6. MM5 AND CALMET OUTPUT ANALYSIS

Annual wind roses are plotted at four meteorological stations for observations, MM5 run output, and CALMET predictions. Figure 6-1 shows plots for Vattarnes and Somastadagerdi. Figure 6-2 shows plots for Ljosa and Kollaleira. At the four meteorological stations, the predicted MM5 winds reproduce the observed winds very well. Small differences in wind direction are observed, but in general, the agreement is good. A very strong correlation exists between observations and CALMET predictions as one would expect with a diagnostic model. Because the CALMET wind fields are used to drive CALPUFF, the process of introducing the observed winds into the MM5 fields ensures an accurate representation of the observed flow in the areas around where the measurements are made. Figure 6-3 shows annual wind roses for CALMET predictions at three other meteorological stations where observations were not available for the same time period. Annual wind roses of observations are plotted on the map in Figure 6-4 for a different period. A qualitative analysis comparing Figures 6-3 and 6-4 show a good agreement between CALMET predictions and observations. At all three stations, predicted winds show the same direction and wind speed as the observed winds. At the Eyri station, predicted winds slightly overestimate the frequency of easterlies, while at Leirur, the frequency of westerlies is slightly underestimated in the prediction. Overall though, good agreement exists between the predicted winds from CALMET and observed winds. A strong influence of terrain on the winds may be observed in both.

A critical dispersion condition found in the observations during summer months is the flow reversal event. It is characterized by light typically westerly winds during the night and into the morning, which are then followed by strong easterly winds. This condition is an important one for Reydarfjordur village because it means that after the air mass has stagnated near the aluminum facility during the weak westerlies of the night and morning, the sudden onset of strong winds from the east will tend to bring the now pooled facility emissions toward the village. This event is illustrated with vector plots (Figure 6-5) for July 23, 2000 from the CALMET run.

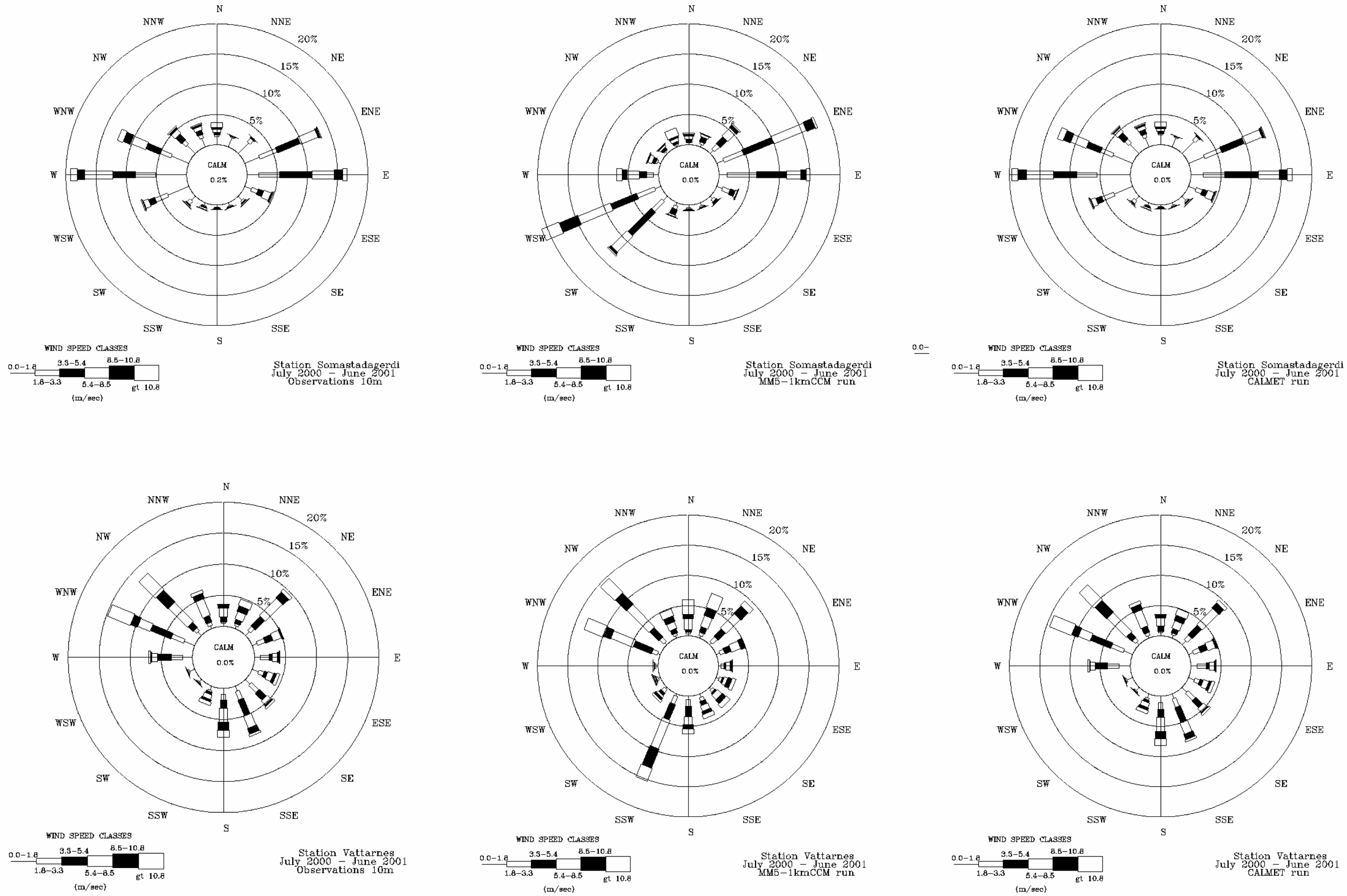


Figure 6-1. Annual average wind roses plotted at meteorological stations Somastadagerdi (top) and Vattarnes (bottom). From left to right, plots are for observations, MM5, and CALMET.

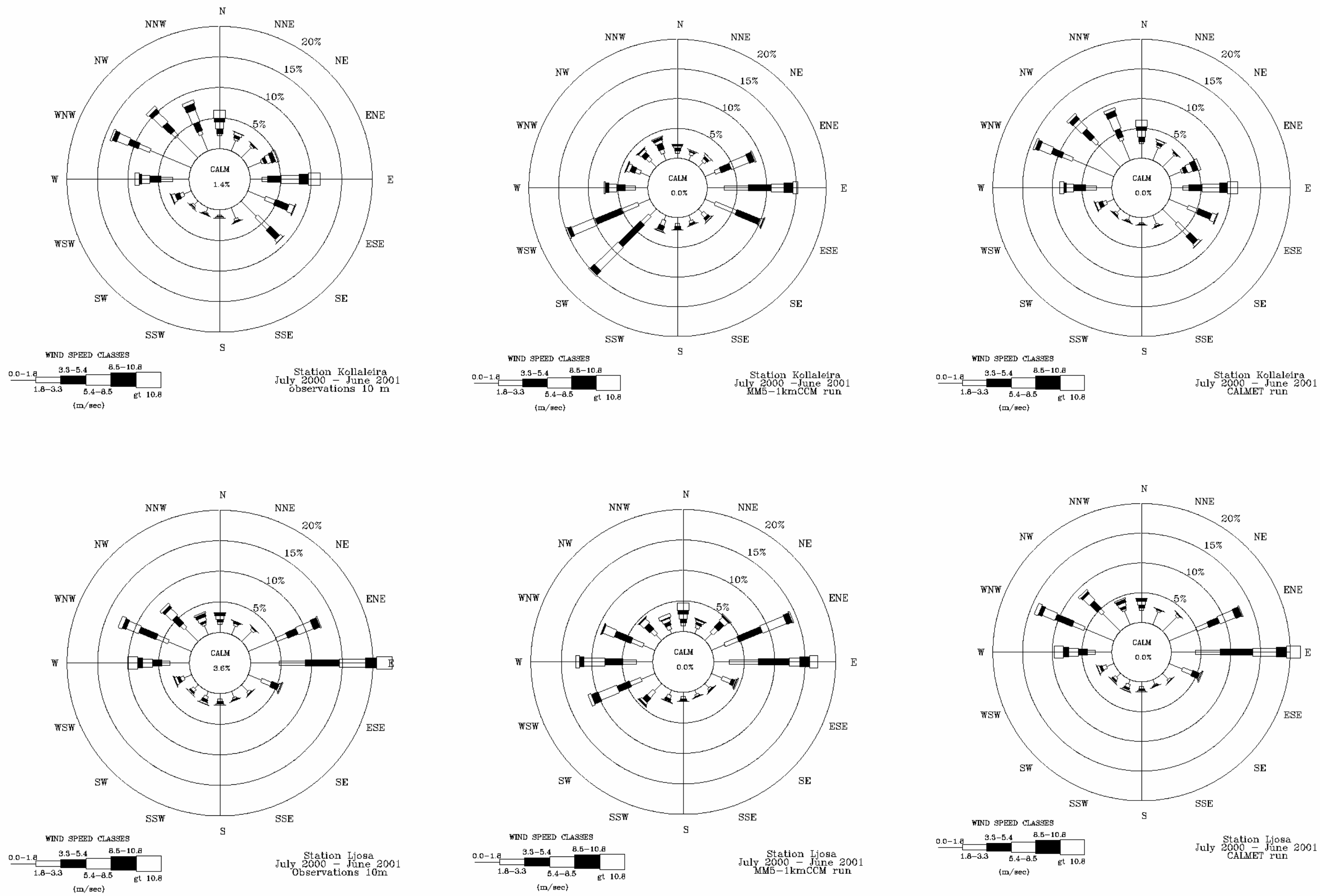


Figure 6-2. Annual average wind roses plotted at meteorological stations Kollaleira (top) and Ljosa (bottom). From left to right, plots are for observations, MM5, and CALMET.

