23.8	0.0	0.0	0.0
96/01/01->97/01/01	18.1	18.0	18.0	18.1	17.6	18.1	0.0	18.1	0.0	0.0	0.0
97/01/01->98/01/01	37.1	37.1	37.1	37.2	35.5	37.2	0.0	37.2	0.0	0.0	0.0
98/01/01->99/01/01	38.3	38.3	38.3	38.3	37.4	38.3	0.0	38.3	0.0	0.0	0.0
99/01/01->00/01/01	38.9	38.9	38.9	38.9	37.6	38.9	0.0	38.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	-6.9	100.69	1.320	5.8	285.	23.7	-N/A-	282.	-N/A-	-N/A-	-N/A-

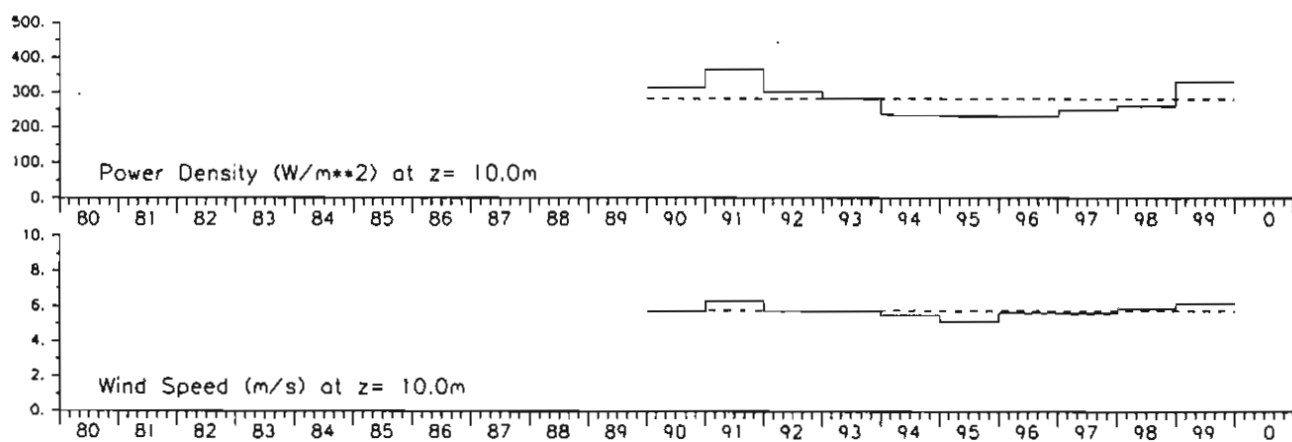
Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	31.3	31.3	31.3	31.3	29.6	31.3	0.0	31.3	0.0	0.0	0.0

01/04/16

ANNUAL AVERAGES

Northern QC WRA II - AES Stations

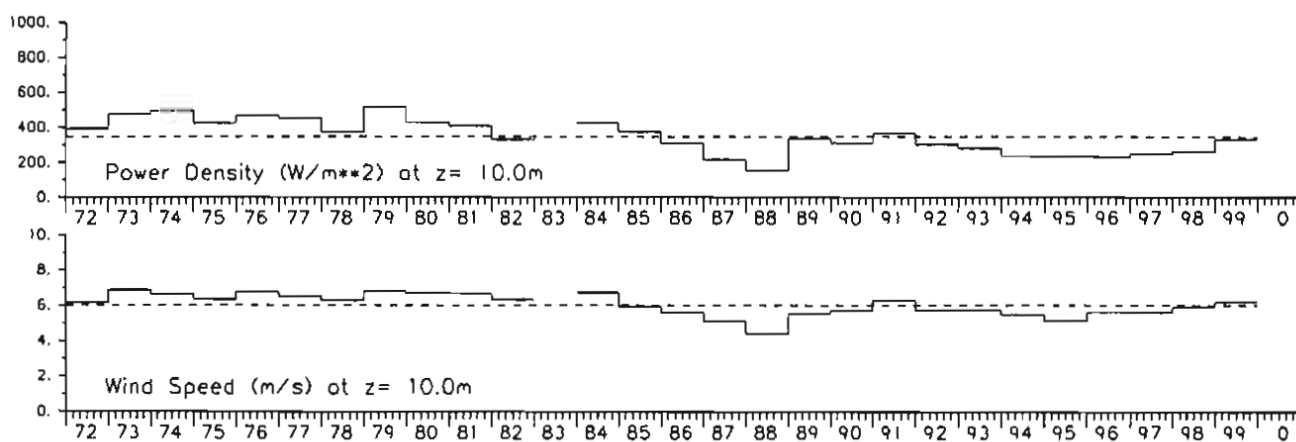


Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Quaqtaq (2)

ANNUAL AVERAGES

Northern QC WRA II - AES Stations



Period: 1972 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Quaqtaq (2)

SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00

Quaqtaq (2)

Seasonal Average

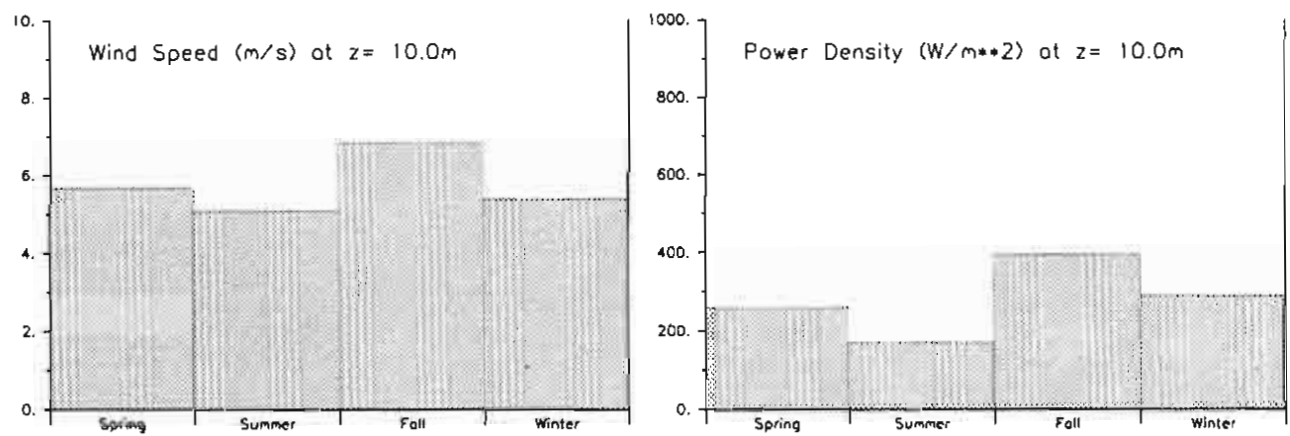
	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Spring	-11.0	101.12	1.344	5.7	297.	20.5	-N/A-	259.	-N/A-	-N/A-	-N/A-
Summer	5.3	100.61	1.259	5.1	310.	19.7	-N/A-	172.	-N/A-	-N/A-	-N/A-
Fall	-1.6	100.47	1.289	6.8	296.	23.7	-N/A-	396.	-N/A-	-N/A-	-N/A-
Winter	-20.6	100.55	1.388	5.4	253.	23.3	-N/A-	290.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
Spring	29.2	29.2	29.2	29.2	27.5	29.2	0.0	29.2	0.0	0.0	0.0
Summer	30.7	30.7	30.7	30.7	29.7	30.7	0.0	30.7	0.0	0.0	0.0
Fall	33.4	33.3	33.3	33.4	32.5	33.4	0.0	33.4	0.0	0.0	0.0
Winter	31.9	31.9	31.9	31.9	28.7	31.9	0.0	31.9	0.0	0.0	0.0

01/04/19

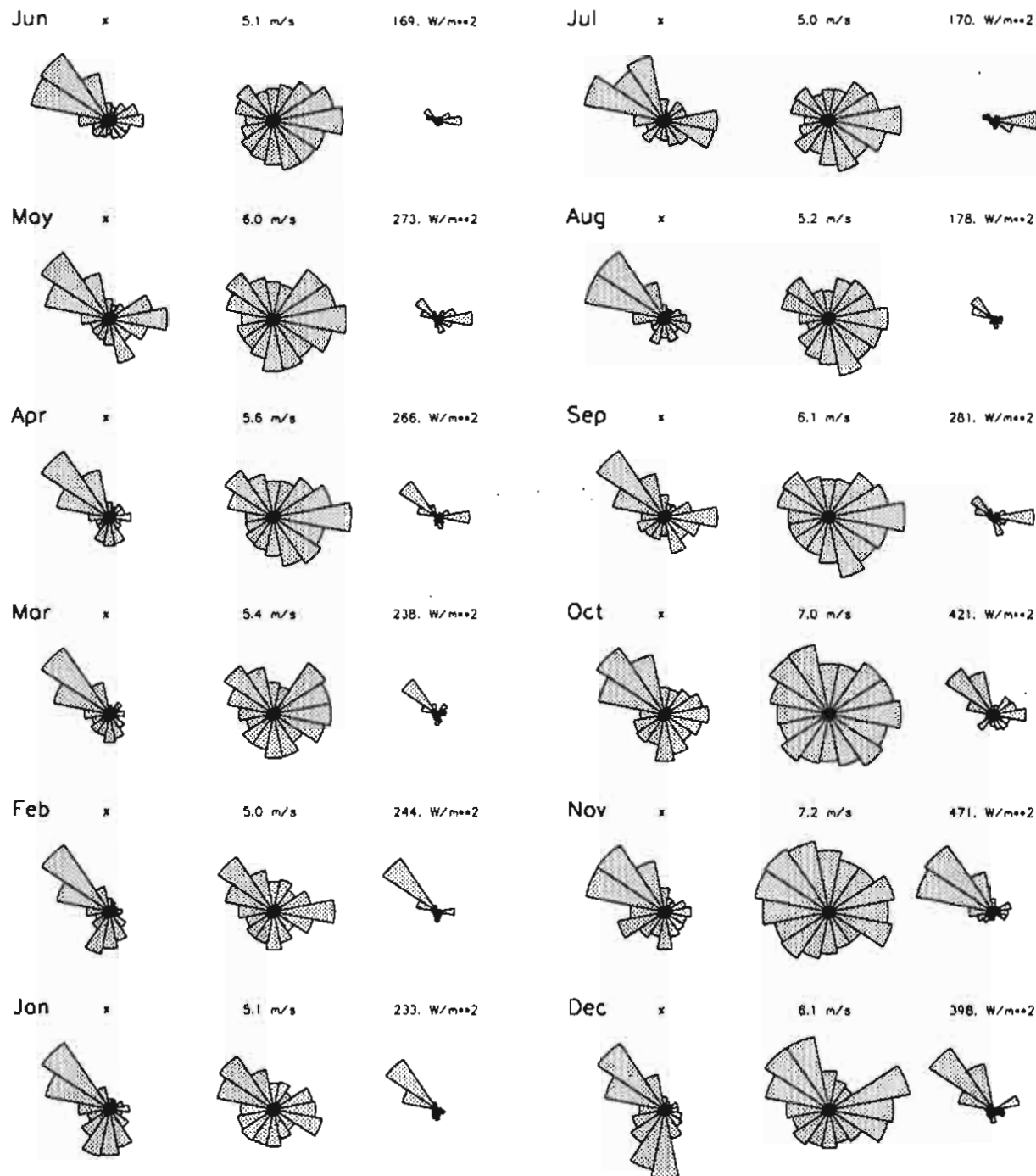
SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Quaqtaq (2)

MONTHLY ROSES

Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00

Station: Quaqtaq (2)

Wind Speed (m/s) at z= 10.0m

Wind Direction (deg) at z= 10.0m

Frequency (x) | Average speed (m/s) | x Power density (W/m²)

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
 Quaqtaq (2)

Monthly Average

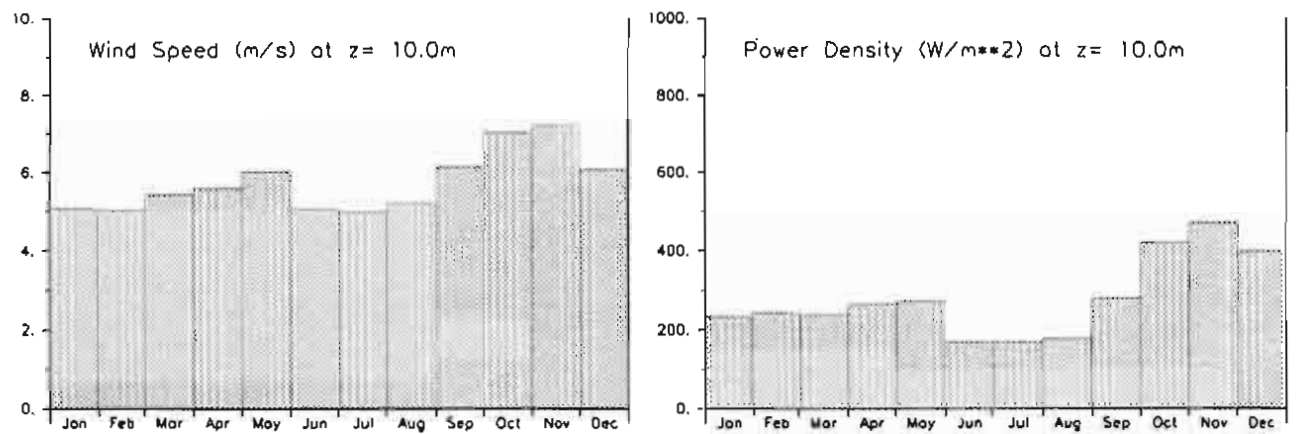
	Temp 1.5m C	SPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Jan	-22.6	100.41	1.397	5.1	250.	20.7	-N/A-	233.	-N/A-	-N/A-	-N/A-
Feb	-23.2	100.61	1.403	5.0	264.	19.6	-N/A-	244.	-N/A-	-N/A-	-N/A-
Mar	-18.8	100.91	1.382	5.4	282.	18.3	-N/A-	238.	-N/A-	-N/A-	-N/A-
Apr	-11.2	101.31	1.347	5.6	301.	20.5	-N/A-	266.	-N/A-	-N/A-	-N/A-
May	-3.0	101.14	1.304	6.0	342.	18.0	-N/A-	273.	-N/A-	-N/A-	-N/A-
Jun	2.3	100.82	1.275	5.1	317.	16.2	-N/A-	169.	-N/A-	-N/A-	-N/A-
Jul	6.8	100.46	1.250	5.0	323.	16.8	-N/A-	170.	-N/A-	-N/A-	-N/A-
Aug	6.6	100.57	1.252	5.2	295.	19.7	-N/A-	178.	-N/A-	-N/A-	-N/A-
Sep	3.4	100.55	1.267	6.1	315.	18.1	-N/A-	281.	-N/A-	-N/A-	-N/A-
Oct	-1.4	100.47	1.288	7.0	309.	20.8	-N/A-	421.	-N/A-	-N/A-	-N/A-
Nov	-6.9	100.38	1.313	7.2	285.	23.7	-N/A-	471.	-N/A-	-N/A-	-N/A-
Dec	-16.2	100.61	1.365	6.1	246.	23.3	-N/A-	398.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	SPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
Jan	32.7	32.7	32.6	32.7	29.2	32.7	0.0	32.7	0.0	0.0	0.0
Feb	33.1	33.1	33.1	33.1	28.9	33.1	0.0	33.1	0.0	0.0	0.0
Mar	27.6	27.6	27.6	27.6	25.4	27.6	0.0	27.6	0.0	0.0	0.0
Apr	31.3	31.3	31.3	31.3	29.2	31.3	0.0	31.3	0.0	0.0	0.0
May	28.9	28.9	28.9	28.9	27.8	28.9	0.0	28.9	0.0	0.0	0.0
Jun	29.4	29.4	29.4	29.4	28.6	29.4	0.0	29.4	0.0	0.0	0.0
Jul	34.5	34.5	34.5	34.6	33.3	34.6	0.0	34.6	0.0	0.0	0.0
Aug	28.1	28.1	28.1	28.1	27.2	28.1	0.0	28.1	0.0	0.0	0.0
Sep	30.3	30.3	30.3	30.3	29.6	30.3	0.0	30.3	0.0	0.0	0.0
Oct	35.2	35.1	35.1	35.2	34.3	35.2	0.0	35.2	0.0	0.0	0.0
Nov	34.6	34.5	34.5	34.6	33.5	34.6	0.0	34.6	0.0	0.0	0.0
Dec	30.1	30.1	30.0	30.1	28.0	30.1	0.0	30.1	0.0	0.0	0.0

01/04/19

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
Station: Quoqtaq (2)

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
Quaqtaq (2)

Wind Speed (m/s) z= 10.0m

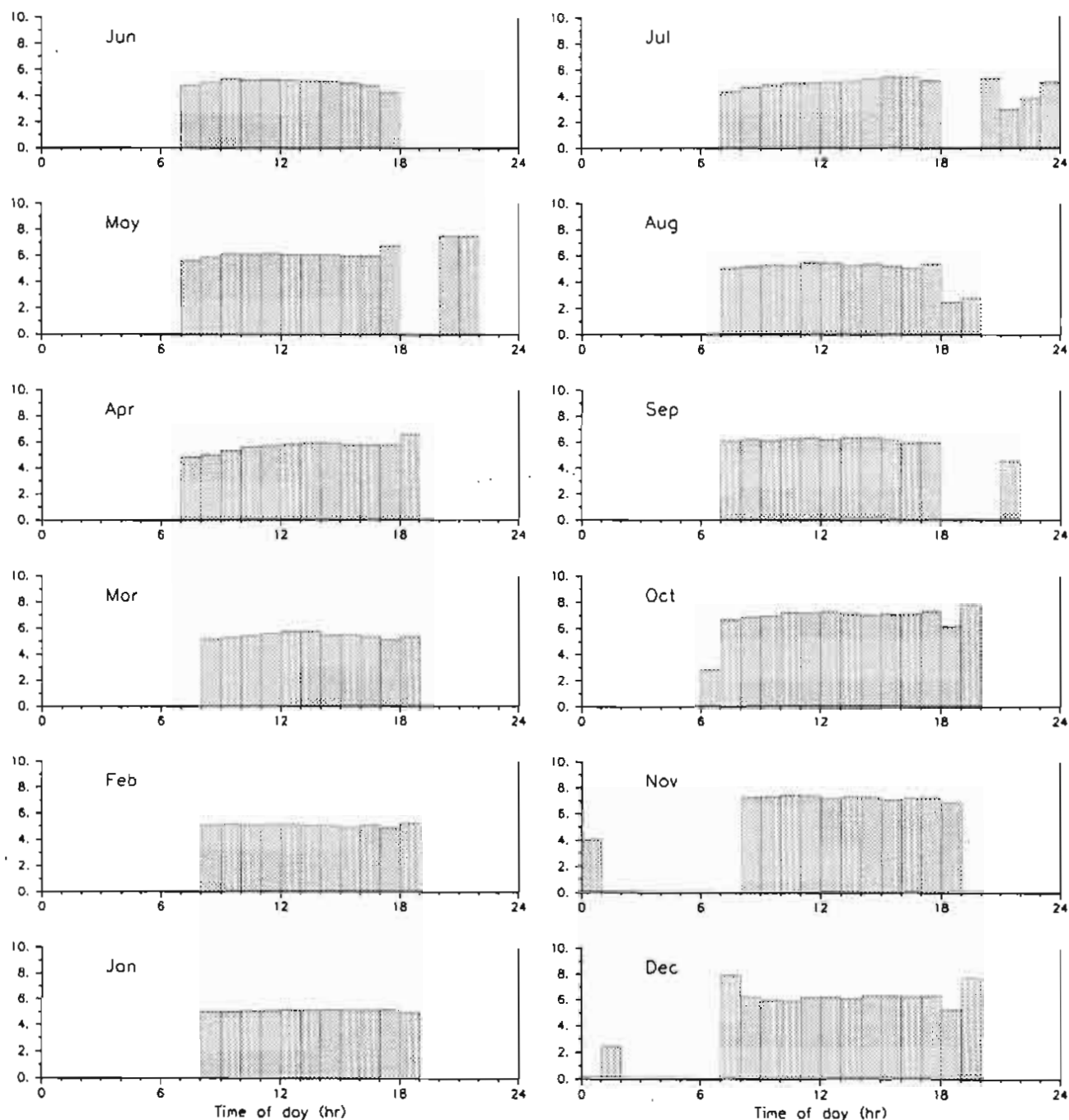
Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	4.0	-N/A-
1	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	2.4
2	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
3	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
4	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
6	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	2.8	-N/A-	-N/A-
7	-N/A-	-N/A-	-N/A-	4.8	5.6	4.8	4.3	5.0	6.0	6.6	-N/A-	7.8
8	5.0	5.0	5.1	5.0	5.8	5.1	4.6	5.1	6.1	6.8	7.2	6.2
9	5.0	5.1	5.3	5.3	6.1	5.3	4.8	5.2	6.0	6.9	7.3	5.9
10	5.0	5.0	5.4	5.6	6.1	5.2	4.9	5.2	6.2	7.2	7.4	5.8
11	5.0	5.1	5.6	5.7	6.1	5.2	5.0	5.4	6.3	7.1	7.3	6.1
12	5.1	5.1	5.7	5.8	6.1	5.2	5.0	5.4	6.1	7.2	7.1	6.1
13	5.1	5.0	5.7	5.9	6.0	5.2	5.1	5.2	6.3	7.1	7.3	6.0
14	5.1	5.0	5.5	5.9	6.0	5.1	5.3	5.3	6.3	7.0	7.2	6.3
15	5.1	4.9	5.5	5.8	5.9	5.0	5.4	5.1	6.1	7.1	7.1	6.2
16	5.1	5.1	5.3	5.7	5.9	4.8	5.4	5.0	5.9	7.1	7.2	6.2
17	5.1	4.9	5.1	5.8	6.7	4.3	5.1	5.3	5.9	7.3	7.2	6.2
18	4.9	5.2	5.3	6.6	-N/A-	-N/A-	-N/A-	2.4	-N/A-	6.2	6.6	5.1
19	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	2.7	-N/A-	7.8	-N/A-	7.6
20	-N/A-	-N/A-	-N/A-	-N/A-	7.5	-N/A-	5.3	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
21	-N/A-	-N/A-	-N/A-	-N/A-	7.5	-N/A-	2.9	-N/A-	4.5	-N/A-	-N/A-	-N/A-
22	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	3.8	-N/A-	-N/A-	-N/A-	-N/A-	0.0
23	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	5.0	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-

