Appendix 4-2-F Meteorological Data Comparison

F.1. Introduction

The Ministry, in their June 30, 2007 comments on the air quality dispersion modelling plan recommended that other meteorological data be examined in the region to get a sense of how reasonable the MM5 wind fields are. Those available through the Ministry of Forests and Range and through the Ministry of Transportation lay outside the modelling domain. To provide a measure of the final wind fields reasonableness the Ministry recommended a comparison of final CALMET wind fields to the surface meteorological data being collected at station M5 (Project site).

This was accomplished by extracting surface level time series CALMET data from the M5 location and using this information in an analysis of measured parameters (wind speed and direction, temperature and relative humidity). Some selected additional QA/QC was performed as per Section 10.2.1.2 of the Guideline (BC MOE 2008) to provide confidence in the modelled results.

In developing meteorological input data for CALPUFF dispersion assessment of the Taseko Prosperity Project, Jacques Whitford AXYS sought the nearest most representative surface meteorological data for 2002—the modelled year. Being in a remote location there were no representative surface data proximate to that site for that time period. As a result no surface data were used to make adjustments to the MM5 prognostic wind field. In remote locations, without nearby surface stations, MM5 prognostic data can provide reasonable estimates of local surface meteorological conditions as well as upper air radiosonde data to help initialize CALMET model. In this report, CALMET predictions were examined at representative extraction points and found to be consistent with expectations given the sites topography.

Taseko had established in late 2006 a meteorological station proximate to the site and in a location representative of regional wind regimes (station M05). At the time JWA were developing their meteorological input data only two months of data were available for comparison to predicted wind fields. These were qualitatively assessed, and it was concluded that a meaningful comparison was not possible given the short period of record, and the disparity in time (2006–2007 vs. 2002).

At this time a full year of surface meteorological data are available. Following is a quantitative comparison of the measured surface meteorological data from station M05 and that produced by MM5 for that same location.

Taseko provided JWA with quality assured surface meteorological data for station M05 for one year (October 1, 2006 to September 30, 2007). These data were compared with the prognostic data derived from MM5 (2002) at the same location (Easting 457713.439 m / Northing 5702948.200 m / UTM Zone 10). Note that owing to the year of measured data not coinciding with the calendar year that Winter (December 2006–February 2007) is spread over 2006–2007, but seasonally correct (contiguous months). Fall data (September 2007, October 2006 and November 2006) is a blend of two years data. Spring (March–May 2007) and summer (June–August 2007) are both seasonally correct representations of 2007.

The MM5 data, being derived from the year 2000, have a different seasonal mix. Spring (March–May 2002), summer (June–August 2002), and fall (September–November 2002) are all seasonally correct representations of 2002. Winter is a mix of 2002 (December, January and February 2002), and thus seasonally incorrect (not contiguous months).

Wind Roses and wind classes frequency distribution for the measured and the modelled speed and direction data were developed for annual and seasonal periods (attached). Wind roses are an efficient and convenient means of presenting wind data. The length of the radial barbs gives the total percent frequency of winds from the indicated direction, of which there are 16. Portions of the barbs of different lengths indicate the frequency associated with each wind speed category.

A statistic analysis of measured and modelled wind speed, temperature, and relative humidity were also developed for annual and seasonal periods (attached).

Following is a comparison and analysis of these data conducted to identify the similarities and differences between the measured and modelled wind fields and other meteorological parameters for annual and seasonal periods. This section concludes with remarks on the representativeness of the prognostic wind field, and the implications for dispersion modelling.

F.2. Annual Meteorological Data Analysis

F.7.1. Wind Rose

Wind roses of the annual measured and modelled hourly wind data are presented in Figure F–1.

The measured wind rose indicates the prevailing wind is southerly (over 50%). Northerly winds represent less than 15% of occurrences, and other wind directions are virtually absent. Calms in the measured wind data (<0.5 m/s) account for only 2.44% of the data.

The modelled wind rose indicates the prevailing wind is south-easterly (15%). The remaining winds are spread across a wide spectrum ranging from south-westerly to north-westerly. Calms in the modelled wind data (<0.5 m/s) account for 10.79% of the data.

F.7.2. Wind Class Frequency Distribution

Figure F–1 also presents the comparison of wind class frequency distribution for the measured and the modelled hourly data.

Approximately 88% of measured winds are clustered in the first two wind classes (0.5 to 3.6 m/s), with most winds in the lower range (0.5 to 2.1 m/s). There are no hourly wind observations greater than 8.8 m/s in the measured data.

In contrast, modelled wind speeds are spread across all six wind classes, with the majority (84%) in the first four (0.5 to 8.8 m/s). The largest portion (26.9%) is in the 2.1 to 3.6 m/s class. Winds greater than 8.8 m/s account for 4.8% of the modelled data.

The measured wind class frequency distribution is smaller in extent compared to the modelled, indicating a site somewhat sheltered from the extreme winds one would expect occasionally on an exposed site in the Interior Plateau.

F.7.3. Wind Speed

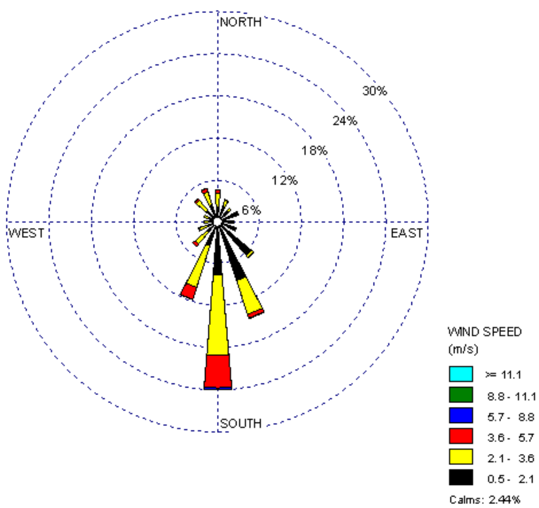
The annual and seasonal wind speed statistical analysis for the measured hourly data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the maximum and median wind speeds are 8.5 and 2 m/s respectively. The average wind speed (2.1 m/s) exceeds the median, indicating a slight positive skew in the distribution.

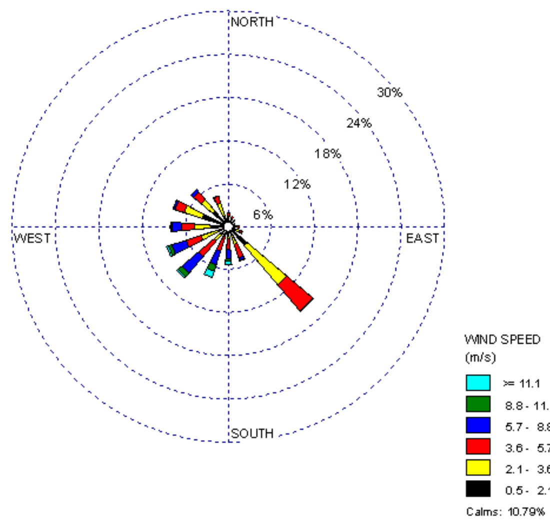
The modelled data has maximum and median wind speeds of 21.4 and 3.1 m/s respectively. The average wind speed is 3.5 m/s, exceeding the median value by 0.4 m/s.

The measured wind speeds are substantially lower than those modelled, both on average, and in the maximum. Again, measured winds are lower than expected for such a site.