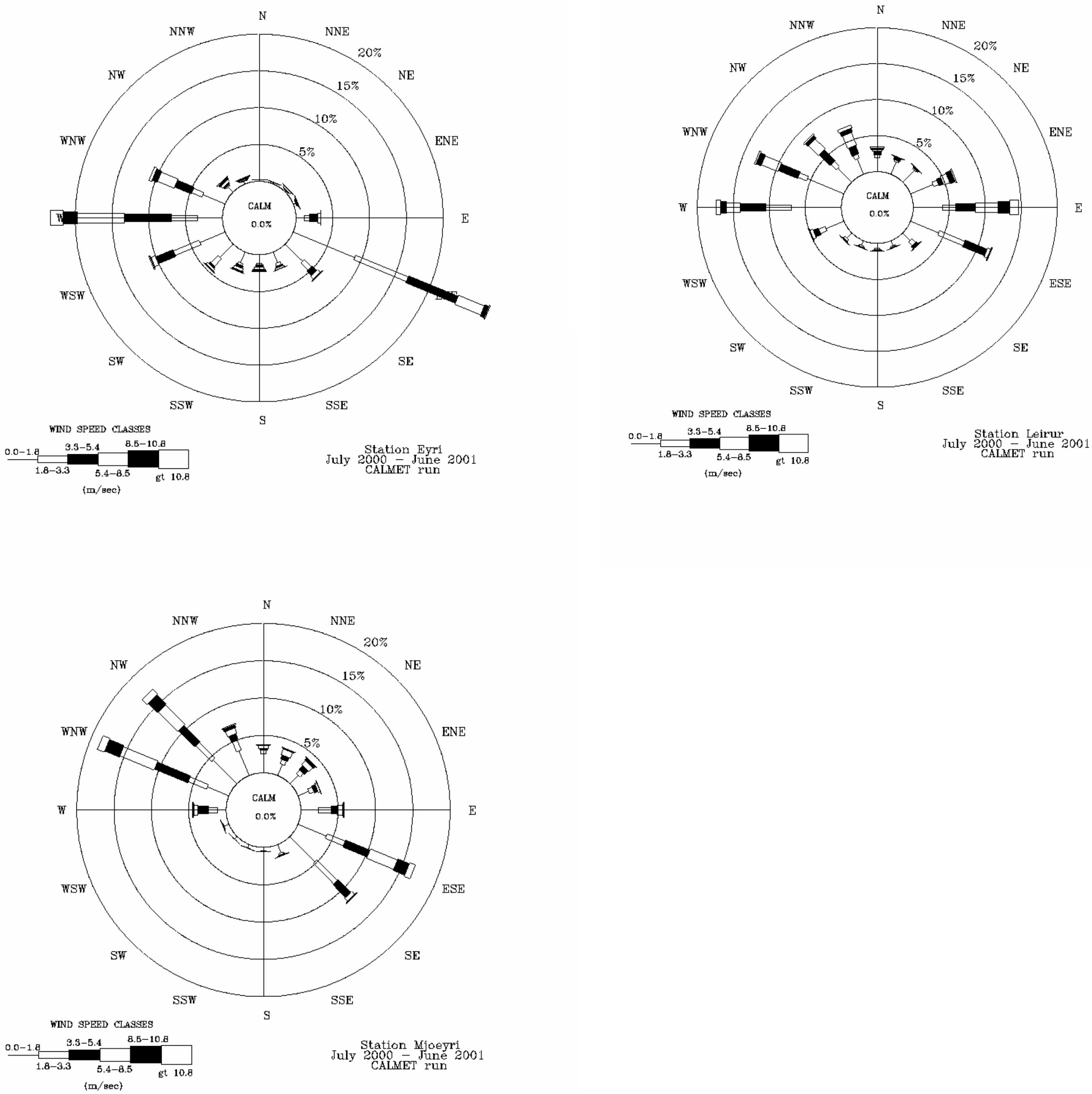


Figure 6-3. Annual average wind roses plotted at three meteorological stations, only CALMET predictions are plotted. Observations were not available for this period. Top left is for Station Eyri, top right is for Station Leirur and bottom is for Station Mjoeyri.

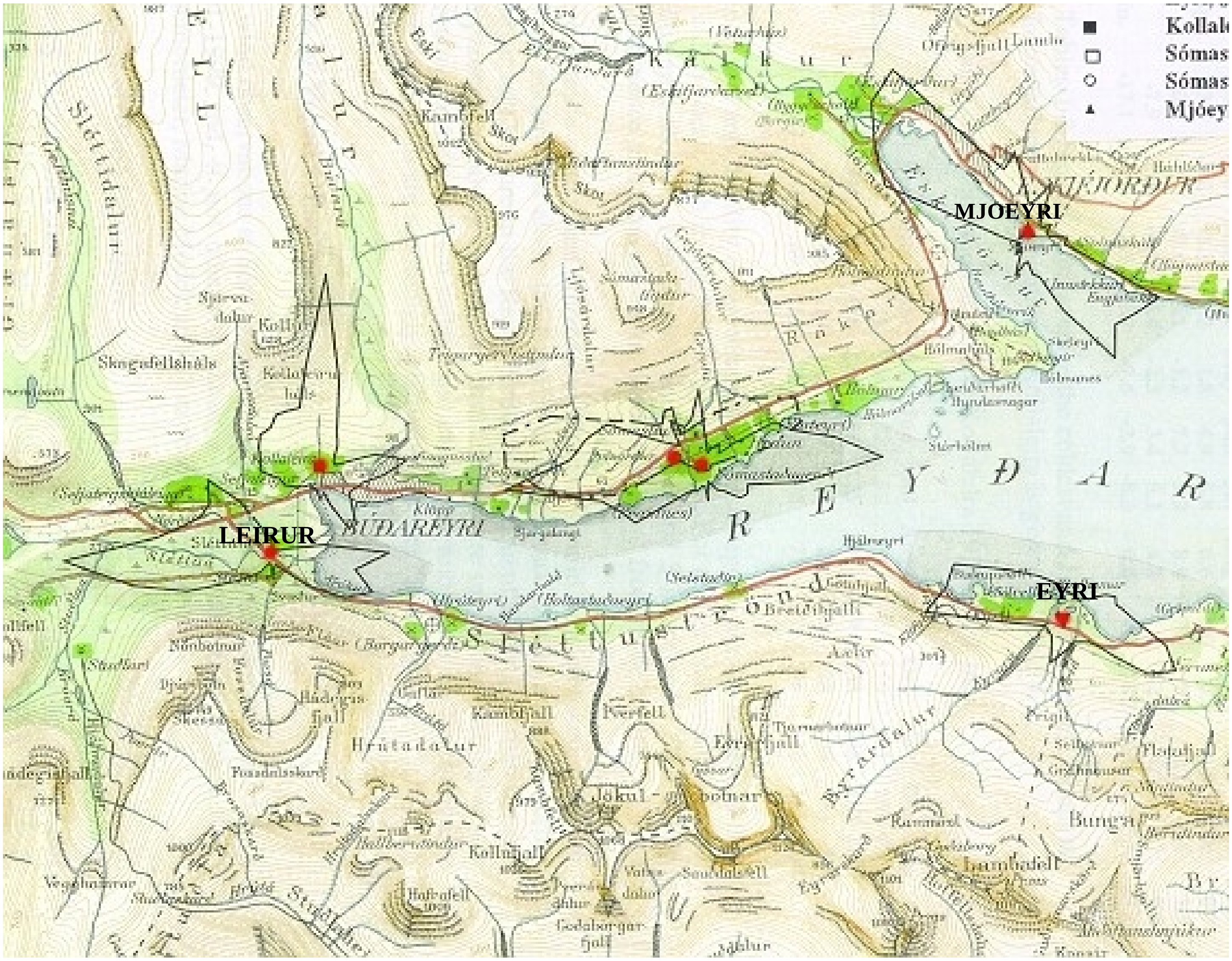
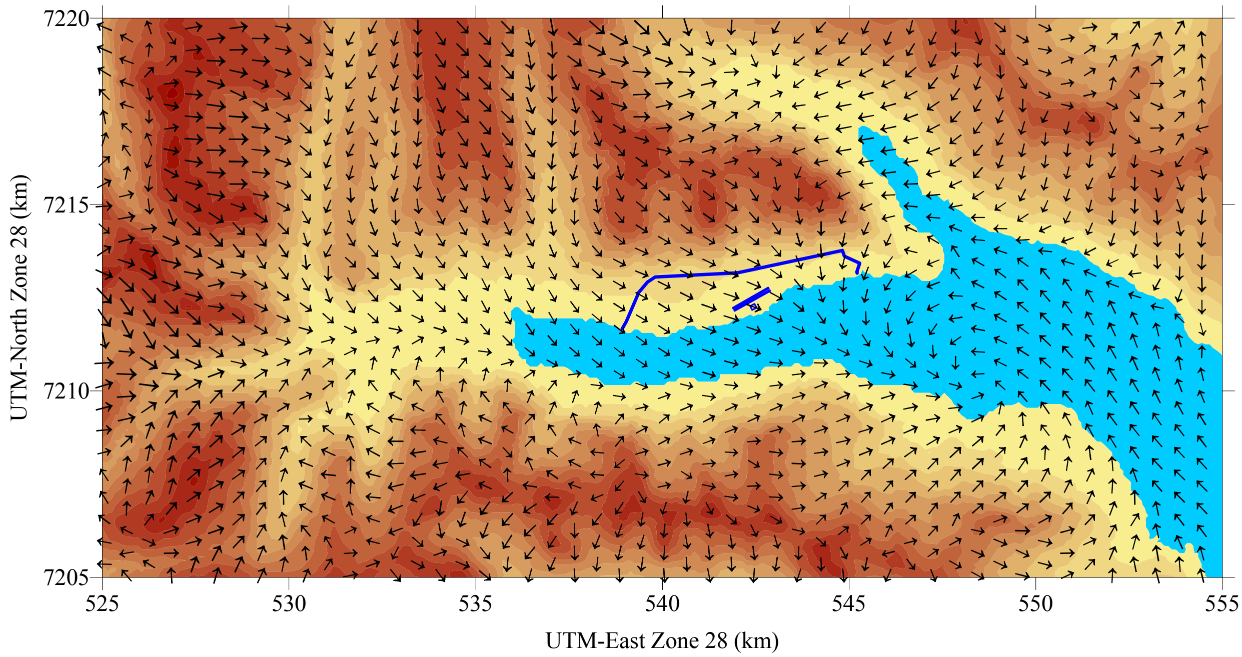


Figure 6-4. A map of the Reydarfjordur area with annual wind roses plotted at different locations (From Sigurdsson F.H., 1999). At Leirur, observations are from October 1993 to September 1995. At Eyri, observations are from July 1993 to June 1994. At Mjoeyri, observations are from October 1982 to September 1984.

CALMET run with MM5-1km + CCM - July 23, 2001 - 1AM - level 1



CALMET with MM5-1km+CCM - July 23, 2000 - 12PM - level 1

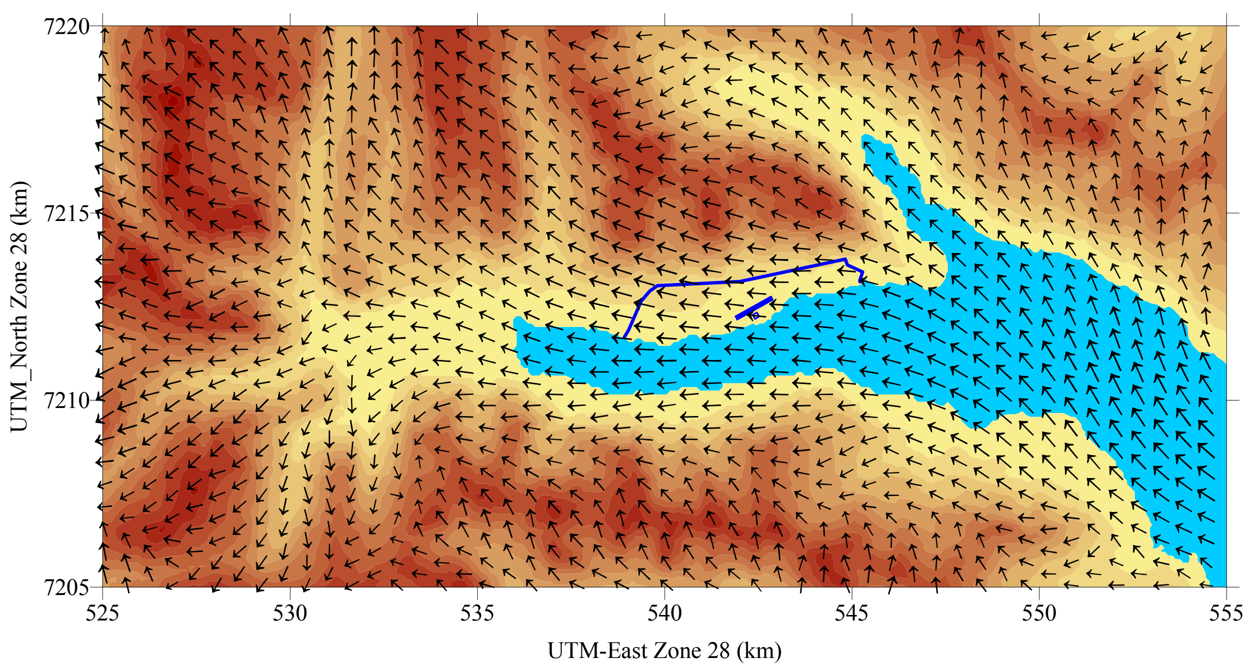


Figure 6-5. Plots of CALMET Level 1 wind vectors. The top plot is for July 23, 2000 at 1am, and the bottom plot is for July 23, 2000 at 12pm.