Power Density (W/m**2) z= 10.0m

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	44.	-N/A-
1	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	10.
2	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
3	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
4	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
6	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	15.	-N/A-	-N/A-
7	-N/A-	-N/A-	-N/A-	206.	228.	143.	119.	170.	273.	393.	-N/A-	579.
8	225.	255.	236.	207.	263.	164.	137.	164.	273.	414.	429.	447.
9	215.	249.	230.	234.	286.	193.	158.	168.	259.	418.	464.	392.
10	231.	239.	242.	260.	282.	164.	167.	165.	280.	443.	470.	359.
11	227.	253.	251.	282.	283.	191.	168.	193.	297.	425.	468.	413.
12	230.	251.	252.	286.	274.	179.	166.	198.	292.	449.	440.	426.
13	234.	252.	269.	293.	280.	178.	175.	177.	295.	420.	476.	388.
14	231.	229.	236.	301.	276.	179.	199.	191.	292.	414.	482.	443.
15	250.	212.	241.	277.	259.	166.	202.	183.	300.	419.	458.	404.
16	240.	245.	211.	288.	258.	151.	194.	160.	253.	427.	504.	392.
17	248.	227.	214.	295.	371.	123.	205.	207.	265.	413.	520.	397.
18	225.	281.	225.	306.	-N/A-	-N/A-	-N/A-	9.	-N/A-	262.	481.	222.
19	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	13.	-N/A-	301.	-N/A-	843.
20	-N/A-	-N/A-	-N/A-	-N/A-	267.	-N/A-	92.	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-
21	-N/A-	-N/A-	-N/A-	-N/A-	266.	-N/A-	15.	-N/A-	57.	-N/A-	-N/A-	-N/A-
22	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	33.	-N/A-	-N/A-	-N/A-	-N/A-	0.
23	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	76.	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-

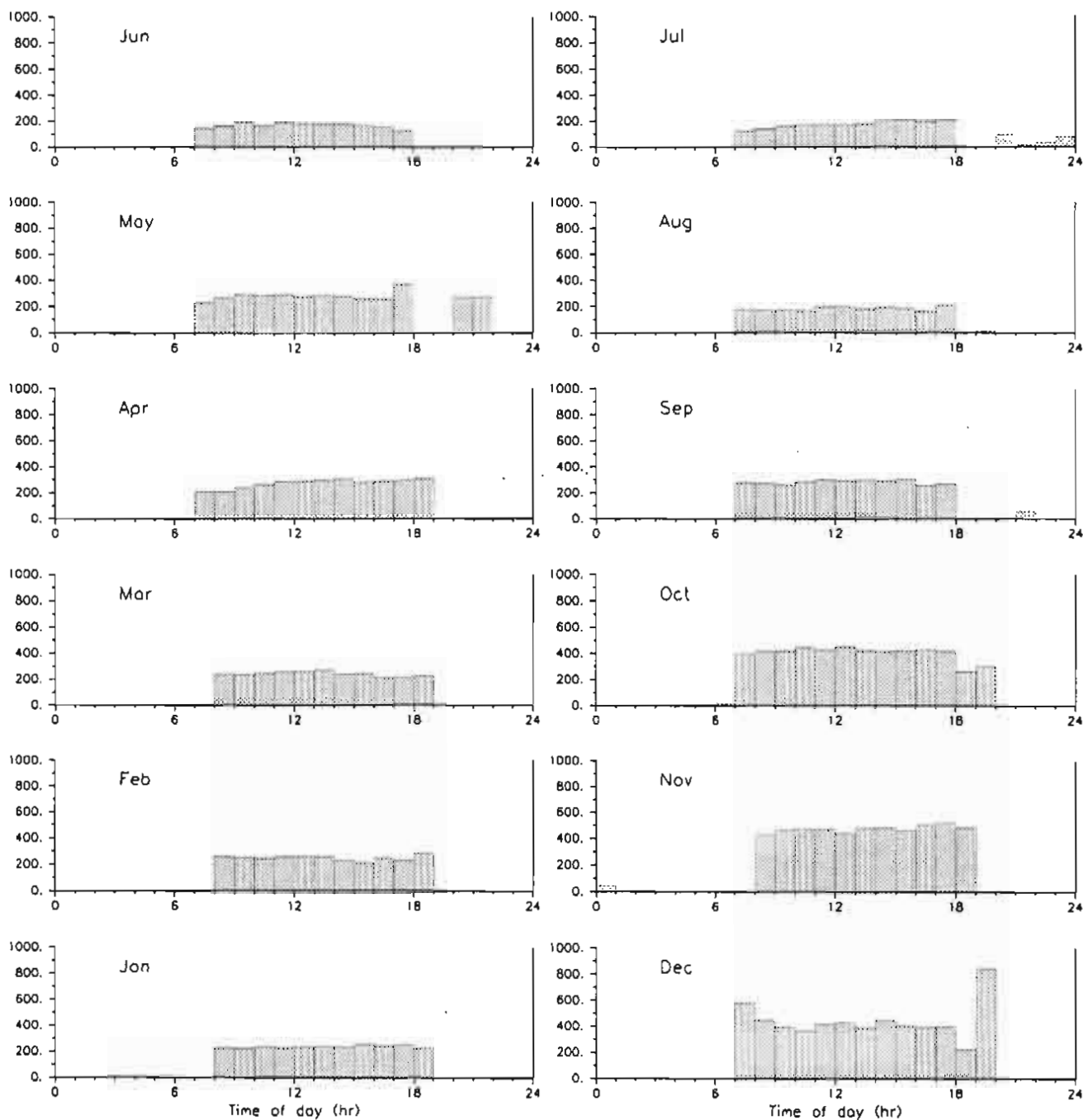
01/04/19

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
 Station: Quaqtaq (2)
 Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
 Station: Quaqtaq (2)
 Power Density (W/m²) at z= 10.0m

WIND DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Umiujaq A (3)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

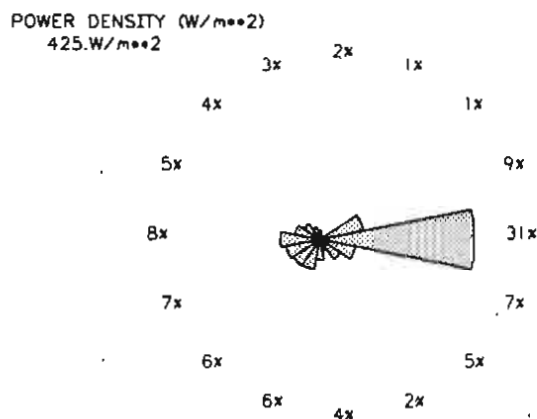
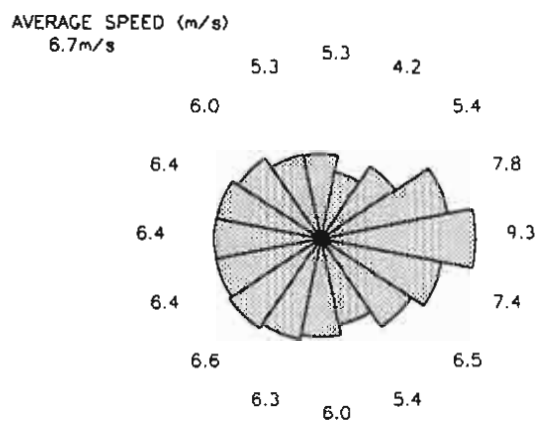
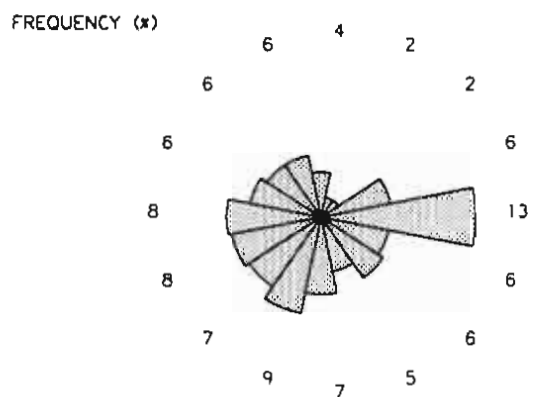
Percentage of Observations per Bin

WSpd(m/s)	WDir(degt)															
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
	348.8	11.3	33.8	56.3	78.8	101.3	123.8	146.3	168.8	191.3	213.8	236.3	258.8	281.3	303.8	326.3
	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to	to
0.0 to 0.5	11.3	33.8	56.3	78.8	101.3	123.8	146.3	168.8	191.3	213.8	236.3	258.8	281.3	303.8	326.3	348.8
0.5 to 1.0	0.24	0.23	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.22	0.24	0.24	0.22	0.22	0.23
1.0 to 1.5	0.04	0.03	0.01	0.02	0.01	0.02	0.04	0.04	0.06	0.05	0.04	0.06	0.09	0.07	0.07	0.04
1.5 to 2.0	0.16	0.11	0.03	0.08	0.07	0.08	0.12	0.10	0.12	0.14	0.15	0.22	0.25	0.19	0.16	0.11
2.0 to 2.5	0.19	0.19	0.06	0.12	0.13	0.15	0.15	0.23	0.21	0.26	0.21	0.31	0.51	0.24	0.21	0.31
2.5 to 3.0	0.21	0.09	0.08	0.15	0.18	0.12	0.22	0.24	0.24	0.30	0.29	0.37	0.46	0.25	0.21	0.26
3.0 to 3.5	0.21	0.10	0.09	0.19	0.24	0.21	0.22	0.23	0.25	0.29	0.27	0.45	0.43	0.27	0.23	0.36
3.5 to 4.0	0.16	0.09	0.11	0.14	0.27	0.18	0.22	0.27	0.21	0.33	0.36	0.44	0.45	0.22	0.29	0.31
4.0 to 4.5	0.25	0.11	0.08	0.24	0.38	0.29	0.31	0.36	0.37	0.44	0.46	0.41	0.40	0.28	0.35	0.30
4.5 to 5.0	0.23	0.13	0.08	0.22	0.41	0.26	0.34	0.33	0.48	0.54	0.42	0.41	0.40	0.34	0.33	0.48
5.0 to 5.5	0.16	0.06	0.06	0.20	0.38	0.20	0.30	0.28	0.34	0.51	0.26	0.29	0.28	0.20	0.24	0.25
5.5 to 6.0	0.28	0.08	0.04	0.27	0.49	0.26	0.30	0.36	0.51	0.60	0.45	0.38	0.35	0.33	0.29	0.41
6.0 to 6.5	0.14	0.03	0.06	0.21	0.35	0.18	0.25	0.22	0.29	0.27	0.30	0.19	0.21	0.25	0.23	0.20
6.5 to 7.0	0.22	0.07	0.10	0.29	0.62	0.35	0.41	0.29	0.59	0.60	0.35	0.40	0.35	0.38	0.36	0.39
7.0 to 7.5	0.30	0.07	0.12	0.36	0.74	0.37	0.60	0.32	0.47	0.74	0.41	0.41	0.34	0.40	0.39	0.36
7.5 to 8.0	0.14	0.04	0.09	0.25	0.40	0.25	0.32	0.20	0.29	0.44	0.25	0.28	0.28	0.28	0.22	0.22
8.0 to 8.5	0.36	0.11	0.16	0.45	1.09	0.54	0.58	0.37	0.62	0.76	0.47	0.42	0.38	0.47	0.39	0.46
8.5 to 9.0	0.11	0.01	0.08	0.20	0.35	0.16	0.20	0.13	0.20	0.25	0.22	0.21	0.20	0.20	0.13	0.12
9.0 to 9.5	0.11	0.02	0.05	0.23	0.49	0.22	0.22	0.16	0.31	0.30	0.33	0.33	0.29	0.27	0.22	0.18
9.5 to 10.0	0.22	0.04	0.12	0.42	0.89	0.37	0.34	0.20	0.32	0.42	0.33	0.37	0.39	0.26	0.22	0.14
10.0 to 10.5	0.04	0.01	0.01	0.09	0.19	0.08	0.09	0.05	0.08	0.11	0.14	0.14	0.09	0.09	0.05	0.04
10.5 to 11.0	0.11	0.06	0.04	0.33	0.85	0.25	0.32	0.07	0.27	0.36	0.30	0.37	0.33	0.21	0.19	0.14
11.0 to 11.5	0.01	0.01	0.02	0.10	0.29	0.06	0.07	0.04	0.07	0.11	0.13	0.11	0.12	0.04	0.04	0.05
11.5 to 12.0	0.02	0.02	0.01	0.16	0.43	0.19	0.11	0.03	0.08	0.11	0.20	0.15	0.17	0.11	0.08	0.04
12.0 to 12.5	0.01	0.01	0.01	0.14	0.45	0.17	0.16	0.04	0.06	0.08	0.19	0.16	0.20	0.14	0.06	0.02
12.5 to 13.0	0.00	0.02	0.01	0.07	0.31	0.11	0.04	0.02	0.01	0.08	0.12	0.13	0.12	0.05	0.04	0.02
13.0 to 13.5	0.01	0.00	0.01	0.20	0.48	0.13	0.13	0.04	0.05	0.07	0.17	0.17	0.20	0.15	0.11	0.00
13.5 to 14.0	0.00	0.00	0.02	0.08	0.23	0.06	0.04	0.01	0.02	0.05	0.09	0.03	0.09	0.03	0.04	0.01
14.0 to 14.5	0.00	0.00	0.00	0.11	0.34	0.05	0.05	0.01	0.00	0.05	0.05	0.10	0.11	0.07	0.04	0.01
14.5 to 15.0	0.00	0.00	0.01	0.08	0.23	0.06	0.03	0.01	0.02	0.03	0.07	0.08	0.05	0.04	0.01	0.01
15.0 to 15.5	0.00	0.00	0.00	0.04	0.17	0.04	0.02	0.01	0.00	0.04	0.02	0.02	0.07	0.02	0.01	0.00
15.5 to 16.0	0.00	0.00	0.00	0.07	0.26	0.08	0.01	0.00	0.01	0.04	0.01	0.05	0.04	0.02	0.02	0.00
16.0 to 16.5	0.01	0.00	0.00	0.05	0.17	0.05	0.01	0.00	0.00	0.01	0.03	0.01	0.03	0.01	0.01	0.01
16.5 to 17.0	0.00	0.00	0.00	0.03	0.11	0.02	0.00	0.00	0.01	0.00	0.02	0.01	0.02	0.01	0.00	0.01
17.0 to 17.5	0.00	0.00	0.00	0.05	0.16	0.04	0.00	0.00	0.00	0.01	0.00	0.01	0.03	0.02	0.01	0.01
17.5 to 18.0	0.00	0.00	0.00	0.04	0.08	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.00
18.0 to 18.5	0.00	0.00	0.00	0.03	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
18.5 to 19.0	0.00	0.00	0.00	0.03	0.07	0.02	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01	0.00	0.00
19.0 to 19.5	0.00	0.00	0.00	0.03	0.05	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
19.5 to 20.0	0.00	0.00	0.00	0.03	0.10	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00
20.0 to 20.5	0.00	0.00	0.00	0.02	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
20.5 to 21.0	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
21.0 to 21.5	0.00	0.00	0.00	0.01	0.10	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00
21.5 to 22.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.0 to 22.5	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22.5 to 23.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23.0 to 23.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23.5 to 24.0	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24.0 to 24.5	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24.5 to 25.0	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3.96	1.76	1.78	6.06	13.25	5.93	6.45	4.90	6.83	8.65	7.37	7.78	8.06	6.16	5.52	5.53
Weibull C (m/s)	5.7	4.6	5.9	8.7	10.5	8.3	7.3	6.0	6.6	7.1	7.4	7.1	7.1	7.0	6.6	5.9
Weibull k	1.7	1.3	1.5	1.7	2.0	1.8	1.9	1.8	2.0	2.0	1.8	1.7	1.6	1.7	1.7	1.9
Ave.Speed (m/s)	5.26	4.20	5.38	7.83	9.29	7.42	6.53	5.40	6.04	6.32	6.63	6.43	6.42	6.39	5.98	5.32
For all directions: Weibull C (m/s) = 7.4 k = 1.7 Ave.Speed (m/s) = 6.7																