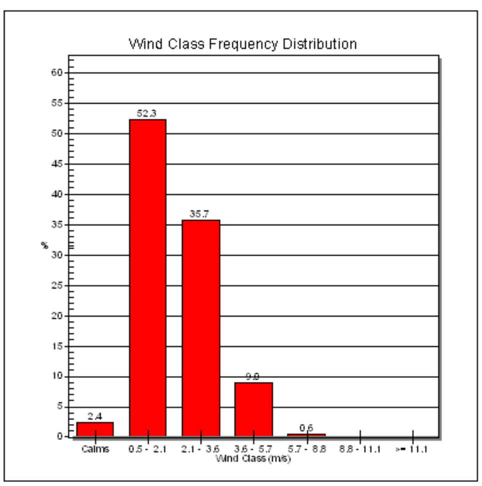
2006–2007 Annual Wind Rose (Measured)



2002 Annual Wind Rose (Modelled)



2006–2007 Annual Wind Classes (Measured)



2002 Annual Wind Classes (Modelled)

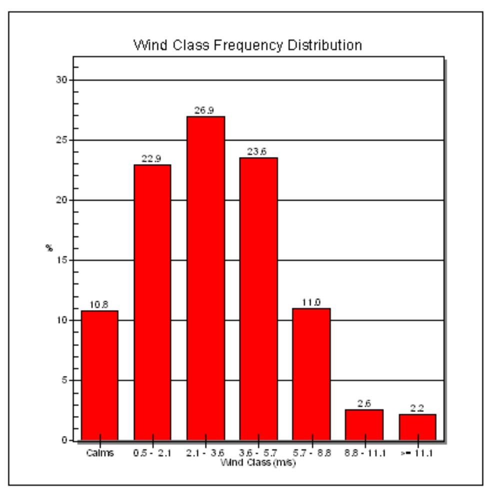


Figure F–1 Comparison of Measured (2006–2007) and Modelled Annual Winds (2002)

F.7.4. Temperature

The annual and seasonal temperature statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

The measured hourly temperatures indicate for 2006–2007 the maximum and median temperatures were 29.5 and 3.5°C respectively. The minimum measured hourly temperature was -38°C.

The modelled hourly temperatures for 2002 have a maximum and median temperature of 25.5 and 0.8°C respectively. The minimum modelled hourly temperature was -33°C.

The measured annual temperatures are somewhat higher than those modelled on average. The measured maximum exceeds that modelled, and the modelled minimum is higher than that measured.

F.7.5. Relative Humidity

The annual and seasonal relative humidity (RH) statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the median and average RH are 71 and 67% respectively. The modelled hourly RH has a median and average value of 73 and 67%.

Annually, the maximum and minimum values for both sets are comparable, adding to the general agreement in the measured and modelled data.

Table F–1 Measured Wind Speed, Temperature and Relative Humidity (2006–2007)

Wind Speed (m/s)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	8.5	7.0	6.7	6.5	8.5
99th percentile	5.4	5.8	5.3	4.3	5.7
75th percentile	2.8	3.0	3.0	2.6	2.6
Median	2.0	2.1	2.3	1.9	1.7
Average	2.1	2.3	2.3	1.9	2.0
Minimum	0.0	0.0	0.0	0.0	0.0
Temperature (°C)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	29.5	6.6	19.8	29.5	23.7
99th percentile	22.3	3.3	18.6	24.4	20.6
75th percentile	9.3	-0.9	8.7	13.8	6.0
Median	3.5	-4.3	4.1	9.6	1.2
Average	3.3	-5.3	4.6	10.0	0.5
Minimum	-38.0	-35.7	-7.0	-2.8	-38.0
Relative Humidity (%)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	100	100	100	99	100
99th percentile	99	99	99	99	99
75th percentile	86	90	73	79	90
Median	71	79	53	62	77
Average	67	78	55	61	73
Minimum	11	21	12	15	11

Table F–2 Modelled Wind Speed, Temperature and Relative Humidity (2002)

Wind speed (m/s)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	21.4	21.4	17.6	10.8	15.6
99th percentile	13.3	17	12.8	7.4	10.3
75th percentile	4.5	6.6	4.7	3.4	3.9
Median	3.1	4.4	3.0	2.3	2.9
Average	3.5	5.1	3.5	2.3	3.1
Minimum	0.0	0.1	0.0	0.0	0.0
Temperature (°C)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	25.5	5.6	14.6	25.5	17.5
99th percentile	22.1	2.8	12.0	24.1	15.1
75th percentile	6.9	-2.5	1.9	15.2	5.7
Median	0.8	-5.6	-2.4	10.6	2.4
Average	0.8	-6.7	-3.8	10.9	2.6
Minimum	-33.3	-26.6	-33.3	-6.3	-14.4
Relative Humidity(%)					
	Annual	**Winter**	**Spring**	**Summer**	**Fall**
Maximum	99	99	99	99	99
99th percentile	99	99	99	99	99
75th percentile	84	84	86	73	86
Median	73	79	77	49	70
Average	67	75	73	53	67
Minimum	8	8	8	8	10

F.3. Winter Meteorological Data Analysis

F.3.1. Wind Rose

Wind roses of measured and modelled hourly wind data in winter are presented in Figure F–2.

The measured wind rose indicates the prevailing wind is southerly (almost 60%). Northerly winds represent less than 10% of occurrences, and other wind directions are virtually absent. Calms in the measured wind data (<0.5 m/s) account for only 2.27% of the data.

The modelled wind rose indicates the prevailing wind is south to southeasterly (40%), with the south-easterly wind dominant (17%). The remaining winds ranging from south-westerly to south-easterly. Calms in the modelled wind data (<0.5 m/s) account for 2.13% of the data.

F.7.6. Wind Class Frequency Distribution

Figure F–2 also presents the comparison of wind class frequency distribution for the measured and the modelled hourly data for winter season.

Approximately 84% of measured winds are clustered in the first two wind classes (0.5 to 3.6 m/s), with most winds in the lower range (0.5 to 2.1 m/s). There are no hourly wind observations greater than 8.8 m/s in the measured data.

In contrast, modelled wind speeds are spread across all six wind classes, with the majority (86%) in the first four (0.5 to 8.8 m/s). The largest portion (36%) is in the 3.6 to 5.7 m/s class. Winds greater than 8.8 m/s account for 11.5% of the modelled data.

The measured wind class frequency distribution is smaller in extent compared to the modelled, indicating a site somewhat sheltered from the extreme winds one would expect occasionally on an exposed site in the Interior Plateau.

F.7.7. Wind Speed

The winter seasonal wind speed statistical analysis for the measured hourly data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the maximum and median wind speeds are 7 and 2.1 m/s respectively. The average wind speed (2.3 m/s) exceeds the median, indicating a slight positive skew in the distribution.

The modelled data has maximum and median wind speeds of 21.4 and 4.4 m/s respectively. The average wind speed is 5.1 m/s, exceeding the median value by 0.7 m/s, indicating a positive skew in the distribution.

The measured wind speeds are substantially lower than those modelled, both on average, and in the extremes. Again, measured winds are lower than expected for such a site.

F.7.8. Temperature

The winter seasonal temperature statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

The measured hourly temperatures indicate for winter season from 2006–2007 the maximum and median temperatures were 6.6 and -4.3°C respectively. The minimum measured hourly temperature in winter was -36°C.

The modelled hourly temperatures for winter 2002 have a maximum and median temperature of 5.6 and -5.6°C respectively. The minimum modelled hourly temperature in winter was -27°C.

In winter the measured temperatures are slightly higher than those modelled on average. The measured maximum exceeds that modelled, and the modelled minimum is higher than that measured.