7. MODELED PERIOD VERSUS CLIMATOLOGY

At the Somastadagerdi meteorological station, nearly four full years of data are available, from June 1998 to May 2002. This period will define the climatological period with which the year modeled will be compared and analyzed. Because the modeled year begins in July 2000 and ends in June 2001, the year to year comparison will also be for the period from July to June. Therefore, Year 1 is July 1998 – June 1999, Year 2 is July 1999 – June 2000, Year 3 is July 2000 – June 2001 and Year 4 is July 2001 – June 2002. Note that for the fourth year, the last month (June 2002) is not available in the observed Somastadagerdi data set.

At Somastadagerdi, the annual average wind roses have two dominant wind directions: easterlies and westerlies (Figure 7-1). In summer (July to September), the wind rose at night (0h-6h) is represented primarily by light winds with an east-west orientation (Appendix E). During the day (12h-18h), the winds are mainly from the east and much stronger (Appendix E). All four years show the same features.

The wind velocity is then plotted as a function of wind direction (every 10 degrees) for two periods: summer (April-September), shown in Figure 7-2, and winter (October-March), shown in Figure 7-3. For both periods, similar to the annual wind roses, two wind directions dominate, easterly and westerly. Easterlies are more prevalent during the summer, while westerlies are more frequent during the winter. On average, for both periods, westerlies are the strongest. Easterlies during the summer tend to be weaker than in winter by an average of approximately 3 m/s. The westerlies in Year 3 tend to be slightly weaker than in the other years.

Table 7-1 shows the number of calm periods per year, defined as the number of consecutive hours with calm winds (i.e. wind speeds less than 1 m/s). Year 3 has the largest number of calm hours (1,642 hours), while Year 2 has the least (1,458 hours).

Table 7-2 shows the number of high wind events per year, defined as nine or more hours per day with wind speeds greater than 5 m/s. Year 4 (even without June) has the highest number of days with strong winds. Year 1 has the largest number of days with strong westerlies. Year 3 has the highest number of days with strong easterlies, but does not have as many days of strong westerlies as the other years.

As one would expect, a small amount of annual variability exists between the four years analyzed. Year 3, the year modeled in this study, has a larger percentage of calm winds than the other three years analyzed, including weaker westerlies. In order to address the question of how important these factors are in the estimation of high concentration peaks in the vicinity of the aluminum plant, the frequency of occurrence of critical meteorological events that are expected to lead to high concentrations are analyzed below.

The three events representative of poor dispersion conditions that are expected to lead to high concentrations of pollutants in the vicinity of the facility are:

- Flow reversals
- Stagnation
- Stagnation with inversion conditions

These events can be objectively tracked for each year for the 12-month period July to June. The first event to be analyzed is the flow reversal event. It is defined as light winds ($\leq$ 2 m/s) for at least 5 hours between 0h and 8h, followed by strong easterlies (wind stronger than 3 m/s with a wind direction between 60 and 120 degrees). Table 7-3 shows that 57 of these events occurred during Year 3, while only 40 occurred during Year 1 and 43 during Year 2. The flow reversal event appears mostly in the summer and spring (the period from April to September) for all four years. The maximum number of flow reversal events is observed during the summer (July to September) of Year 3 with 28 occurrences.

The second event is stagnation, characterized by calm winds ($\leq$ 1 m/s) over a period of several consecutive hours. Year 3 has the largest number of calm wind hours (Table 7-4). Stagnation events with periods of 6 to 15 consecutive hours occurred 68 times in Year 3, 70 times in Year 1 and 53 times in Year 2.

An inversion condition event is defined here as light winds ($\leq$ 2 m/s) combined with a temperature inversion (the temperature at 36 m is greater than the temperature at 10 m) for a period longer than 5 consecutive hours. The number of these events is computed for each year. Figure 7-4 shows that the inversion condition events are longer during winter and fall. These conditions can last for more than 40 hours during the winter (e.g., Year 1) and can end at any hour during the day. In general, inversion events last for less than 20 hours during spring and summer with the event usually ending before 10am. All four years show a similar pattern of inversion condition behavior.

Despite slight year to year differences, stagnation, inversion conditions and flow reversal are very well represented in the year (Year 3) chosen for modeling in this study. Flow reversal conditions are observed to be more frequent in Year 3 than in any of the other years, as is the frequency of stagnation events (Table 7-3 and Table 7-4). Also, the pattern of inversion conditions in Year 3 is similar to the other three years analyzed. The critical compliance issues tend to be associated with the frequency of occurrence of the poor dispersion conditions that were analyzed here.

This analysis suggests that the year modeled (Year 3) is, in fact, likely to be a conservative indicator of compliance.

An additional analysis of stagnation events during the summer of 2003 was performed, as this summer was considered to have had a relatively large number of stagnation events. This was done in order to determine whether the summer of 2003 had a significantly higher frequency of stagnation event occurrences than summers of other years, in particular the modeled summer of 2000. Year 2003 had not been included in the initial analysis since the data were not available at the time. The stagnation events during the summers of all four years (1998, 1999, 2000 and 2001) were compared to that of 2003. Summer was defined to span the months July, August and September (i.e. July 1 to September 30). Wind data analyzed were obtained from the on-site station Somastadagerdi at a height of 10.5 meters and calm winds were defined as wind speeds less than or equal to 1.0 m/s. The results of this analysis are summarized hereafter in Table 7-4. The summer of 2003 does not have a significantly higher number of stagnation events than the summer of 2000, which is used in the modeling study, nor does it have a higher number of stagnation events than any of the other summers examined in this analysis (1998 to 2001). In fact, the frequencies of short, medium, and long stagnation events are higher in the summer of the modeled year 2000 (see Table 7-4) than in the summer of 2003. For example, 167 stagnations events of 6 hours or less were recorded in 2000 while 165 events were recorded in 2003. For stagnation events with lengths between 6 and 11 hours, 23 are recorded in 2000 and only 11 in 2003. Finally, 4 stagnation events of 12 hours or more are observed in 2000 with only 3 observed in 2003. This additional analysis confirms that in fact the year modeled (Year 3) is likely to be a conservative indicator for compliance.

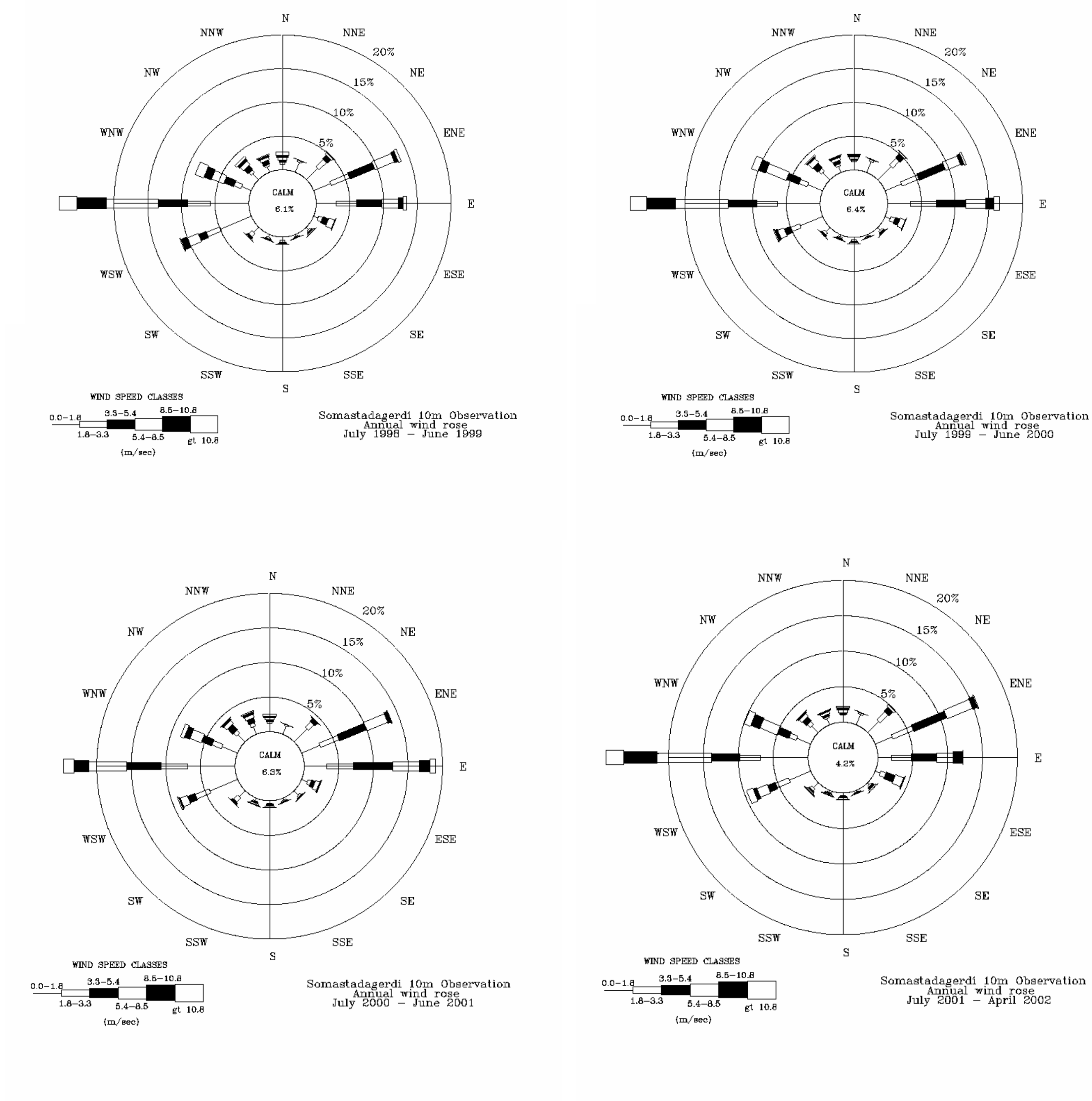
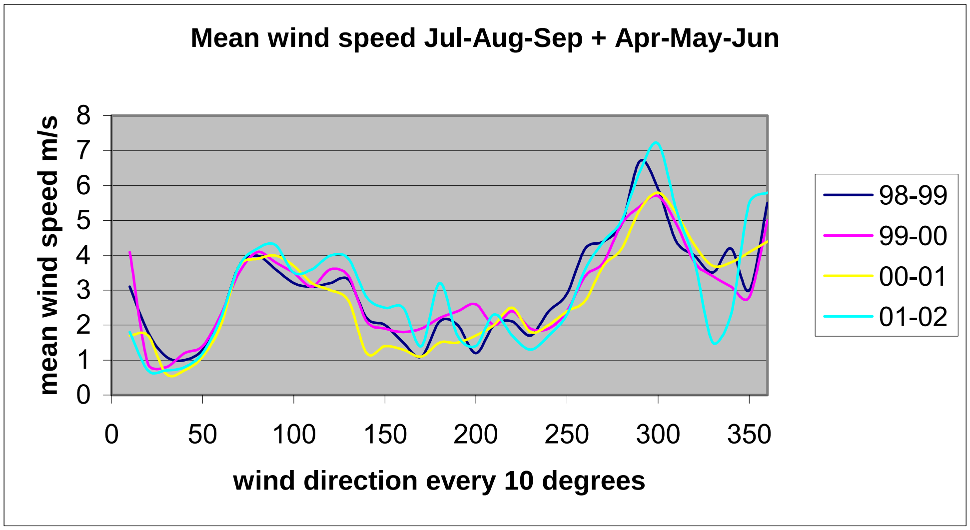


Figure 7-1. Annual wind roses of 10 meter winds observed at Somastadagerdi for each year (June-July) of the 4-year period (1998-2002).