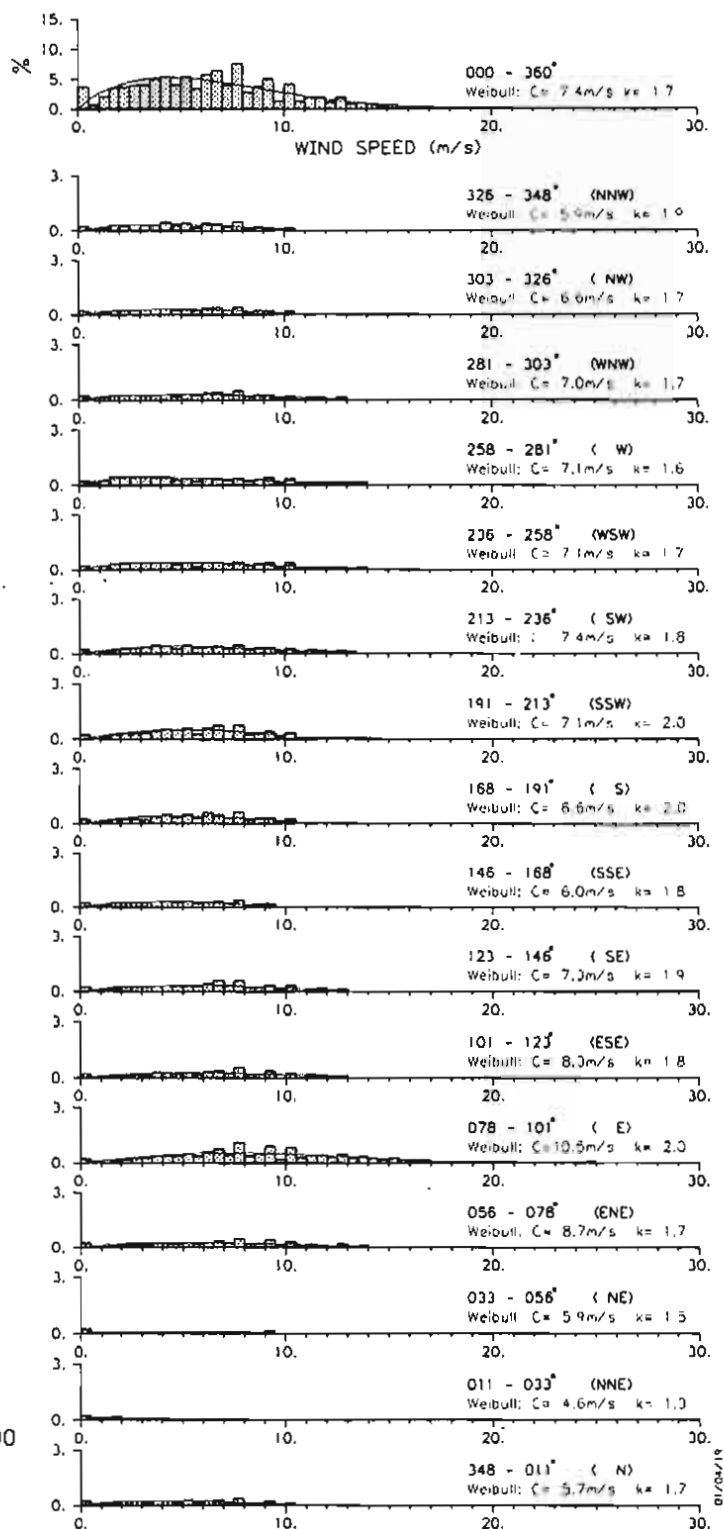
Total Time Periods: 61345 Total Observations: 22428 36.6% Data Availability

Includes 810 calms distributed evenly throughout direction bins.

01/04/19



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
Station: Umiuq A (3)
Wind Speed (m/s) at z= 10.0m
Wind Direction (degt) at z= 10.0m



ANNUAL AVERAGES Northern QC WRA II - AES Stations

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
 Umiujaq A (3)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m deg	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m KW	TrbnOut 10.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	6.8	193.	27.7	-N/A-	461.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	7.3	204.	27.8	-N/A-	565.	-N/A-	-N/A-	-N/A-
95/02/01->96/02/01	-4.1	100.23	1.301	6.8	209.	26.0	-N/A-	420.	-N/A-	-N/A-	-N/A-
96/02/01->97/02/01	-4.0	100.23	1.300	6.3	213.	22.0	-N/A-	341.	-N/A-	-N/A-	-N/A-
97/02/01->98/02/01	-3.9	100.22	1.300	6.4	177.	24.4	-N/A-	364.	-N/A-	-N/A-	-N/A-
98/02/01->99/02/01	-3.0	100.23	1.296	6.8	188.	26.8	-N/A-	455.	-N/A-	-N/A-	-N/A-
99/02/01->00/02/01	-3.0	100.24	1.296	6.4	154.	23.1	-N/A-	352.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->94/02/01	41.8	41.8	41.8	41.8	40.0	41.8	0.0	41.8	0.0	0.0	0.0
94/02/01->95/02/01	36.5	36.3	36.3	36.3	35.1	36.3	0.0	36.3	0.0	0.0	0.0
95/02/01->96/02/01	35.7	35.5	35.5	35.7	34.7	35.7	0.0	35.7	0.0	0.0	0.0
96/02/01->97/02/01	28.2	28.1	28.1	28.2	27.3	28.2	0.0	28.2	0.0	0.0	0.0
97/02/01->98/02/01	38.0	37.9	37.9	37.9	36.1	37.9	0.0	37.9	0.0	0.0	0.0
98/02/01->99/02/01	38.1	38.1	38.1	38.1	36.5	38.1	0.0	38.1	0.0	0.0	0.0
99/02/01->00/02/01	37.9	37.9	37.9	37.9	37.0	37.9	0.0	37.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	-3.8	100.24	1.299	6.7	192.	27.8	-N/A-	425.	-N/A-	-N/A-	-N/A-

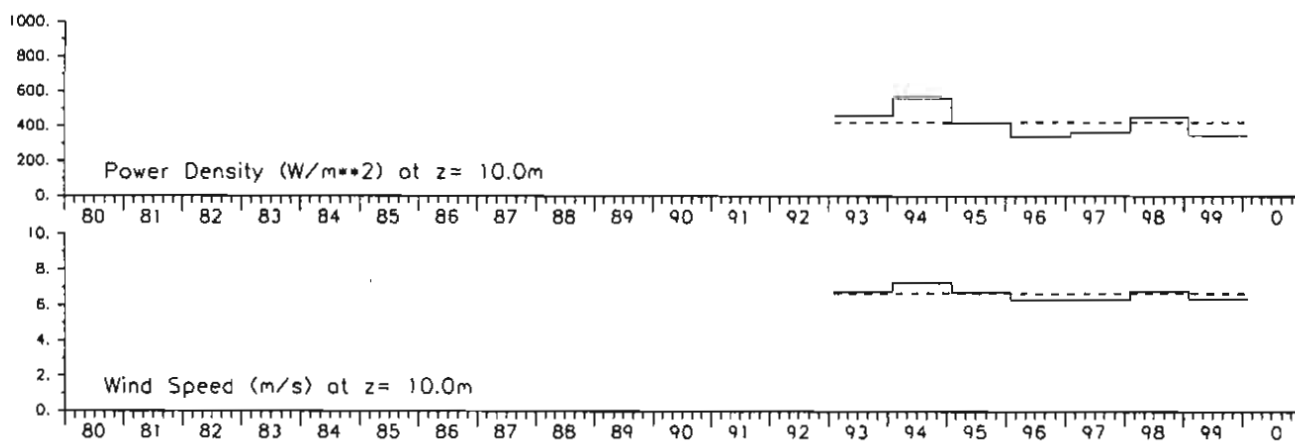
Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	36.8	36.5	36.5	36.6	35.2	36.6	0.0	36.6	0.0	0.0	0.0

01/04/19

ANNUAL AVERAGES

Northern QC WRA II - AES Stations



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Station: Umiujaq A (3)

SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
 Umiujaq A (3)

Seasonal Average

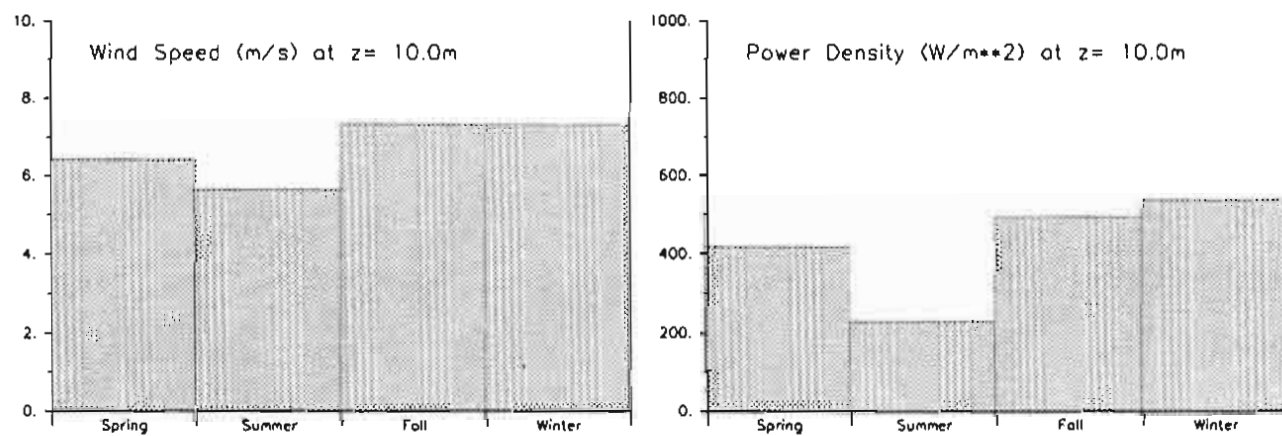
	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degC	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Spring	-7.1	100.54	1.318	6.4	167.	27.8	-N/A-	418.	-N/A-	-N/A-	-N/A-
Summer	9.8	100.06	1.232	5.6	246.	27.7	-N/A-	231.	-N/A-	-N/A-	-N/A-
Fall	1.5	100.02	1.269	7.3	192.	26.0	-N/A-	493.	-N/A-	-N/A-	-N/A-
Winter	-19.7	100.30	1.380	7.3	166.	26.8	-N/A-	536.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
Spring	38.1	38.0	38.0	38.0	36.1	38.0	0.0	38.0	0.0	0.0	0.0
Summer	32.6	32.5	32.5	32.6	31.7	32.6	0.0	32.6	0.0	0.0	0.0
Fall	38.9	38.8	38.8	38.8	37.8	38.8	0.0	38.8	0.0	0.0	0.0
Winter	36.9	36.8	36.8	36.9	35.4	36.9	0.0	36.9	0.0	0.0	0.0

01/04/19

SEASONAL DISTRIBUTION Northern QC WRA II - AES Stations

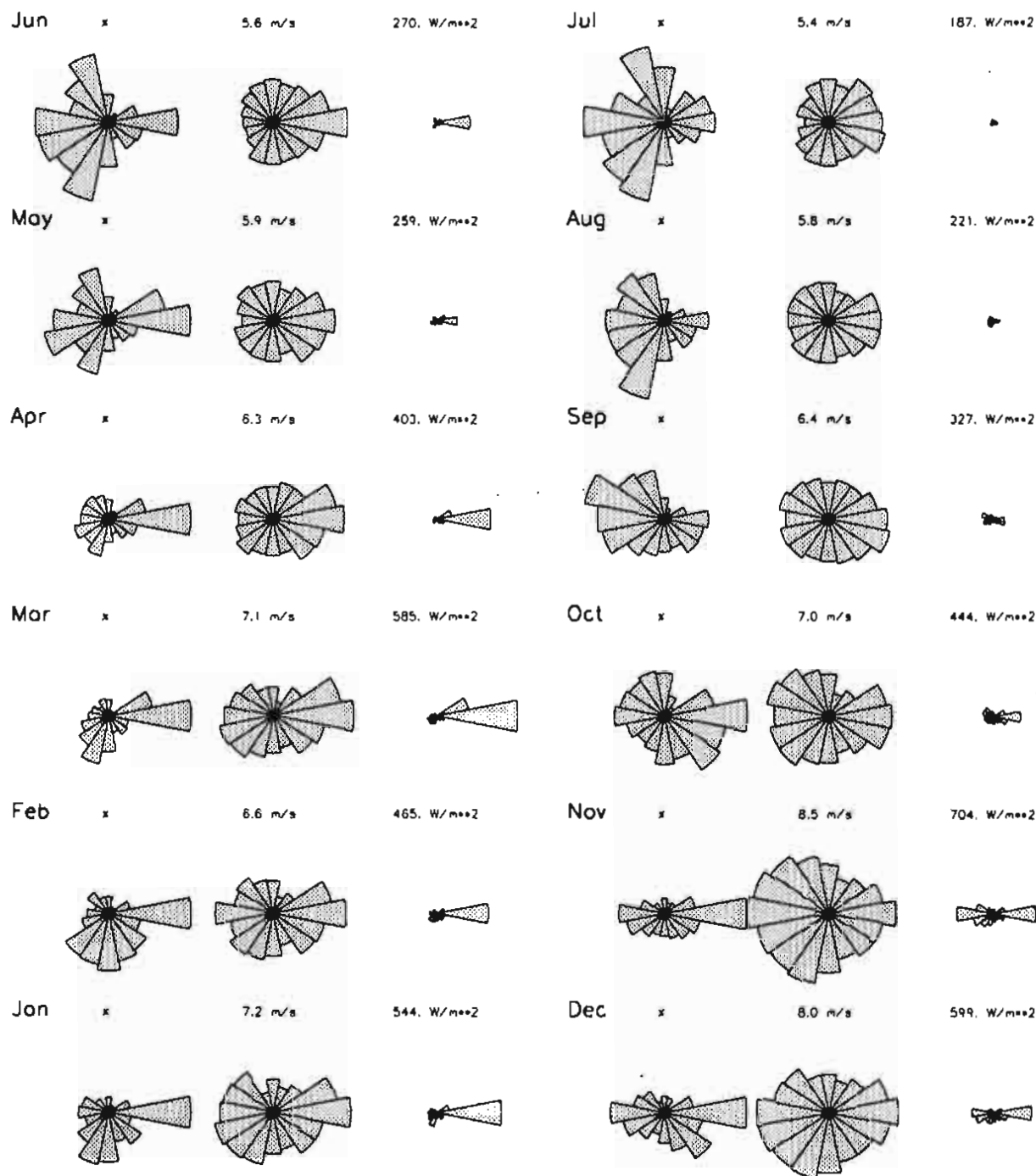


Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Station: Umiujaq A (3)

MONTHLY ROSES

Northern QC WRA II - AES Stations



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Station: Umiujaq A (3)

Wind Speed (m/s) at z= 10.0m

Wind Direction (degt) at z= 10.0m

Frequency (x) | Average speed (m/s) | x Power density (W/m²)

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
Umiujag A (3)

Monthly Average

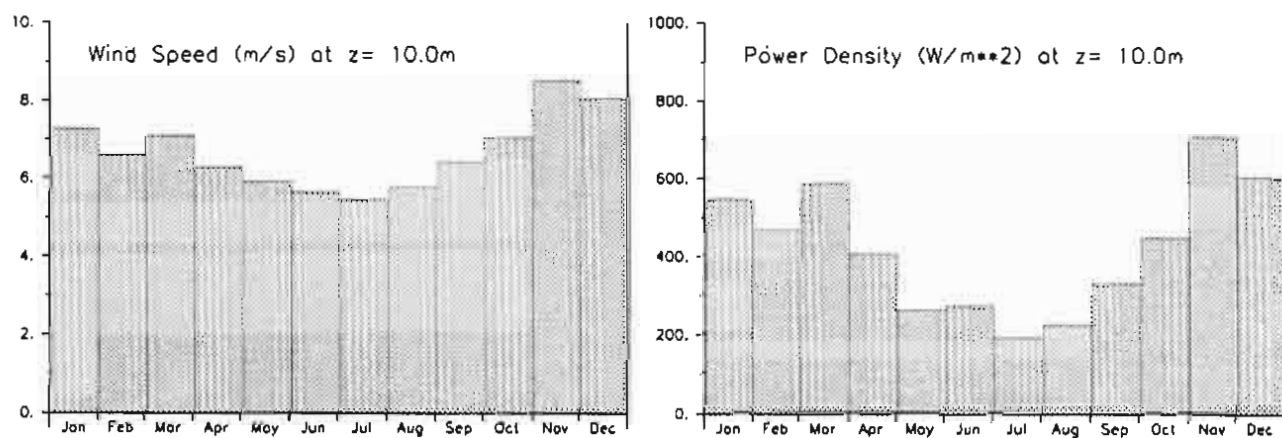
	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbnInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
Jan	-22.8	100.29	1.396	7.2	165.	21.8	-N/A-	544.	-N/A-	-N/A-	-N/A-
Feb	-22.6	100.41	1.396	6.6	165.	26.8	-N/A-	465.	-N/A-	-N/A-	-N/A-
Mar	-16.4	100.65	1.366	7.1	152.	24.8	-N/A-	585.	-N/A-	-N/A-	-N/A-
Apr	-6.7	100.57	1.315	6.3	145.	27.8	-N/A-	403.	-N/A-	-N/A-	-N/A-
May	1.7	100.39	1.273	5.9	240.	20.6	-N/A-	259.	-N/A-	-N/A-	-N/A-
Jun	7.3	100.16	1.245	5.6	243.	27.7	-N/A-	270.	-N/A-	-N/A-	-N/A-
Jul	11.2	100.00	1.225	5.4	264.	18.1	-N/A-	187.	-N/A-	-N/A-	-N/A-
Aug	11.0	100.02	1.227	5.8	241.	15.6	-N/A-	221.	-N/A-	-N/A-	-N/A-
Sep	7.4	100.08	1.243	6.4	257.	23.1	-N/A-	327.	-N/A-	-N/A-	-N/A-
Oct	2.1	100.05	1.267	7.0	137.	26.0	-N/A-	444.	-N/A-	-N/A-	-N/A-
Nov	-4.9	99.94	1.298	8.5	147.	23.1	-N/A-	704.	-N/A-	-N/A-	-N/A-
Dec	-14.2	100.22	1.349	8.0	162.	24.4	-N/A-	599.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbnInts	TrbnPwr	TrbnOut
Jan	36.8	36.7	36.7	36.8	35.1	36.8	0.0	36.8	0.0	0.0	0.0
Feb	38.9	38.7	38.7	38.9	36.5	38.9	0.0	38.9	0.0	0.0	0.0
Mar	39.5	39.5	39.4	39.3	36.6	39.3	0.0	39.3	0.0	0.0	0.0
Apr	37.1	37.1	37.0	37.1	35.3	37.1	0.0	37.1	0.0	0.0	0.0
May	37.6	37.5	37.5	37.6	36.4	37.6	0.0	37.6	0.0	0.0	0.0
Jun	37.4	37.3	37.3	37.5	36.5	37.5	0.0	37.5	0.0	0.0	0.0
Jul	24.6	24.5	24.5	24.6	24.0	24.6	0.0	24.6	0.0	0.0	0.0
Aug	35.8	35.7	35.7	35.8	34.7	35.8	0.0	35.8	0.0	0.0	0.0
Sep	37.9	37.9	37.9	37.9	36.7	37.9	0.0	37.9	0.0	0.0	0.0
Oct	39.4	39.3	39.3	39.3	38.0	39.3	0.0	39.3	0.0	0.0	0.0
Nov	39.3	39.2	39.2	39.3	38.7	39.3	0.0	39.3	0.0	0.0	0.0
Dec	35.2	35.2	35.2	35.1	34.7	35.1	0.0	35.1	0.0	0.0	0.0

01/04/19

MONTHLY DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Station: Umiujaq A (3)

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
Umiujaq A (3)