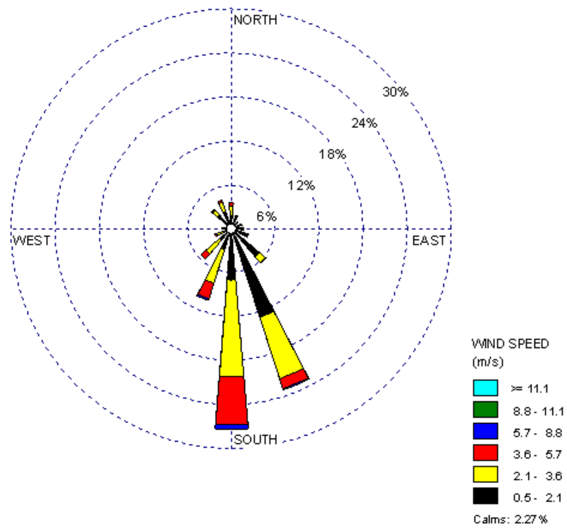
F.7.9. Relative Humidity

The winter seasonal RH statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

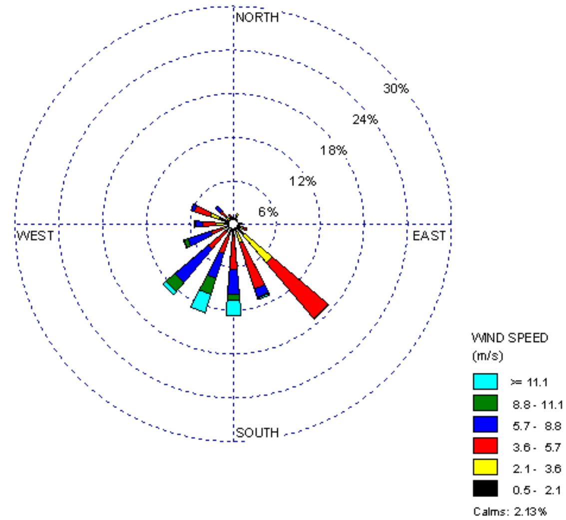
In the measured data set the median and average RH are 79 and 78% respectively. The modelled hourly RH has a median and average value of 79 and 75%.

Median and average values for both sets in winter season are comparable, adding to the general agreement in the measured and modelled data.

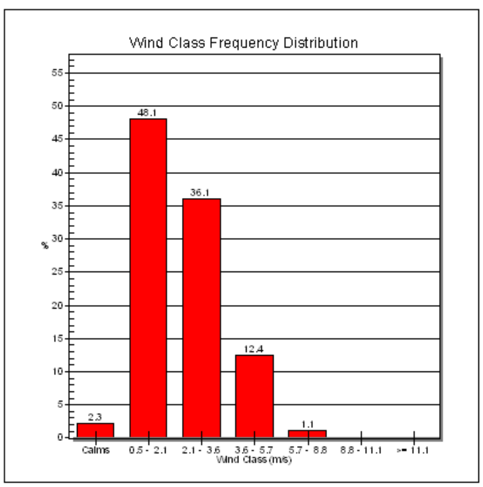
2006–2007 Winter Wind Rose (Measured)



2002 Winter Wind Rose (Modelled)



2006–2007 Winter Wind Classes (Measured)



2002 Winter Wind Classes (Modelled)

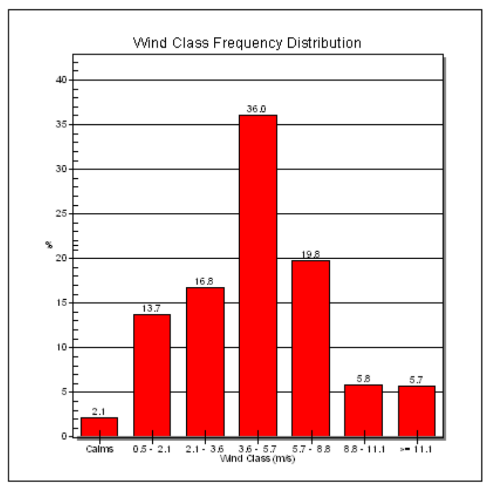


Figure F–2 Comparison of Measured (2006–2007) and Modelled Winter Winds (2002)

F.4. Spring Meteorological Data Analysis

F.4.1. Wind Rose

Wind roses of measured and modelled hourly wind data in spring are presented in Figure F–3.

The measured wind rose indicates the prevailing wind is southerly (nearly 50%). Northerly winds represent less than 10% of occurrences, and other wind directions are virtually absent. Calms in the measured wind data (<0.5 m/s) account for only 2.45% of the data.

The modelled wind rose indicates winds are spread across a wide spectrum ranging from south-easterly to north-westerly, and the prevailing wind is westerly (31%). South-easterly winds account for 10% of all winds. Calms in the modelled wind data (<0.5 m/s) account for 11.06% of the data.

F.7.10. Wind Class Frequency Distribution

Figure F–3 also presents the comparison of wind class frequency distribution for the measured and the modelled hourly data for spring season.

Approximately 86% of measured winds are clustered in the first two wind classes (0.5 to 3.6 m/s), with almost equal distribution in those two ranges,43.0% for the lower one which is from 0.5 to 2.1 m/s , and 43.2% for the higher one which is from 2.1 to 3.6 m/s. There are no hourly wind observations greater than 8.8 m/s in the measured data.

In contrast, modelled wind speeds are spread across all six wind classes, with the majority (84%) in the first four (0.5 to 8.8 m/s). The largest portion (26%) is in the 0.5 to 2.1 m/s class. Winds greater than 8.8 m/s account for 4.9% of the modelled data.

The measured wind class frequency distribution is smaller in extent compared to the modelled, indicating a site somewhat sheltered from the extreme winds one would expect occasionally on an exposed site in the Interior Plateau.

F.7.11. Wind Speed

The spring seasonal wind speed statistical analysis for the measured hourly data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the maximum and median wind speeds are 6.7 and 2.3 m/s respectively. The average wind speed (2.3 m/s) is equal to the median value.

The modelled data has maximum and median wind speeds of 17.6 and 3 m/s respectively. The average wind speed is 3.5 m/s, exceeding the median value by 0.5 m/s (positively skewed).

The measured wind speeds are substantially lower than those modelled, both on average, and in the extremes. Again, measured winds are lower than expected for such a site.

F.7.12. Temperature

The spring seasonal temperature statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

The measured hourly temperatures indicate for spring 2007 the maximum and median temperatures were 19.8 and 4.1°C respectively. The minimum measured hourly temperature in spring was -7°C.

The modelled hourly temperatures for spring 2002 have a maximum and median temperature of 14.6 and -2.4°C respectively. The minimum modelled hourly temperature was -33.3°C in spring.

The measured temperatures are higher than those modelled on average. The measured maximum exceed that modelled in spring, and he modelled minimum is lower than that measured.

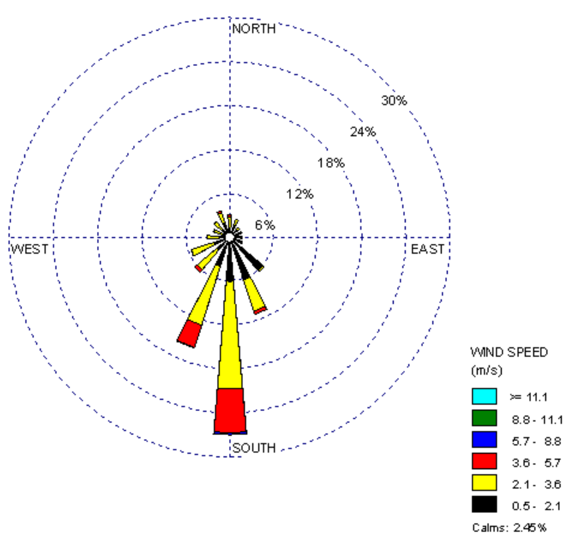
F.7.13. Relative Humidity

The spring seasonal RH statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

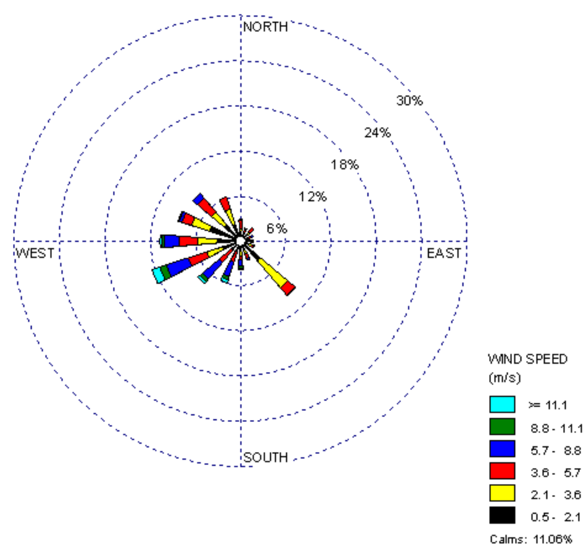
In the measured data set the median and average RH are 53 and 55% respectively. The modelled hourly RH has a median and average value of 77 and 73%.