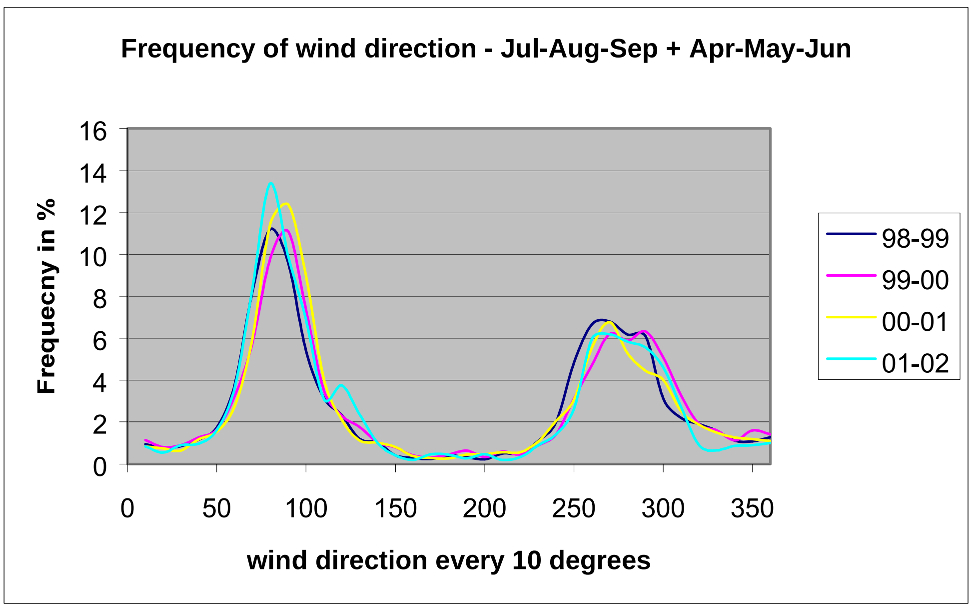
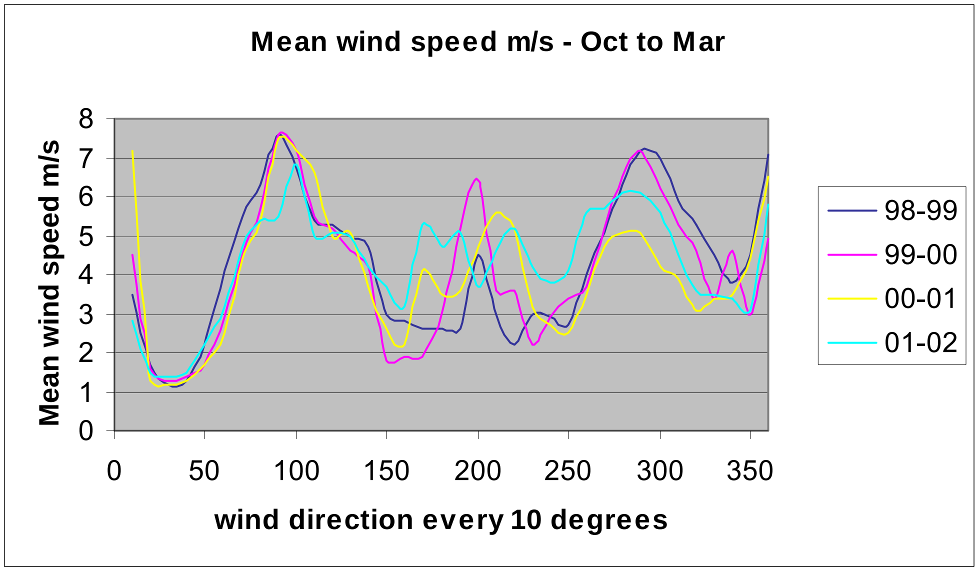


Figure 7-2. Mean wind speed and frequency in % of total hours over the period plotted as a function of wind direction. The period selected is July-September + April-June the following calendar year. Each color represents a different year. The yellow line is the year modeled.



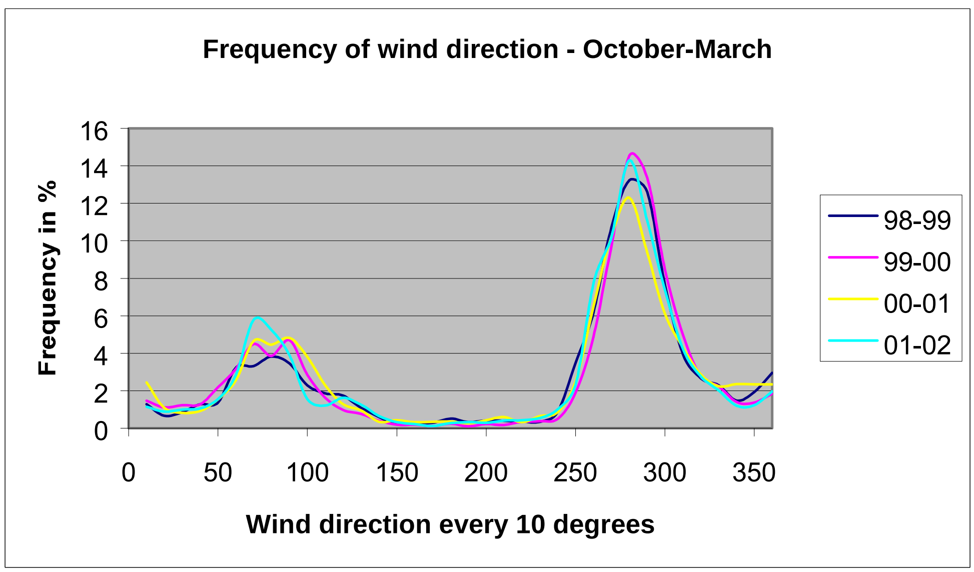


Figure 7-3. Mean wind speed and frequency in % of total hours over the period plotted as a function of wind direction. The period selected is October to March. Each color represents a different year. The yellow line is the year modeled.

Table 7-1. Number of Occurrences of Calm Events[1] – Length of an Event Varies from 1h to 24h.

	No. of Events of 1 to 5h	No. of Events of 6 to 10h	No. of Events of 11 to 15h	No. of Events of 16 to 20h	No. of Events of 21 to 24h	Total No. of Events Per Year
Year 1 (July 98-June 99)	468	58	12	1	1	1486
Year 2 (July 99- June 00)	523	44	9	1	0	1458
Year 3 (July 00-June 01)	542	55	13	0	0	1642
Year 4 (July 01- May 02)	411	28	4	0	1	1075

1 A calm event is defined as winds less than or equal to 1 m/s.

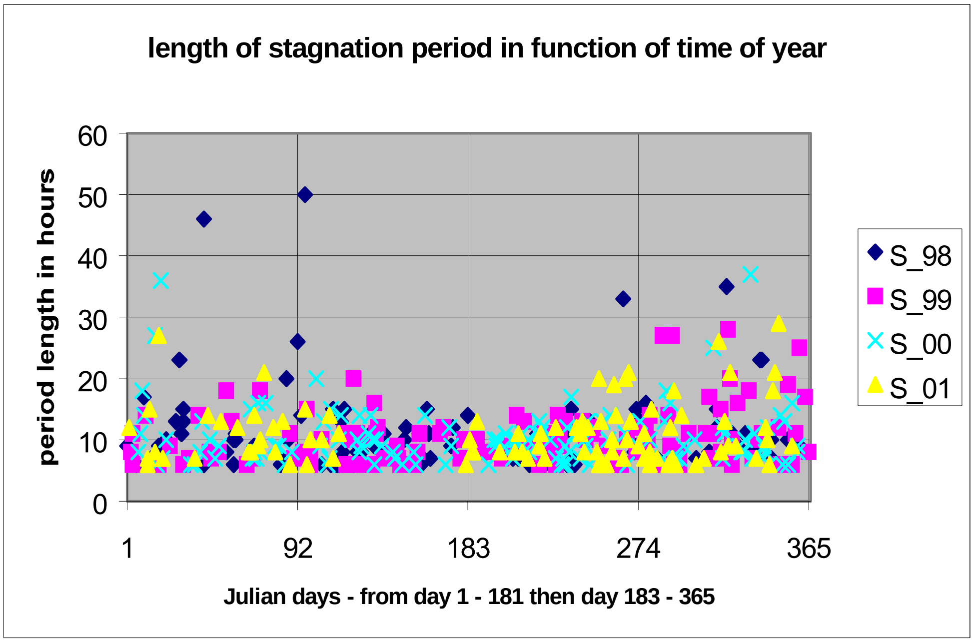
Table 7-2. Number of Occurrences of Strong Winds[1].

Wind Direction	Year1 (July 98-June 99)	Year 2 (July 99-June 00)	Year 3 (July 00-June 01)	Year 4 (July 01-June 02)
No main direction	175 days	186 days	142 days	198 days
60 < Easterlies < 120	41 days	33 days	43 days	37 days
240 < Westerlies < 300	101 days	93 days	59 days	89 days

1 A high wind speed event is defined as more than 9 hours in a day with winds stronger than 5 m/s.

Table 7-3. Number of Occurrences (in days) of a Flow Reversal Pattern: Light Winds Followed by Strong Easterlies.

Period	Year 1 (July 98-June 99)	Year 2 (July 99-June 00)	Year 3 (July 00-June 01)	Year 4 (July 01-June 02)
Jul - Sept	17	16	28	23
Oct - Dec	3	5	5	2
Jan -Mar	2	2	2	4
Apr – Jun	18	22	22	-
Year (Jul – Jun)	40	45	57	-



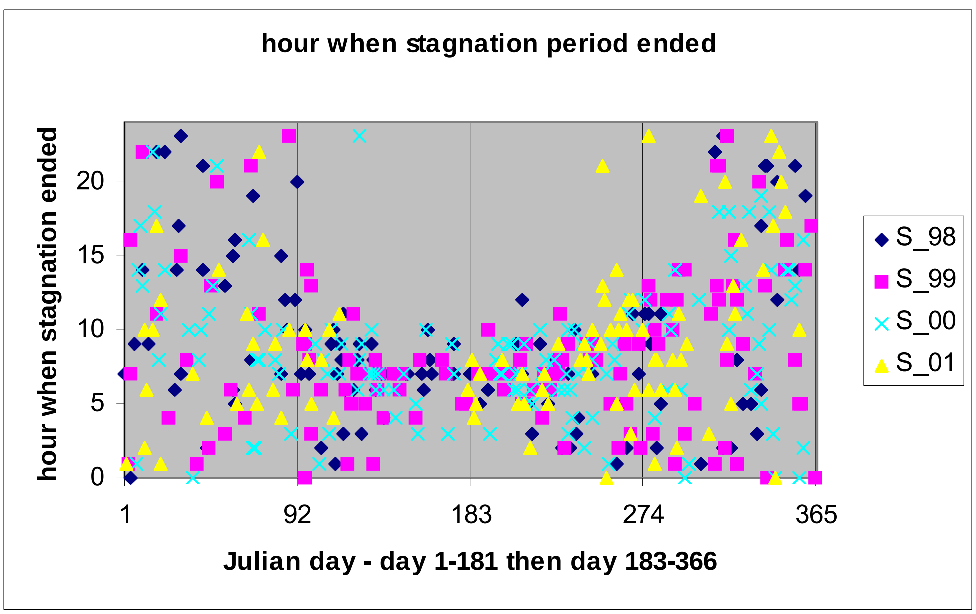


Figure 7-4. Length of stagnation period (top) and hour when stagnation period ended (bottom) are plotted as a function of time of year. S_98 is Year 1: July 1998-June 1999; S_99 is Year 2: July 1999-June 2000; S_00 is Year 3: July 2000- June 2001 and S_01 is Year 4: July 2001-May 2002

Table 7-4. Stagnation Events during Summer 2003 as compared to Summers 1998 to 2001.