Wind Speed (m/s) z= 10.0m

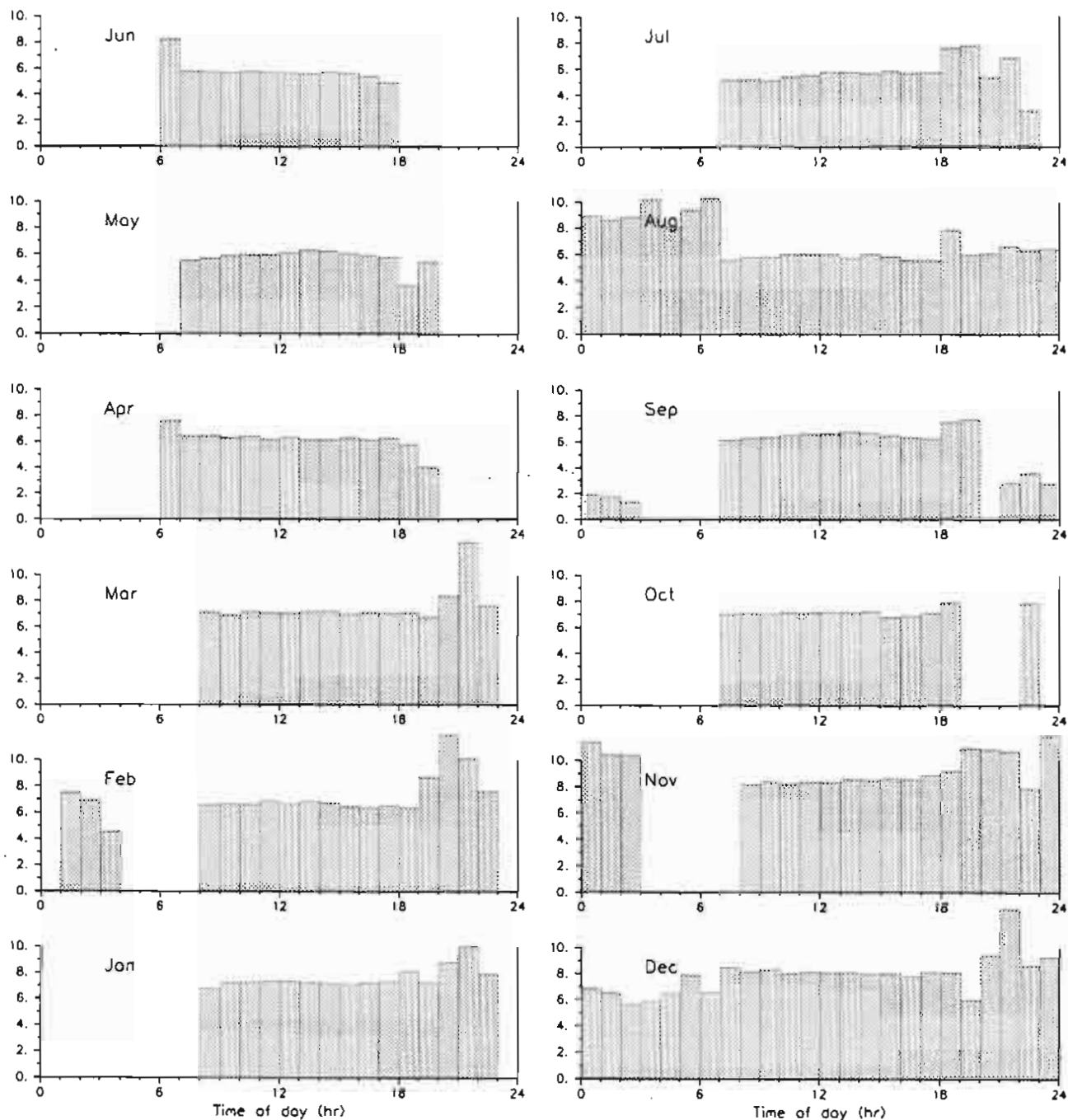
Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	8.5	1.8	-N/A-	11.3	6.8
1	-N/A-	7.5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	8.5	1.7	-N/A-	10.4	6.5
2	-N/A-	6.9	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	8.8	1.3	-N/A-	10.4	5.6
3	-N/A-	4.5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	10.2	-N/A-	-N/A-	-N/A-	5.8
4	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	8.0	-N/A-	-N/A-	-N/A-	5.5
5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	9.3	-N/A-	-N/A-	-N/A-	7.9
6	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	10.3	-N/A-	-N/A-	-N/A-	6.5
7	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	5.5	6.0	6.9	-N/A-	8.5
8	6.8	6.6	7.1	6.4	5.5	6.8	5.1	7.7	6.2	7.1	8.2	8.1
9	7.2	6.6	6.9	6.3	6.8	6.6	5.1	7.7	6.3	7.0	8.4	8.3
10	7.5	6.6	7.1	6.4	6.9	6.3	5.3	7.9	6.5	7.1	8.2	8.0
11	7.5	6.6	7.0	6.1	6.0	6.7	5.4	6.0	6.6	7.1	8.3	8.1
12	7.5	6.6	7.0	6.1	6.1	6.7	5.7	5.9	6.6	7.1	8.3	8.1
13	7.5	6.6	7.1	6.1	6.3	6.6	5.7	7.7	6.7	7.1	8.5	8.1
14	7.5	6.7	7.2	6.2	6.2	6.7	5.9	7.9	6.7	7.1	8.5	8.0
15	7.5	6.4	7.0	6.3	6.0	6.6	5.8	7.7	6.4	6.7	8.6	8.0
16	7.5	6.3	7.1	6.3	5.8	6.4	5.6	5.5	6.3	6.8	8.5	7.8
17	7.5	6.5	7.0	6.2	5.7	6.9	5.6	5.5	6.2	7.0	8.9	8.1
18	8.3	6.3	7.0	5.7	5.4	-N/A-	7.5	7.8	7.5	7.9	9.2	8.1
19	7.5	8.7	6.7	5.0	5.4	-N/A-	7.7	5.9	7.7	-N/A-	10.9	5.9
20	8.8	11.9	8.3	-N/A-	-N/A-	-N/A-	5.3	6.0	-N/A-	-N/A-	10.8	9.4
21	10.0	10.1	12.5	-N/A-	-N/A-	-N/A-	6.7	6.5	2.8	-N/A-	10.7	13.0
22	7.9	7.6	7.6	-N/A-	-N/A-	-N/A-	2.7	6.3	3.5	7.8	7.8	8.6
23	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	6.3	2.7	-N/A-	11.9	9.2

Power Density (W/m**2) z= 10.0m

Hour	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	440.	7.	-N/A-	987.	262.
1	-N/A-	289.	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	390.	3.	-N/A-	757.	261.
2	-N/A-	225.	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	421.	1.	-N/A-	754.	228.
3	-N/A-	64.	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	656.	-N/A-	-N/A-	-N/A-	205.
4	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	322.	-N/A-	-N/A-	-N/A-	175.
5	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	509.	-N/A-	-N/A-	-N/A-	311.
6	-N/A-	-N/A-	-N/A-	279.	-N/A-	350.	-N/A-	683.	-N/A-	-N/A-	-N/A-	181.
7	-N/A-	-N/A-	-N/A-	477.	247.	376.	183.	225.	289.	412.	-N/A-	419.
8	445.	494.	647.	475.	255.	325.	165.	228.	311.	432.	681.	646.
9	540.	477.	575.	481.	273.	274.	161.	224.	318.	413.	681.	721.
10	564.	484.	595.	431.	255.	300.	173.	234.	350.	435.	674.	550.
11	577.	456.	604.	338.	266.	287.	187.	231.	340.	451.	700.	624.
12	533.	434.	579.	410.	268.	256.	185.	223.	354.	471.	665.	577.
13	531.	472.	569.	342.	279.	214.	183.	202.	382.	473.	689.	589.
14	522.	485.	590.	362.	275.	255.	193.	222.	341.	482.	671.	584.
15	503.	430.	547.	371.	266.	250.	212.	217.	326.	409.	732.	590.
16	532.	433.	586.	377.	231.	227.	193.	197.	291.	422.	736.	541.
17	582.	554.	590.	368.	222.	183.	232.	208.	298.	495.	757.	587.
18	777.	359.	532.	293.	28.	-N/A-	261.	464.	262.	400.	809.	610.
19	281.	472.	459.	43.	92.	-N/A-	278.	146.	285.	-N/A-	880.	212.
20	536.	1182.	557.	-N/A-	-N/A-	-N/A-	124.	188.	-N/A-	-N/A-	848.	1032.
21	707.	706.	1776.	-N/A-	-N/A-	-N/A-	190.	191.	13.	-N/A-	810.	1528.
22	344.	300.	306.	-N/A-	-N/A-	-N/A-	13.	162.	26.	297.	313.	415.
23	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	-N/A-	191.	13.	-N/A-	1149.	506.

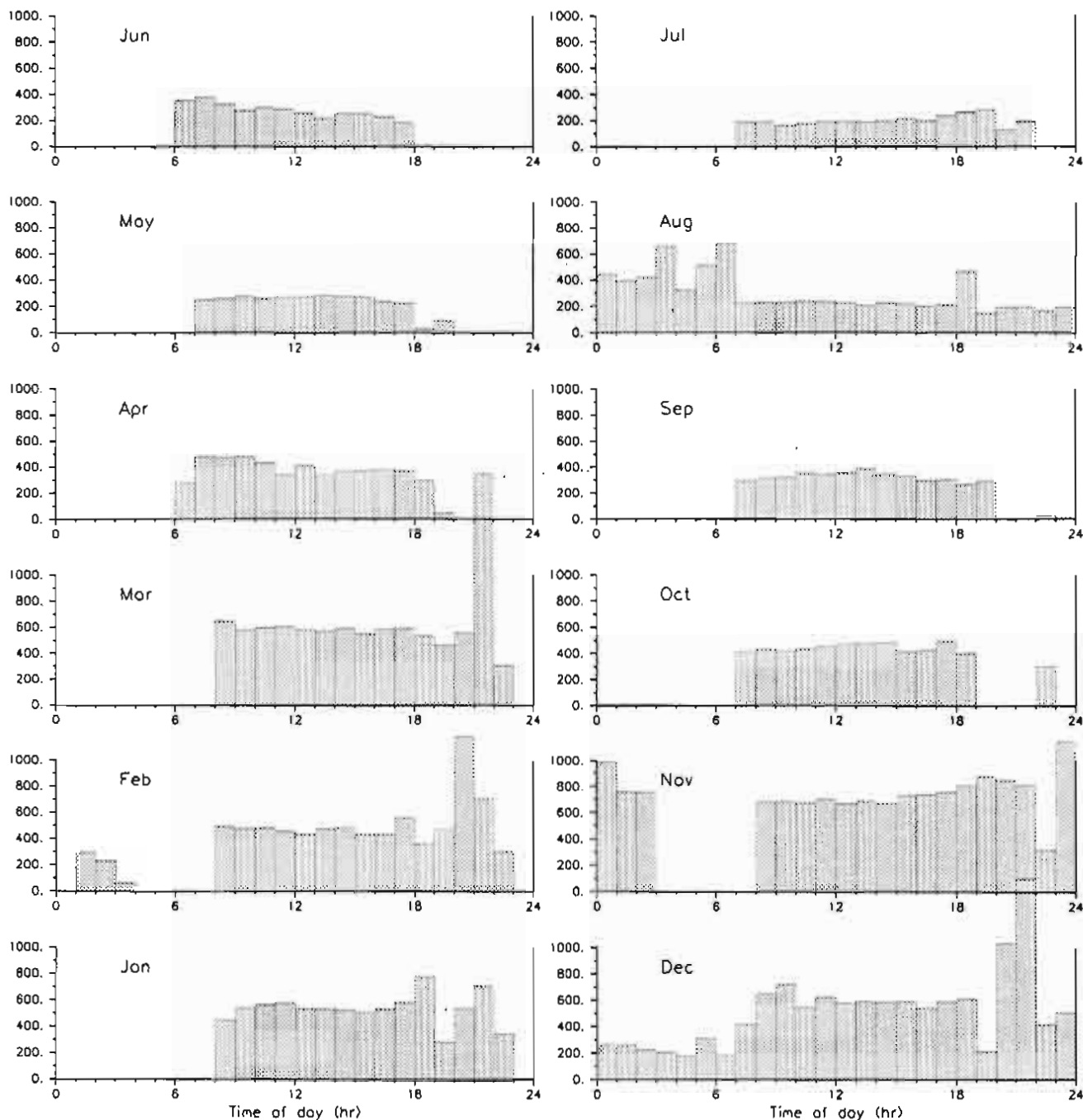
01/04/19

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
 Station: Umiujaq A (3)
 Wind Speed (m/s) at z= 10.0m

DIURNAL DISTRIBUTION Northern QC WRA II - AES Stations



Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00
 Station: Umiujaq A (3)
 Power Density (W/m²) at z= 10.0m

13 APPENDIX E - WINDS AT STANDARD LEVELS

This appendix contains annual summary tables of estimated parameters for the 3 stations at standard heights of 10 and 25m. Extrapolations of the wind speeds to the standard heights were carried out as described in Appendix A of the 1995 report. All averages were also calculated as described in that appendix. The table format is described below.

13.1 Annual Averages (Table)

For each station, the data are averaged by year and total period of record. Where a specific data type was not measured, and where a climatological value could not be used in its place, it is listed as Not Available (N/A). The following data are output:

Column 1 - Average air temperature in degrees Celsius.

Where temperature data for the particular station were not available, climatological data from a nearby station were used instead. The observation height above ground level was taken as 1.5m in each case.

Column 2 - Average station barometric pressure in kiloPascals.

As noted for the air temperature, climatological data for a nearby station were used (with adjustments for the difference in elevation) where station data were missing, or not measured. The observation height was taken as 1.5m.

Column 3 - Average air density in kilograms per cubic metre.

Density was computed from the hourly values of temperature and pressure as described in Appendix A of the 1995 report, and then averaged.

Column 4 - Average wind speed in metres per second at the standard height.

Adjustment of the wind speed to the standard height was carried out according to the method described in Appendix A of the 1995 report. The sector-dependent roughness lengths used are noted at the top of the table.

Column 5 - Average wind direction in degrees from true north.

The direction is not adjusted. It is taken from the original, measured wind direction.

Column 6 - Annual maximum value of the wind speed, in metres per second.

For example, in the case of MSC stations using hourly data, this would be the maximum hourly wind speed during the year adjusted to the standard height.

Column 7 - Maximum gust speed in metres per second

The instantaneous gust speed was not determined at any of the stations.

Column 8 - Average wind power density in watts per square metre.

The wind power density is derived for each wind speed observation (which is adjusted to the standard height) and then averaged to produce the value in the table. The method of Appendix A of the 1995 report is used to determine the power density.

Column 9 - Average turbulence intensity.

This is a non-dimensional measure of the short-term, turbulent fluctuations in the wind during the time of measurement. It is computed as the ratio of the standard deviation of wind speed, σ_u , during the measurement period to the mean wind speed during the period. Turbulence intensity was not measured at any of the stations.

Column 10 - Average Turbine Power

Turbine output characteristics were not determined for this table.

Column 11 - Annual Turbine Output

Turbine output characteristics were not determined for this table.

ANNUAL AVERAGES Northern QC WRA II - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

10.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1980 Jan 01 00:00 to 2000 Jan 01 00:00

Kuujuaq A (1)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m ³	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m ²	Trblnts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	3.8	278.	17.2	-N/A-	108.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.0	286.	19.7	-N/A-	115.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	4.7	266.	20.4	-N/A-	180.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	5.9	100.91	1.320	4.2	283.	18.6	-N/A-	112.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	4.4	272.	22.9	-N/A-	140.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	4.3	284.	19.1	-N/A-	142.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	4.6	264.	23.5	-N/A-	164.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.1	284.	17.7	-N/A-	128.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.0	268.	15.6	-N/A-	105.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	4.5	271.	19.3	-N/A-	143.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	4.4	261.	16.9	-N/A-	138.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	3.9	265.	21.7	-N/A-	102.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.2	271.	18.5	-N/A-	129.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.3	265.	27.4	-N/A-	138.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.63	1.314	4.7	273.	21.5	-N/A-	180.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-4.4	100.82	1.311	3.8	261.	21.8	-N/A-	99.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-4.0	100.80	1.308	3.7	281.	23.1	-N/A-	109.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-5.0	100.57	1.310	3.7	290.	18.5	-N/A-	92.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-3.7	100.80	1.307	3.5	290.	20.5	-N/A-	76.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-3.1	100.71	1.302	3.9	289.	20.5	-N/A-	91.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	Trblnts	TrbnPwr	TrbnOut
80/01/01->81/01/01	100.0	100.0	100.0	100.0	85.6	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	92.3	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	94.8	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	92.7	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	94.2	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	91.3	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	100.0	100.0	100.0	100.0	92.8	100.0	0.0	100.0	0.0	0.0	0.0
90/01/01->91/01/01	100.0	100.0	100.0	100.0	94.0	100.0	0.0	100.0	0.0	0.0	0.0
91/01/01->92/01/01	100.0	100.0	100.0	100.0	93.0	100.0	0.0	100.0	0.0	0.0	0.0
92/01/01->93/01/01	100.0	100.0	100.0	100.0	93.5	100.0	0.0	100.0	0.0	0.0	0.0
93/01/01->94/01/01	100.0	100.0	100.0	100.0	94.9	100.0	0.0	100.0	0.0	0.0	0.0
94/01/01->95/01/01	99.9	99.9	99.9	99.9	94.9	99.9	0.0	99.9	0.0	0.0	0.0
95/01/01->96/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
96/01/01->97/01/01	99.9	99.9	99.9	99.9	88.1	99.9	0.0	99.9	0.0	0.0	0.0
97/01/01->98/01/01	99.9	99.9	99.9	99.9	87.7	99.9	0.0	99.9	0.0	0.0	0.0
98/01/01->99/01/01	99.8	99.8	99.8	99.8	86.9	99.8	0.0	99.8	0.0	0.0	0.0
99/01/01->00/01/01	99.9	99.9	99.9	99.9	91.5	99.9	0.0	99.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	Trblnts	TrbnPwr	TrbnOut
80/01/01->00/01/01	-5.3	100.70	1.314	4.1	274.	27.4	-N/A-	125.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	Trblnts	TrbnPwr	TrbnOut
80/01/01->00/01/01	100.0	100.0	100.0	100.0	92.1	100.0	0.0	100.0	0.0	0.0	0.0