Maximum and minimum values for both sets are comparable, adding to the general agreement in the measured and modelled data.

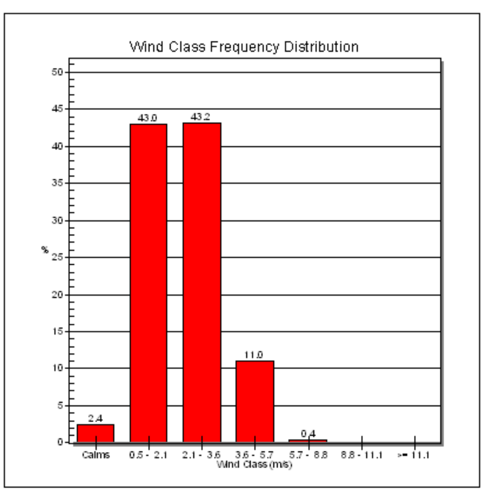
2007 Spring Wind Rose (Measured)



2002 Spring Wind Rose (Modelled)



2007 Spring Wind Classes (Measured)



2002 Spring Wind Classes (Modelled)

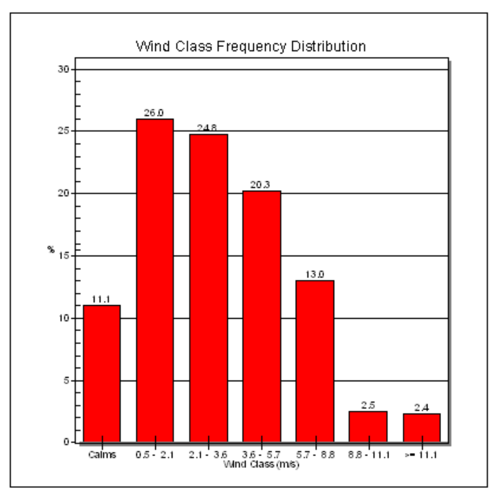


Figure F–3 Comparison of Measured (2007) and Modelled Spring Winds (2002)

F.5. Summer Meteorological Data Analysis

F.7.1. Wind Rose

Wind roses of measured and modelled hourly wind data in summer are presented in Figure F–4.

The measured wind rose indicates the prevailing wind is southerly (almost 50%). Northerly winds represent less than 15% of occurrences, and other wind directions are virtually absent. Calms in the measured wind data (<0.5 m/s) account for only 1.42% of the data.

The modelled wind rose indicates winds are spread across a wide spectrum ranging from south-easterly to north-westerly, and the prevailing wind is westerly (31%). South-easterly winds account for 10% of all winds. Calms in the modelled wind data (<0.5 m/s) account for 20.16% of the data.

F.7.2. Wind Class Frequency Distribution

Figure F–4 also presents the comparison of wind class frequency distribution for the measured and the modelled hourly data for summer season.

Approximately 95% of measured winds are clustered in the first two wind classes (0.5 to 3.6 m/s), with most winds in the lower range (0.5 to 2.1 m/s). There are no hourly wind observations greater than 8.8 m/s in the measured data.

In contrast, modelled wind speeds are spread across five wind classes, with the majority (80%) in the first four (0.5 to 8.8 m/s). The largest portion (32.5%) is in the 2.1 to 3.6 m/s class. Winds greater than 8.8 m/s only account for 0.1% of the modelled data.

The measured wind class frequency distribution is smaller in extent compared to the modelled, indicating a site somewhat sheltered from the extreme winds one would expect occasionally on an exposed site in the Interior Plateau.

F.7.3. Wind Speed

The summer seasonal wind speed statistical analysis for the measured hourly data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the maximum and median wind speeds are 6.5 and 1.9 m/s respectively. The average wind speed (1.9 m/s) is equal to the median value, indicating the distribution is not skewed.

The modelled data has maximum and median wind speeds of 10.8 and 2.3 m/s respectively. The average wind speed is 2.3 m/s, which is equal to the median value.

The measured wind speeds are lower than those modelled, both on average, and in the maximum.

F.7.4. Temperature

The summer seasonal temperature statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

The measured hourly temperatures indicate for summer 2006–2007 the maximum and median temperatures were 29.5 and 9.6°C respectively. The minimum measured hourly temperature in summer was -2.8°C.

The modelled hourly temperatures for summer 2002 have a maximum and median temperature of 25.5 and 10.6°C respectively. The minimum modelled hourly temperature was -6.3°C in summer.

The measured temperatures are slightly lower than those modelled on average. The measured maximum exceeds that modelled, while the modelled minimum is lower than that measured.

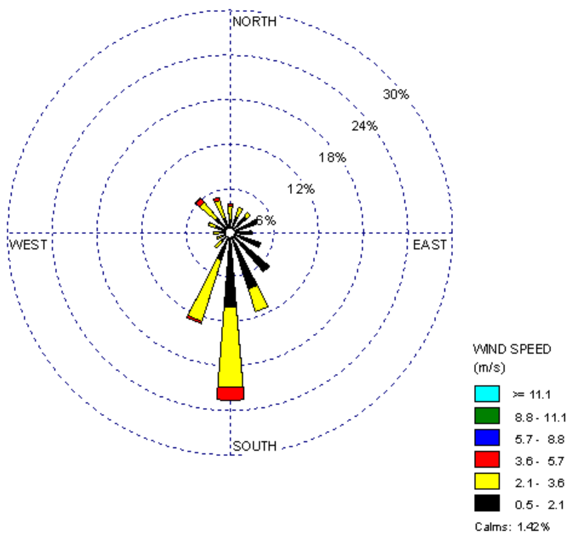
F.7.5. Relative Humidity

The summer seasonal RH statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

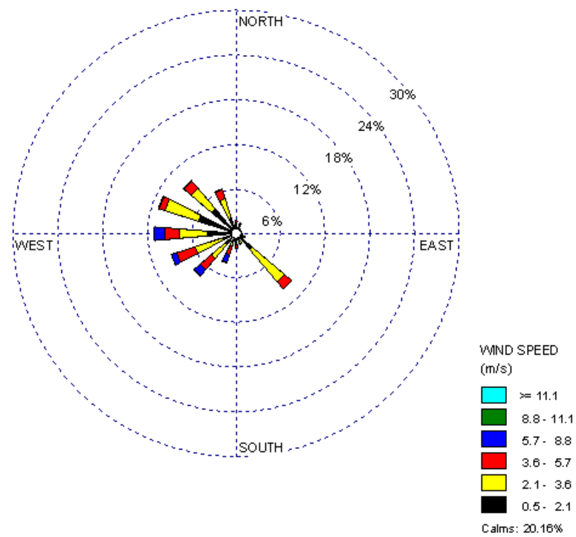
In the measured data set the median and average RH are 62 and 61% respectively. The modelled hourly RH has a median and average value of 49 and 53%.

Maximum values for both sets in summer season are comparable, adding to the general agreement in the measured and modelled data.