Number of Consecutive Hours of Calm Winds	Number of Times Such An Event Occurs				
	Summer 1998	Summer 1999	Summer 2000	Summer 2001	Summer 2003
1	59	81	**86**	40	**80**
2	31	37	**35**	29	**38**
3	10	16	**16**	25	**26**
4	13	15	**19**	12	**9**
5	10	12	**11**	15	**12**
6	9	7	**6**	1	**3**
7	4	6	**5**	6	**2**
8	4	2	**4**	5	**1**
9	1	2	**3**	6	**2**
10	1	2	**4**	2	**2**
11	1	1	**1**	1	**1**
12	2	1	**2**	1	**1**
13	1	3	**1**	0	**1**
14	0	1	**1**	1	**0**
15	0	0	**0**	0	**0**
16	0	0	**0**	0	**1**
17	0	0	**0**	0	**0**
18	0	0	**0**	0	**0**
19	0	0	**0**	0	**0**
20	1	0	**0**	0	**0**
21	0	0	**0**	1	**0**
22	0	0	**0**	0	**0**
23	0	0	**0**	0	**0**
TOTAL Number of Calm Hours	**454**	**537**	**567**	**516**	**460**

1 Summer = July/August/September
2 Calm Winds = winds ≤1.0m/s
3 Meteorological data from Station Somastadagerdi (ID = 7078)

8. RESULTS

8.1 Ambient Standards

Table 8-1 summarizes the air quality guidelines that need to be met for this study. These guidelines are from Icelandic regulations, Norwegian regulatory guidance and European Union directives. Both short-term (1h and 24h) and long-term (seasonal and annual) averages are covered. The Norwegian authorities and EFA (*European Federation of Asthma and Allergy Associations*) have established ambient standards for HF designed to protect vegetation and human health. Icelandic regulations have placed upper and lower evaluation limits for SO_2 in the winter season for the ecosystem. Note also, that some limits are allowed to be exceeded a specified number of times per year.

The air quality analysis is performed in two steps. First, the maximum predicted concentrations resulting from the proposed facility emissions are evaluated and compared to the corresponding guideline concentrations. If the predicted maximum concentrations exceed the guideline limits, then a second step is taken in order to determine the number of averaging periods for which the guideline limit values are exceeded. This number is then compared with the number of exceedances allowed.

Table 8-2 to Table 8-5 summarize the predicted number of exceedances outside the dilution zone for all modeled species for Scenario A to Scenario D, respectively. Scenarios A and C, run using annual average emission rates, evaluate the impacts of SO_2, HF, PM_{10}, PAH and BaP for all regulated averaging time periods. Scenarios B and D, designed to examine the impact of increased HF emissions during the growing season, evaluate only the impact that HF has for the growing season averaging time period.

The results for Scenario A are shown in Figures 8-1 and 8-3 and Figures 8-5 to 8-14, and Figures 8-2 and 8-4 show the results for Scenario B. The results for Scenario C may be seen in Figures 8-15 and 8-17 and Figures 8-19 to 8-27, and Figures 8-16 and 8-18 have the results for Scenario D. These results show that the predicted impacts from the Alcoa facility will be in compliance with the applicable standards and guidelines for all four scenarios considered. The following sections describe in detail the modeling results for each pollutant.

8.2 HF Concentrations

For HF concentrations, there are two relevant averaging periods with applicable guidelines: the 24-hour average and the growing season average. The growing season is defined as the period between April 1 and September 30. Because the modeled year spans two calendar years, the growing season averages are for the combined time periods July-September 2000 and April-June 2001. The highest predicted 24-hour average concentration values occur inside the dilution zone: 9.29 $\mu g/m^3$ in Scenario A (Figure 8-1), 11.96 $\mu g/m^3$ in Scenario B (Figure 8-2), 9.36 $\mu g/m^3$ in Scenario C (Figure 8-15), and 12.03 $\mu g/m^3$ in Scenario D (Figure 8-16). All are well below the 24-hour average HF concentration guideline of 25 $\mu g/m^3$. Outside the dilution zone, the maximum 24-hour average concentration values are significantly smaller, by approximately one order of magnitude. Although the predicted HF growing season average concentrations inside the dilution zone exceed the 0.3 $\mu g/m^3$ guideline for Scenarios A and B (Figures 8-3 and 8-4) and Scenarios C and D (Figures 8-17 and 8-18), outside the dilution zone no exceedances are predicted for any of the four scenarios considered. Therefore, the proposed facility is predicted to be in compliance with HF air quality regulations.

8.3 SO_2 Concentrations

Four different averaging periods are considered for SO_2 concentrations. The first is the 1-hour average. In Scenario A, the highest 1-hour peak is 739.5 $\mu g/m^3$ predicted on Day 112, Hour 10 (April 22, 2001). This value occurs over the water to the south of the facility. The highest 1-hour concentrations of SO_2 outside the dilution zone are observed across the fjord from the facility and close to the village at the water-land boundary at the end of the fjord (Figure 8-5). The 350 $\mu g/m^3$ SIL is reached several times in different locations outside the dilution zone for Scenario A, but never more than 5 times at the same receptor (Figure 8-6), while up to 24 times are allowed. In Scenario C, the maximum 1-hour peak of 466.5 $\mu g/m^3$ occurs inside the dilution zone and is predicted on Day 205, Hour 21 (July 24, 2000) (Figure 8-19). There are no exceedances of the 350 $\mu g/m^3$ SIL outside the dilution zone in Scenario C (Figure 8-20).

For the 24-hour average, in Scenario A the highest concentrations occur on the slope of the hill just north-west of the facility, on the east side of the facility, across the fjord and close to the village at the water-land boundary at the end of the fjord (Figure 8-7). The 24-hour average guideline value of 50 $\mu g/m^3$ is never exceeded more than 2 times at the same receptor for Scenario A (Figure 8-8), while up to 7 exceedances are allowed in a given year. The 24h-average threshold is never reached in Scenario C (Figure 8-21), the maximum value occurring inside the dilution zone at 40.3 $\mu g/m^3$ on Day 205 (July 24, 2000). The highest 24h-average peak for Scenario A occurs outside the dilution zone with a value of 72.2 $\mu g/m^3$ predicted on Day 268 (September 24, 2000). This falls well below the 24-hour SIL of 125 $\mu g/m^3$. The maximum annual average values for both Scenario A and Scenario C occur inside the dilution zone and have values of 6.8 μg/m^3 (Figure 8-10) for Scenario A and 10.9 μg/m^3 (Figure 8-23) for Scenario C. Both of these values fall well below the guideline value of 20 μg/m^3. The winter period (from October 1, 2000 to March 30, 2001) also needs to be considered. The highest SO_2 predicted concentration average over this period is 5.8 μg/m^3 in Scenario A (Figure 8-9) and 9.3 μg/m^3 in Scenario C (Figure 8-22). Both values occur inside the dilution zone, and fall well below the guideline value of 20 μg/m^3. No violations of any SO_2 air quality guidelines are predicted due to emissions from the proposed facility. Therefore, the proposed facility is predicted to be in compliance with SO_2 ambient air quality guidelines.

8.4 PM_{10} Concentrations

For PM_{10}, the peak predicted 24-hour average concentration is 4.63 μg/m^3 (Figure 8-11) for Scenario A and 7.6 μg/m^3 (Figure 8-24) for Scenario C Both of these values occur inside the dilution zone and are much lower than the guideline value of 50 μg/m^3. For the annual average PM_{10} concentrations, a maximum value of 1.25 μg/m^3 is predicted (Figure 8-12) for Scenario A and 1.46 μg/m^3 (Figure 8-25) for Scenario C. Both values occur inside the dilution zone, and fall well below the guideline value of 20 μg/m^3. No violations of any PM_{10} air quality regulations are predicted due to emissions from the proposed facility. Therefore, the proposed facility is predicted to be in compliance with PM_{10} ambient air quality guidelines.

8.5 PAH Concentrations

The predicted PAH annual average concentrations all fall below the guideline value of 10-100 ng/m^3. The maximum predicted PAH concentration is 8.9 ng/m^3 in Scenario A (Figure 8-13) and 9 ng/m^3 in Scenario C (Figure 8-26), with both values occurring inside the dilution zone. Therefore, the proposed facility is predicted to be in compliance with PAH ambient air quality guidelines.

8.6 BaP Concentrations

The predicted BaP annual average concentrations are all below the guideline values of 0.1-1 ng/m^3. The maximum predicted BaP concentration is 0.09 ng/m^3 in Scenario A (Figure 8-14) and 0.091 ng/m^3 in Scenario C (Figure 8-27). Both values occur inside the dilution zone. Therefore, the proposed facility is predicted to be in compliance with BaP ambient air quality guidelines.

Table 8-1. Summary of Relevant Air Standards and Guidelines.

Parameter	Averaging Period	Limit Value ($\mu g/m^3$)	Allowed Exceedances [4]	Source
HF	24-consecutive hours	25	0	Norwegian guidelines – Protection of human health
	Growing season (April 1 – September 30)	0.3	0	EFA guideline for existing aluminum plants in Iceland (Norwegian guidelines) Protection of vegetation
SO_2	1-hour	350	24 times/year	Icelandic regulation No. 251/2002
	24- consecutive hours	125	3 times/year	Icelandic regulation No. 251/2002
		75-50[1]	3 times/year	Icelandic regulation No. 251/2002
		50	7 times/year	Icelandic regulation No. 251/2002
	Winter season (October 1- March 31)	20	0	Icelandic regulation No. 251/2002
		12-8[2]	0	Icelandic regulation No. 251/2002
	Annual	20	0	Icelandic regulation No. 251/2002
PM_{10}	24-consecutive hours	50	7 times/year	Icelandic regulation from 2010
		30-20[1]	7 times/year	Icelandic regulation No. 251/2002
	Annual	20	0	Icelandic regulation No. 251/2002
		14-10[3]	0	Icelandic regulation No. 251/2002
BaP (x100 = PAH)	Annual	0.1-1 ng/m^3	0	Ambient air quality standard in Belgium, France, Italy, Netherlands, Sweden and United Kingdom

(1) Upper and lower threshold for monitoring.

(2) Upper and lower evaluation limit for ecosystem.

(3) Upper and lower assessment threshold.

(4) Number of exceedances allowed at a particular receptor in a given year outside the dilution zone.

Table 8-2. Summary of CALPUFF Modeling Results for Scenario A (no seawater scrubbers).

Parameter	Averaging Period	Limit Value ($\mu g/m^3$)	Number of Exceedances Allowed [1]	Number of Exceedances Predicted [1]	In Compliance?
HF	24-consecutive hours	25	0	0	Yes
	Growing season (April 1 – September 30)	0.3	0	0	Yes
SO_2	1-hour	350	24	5	Yes
	24- consecutive hours	50	7	2	Yes
		125	3	0	Yes
	Winter season (October 1- March 31)	20	0	0	Yes
	Annual	20	0	0	Yes
PM_{10}	24-consecutive hours	50	7	0	Yes
	Annual	20	0	0	Yes
BaP (x100 = PAH)	Annual	0.1-1 ng/m^3	0	0	Yes

1 Maximum number of exceedances at any receptor outside the dilution zone.

Table 8-3. Summary of CALPUFF Modeling Results for Scenario B (no seawater scrubbers).