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m ³	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m ²	Trblnts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
80/01/01->81/01/01	-4.8	100.59	1.309	4.4	278.	20.0	-N/A-	168.	-N/A-	-N/A-	-N/A-
81/01/01->82/01/01	-3.0	100.68	1.301	4.6	286.	22.9	-N/A-	178.	-N/A-	-N/A-	-N/A-
82/01/01->83/01/01	-6.3	100.60	1.317	5.4	266.	23.6	-N/A-	279.	-N/A-	-N/A-	-N/A-
83/01/01->84/01/01	5.9	100.91	1.320	4.9	283.	21.5	-N/A-	174.	-N/A-	-N/A-	-N/A-
84/01/01->85/01/01	-5.5	100.72	1.316	5.1	272.	26.5	-N/A-	217.	-N/A-	-N/A-	-N/A-
85/01/01->86/01/01	-4.8	100.62	1.310	5.0	284.	22.1	-N/A-	220.	-N/A-	-N/A-	-N/A-
86/01/01->87/01/01	-6.3	100.62	1.317	5.8	264.	27.2	-N/A-	255.	-N/A-	-N/A-	-N/A-
87/01/01->88/01/01	-5.1	100.76	1.313	4.6	284.	20.5	-N/A-	199.	-N/A-	-N/A-	-N/A-
88/01/01->89/01/01	-5.7	100.70	1.316	4.6	268.	18.1	-N/A-	163.	-N/A-	-N/A-	-N/A-
89/01/01->90/01/01	-6.6	100.63	1.319	5.1	271.	22.4	-N/A-	222.	-N/A-	-N/A-	-N/A-
90/01/01->91/01/01	-6.3	100.61	1.318	5.1	261.	19.4	-N/A-	214.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-6.1	100.74	1.319	4.5	265.	25.1	-N/A-	158.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.73	1.325	4.9	271.	21.4	-N/A-	200.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-6.4	100.73	1.320	4.9	265.	31.7	-N/A-	214.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-5.4	100.63	1.314	5.5	273.	24.9	-N/A-	279.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-4.4	100.82	1.311	4.4	261.	25.2	-N/A-	153.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-4.0	100.80	1.308	4.3	281.	26.8	-N/A-	169.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-5.0	100.57	1.310	4.2	290.	21.4	-N/A-	143.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-3.7	100.80	1.307	4.0	290.	23.7	-N/A-	117.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-3.1	100.71	1.302	4.5	289.	23.7	-N/A-	142.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	Trblnts	TrbnPwr	TrbnOut
80/01/01->81/01/01	100.0	100.0	100.0	100.0	85.6	100.0	0.0	100.0	0.0	0.0	0.0
81/01/01->82/01/01	100.0	100.0	100.0	100.0	92.3	100.0	0.0	100.0	0.0	0.0	0.0
82/01/01->83/01/01	100.0	100.0	100.0	100.0	94.8	100.0	0.0	100.0	0.0	0.0	0.0
83/01/01->84/01/01	100.0	100.0	100.0	100.0	92.7	100.0	0.0	100.0	0.0	0.0	0.0
84/01/01->85/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
85/01/01->86/01/01	100.0	100.0	100.0	100.0	94.2	100.0	0.0	100.0	0.0	0.0	0.0
86/01/01->87/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
87/01/01->88/01/01	100.0	100.0	100.0	100.0	91.3	100.0	0.0	100.0	0.0	0.0	0.0
88/01/01->89/01/01	100.0	100.0	100.0	100.0	93.1	100.0	0.0	100.0	0.0	0.0	0.0
89/01/01->90/01/01	100.0	100.0	100.0	100.0	92.8	100.0	0.0	100.0	0.0	0.0	0.0
90/01/01->91/01/01	100.0	100.0	100.0	100.0	94.0	100.0	0.0	100.0	0.0	0.0	0.0
91/01/01->92/01/01	100.0	100.0	100.0	100.0	93.0	100.0	0.0	100.0	0.0	0.0	0.0
92/01/01->93/01/01	100.0	100.0	100.0	100.0	93.5	100.0	0.0	100.0	0.0	0.0	0.0
93/01/01->94/01/01	100.0	100.0	100.0	100.0	94.9	100.0	0.0	100.0	0.0	0.0	0.0
94/01/01->95/01/01	99.9	99.9	99.9	99.9	94.9	99.9	0.0	99.9	0.0	0.0	0.0
95/01/01->96/01/01	100.0	100.0	100.0	100.0	93.6	100.0	0.0	100.0	0.0	0.0	0.0
96/01/01->97/01/01	99.9	99.9	99.9	99.9	88.1	99.9	0.0	99.9	0.0	0.0	0.0

97/01/01->98/01/01	99.9	99.9	99.9	99.9	87.7	99.9	0.0	99.9	0.0	0.0	0.0
98/01/01->99/01/01	99.8	99.8	99.8	99.8	86.9	99.8	0.0	99.8	0.0	0.0	0.0
99/01/01->00/01/01	99.9	99.9	99.9	99.9	91.5	99.9	0.0	99.9	0.0	0.0	0.0

Period Average

80/01/01->00/01/01	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
	-5.3	100.70	1.314	4.8	274.	31.7	-N/A-	193.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

80/01/01->00/01/01	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
	100.0	100.0	100.0	100.0	92.1	100.0	0.0	100.0	0.0	0.0	0.0

01/05/20

ANNUAL AVERAGES Northern QC WRA II - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0002,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300)
 Period: 1990 Jan 01 00:00 to 2000 Jan 01 00:00
 Quaqtaq (2)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
90/01/01->91/01/01	-7.4	100.65	1.322	5.7	285.	20.8	-N/A-	312.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-7.3	100.69	1.322	6.3	273.	20.8	-N/A-	365.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.70	1.323	5.7	274.	20.8	-N/A-	302.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-7.3	100.68	1.322	5.7	255.	23.7	-N/A-	281.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.64	1.319	5.5	287.	20.5	-N/A-	236.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-6.7	100.71	1.319	5.1	289.	23.3	-N/A-	232.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-6.8	100.74	1.320	5.6	289.	17.7	-N/A-	230.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-6.8	100.64	1.318	5.6	296.	19.7	-N/A-	249.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-6.4	100.73	1.318	5.9	300.	20.7	-N/A-	261.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-6.2	100.72	1.317	6.2	294.	23.0	-N/A-	331.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->91/01/01	34.5	34.5	34.5	34.5	30.9	34.5	0.0	34.5	0.0	0.0	0.0
91/01/01->92/01/01	29.7	29.7	29.7	29.7	28.0	29.7	0.0	29.7	0.0	0.0	0.0
92/01/01->93/01/01	19.7	19.7	19.7	19.7	18.1	19.7	0.0	19.7	0.0	0.0	0.0
93/01/01->94/01/01	36.1	36.1	36.1	36.1	33.8	36.1	0.0	36.1	0.0	0.0	0.0
94/01/01->95/01/01	36.9	36.9	36.9	36.9	34.5	36.9	0.0	36.9	0.0	0.0	0.0
95/01/01->96/01/01	23.8	23.8	23.8	23.8	22.6	23.8	0.0	23.8	0.0	0.0	0.0
96/01/01->97/01/01	18.1	18.0	18.0	18.1	17.6	18.1	0.0	18.1	0.0	0.0	0.0
97/01/01->98/01/01	37.1	37.1	37.1	37.2	35.5	37.2	0.0	37.2	0.0	0.0	0.0
98/01/01->99/01/01	38.3	38.3	38.3	38.3	37.4	38.3	0.0	38.3	0.0	0.0	0.0
99/01/01->00/01/01	38.9	38.9	38.9	38.9	37.6	38.9	0.0	38.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	-6.9	100.69	1.320	5.8	285.	23.7	-N/A-	282.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	31.3	31.3	31.3	31.3	29.6	31.3	0.0	31.3	0.0	0.0	0.0

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
90/01/01->91/01/01	-7.4	100.65	1.322	6.6	285.	24.1	-N/A-	481.	-N/A-	-N/A-	-N/A-
91/01/01->92/01/01	-7.3	100.69	1.322	7.2	273.	24.1	-N/A-	562.	-N/A-	-N/A-	-N/A-
92/01/01->93/01/01	-7.5	100.70	1.323	6.6	274.	24.1	-N/A-	466.	-N/A-	-N/A-	-N/A-
93/01/01->94/01/01	-7.3	100.68	1.322	6.6	255.	27.4	-N/A-	432.	-N/A-	-N/A-	-N/A-
94/01/01->95/01/01	-6.9	100.64	1.319	6.3	287.	23.7	-N/A-	363.	-N/A-	-N/A-	-N/A-
95/01/01->96/01/01	-6.7	100.71	1.319	5.9	289.	27.0	-N/A-	357.	-N/A-	-N/A-	-N/A-
96/01/01->97/01/01	-6.8	100.74	1.320	6.5	289.	20.5	-N/A-	354.	-N/A-	-N/A-	-N/A-
97/01/01->98/01/01	-6.8	100.64	1.318	6.5	296.	22.8	-N/A-	384.	-N/A-	-N/A-	-N/A-
98/01/01->99/01/01	-6.4	100.73	1.318	6.8	300.	24.0	-N/A-	402.	-N/A-	-N/A-	-N/A-
99/01/01->00/01/01	-6.2	100.72	1.317	7.1	294.	26.7	-N/A-	511.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->91/01/01	34.5	34.5	34.5	34.5	30.9	34.5	0.0	34.5	0.0	0.0	0.0
91/01/01->92/01/01	29.7	29.7	29.7	29.7	28.0	29.7	0.0	29.7	0.0	0.0	0.0
92/01/01->93/01/01	19.7	19.7	19.7	19.7	18.1	19.7	0.0	19.7	0.0	0.0	0.0
93/01/01->94/01/01	36.1	36.1	36.1	36.1	33.8	36.1	0.0	36.1	0.0	0.0	0.0
94/01/01->95/01/01	36.9	36.9	36.9	36.9	34.5	36.9	0.0	36.9	0.0	0.0	0.0
95/01/01->96/01/01	23.8	23.8	23.8	23.8	22.6	23.8	0.0	23.8	0.0	0.0	0.0
96/01/01->97/01/01	18.1	18.0	18.0	18.1	17.6	18.1	0.0	18.1	0.0	0.0	0.0
97/01/01->98/01/01	37.1	37.1	37.1	37.2	35.5	37.2	0.0	37.2	0.0	0.0	0.0
98/01/01->99/01/01	38.3	38.3	38.3	38.3	37.4	38.3	0.0	38.3	0.0	0.0	0.0
99/01/01->00/01/01	38.9	38.9	38.9	38.9	37.6	38.9	0.0	38.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	-6.9	100.69	1.320	6.6	285.	27.4	-N/A-	434.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
90/01/01->00/01/01	31.3	31.3	31.3	31.3	29.6	31.3	0.0	31.3	0.0	0.0	0.0

01/05/20

ANNUAL AVERAGES Northern QC WRA II - AES Stations

Adjusted to elevation(s). Upstream Zo used (in 16 directions) was:

10.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300,0.0300

Period: 1993 Feb 01 00:00 to 2000 Feb 01 00:00

Umiuq A (3)

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 10.0m m/s	WDir 10.0m degt	MxWSpd 10.0m m/s	Gust 10.0m m/s	Power 10.0m W/m**2	TrbInts 10.0m	TrbnPwr 10.0m kW	TrbnOut 10.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	6.8	193.	27.7	-N/A-	461.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	7.3	204.	27.8	-N/A-	565.	-N/A-	-N/A-	-N/A-
95/02/01->96/02/01	-4.1	100.23	1.301	6.8	209.	26.0	-N/A-	420.	-N/A-	-N/A-	-N/A-
96/02/01->97/02/01	-4.0	100.23	1.300	6.3	219.	22.0	-N/A-	341.	-N/A-	-N/A-	-N/A-
97/02/01->98/02/01	-3.9	100.22	1.300	6.4	177.	24.4	-N/A-	364.	-N/A-	-N/A-	-N/A-
98/02/01->99/02/01	-3.0	100.23	1.296	6.8	188.	26.8	-N/A-	455.	-N/A-	-N/A-	-N/A-
99/02/01->00/02/01	-3.0	100.24	1.296	6.4	154.	23.1	-N/A-	352.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->94/02/01	41.8	41.8	41.8	41.8	40.0	41.8	0.0	41.8	0.0	0.0	0.0
94/02/01->95/02/01	36.5	36.3	36.3	36.3	35.1	36.3	0.0	36.3	0.0	0.0	0.0
95/02/01->96/02/01	35.7	35.5	35.5	35.7	34.7	35.7	0.0	35.7	0.0	0.0	0.0
96/02/01->97/02/01	28.2	28.1	28.1	28.2	27.3	28.2	0.0	28.2	0.0	0.0	0.0
97/02/01->98/02/01	38.0	37.9	37.9	37.9	36.1	37.9	0.0	37.9	0.0	0.0	0.0
98/02/01->99/02/01	38.1	38.1	38.1	38.1	36.5	38.1	0.0	38.1	0.0	0.0	0.0
99/02/01->00/02/01	37.9	37.9	37.9	37.9	37.0	37.9	0.0	37.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	-3.8	100.24	1.299	6.7	192.	27.8	-N/A-	425.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	36.6	36.5	36.5	36.6	35.2	36.6	0.0	36.6	0.0	0.0	0.0

Annual Average

	Temp 1.5m C	BPress 1.5m kPa	Density 1.5m kg/m**3	WSpd 25.0m m/s	WDir 25.0m degt	MxWSpd 25.0m m/s	Gust 25.0m m/s	Power 25.0m W/m**2	TrbInts 25.0m	TrbnPwr 25.0m kW	TrbnOut 25.0m MWhr
93/02/01->94/02/01	-4.6	100.29	1.304	7.9	193.	32.1	-N/A-	715.	-N/A-	-N/A-	-N/A-
94/02/01->95/02/01	-4.1	100.20	1.300	8.4	204.	32.1	-N/A-	876.	-N/A-	-N/A-	-N/A-
95/02/01->96/02/01	-4.1	100.23	1.301	7.8	209.	30.1	-N/A-	652.	-N/A-	-N/A-	-N/A-
96/02/01->97/02/01	-4.0	100.23	1.300	7.3	219.	25.4	-N/A-	530.	-N/A-	-N/A-	-N/A-
97/02/01->98/02/01	-3.9	100.22	1.300	7.4	177.	28.3	-N/A-	566.	-N/A-	-N/A-	-N/A-
98/02/01->99/02/01	-3.0	100.23	1.296	7.9	188.	31.0	-N/A-	705.	-N/A-	-N/A-	-N/A-
99/02/01->00/02/01	-3.0	100.24	1.296	7.4	154.	26.7	-N/A-	546.	-N/A-	-N/A-	-N/A-

Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->94/02/01	41.8	41.8	41.8	41.8	40.0	41.8	0.0	41.8	0.0	0.0	0.0
94/02/01->95/02/01	36.5	36.3	36.3	36.3	35.1	36.3	0.0	36.3	0.0	0.0	0.0
95/02/01->96/02/01	35.7	35.5	35.5	35.7	34.7	35.7	0.0	35.7	0.0	0.0	0.0
96/02/01->97/02/01	28.2	28.1	28.1	28.2	27.3	28.2	0.0	28.2	0.0	0.0	0.0
97/02/01->98/02/01	38.0	37.9	37.9	37.9	36.1	37.9	0.0	37.9	0.0	0.0	0.0
98/02/01->99/02/01	38.1	38.1	38.1	38.1	36.5	38.1	0.0	38.1	0.0	0.0	0.0
99/02/01->00/02/01	37.9	37.9	37.9	37.9	37.0	37.9	0.0	37.9	0.0	0.0	0.0

Period Average

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	-3.8	100.24	1.299	7.7	192.	32.1	-N/A-	660.	-N/A-	-N/A-	-N/A-

Period Data Availability (%)

	Temp	BPress	Density	WSpd	WDir	MxWSpd	Gust	Power	TrbInts	TrbnPwr	TrbnOut
93/02/01->00/02/01	36.6	36.5	36.5	36.6	35.2	36.6	0.0	36.6	0.0	0.0	0.0

01/05/20

14 APPENDIX F - MS-MICRO INPUT AND RESULTS

This appendix contains maps and tables related to the numerical modelling of the wind flow over the complex terrain at each of the 3 villages studied. Note that all horizontal coordinates are in metres in the UTM coordinate system in zone 19. Vertical coordinates are in metres.

There is one set of maps and a table for Quaqtaq and Umiujaq, and two sets (corresponding to $z_0=3$ cm and $z_0=10$ cm for the assumed surface roughness). They are described briefly below. Note that the last four maps correspond to the same domain and can be overlaid for comparisons.

Note that for Kuujjuaq, which is designated as Kuujjuaq-NW in this report to denote that its domain has been extended to the northwest, the model analysis for the $z_0=10$ cm surface roughness (small trees) is distinguished as "Kuujjuaq-NW (Trees)"

Topographic Relief Map

This map shows the 'master grid' used to generate the gridded topographic data used by the model. Note that the vertical scale is exaggerated. (For Quaqtaq and Umiujaq, these can be found in the 1995 report.)

Topographic Shaded Relief Map

This map has been included to help the reader visualize the topography.

Topographic Contour Map

This map displays topographic contours (in metres above sea level) in an 8 km x 8 km (24 km x 24 km for Kuujjuaq) area surrounding the station. This area corresponds exactly to the central quarter of the numerical model domain (which is 16 km x 16 km for Quaqtaq and Umiujaq and 48 km x 48 km for Kuujjuaq).

Surface Roughness Map

On this map, the colours correspond to the type of surface defined by the surface roughness grid input to the MS-Micro/s model. The colours can be related to the actual roughness lengths used through the roughness class listing in the 'MS-Micro MASTER PARAMETER SUMMARY' table for each station.

'MS-Micro MASTER PARAMETER SUMMARY' Table

This table lists the parameters used for the MS-Micro model run for each of the villages. (Note that for the Kuujjuaq-NW (Trees) model analysis, surface roughness type 3 which is normally "Open" and equal to 3 cm, has been changed to "Roughly Open" and equal to 10 cm in order to model the increased surface roughness of a treed terrain.)

Wind Speed Isotach Map

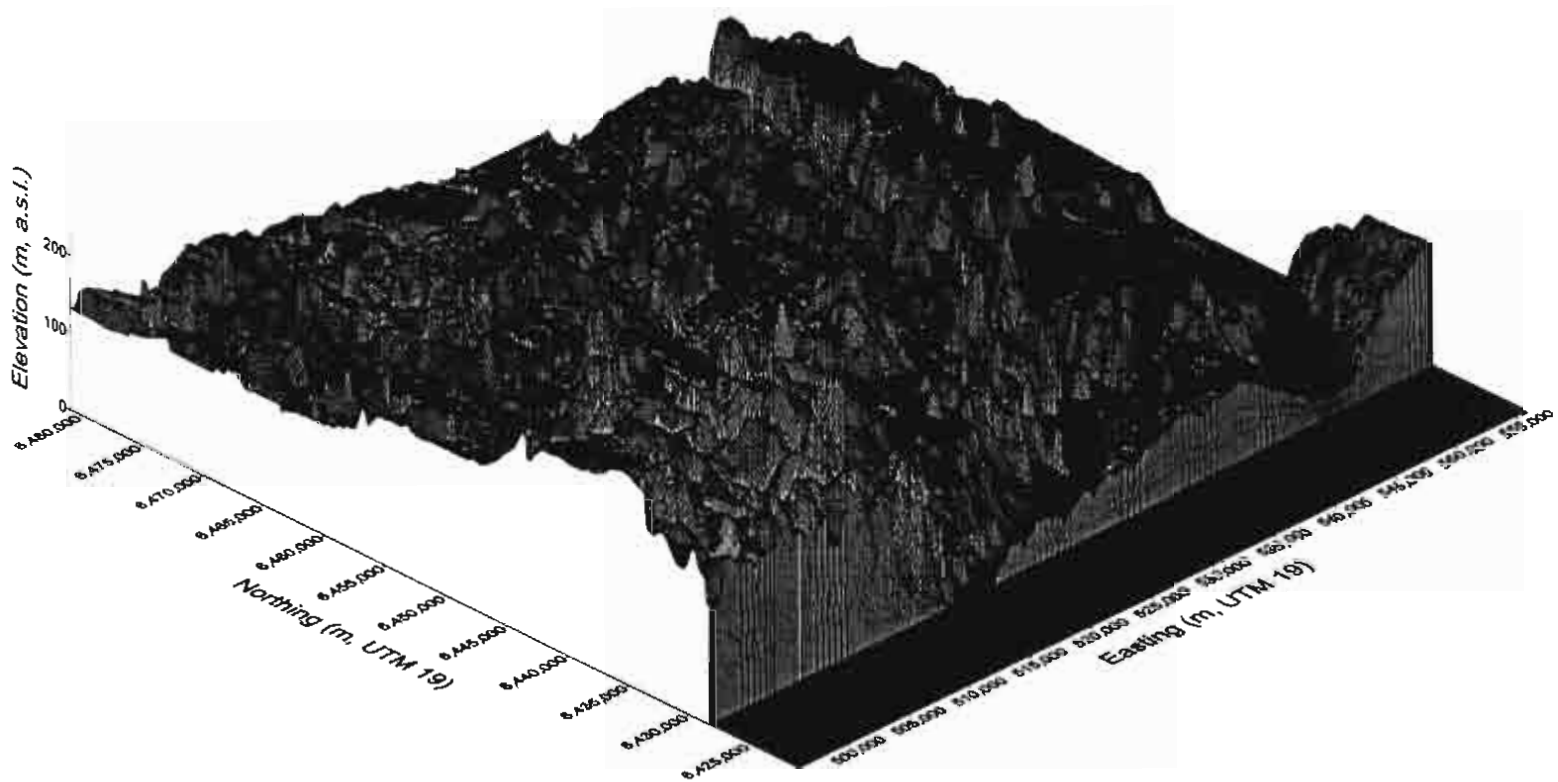
This map displays isotachs of the predicted wind speed over the central area of the model domain.