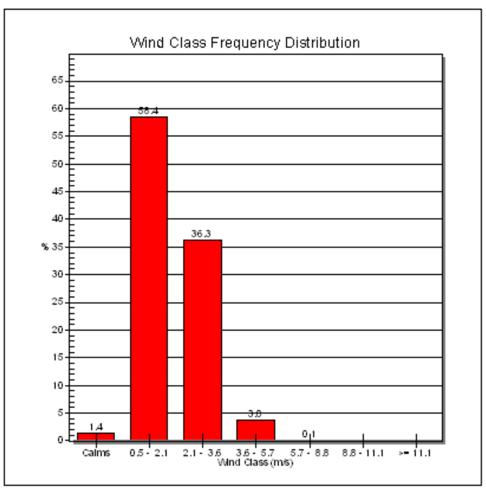
2007 Summer Wind Rose (Measured)



2002 Summer Wind Rose (Modelled)



2007 Summer Wind Classes (Measured)



2002 Summer Wind Classes (Modelled)

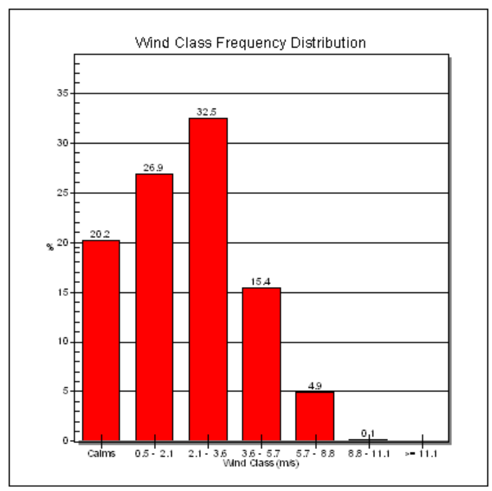


Figure F–4 Comparison of Measured (2007) and Modelled Summer Winds (2002)

F.6. Fall Meteorological Data Analysis

F.7.1. Wind Rose

Wind roses of measured and modelled hourly wind data in fall are presented in Figure F–5.

The measured wind rose indicates the prevailing wind is southerly (over 40%). Northerly winds represent 30% of occurrences. Other wind directions are virtually absent. Calms in the measured wind data (<0.5 m/s) account for only 3.62% of the data.

The modelled wind rose indicates the prevailing wind is south-easterly (25%). The remaining winds are spread across a wide spectrum ranging from south-westerly to north-westerly. Calms in the modelled wind data (<0.5 m/s) account for 9.62% of the data.

F.7.2. Wind Class Frequency Distribution

Figure F–5 also presents the comparison of wind class frequency distribution for the measured and the modelled hourly data in fall.

Approximately 87% of measured winds are clustered in the first two wind classes (0.5 to 3.6 m/s), with most winds in the lower range (0.5 to 2.1 m/s). There are no hourly wind observations greater than 8.8 m/s in the measured data.

In contrast, modelled wind speeds are spread across all six wind classes, with the majority (88%) in the first four (0.5 to 8.8 m/s). The largest portion (33.6%) is in the 2.1 to 3.6 m/s class. Winds greater than 8.8 m/s account for 2.6% of the modelled data.

The measured wind class frequency distribution is smaller in extent compared to the modelled, indicating a site somewhat sheltered from the extreme winds one would expect occasionally on an exposed site in the Interior Plateau.

F.7.3. Wind Speed

The fall seasonal wind speed statistical analysis for the measured hourly data is presented in Table F–1. That for the modelled data is presented in Table F–2.

In the measured data set the maximum and median wind speeds are 8.5 and 1.7 m/s respectively. The average wind speed (2 m/s) exceeds the median, indicating a slight positive skew in the distribution.

The modelled data has maximum and median wind speeds of 15.6 and 2.9 m/s respectively. The average wind speed is 3.1 m/s, exceeding the median value by 0.2 m/s.

The measured wind speeds are substantially lower than those modelled on average. The modelled maximum exceeds that measured substantially. Again, measured winds are lower than expected for such a site.

F.7.4. Temperature

The fall seasonal temperature statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

The measured hourly temperatures indicate for fall 2006–2007 the maximum and median temperatures were 23.7 and 1.2°C respectively. The minimum measured hourly temperature in fall was -38°C.

The modelled hourly temperatures for fall 2002 have a maximum and median temperature of 17.5 and 2.4°C respectively. The average temperature (2.6°C) is slightly higher than the median value. The minimum modelled hourly temperature was -14°C.

The measured temperatures are somewhat lower than those modelled on average. The measured maximum exceeds that modelled, and the modelled minimum is higher than that measured.

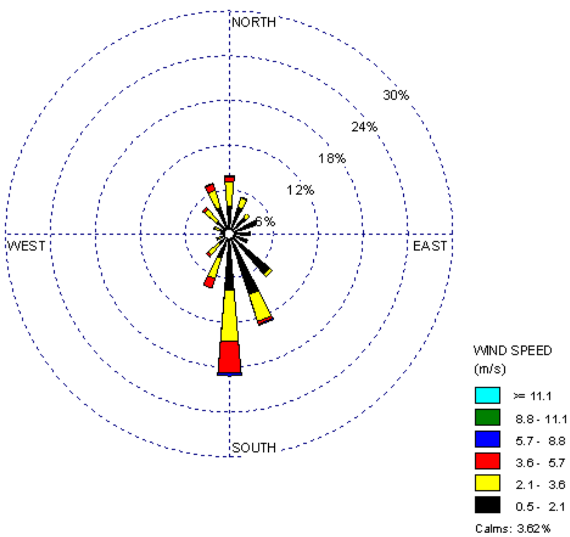
F.7.5. Relative Humidity

The fall seasonal RH statistical analysis for the measured data is presented in Table F–1. That for the modelled data is presented in Table F–2.

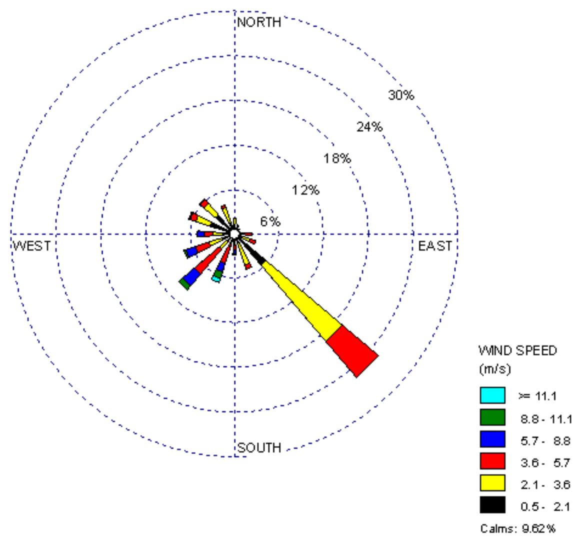
In the measured data set the median and average RH are 77 and 73% respectively. The modelled hourly RH has a median and average value of 70 and 67%.

Maximum and minimum values for both sets are comparable, adding to the general agreement in the measured and modelled data.

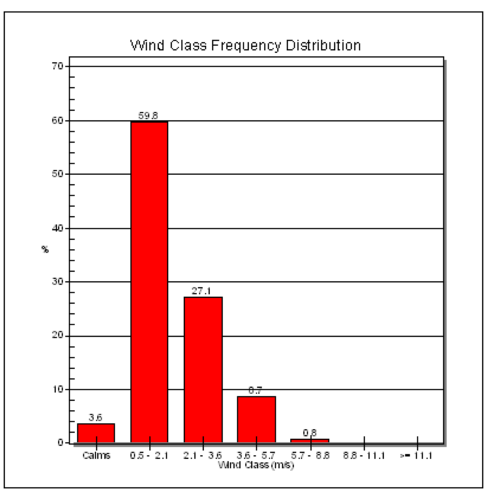
2006–2007 Fall Wind Rose (Measured)



2002 Fall Wind Rose (Modelled)



2006–2007 Fall Wind Classes (Measured)