Parameter	Averaging Period	Limit Value ($\mu g/m^3$)	Number of Exceedances Allowed [1]	Number of Exceedances Predicted [1]	In Compliance?
HF	24-consecutive hours (April 1 – September 30)	25	0	0	Yes
	Growing season (April 1 – September 30)	0.3	0	0	Yes

1 Maximum number of exceedances at any receptor outside the dilution zone.

Table 8-4. Summary of CALPUFF Modeling Results for Scenario C (with seawater scrubbers).

Parameter	Averaging Period	Limit Value ($\mu g/m^3$)	Number of Exceedances Allowed [1]	Number of Exceedances Predicted [1]	In Compliance?
HF	24-consecutive hours	25	0	0	Yes
	Growing season (April 1 – September 30)	0.3	0	0	Yes
SO_2	1-hour	350	24	0	Yes
	24- consecutive hours	50	7	0	Yes
		125	3	0	Yes
	Winter season (October 1- March 31)	20	0	0	Yes
	Annual	20	0	0	Yes
PM_{10}	24-consecutive hours	50	7	0	Yes
	Annual	20	0	0	Yes
BaP (x100 = PAH)	Annual	0.1-1 ng/m^3	0	0	Yes

1 Maximum number of exceedances at any receptor outside the dilution zone.

Table 8-5. Summary of CALPUFF Modeling Results for Scenario D (with seawater scrubbers).

Parameter	Averaging Period	Limit Value ($\mu g/m^3$)	Number of Exceedances Allowed [1]	Number of Exceedances Predicted [1]	In Compliance?
HF	24-consecutive hours (April 1 – September 30)	25	0	0	Yes
	Growing season (April 1 – September 30)	0.3	0	0	Yes

1 Maximum number of exceedances at any receptor outside the dilution zone.

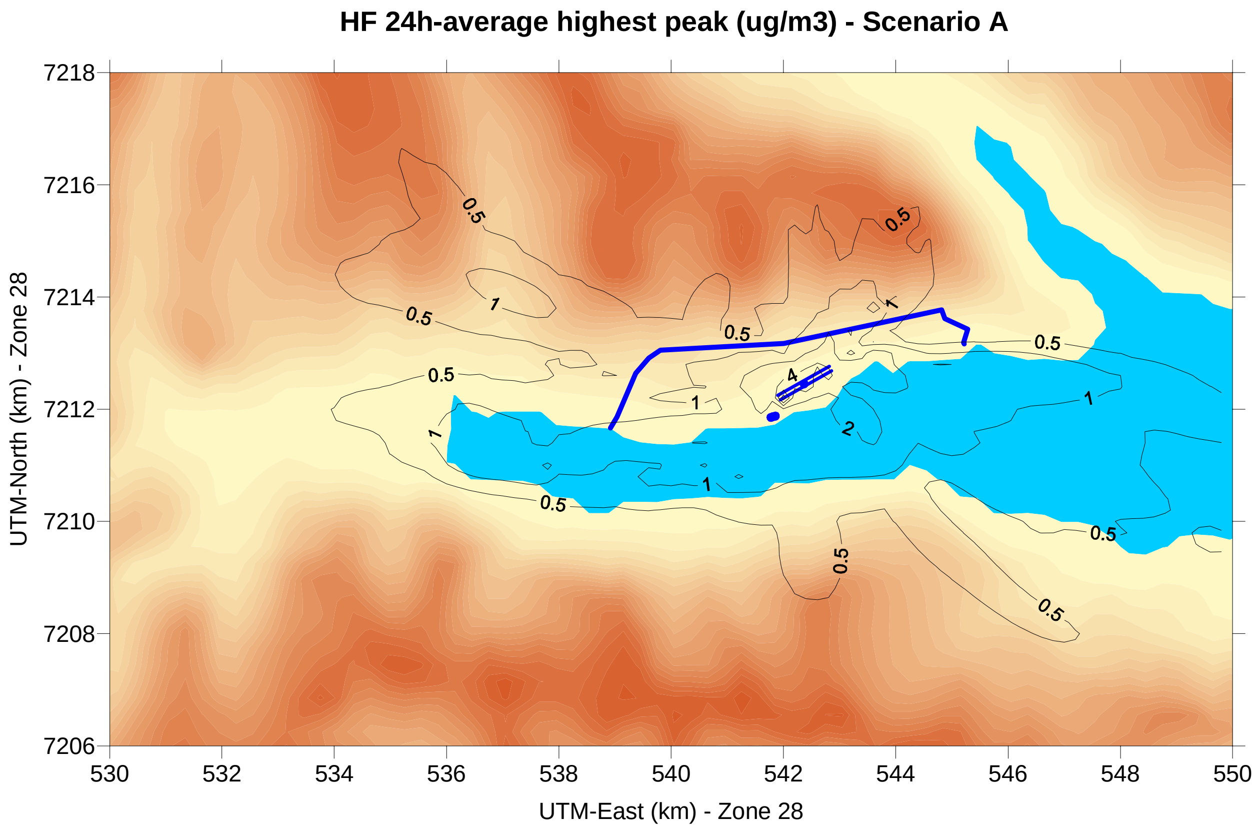


Figure 8-1. Predicted highest 24-hour average HF concentrations at each receptor (µg/m^3) for Scenario A. Threshold limit of 25 µg/m^3 not reached. [Contour Levels = 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0 µg/m^3]

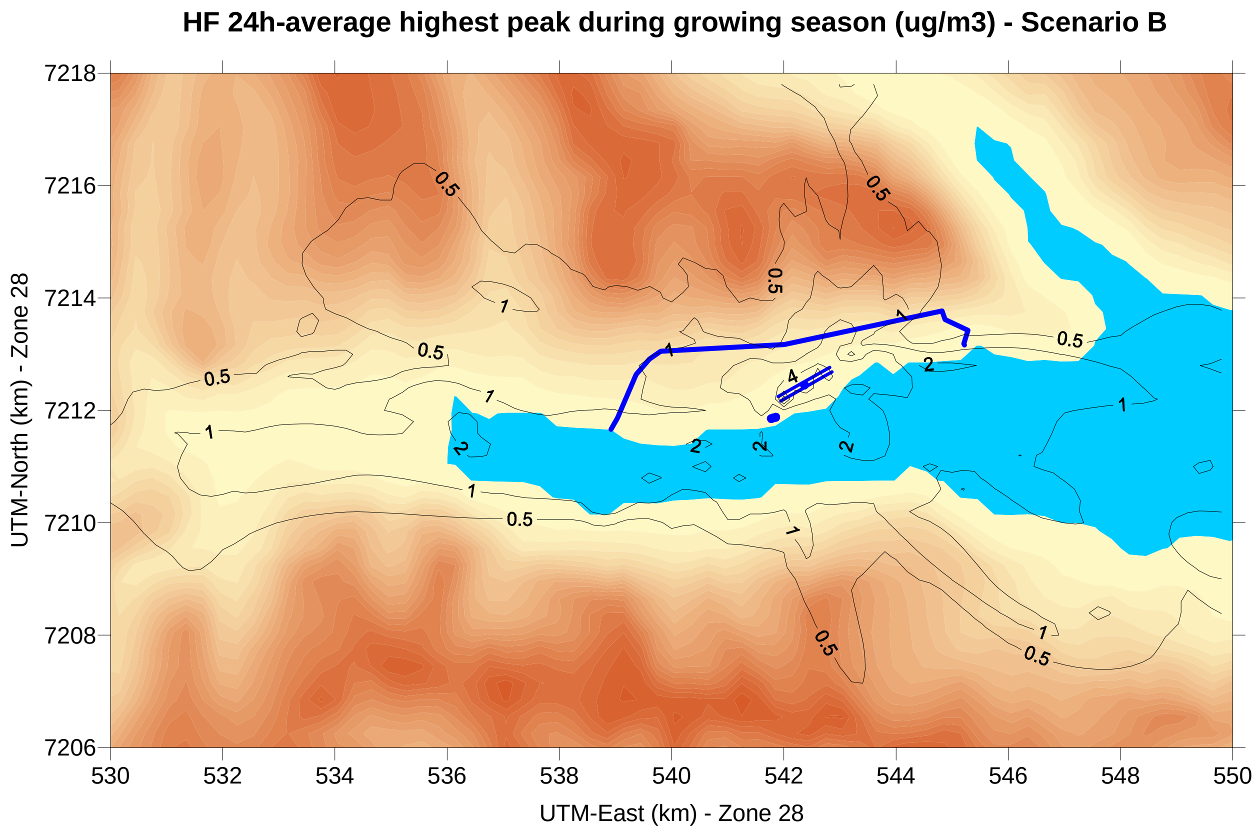


Figure 8-2. Predicted highest 24-hour average HF concentrations at each receptor during the growing season (µg/m^3) for Scenario B. Threshold limit of 25 µg/m^3 not reached. [Contour Levels = 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0 µg/m^3]

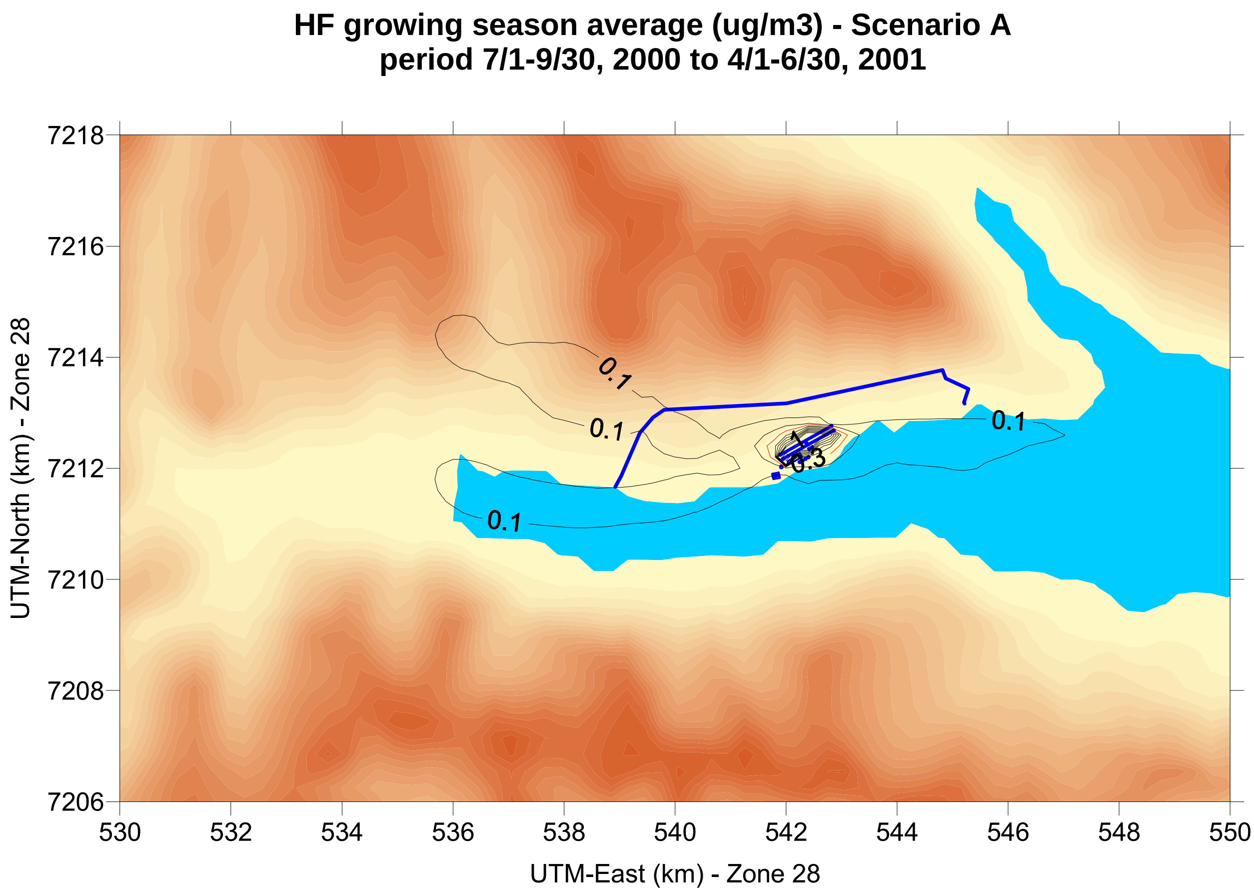


Figure 8-3. Predicted growing season average of HF concentrations (µg/m^3) for Scenario A. Growing season threshold of 0.3µg/m^3 is plotted in red.