Turbine Output Isodyne Map

This map shows isodynes of the predicted output from the AOC 15/50 turbine (in average kW) for the central portion of the model domain. This map can be used for siting turbines for optimum performance.

MS-Micro MODEL INPUT

Zephyr North

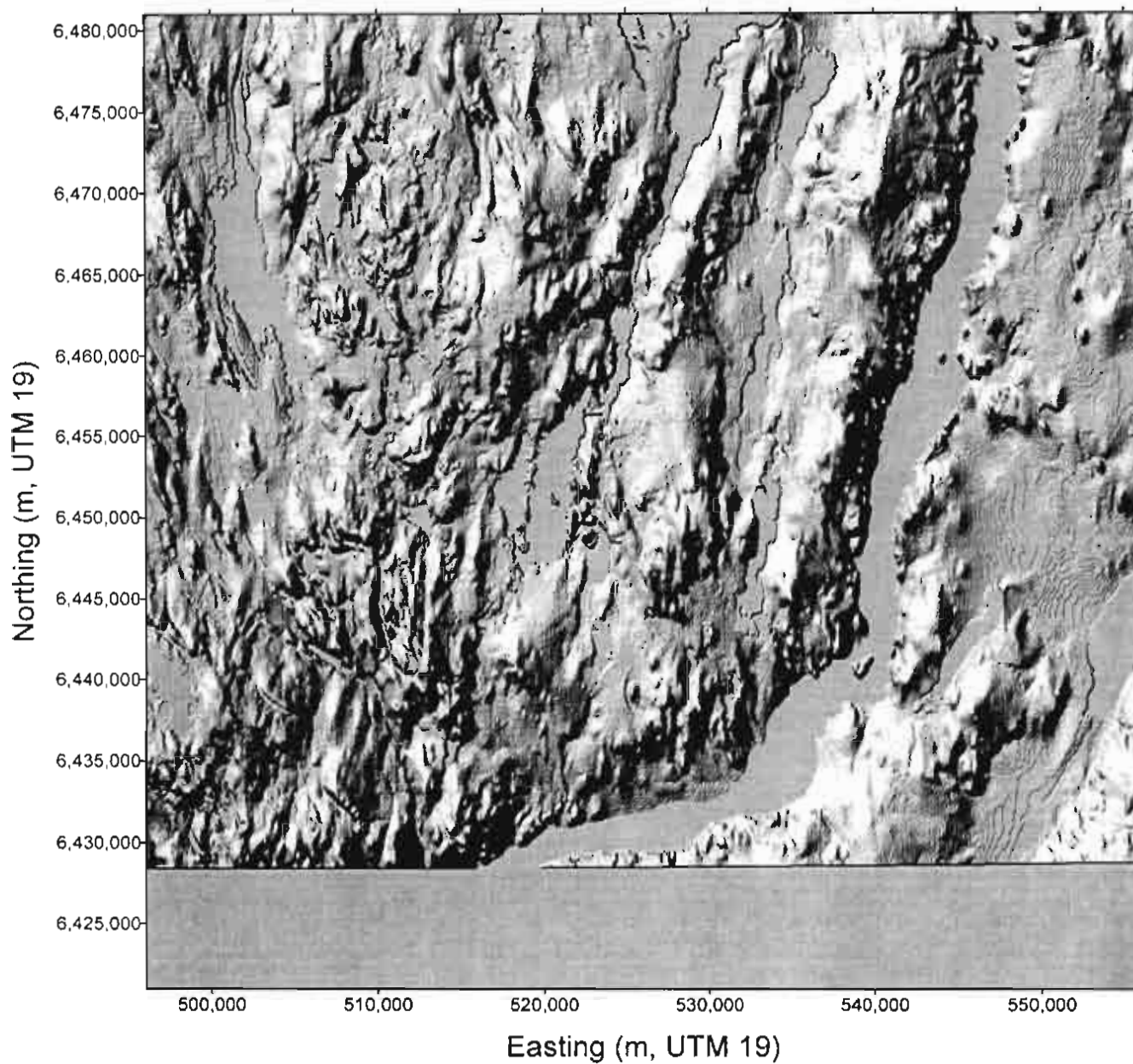


KUJJUAQ-NW

Topography Relief from Master Grid

MS-Micro MODEL INPUT

Zephyr North

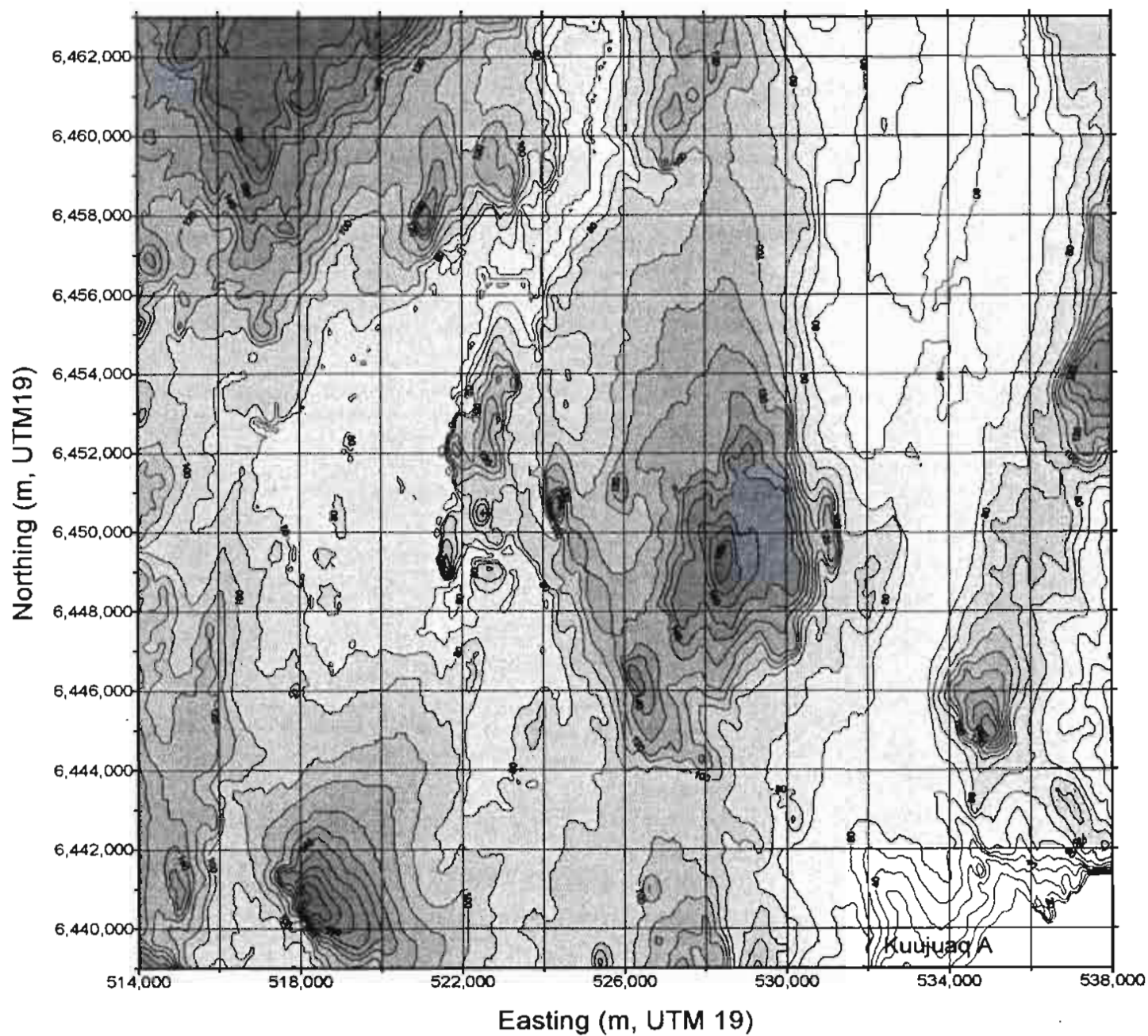


KUUJJUAQ-NW

Topography Shaded Relief from Master Grid

MS-Micro MODEL INPUT

Zephyr North



KUUJJUAQ-NW

Topography Contours from Master Grid (Central Quarter) - (m)

MS-Micro MASTER PARAMETER SUMMARY

Project Name: KUJJUAQ-NW 01/06/06 13:01:06

UTM zone, X-centre, Y-centre (m): 19 526000. 6451000.

Master topography file: KJJQ-NWT.GRD

Master roughness file: KJJQ-NW.RMG

Left, right, lower, upper boundaries (m) : -24000. 24000. -24000. 24000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 13000. 16500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

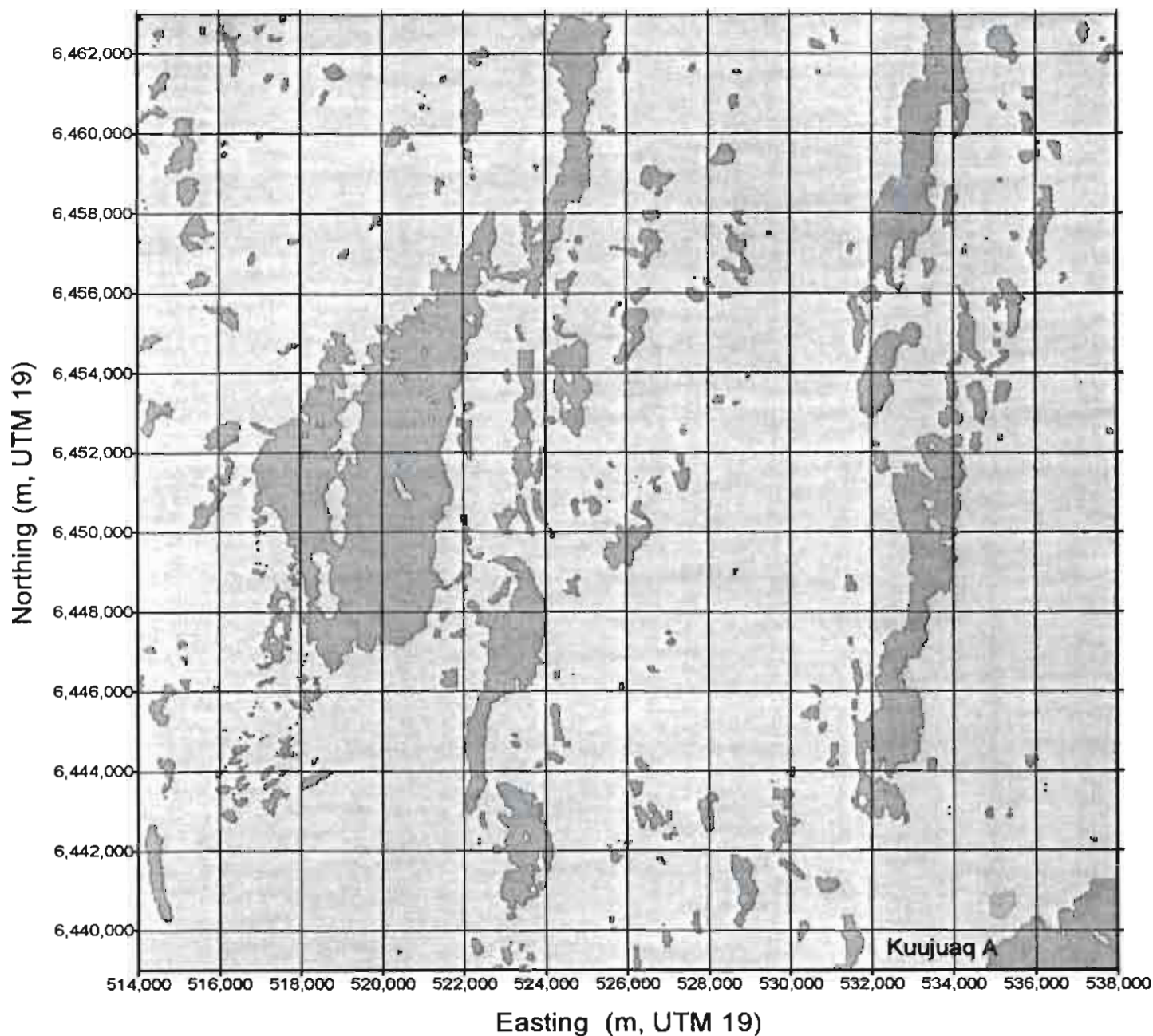
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL INPUT

Zephyr North



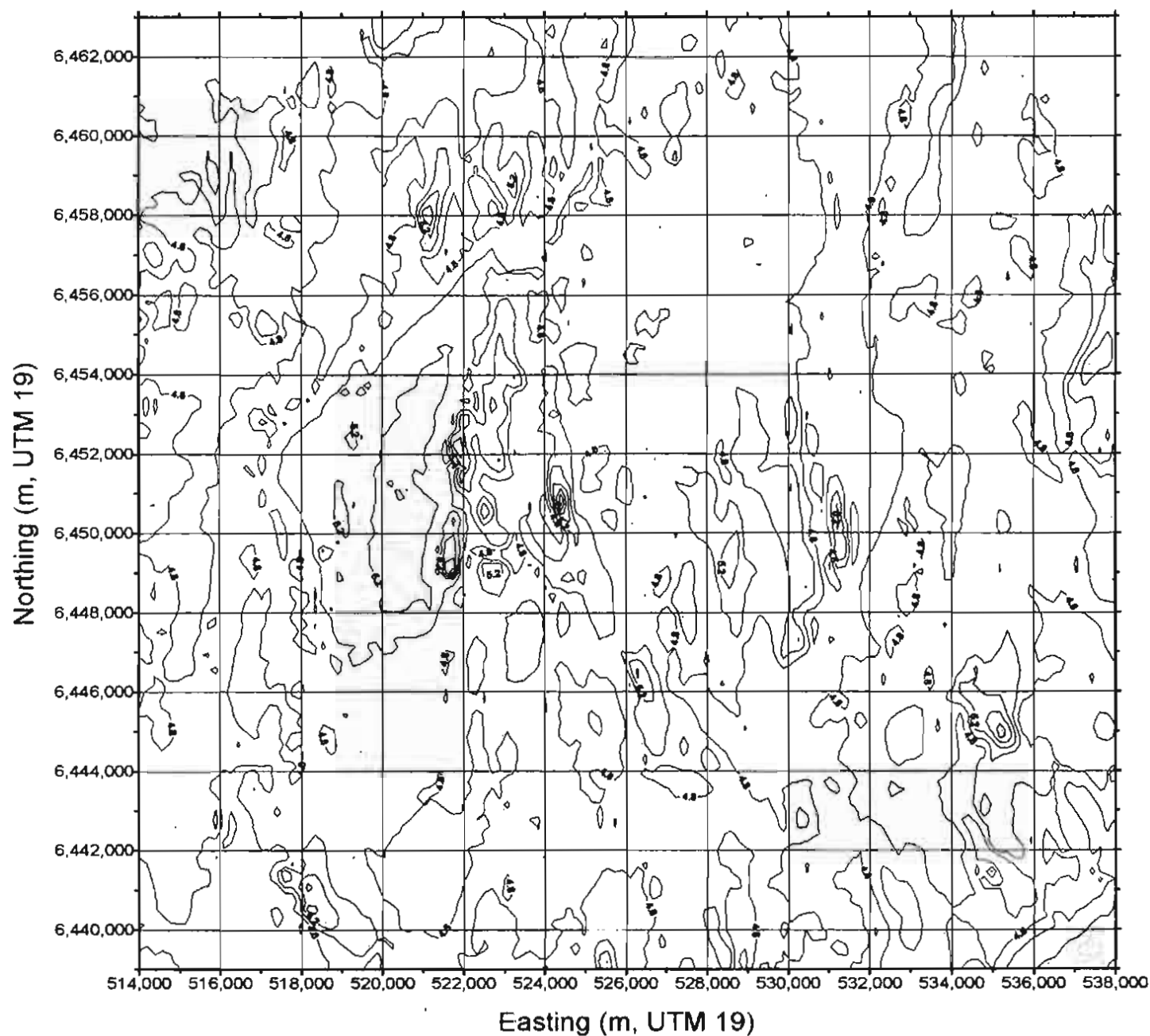
KUJJUAQ-NW

Roughness from Master Grid (Central Quarter)

- 8. Chaotic
- 7. Closed
- 6. Very Rough
- 5. Rough
- 4. Roughly Open
- 3. Open
- 2. Smooth
- 1. Sea

MS-Micro MODEL OUTPUT
Wind Speed (m/s)

Zephyr North



KUUJJUAQ-NW

2001/06/06 13:01:06

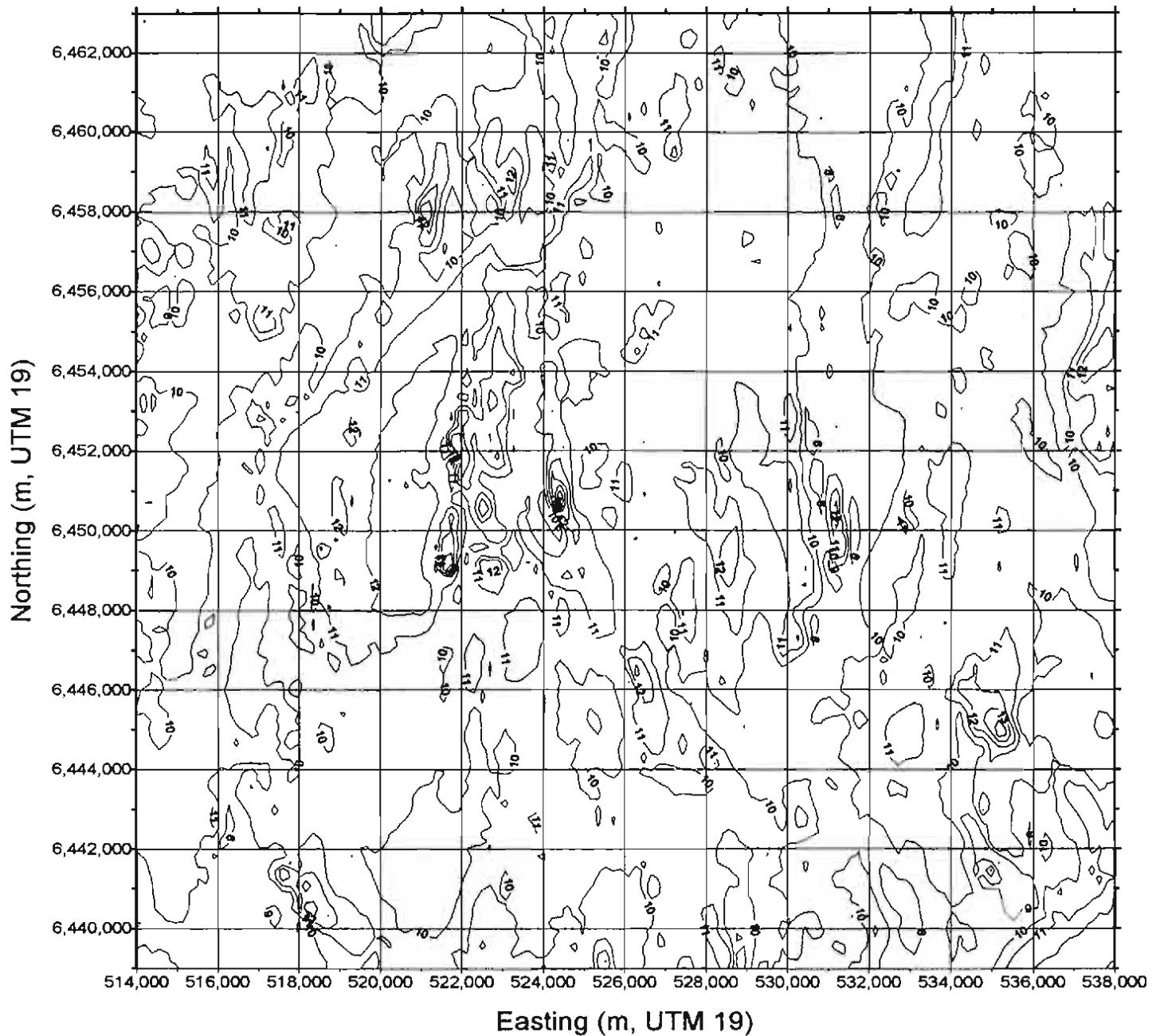
Wind Speed (m/s)

Level: 25.00 m

Wind Distribution: KUUJJUAQ.RJF

MS-Micro MODEL OUTPUT Turbine Power (kW)

Zephyr North



KUJJUAQ-NW

2001/06/06 13:01:06

AOC 15/50 Turbine Power (kW)

Level: 25.00 m

Wind Distribution: KUJJUAQ.RJF

Temperature: -5.7 C Pressure: 100.69 kPa

MS-Micro MASTER PARAMETER SUMMARY

Project Name: KUJJJUAQ-NW (TREES) 01/06/06 14:54:17

UTM zone, X-centre, Y-centre (m): 19 526000. 6451000.