2002 Fall Wind Classes (Modelled)

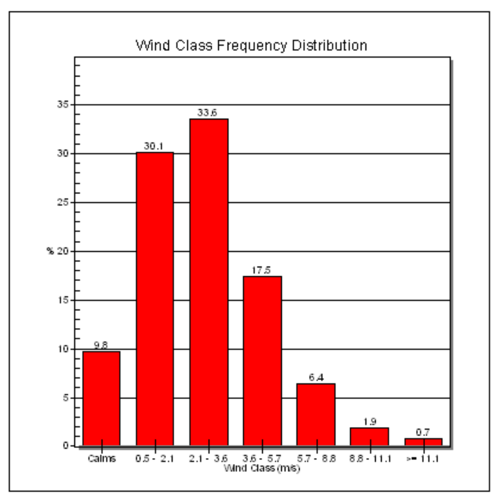
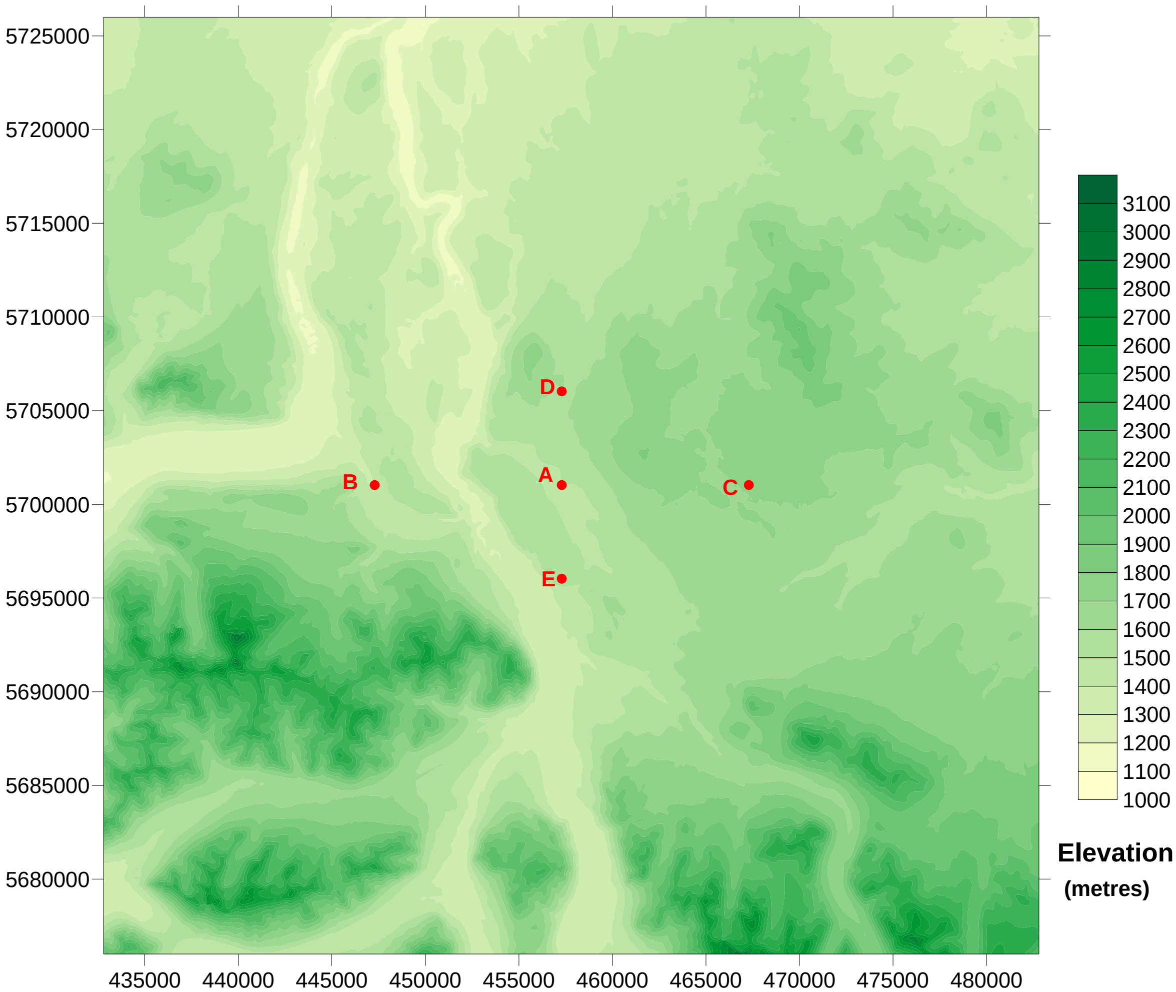


Figure F–5 Comparison of Measured (2006–2007) and Modelled Fall Winds (2002)

F.7. Supplemental Analyses

The Ministry's Guideline (Section 10.2.1.2) suggests additional QA/QC be performed to provide confidence in the modelled results. In order to check the reasonableness and confidence with the CALMET data used in this project, we performed some supplemental analyses with the CALMET time series extracted at five locations (Figure F–6).



Location A: M05 station

Location B: 447290 m E, 5701030 m N

Location C: 467290 m E, 5701030 m N

Location D: 457290 m E, 5706030 m N

Location E: 457290 m E, 5696030 m N

Figure F–6 Five Locations Selected for Supplemental QA/QC Analysis

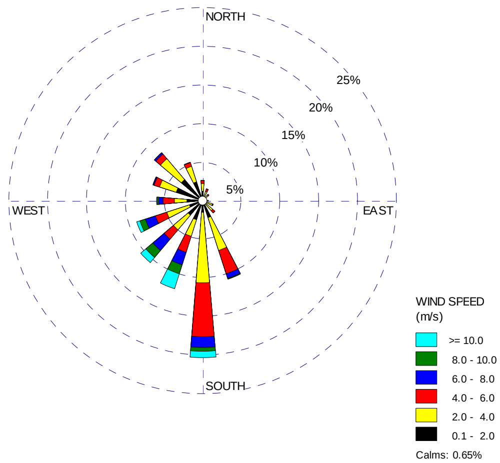
F.7.1. Surface Winds

Wind roses of modelled hourly wind data in 2002 at four locations are presented in Figure F–8. The modelled wind roses indicate the prevailing winds are south-westerly at locations C, D and E. While at location B, the modelled wind rose indicates a large portion of south winds. The remaining winds ranging from south-westerly to south-easterly. Figure F–9 presents the wind speed class frequency distribution for the modelled wind data at four locations B, C, D and E (Figure F–6). All these four locations have similar wind classes distributions compared to the wind classes distributions at the M05 station (Figure F–1).

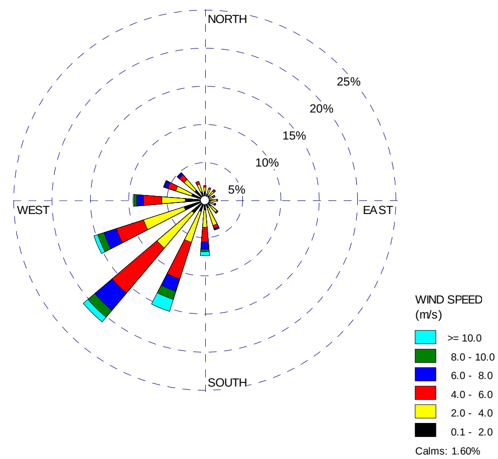
We found show some differences between measured and the modelled wind roses (Section 2.1.2) at M05 station. It's interesting to know that the modelled wind rose at location B (10 km west from the M05 station) is similar to the 2006–2007 annual measured wind rose (Figure F–1) at M05 station.

Usually numerical meteorological models (i.e., MM5, CALMET) have more or less phase errors (spatial or temporal) in simulating surface wind. It's important to understand the uncertainties and limitations in surface winds predictions when verify the model output with the real winds data. In terms of these considerations, we can say that CALMET model has captured most important surface winds characterizations in this study area.