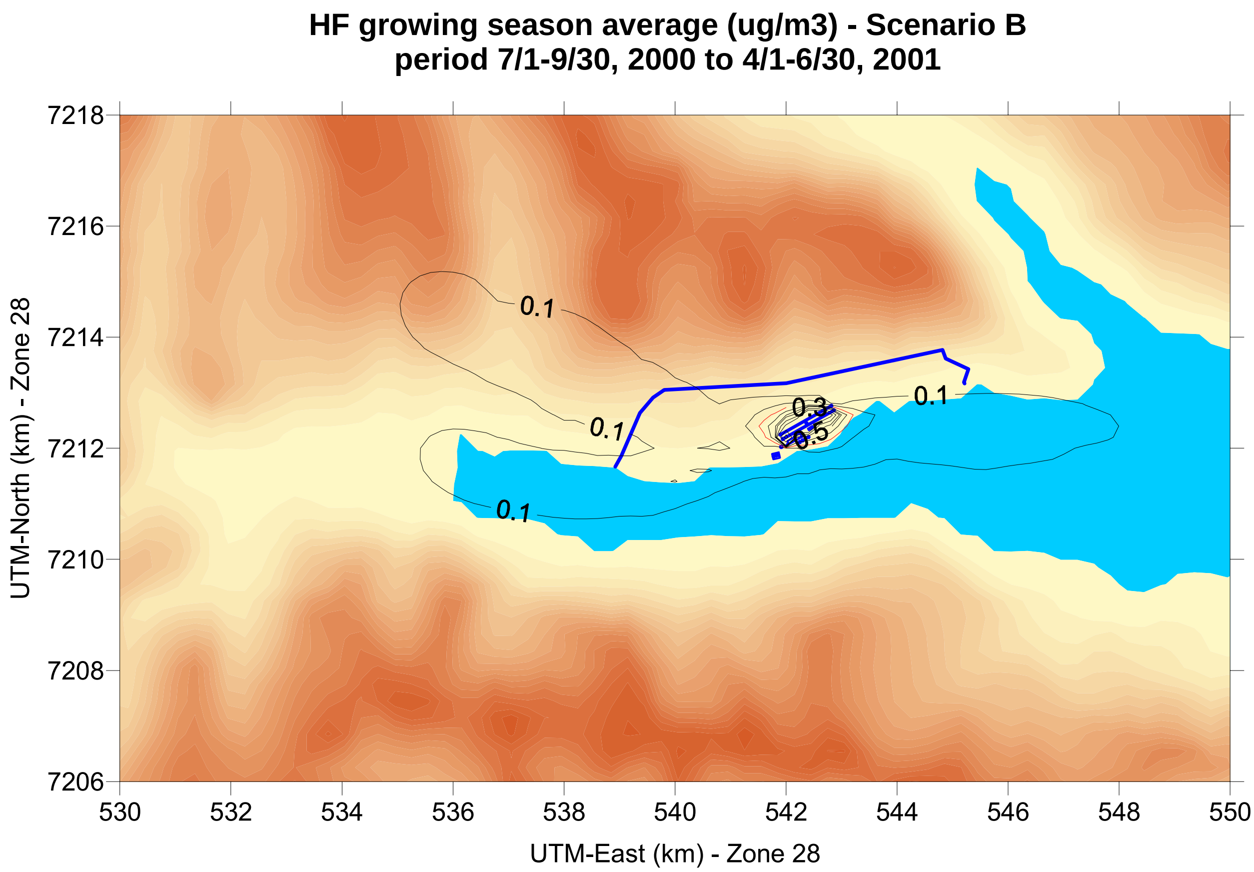


Figure 8-4. Predicted growing season average of HF concentrations (µg/m^3) for Scenario B. Growing season threshold of 0.3µg/m^3 is plotted in red.

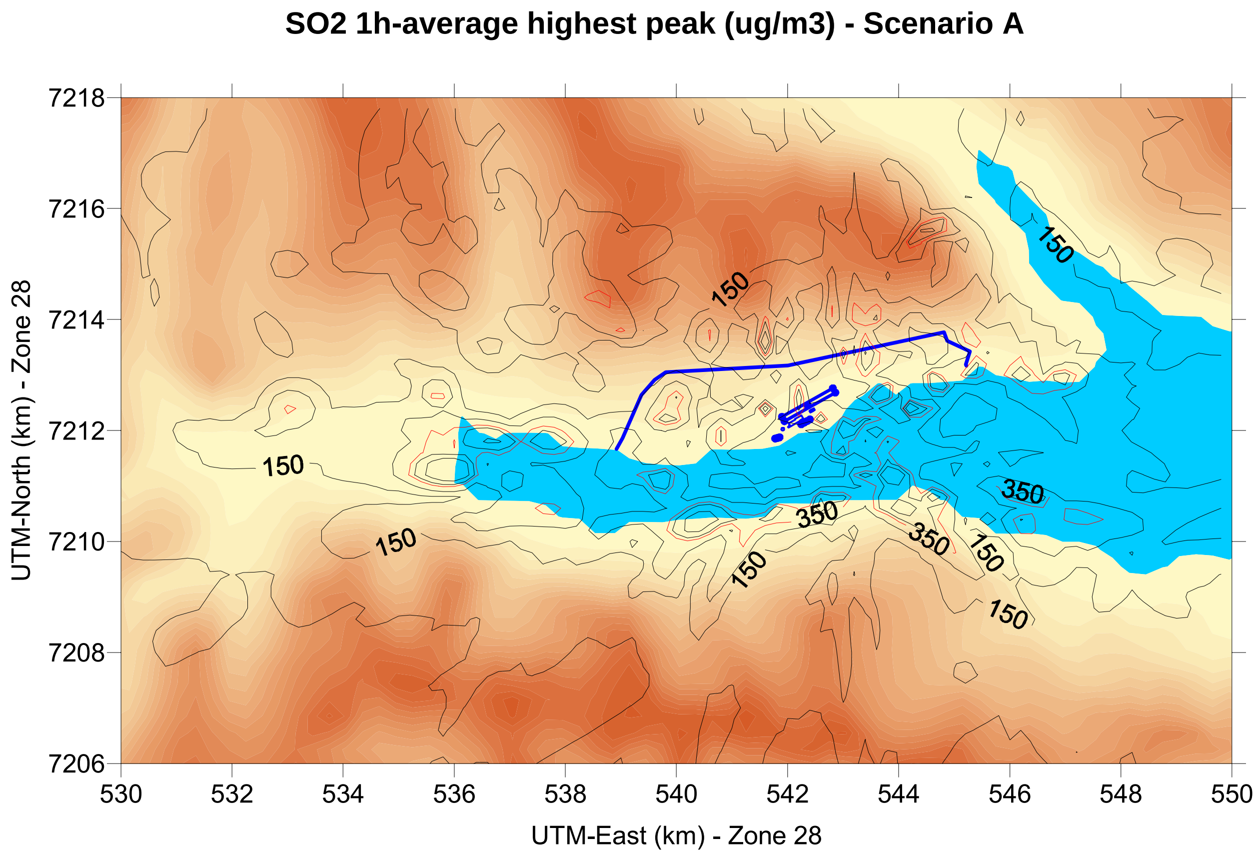


Figure 8-5. Predicted highest 1-hour average SO_2 concentrations at each receptor ($\mu g/m^3$) for Scenario A. The 350 $\mu g/m^3$ threshold is plotted in red.

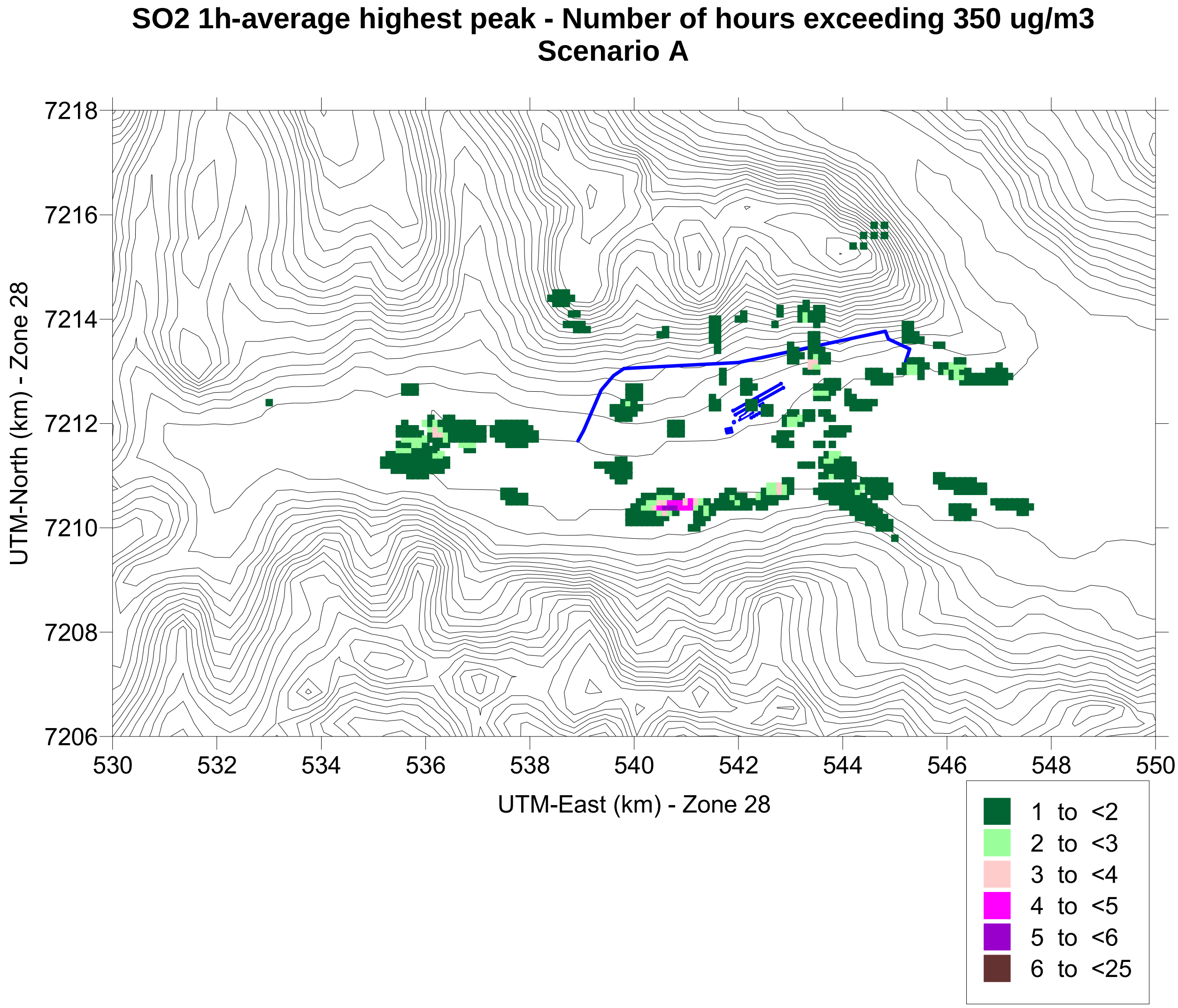


Figure 8-6. SO_2 1-hour averages: Number of exceedances of the 350 $\mu g/m^3$ threshold (in hours) for Scenario A.