Master topography file: KJJQ-NWT.GRD

Master roughness file: KJJQ-NW.RMG

Left, right, lower, upper boundaries (m) : -24000. 24000. -24000. 24000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 13000. 16500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	3
12	247	0.	3
13	270	0.	3
14	292	0.	3
15	315	0.	3
16	337	0.	3

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	1.00E-01	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

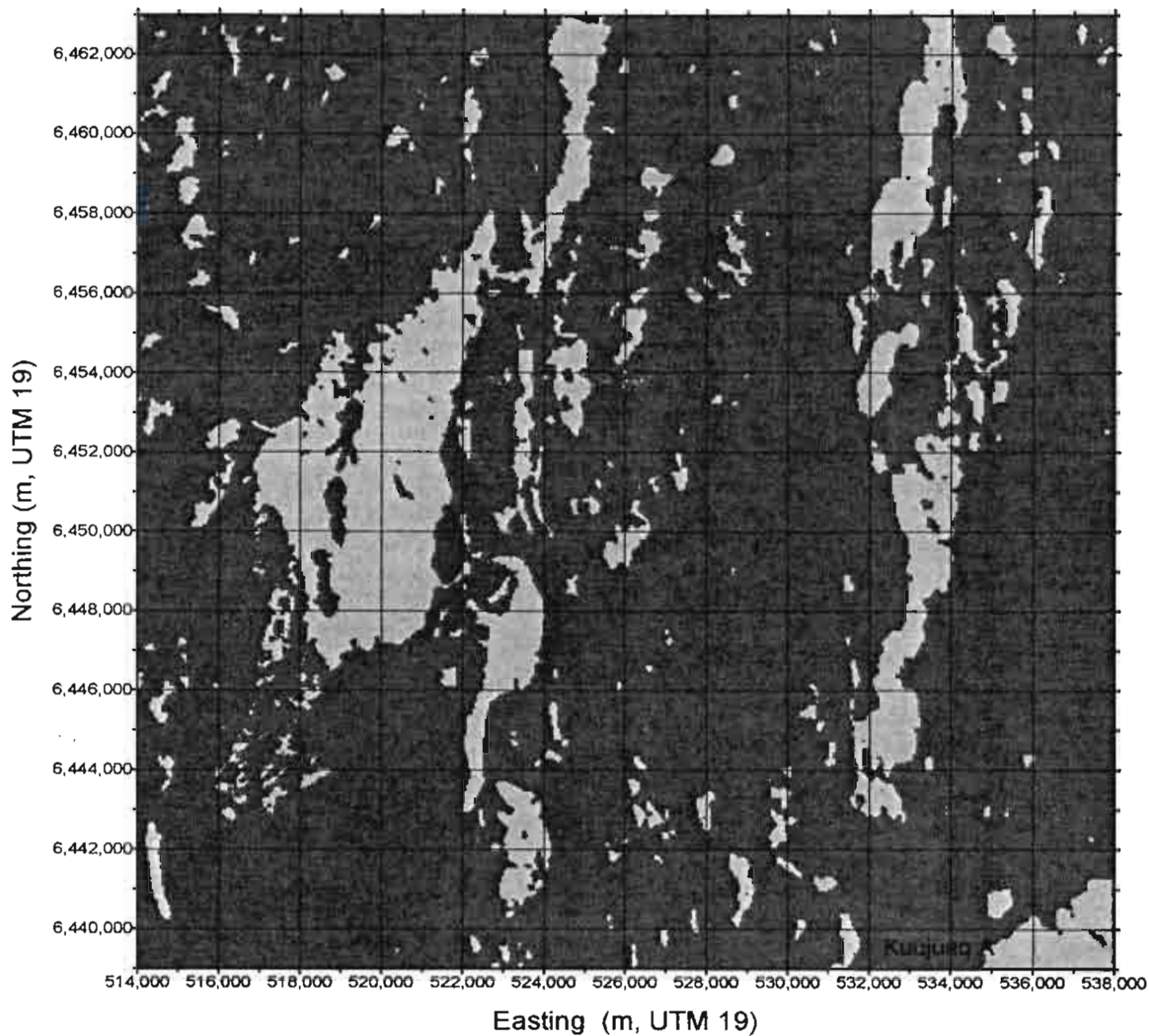
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL INPUT

Zephyr North



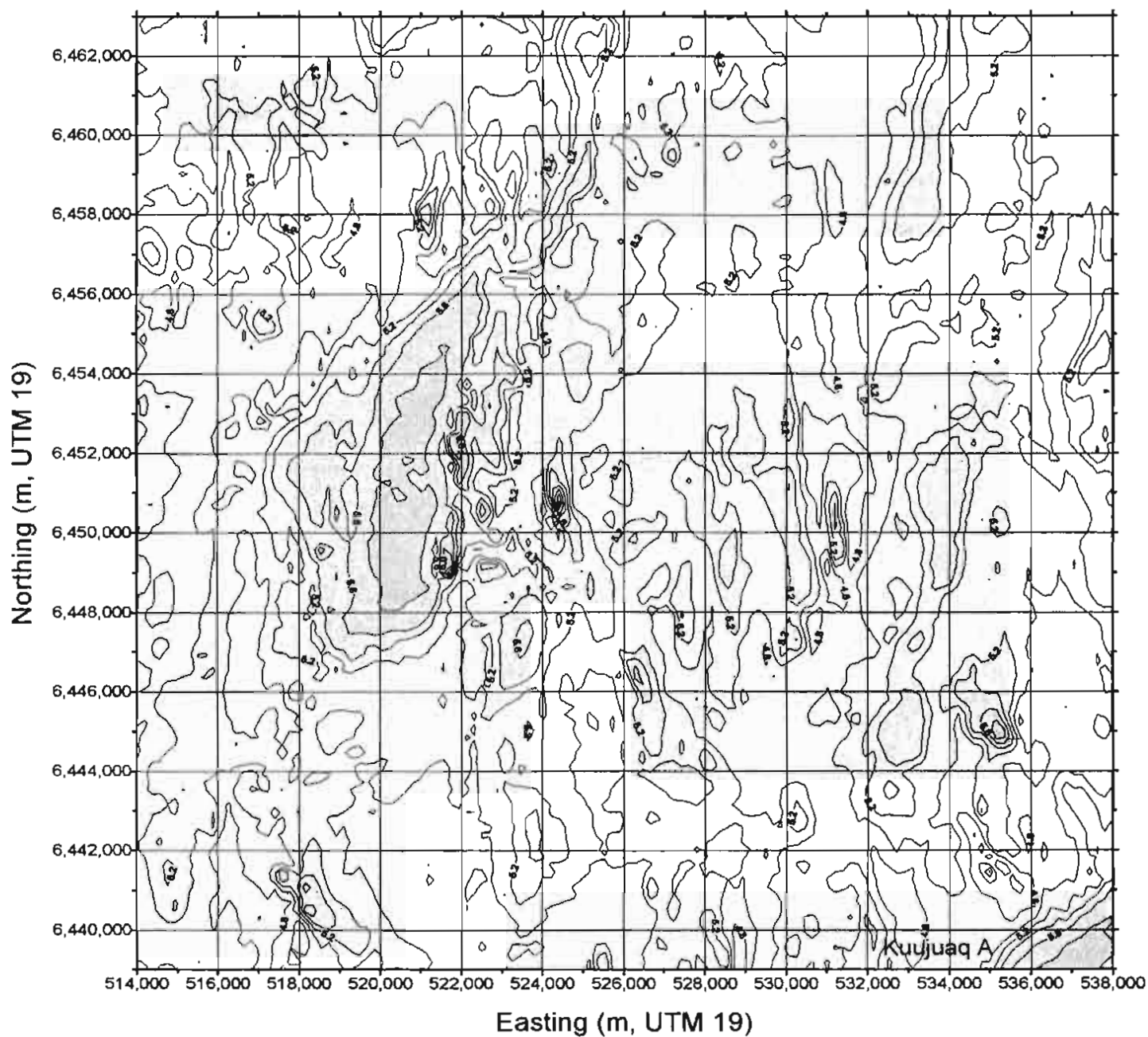
KUUJJUAQ-NW (TREES)

Roughness from Master Grid (Central Quarter)

- 8. Chaotic
- 7. Closed
- 6. Very Rough
- 5. Rough
- 4. Roughly Open
- 3. Open
- 2. Smooth
- 1. Sea

MS-Micro MODEL OUTPUT
Wind Speed (m/s)

Zephyr North

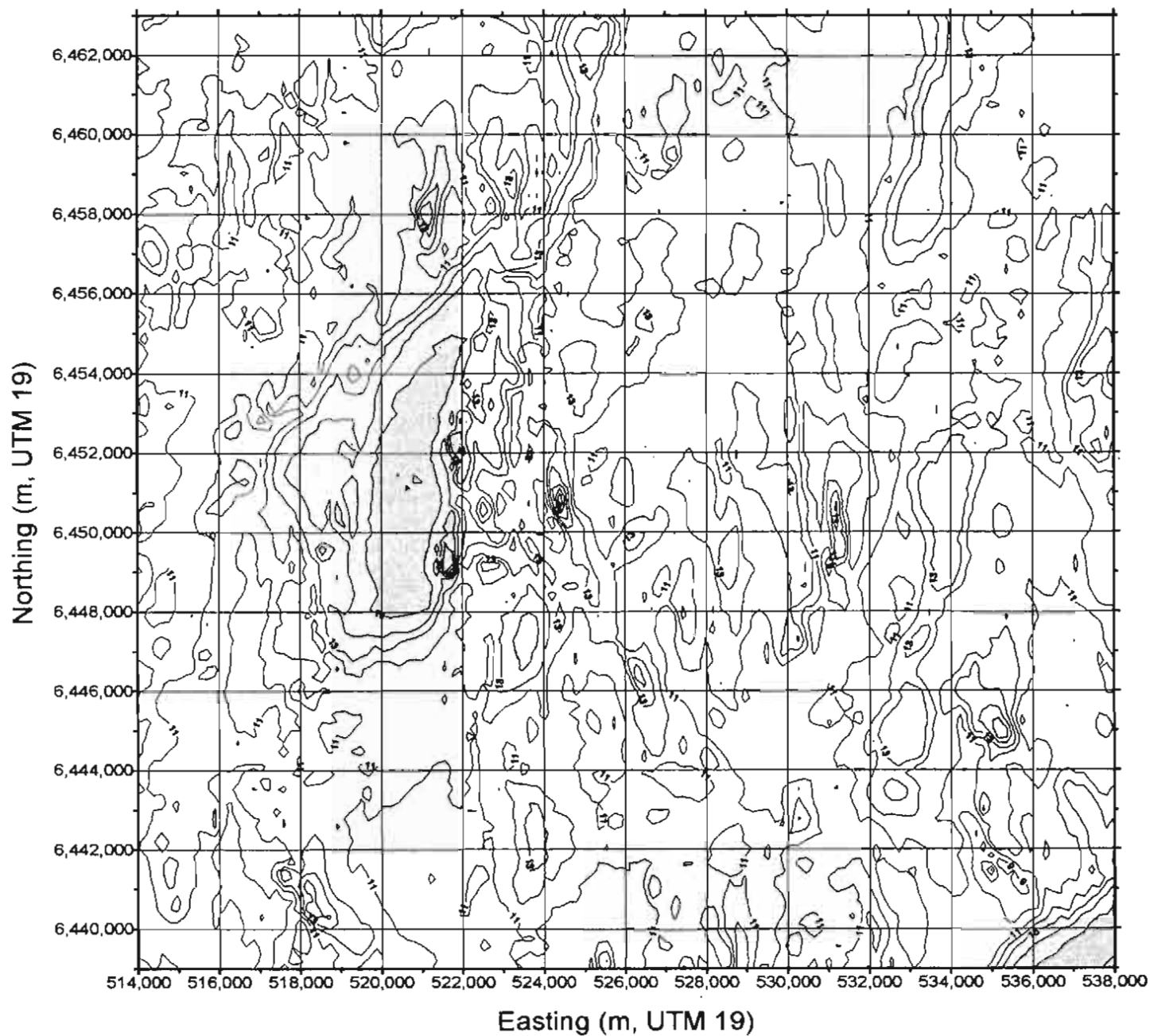


KUJJUAQ-NW (Trees) 2001/06/06 14:54:17

Wind Speed (m/s)
Level: 25.00 m
Wind Distribution: KUJJUAQ.RJF

MS-Micro MODEL OUTPUT
Turbine Power (kW)

Zephyr North



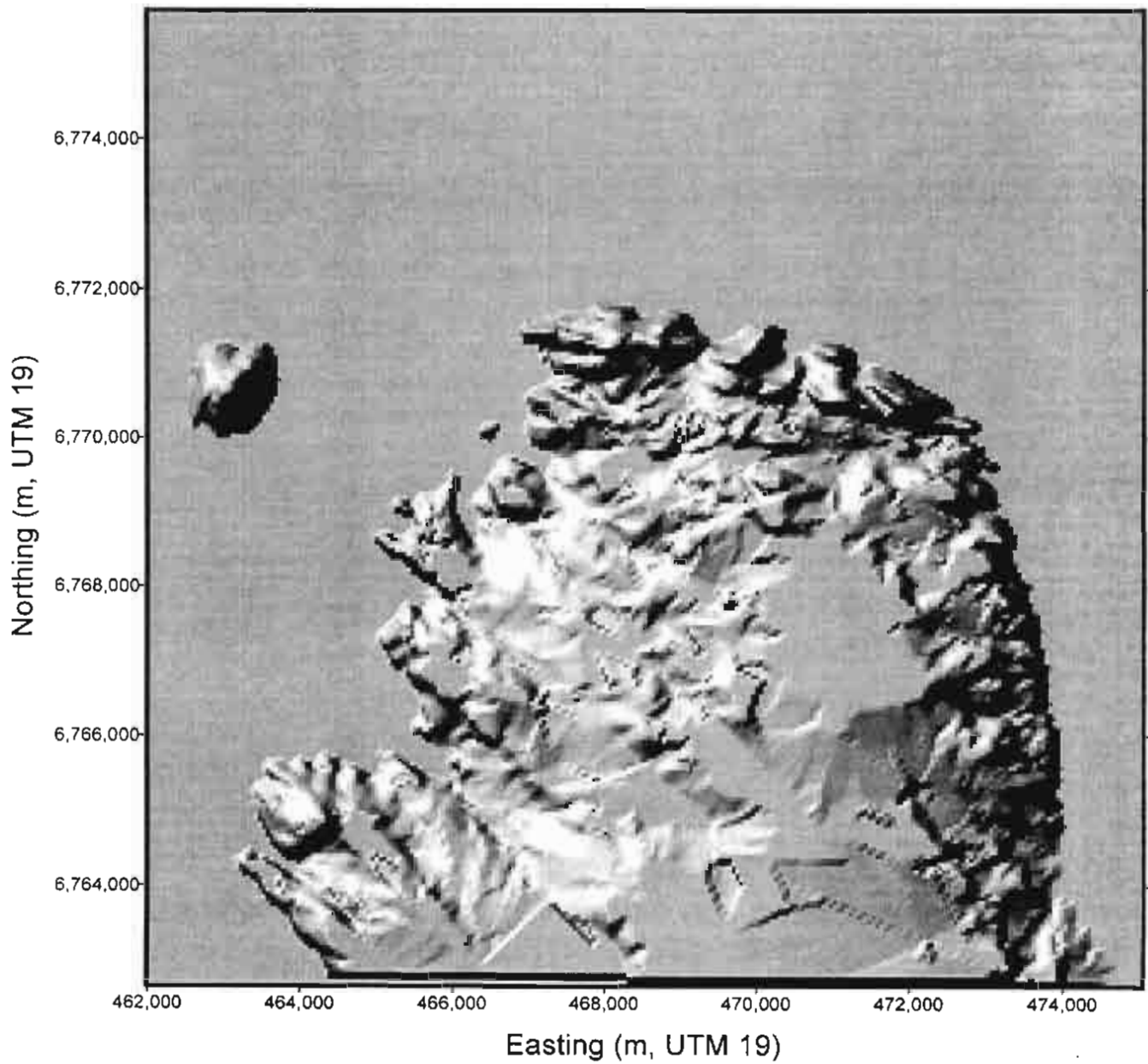
KUUJJUAQ-NW (TREES) 2001/06/06 14:54:17

AOC 15/50 Turbine Power (kW)

Level: 25.00 m

Wind Distribution: KUUJJUAQ.RJF

Temperature: -5.7 C Pressure: 100.69 kPa



QUAQTAQ

Topography Shaded Relief from Master Grid

MS-Micro MASTER PARAMETER SUMMARY

Project Name: QUAQTAQ 01/05/19 12:57:41

UTM zone, X-centre, Y-centre (m): 19 467000. 6768000.