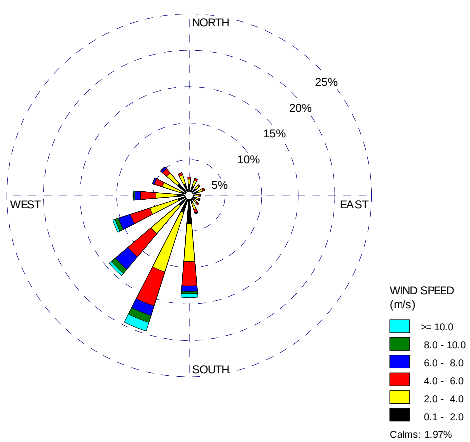
Site B Annual Wind Rose (2002)



Site C Annual Wind Rose (2002)



Site D Annual Wind Rose (2002)



Site E Annual Wind Rose (2002)

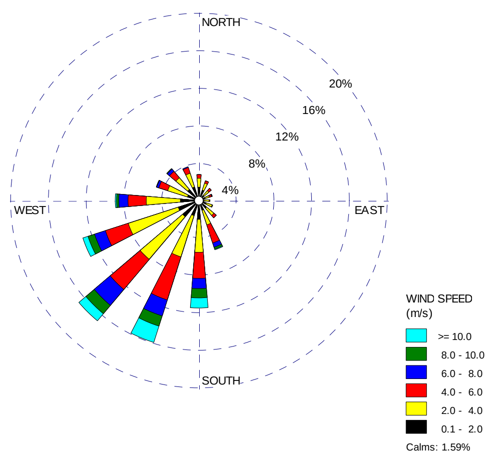
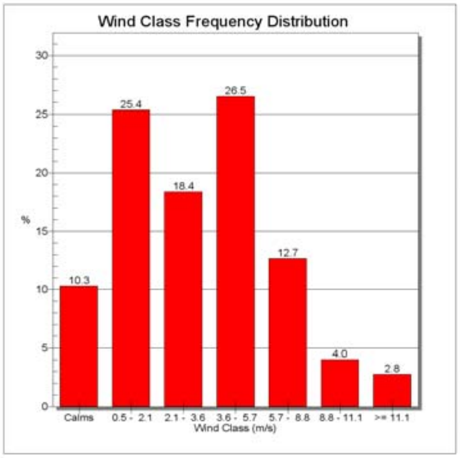
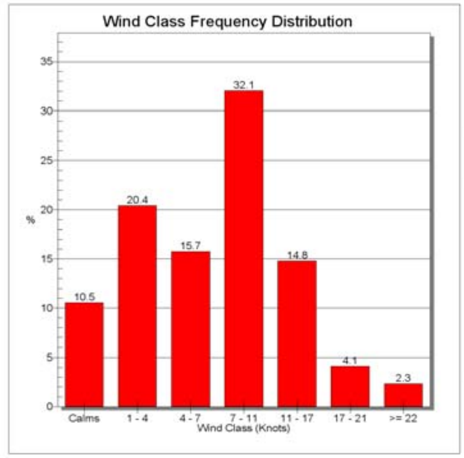


Figure F–7 Comparison of Modelled Surface Winds (2002) at Four Locations (B, C, D and E in Figure E–6)

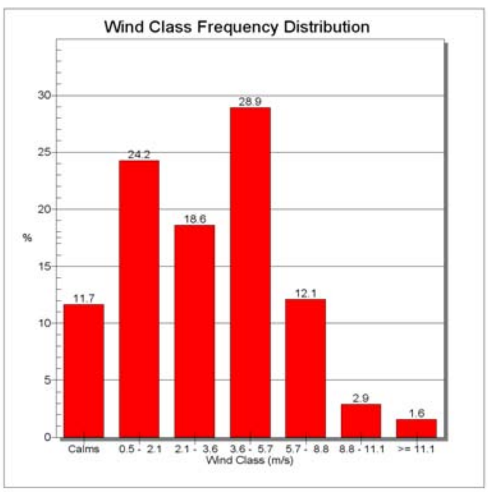
Site B Annual Wind Classes (2002)



Site C Annual Wind Classes (2002)



Site D Annual Wind Classes (2002)



Site E Annual Wind Classes (2002)

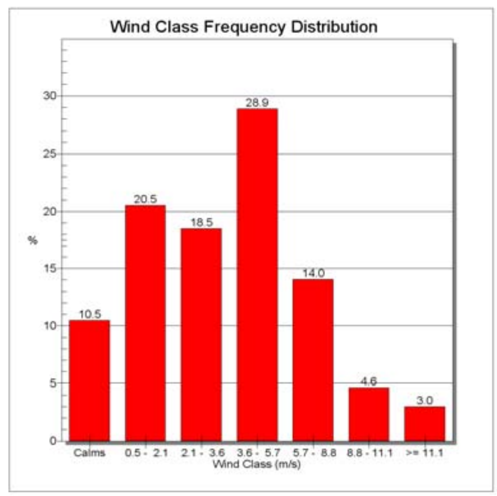


Figure F–8 Frequency Distribution of Surface Wind Speeds for Four Different Locations in the Domain (B, C, D and E in Figure E–6)

F.7.2. Surface Temperature

Figure F–9 shows the modelled monthly average surface temperatures at the project site. The modelled monthly temperatures indicate a reasonable seasonal surface temperature variation.

In March, the project site experiences coldest temperatures during the year. We don't have the onsite observation data in 2002. To explain this, we looked at the 2002 temperature data at nearest MOE Quesnel station. In Quesnel, March 2002 has the lowest monthly average temperature of -4.76°C in 2002. In this study, CALMET model captured the cooler than normal spring.

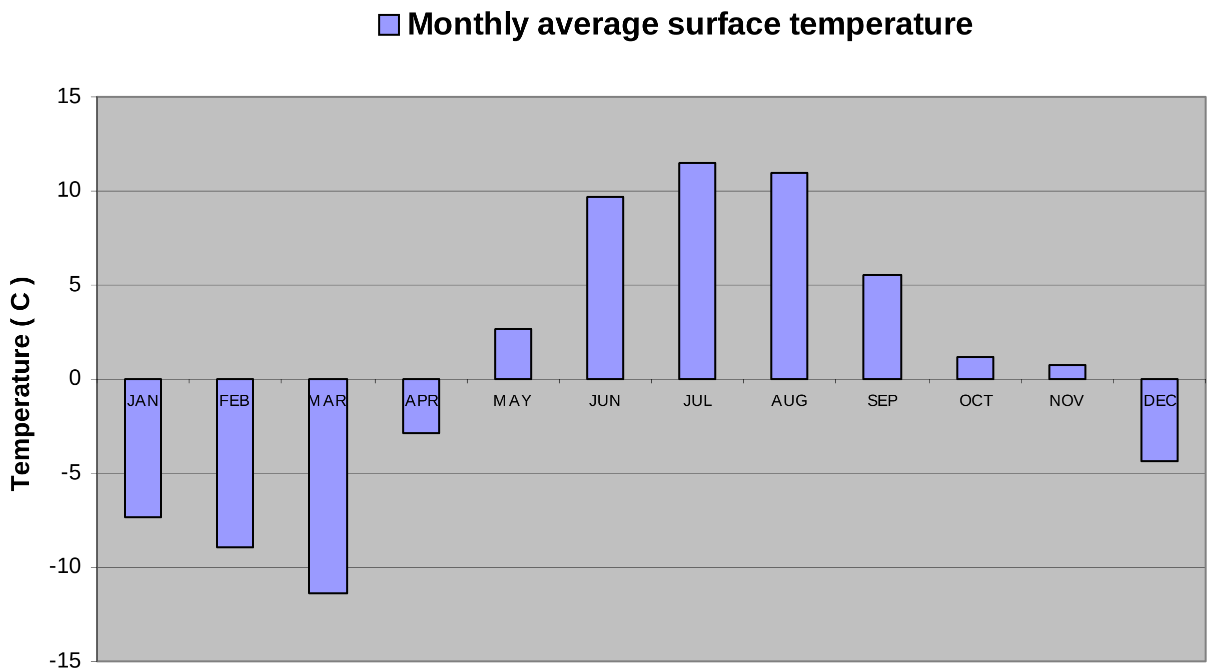


Figure F–9 Predicted Monthly Average Surface Temperature (2002) at Project Site

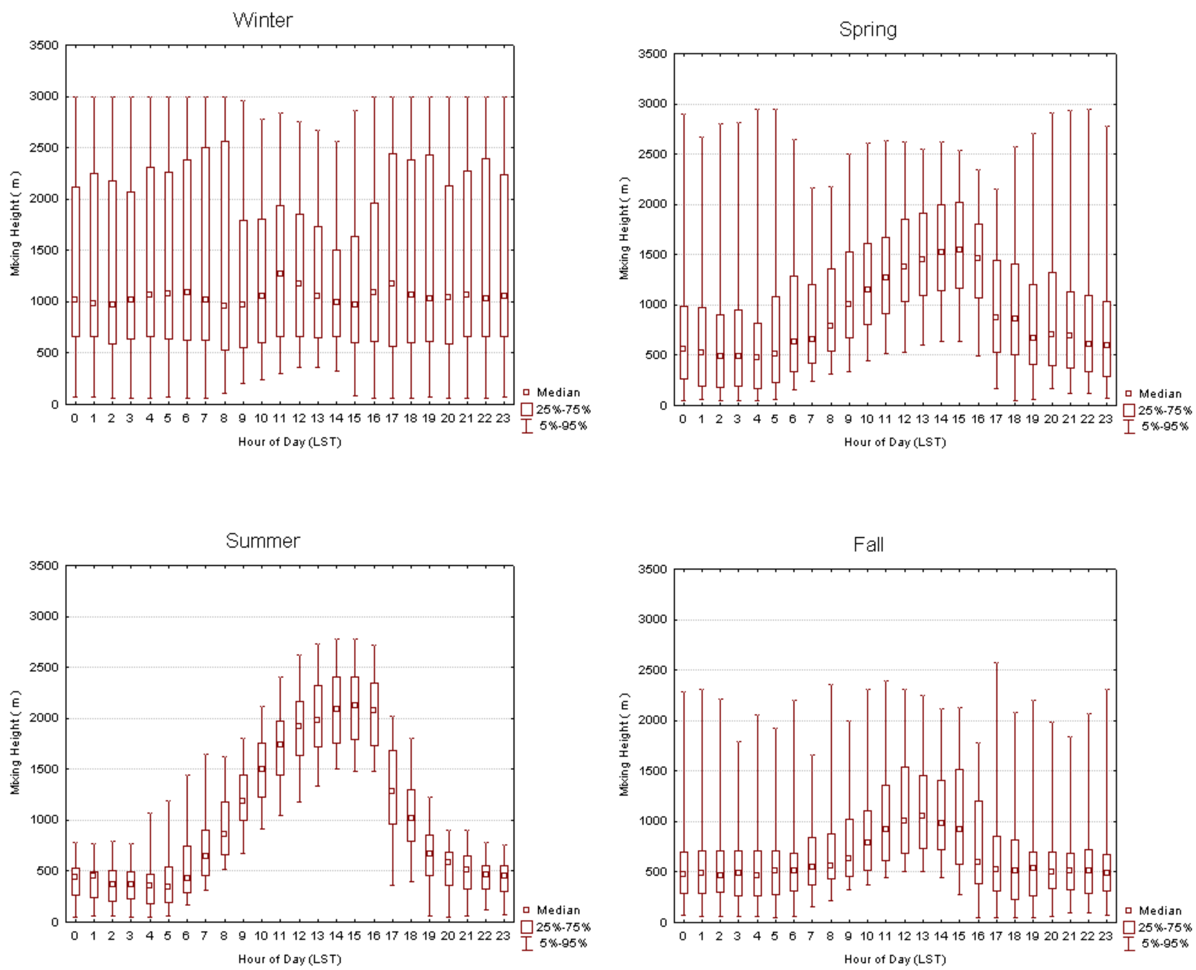
F.7.3. Mixing Height

The CALMET model calculates a maximum mixing height, as determined by either convective or mechanical forces. The convective mixing height is the height to which an air package will rise under the buoyant forces created by the heating of the earth's surface. The convective mixing height is dependent on solar radiation amount, wind speed, as well as the vertical temperature structure of the atmosphere. Mechanical mixing heights are, similarly, the height to which an air package will rise under the influence of mechanical-invoked turbulence. The mechanical mixing height is proportional to low-level wind speeds and surface roughness.

Diurnal variations of mean mixing height, as estimated by the CALMET model at the project site location are shown for each season in Figure F–10. The results show:

- Winter: The mean mixing heights range from 1000 to 1200 m that exhibit less of a diurnal fluctuation than other three seasons. This trend indicates that winter mixing heights in the region are frequently mechanically-induced.
- Spring: The mean maximum afternoon values are about 1500 m. The mean minimum night values are about 500 m. Diurnal fluctuations of mean mixing heights are very pronounced.

- Summer: The mean maximum afternoon values are about 2100 m. The mean minimum night values are about 500 m. Diurnal fluctuations of mean mixing heights are very pronounced.
- Fall: The mean maximum afternoon values are about 1000 m. The mean minimum night values are about 500 m. Diurnal fluctuations of mean mixing heights are pronounced.



NOTE: **Winter** = December, January and February
Spring = March, April and May
Summer = June, July and August
Fall = September, October and November

Figure F–10 Predicted Mixing Heights for Different Seasons and Times of Day at Project Site

F.8. Conclusions: Measured vs. Modelled Meteorology

Taseko provided JWA with quality assured surface meteorological data for station M05 for one year (October 1, 2006 to September 30, 2007). These data were compared with the prognostic data derived from MM5-CALMET (2002) at the same location. Wind Roses and wind classes frequency distribution for the measured and the modelled speed and direction data as well as a statistic analysis of measured and modelled wind speed, temperature, and relative humidity were developed and analyzed for annual and seasonal periods.

The following represents JWAs conclusions respecting the representativeness of the prognostic wind field, and the implications for dispersion modeling.

- Both the annual and seasonal wind rose for the measured and modelled demonstrate winds are spread across wind spectrum ranging from south-easterly to north-westerly. A large portion of winds are distributed in three classes in the range of 0.5 to 5.7 m/s. The average annual and seasonal wind speeds for modelled data have a fair representation of that for the measured one except the winter season with the maximum difference of 2.8 m/s.
- For temperatures, the average values of both annual and four seasons for modelled are very close to that of measured, with the exception of spring season (4ºC measured vs. -2.4ºC modelled) comparing to the average difference of approximately 1.5ºC for other three seasons. Relative humilities of modelled data provide excellent representation for that of measured. Most of the data are absolutely comparable for both the annual and the four seasons.
- The measured wind roses indicate the prevailing winds are southerly for both annual and four seasons. This is likely owing to channelling in the Taseko river valley flowing south to north immediately south of the M05 station. In addition, the measured data are collected on a site with a southerly aspect. This site is sheltered from northerly winds.
- The modelled data tends to overestimate winds speeds at this observed station locations. This is most likely due to the 12-km resolution of the MM5 data, which is not sufficient to fully resolve the complex terrain and surface properties near the surface stations used for comparison.
- Another factor that may contribute to this tendency is that the lowest-level MM5 winds must be extrapolated down to ground level to initialize CALMET. Thus, unless the vertical resolution in the MM5 data is quite fine, it is expected that the near-surface CALMET output winds will be biased toward trends seen in the lowest level of the MM5 data, which has a higher elevation in the region compared to the surface stations. In the point view of different winds spectrums between the measured and modelled, once again, issues with terrain resolution are suggested by the MM5 wind field. Frictional effects on near-surface wind directionality also play a role in explaining the differences between model-output and observed wind directions.
- Moreover, MM5-CALMET surface temperatures are generally underestimated at this monitoring station. Poor resolution of terrain and surface features in the input MM5 data, as well as the interpolation of MM5 temperatures down to surface-level both likely play a role in explaining the bias.

In order to check the reasonableness and confidence with the CALMET model results, some selected additional QA/QC was performed as per Section 10.2.1.2 of the Guideline (BC MOE 2008). The analyses presented in Section 2.1.7 indicate that in general, the MM5-CALMET modelled data used for this study likely does a reasonable job at simulating meteorological conditions (i.e., surface winds, surface temperature, and mixing heights) in the study area. However, biases can arise near the surface, especially compares modelled data with measured data at specific location in areas of complex terrain. This suggests that the use of local surface station data, had they been available, would have been preferred to initialize the lower level winds and surface temperatures for this application.