Master topography file: QUAQTAQ.TMG

Master roughness file: QUAQTAQ.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	1
2	022	0.	1
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	3
8	157	0.	3
9	180	0.	3
10	202	0.	3
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

No. of delta-z levels: 1

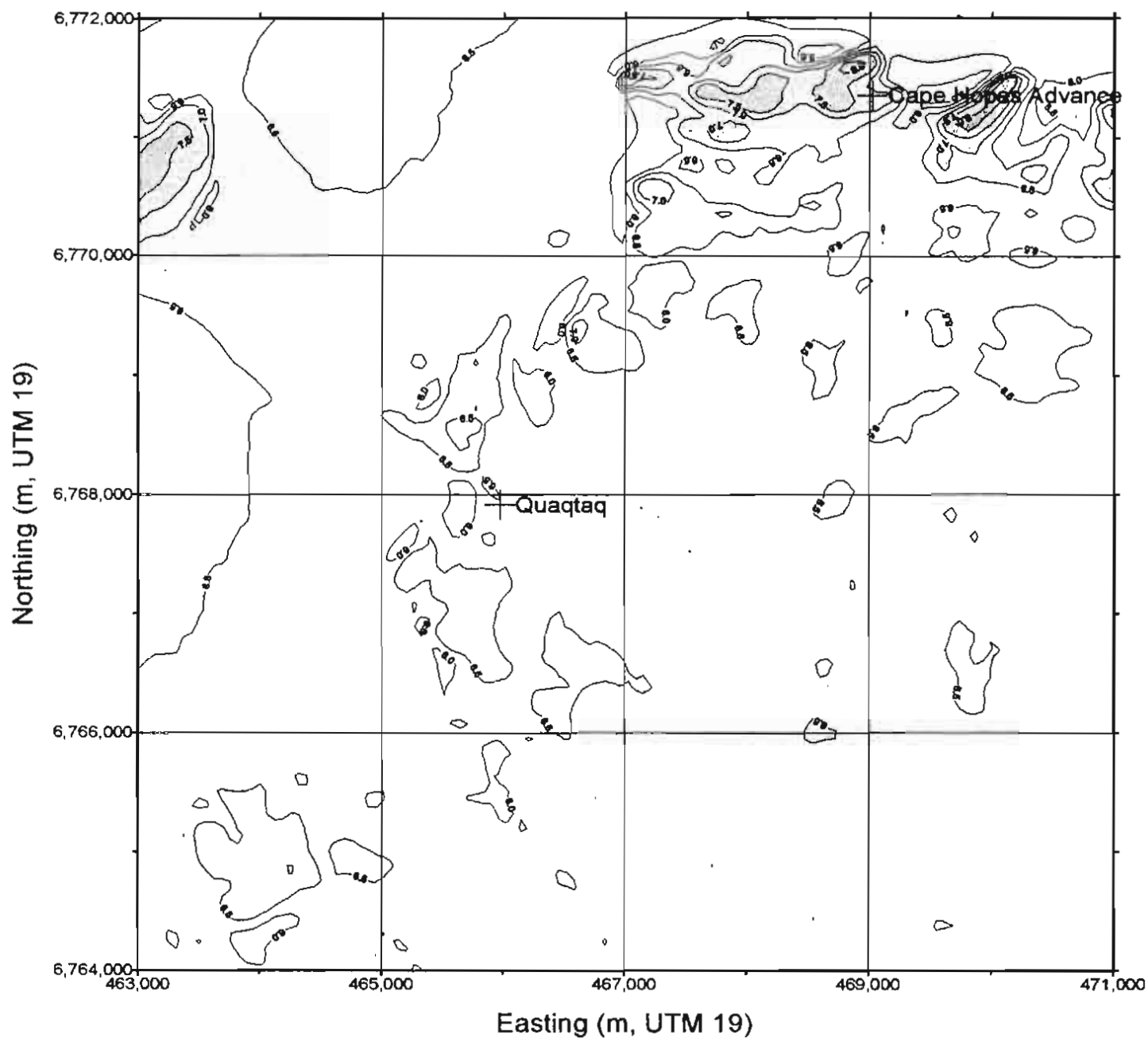
Level No. / Level (m)

1	25.00

End of master parameter summary

MS-Micro MODEL OUTPUT
Wind Speed (m/s)

Zephyr North



QUAQTAQ

2001/05/19 12:57:41

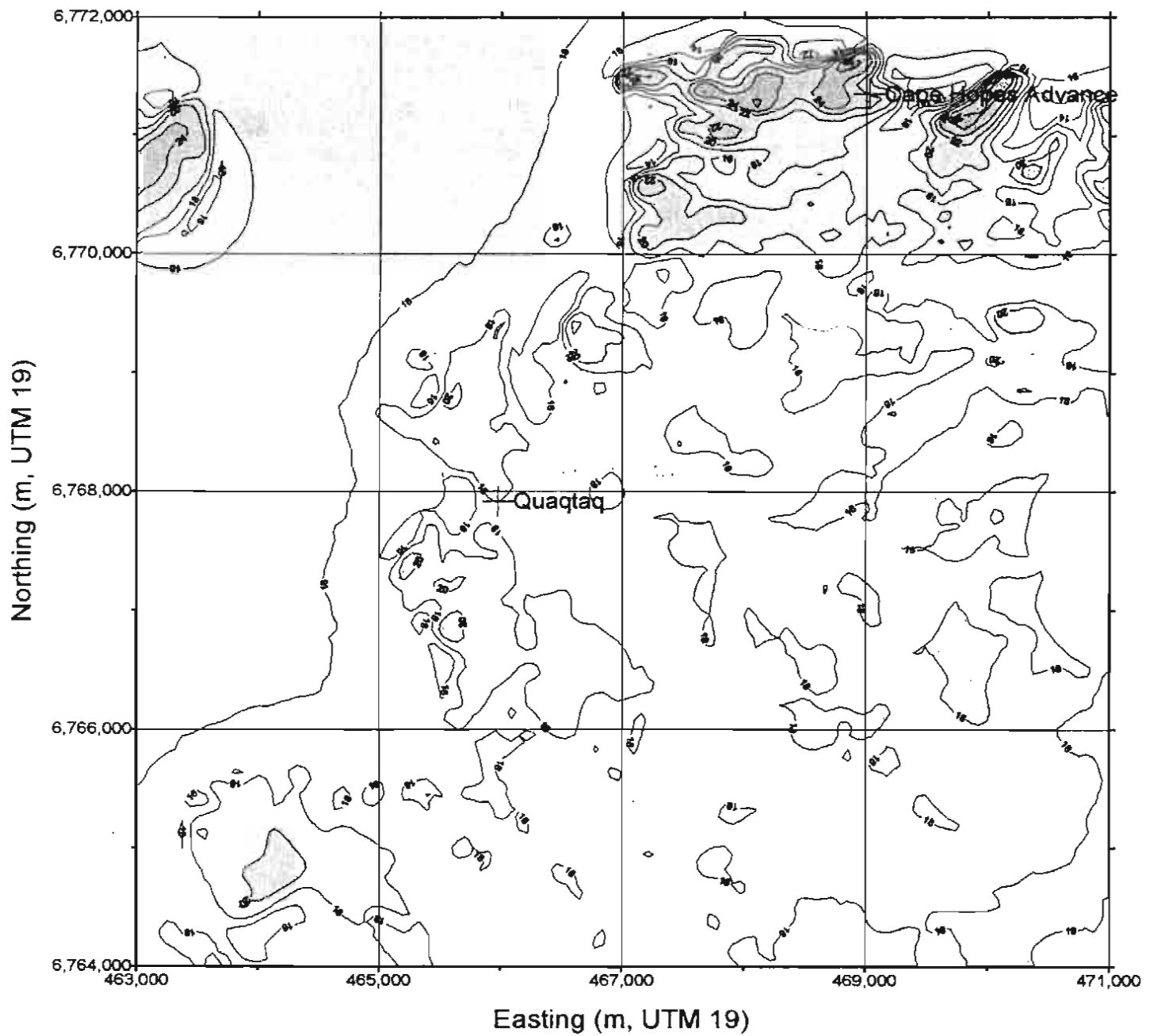
Wind Speed (m/s)

Level: 25.00 m

Wind Distribution: QUAQTAQ.RJF

MS-Micro MODEL OUTPUT
Turbine Power (kW)

Zephyr North



QUAQTAQ

2001/05/19 12:57:41

AOC 15/50 Turbine Power (kW)

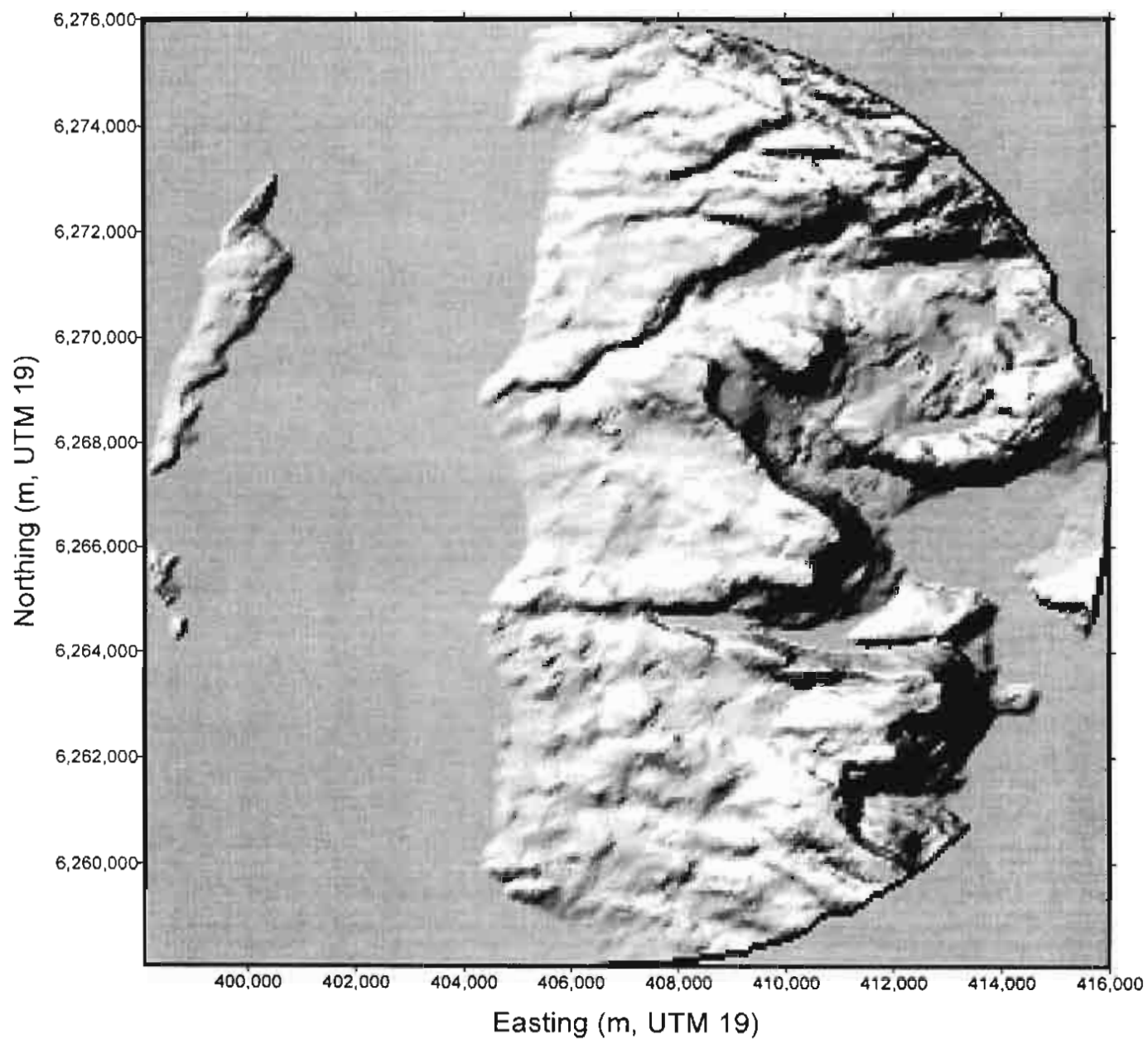
Level: 25.00 m

Wind Distribution: QUAQTAQ.RJF

Temperature: -6.9 C Pressure: 100.69 kPa

MS-Micro MODEL INPUT

Zephyr North



UMIUJQA

Topography Shaded Relief from Master Grid

MS-Micro MASTER PARAMETER SUMMARY

Project Name: UMIUJAO 01/05/19 16:40:10

UTM zone, X-centre, Y-centre (m): 18 407000. 6267000.

Master topography file: UMIUJAO.TMG

Master roughness file: UMIUJAO.RMG

Left, right, lower, upper boundaries (m) : -8000. 8000. -8000. 8000.

No. of X,Y grid lines: 256 256

Inner, Outer matching distances (m): 5000. 6500.

No. of directions: 16

Dir.No. / Dir.(deg) / Outer level (m) / Upstream rough. class

1	000	0.	3
2	022	0.	3
3	045	0.	3
4	067	0.	3
5	090	0.	3
6	112	0.	3
7	135	0.	1
8	157	0.	1
9	180	0.	3
10	202	0.	3
11	225	0.	1
12	247	0.	1
13	270	0.	1
14	292	0.	1
15	315	0.	1
16	337	0.	1

No. of roughness classes: 8

Class.No. / Roughness (m) / Description

1	2.00E-04	Sea
2	5.00E-03	Smooth
3	3.00E-02	Open
4	1.00E-01	Roughly Open
5	2.50E-01	Rough
6	5.00E-01	Very Rough
7	1.00E+00	Closed
8	2.00E+00	Chaotic

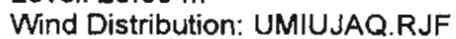
No. of delta-z levels: 1

Level No. / Level (m)

1	25.00

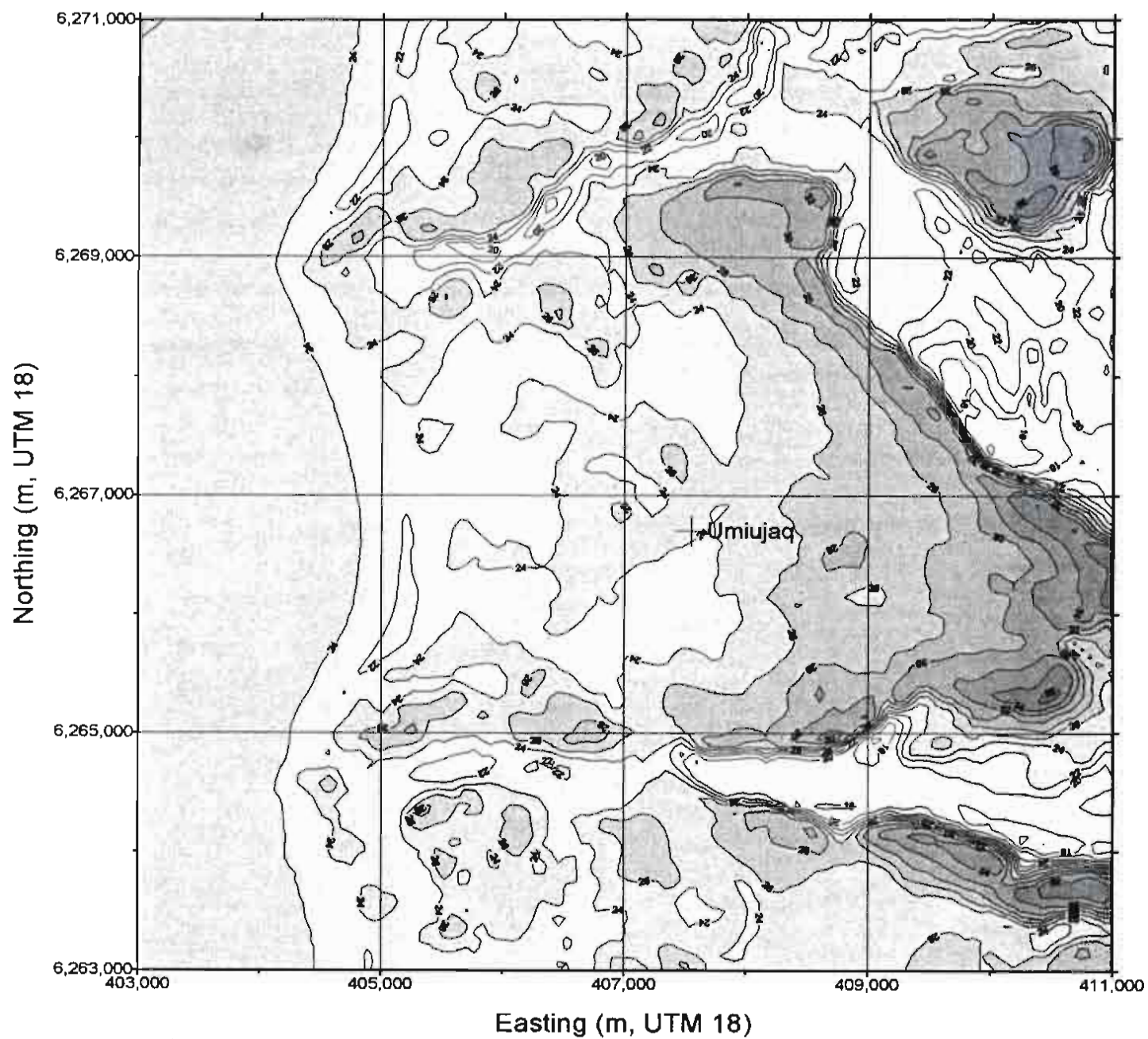
End of master parameter summary

Zephyr North



MS-Micro MODEL OUTPUT
Turbine power (kW)

Zephyr North



UMIUJQAQ

2001/05/19 16:40:10

AOC 15/50 Turbine Power (kW)

Level: 25.00 m

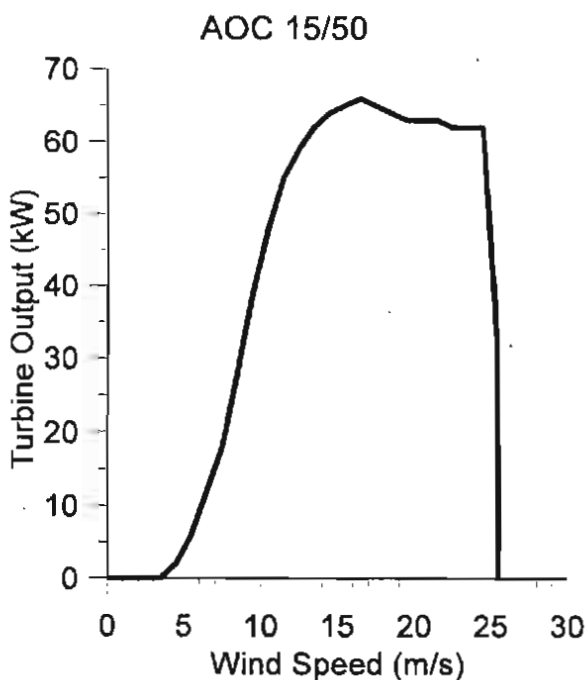
Wind Distribution: UMIUJQAQ.RJF

Temperature: -3.8 Pressure: 100.24 kPa

15 APPENDIX G - AOC 15/50

The Atlantic Orient AOC 15/50 wind turbine is manufactured by the Atlantic Orient Corporation. It is a stall-regulated 50kW (nameplate) horizontal axis wind turbine with a 15m (diameter) downwind, 3-bladed rotor located at 25m above the ground.

The power curve used for the MS-Micro model analysis (Appendix F) is shown below. It applies to standard conditions.



Further information from the turbine manufacturer is listed in Appendix G of the 1995 report.

For reference, the power curve (for an air density of 1.225 kg/m³) is listed below.

Wind Speed (m/s)	Output (KW)
0.0	0.0
3.5	0.0
4.5	2.0
5.5	6.0
6.5	12.0
7.5	18.0
8.5	28.0
9.5	39.0
10.5	48.0
11.5	55.0
12.5	59.0
13.5	62.0
14.5	64.0
15.5	65.0
16.5	66.0
17.5	65.0
18.5	64.0
19.5	63.0
20.5	63.0
21.5	63.0
22.5	62.0
23.5	62.0
24.5	62.0
25.5	31.0