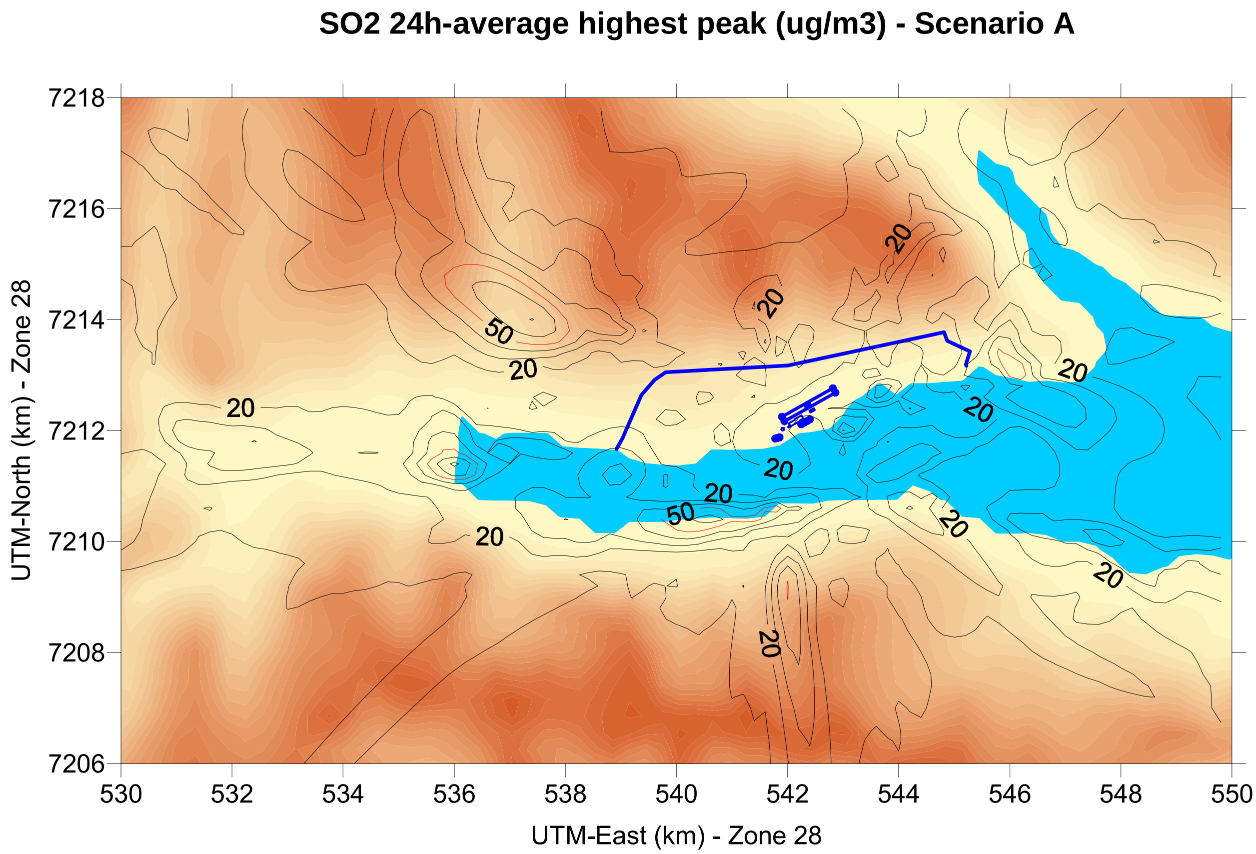


Figure 8-7. Predicted highest 24-hour average SO_2 concentrations at each receptor ($\mu g/m^3$) for Scenario A. The 50 $\mu g/m^3$ threshold is plotted in red.

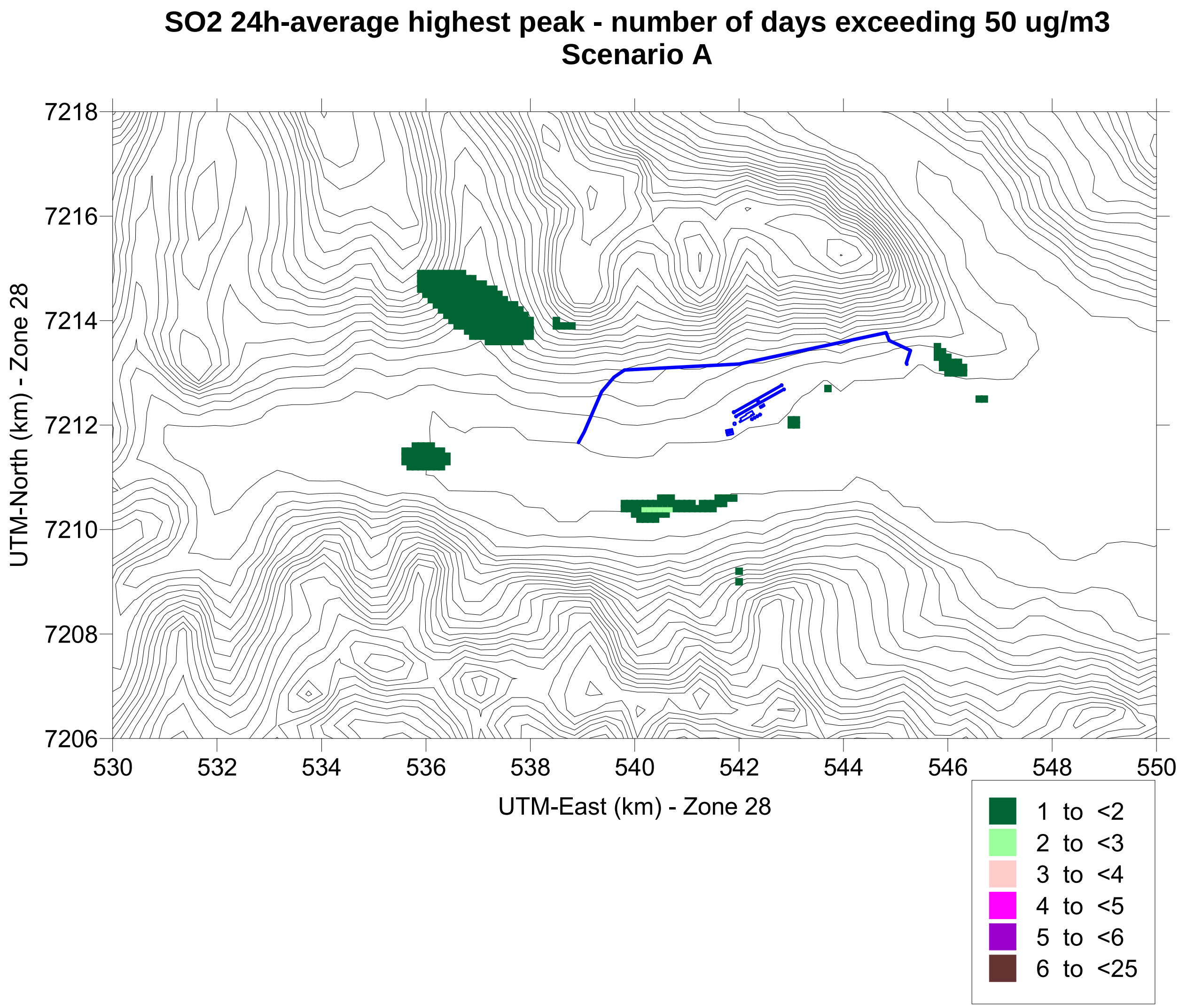


Figure 8-8. SO_2 24-hour averages: Number of exceedances of the 50 µg/m^3 threshold (in days) for Scenario A.

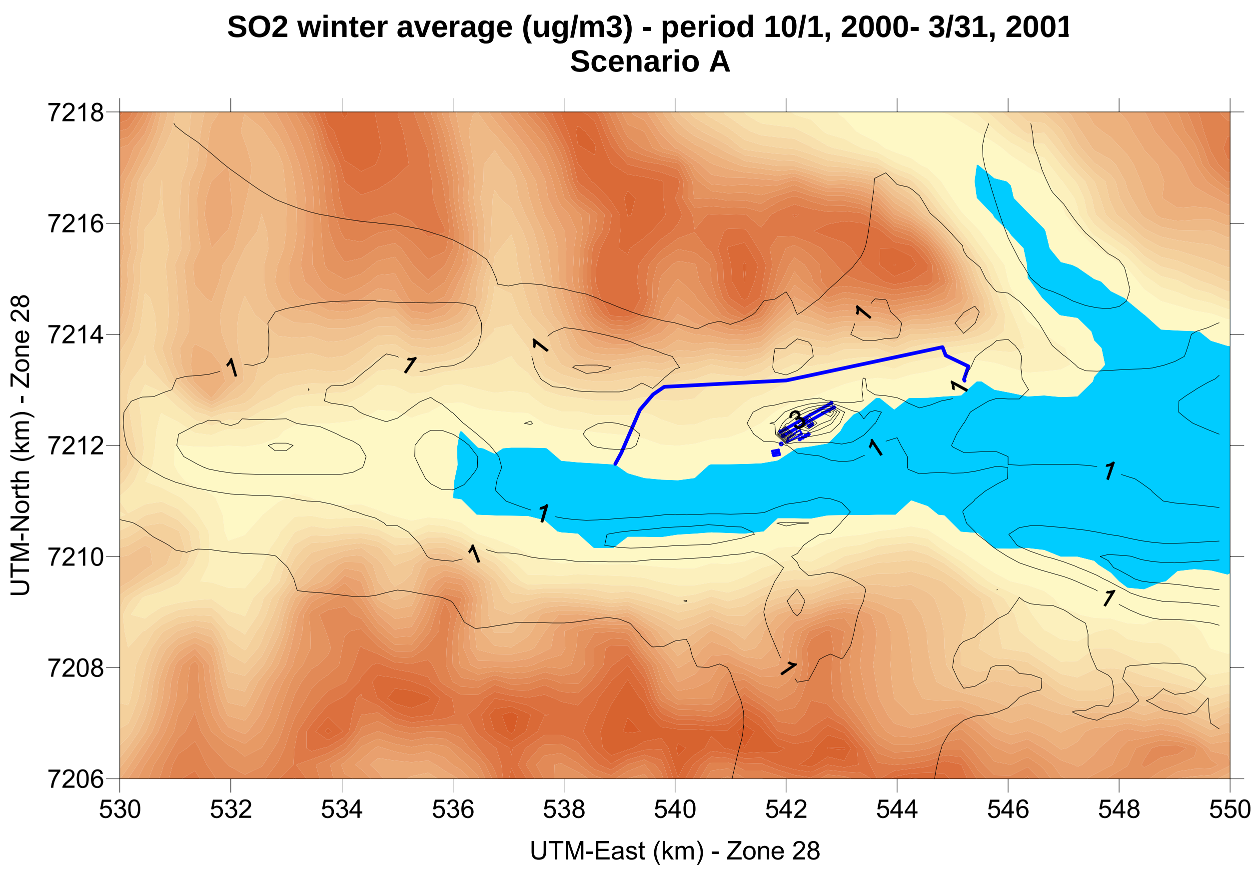


Figure 8-9. Predicted winter average SO_2 concentrations (μg/m^3) for Scenario A. The 20 μg/m^3 threshold is not reached.

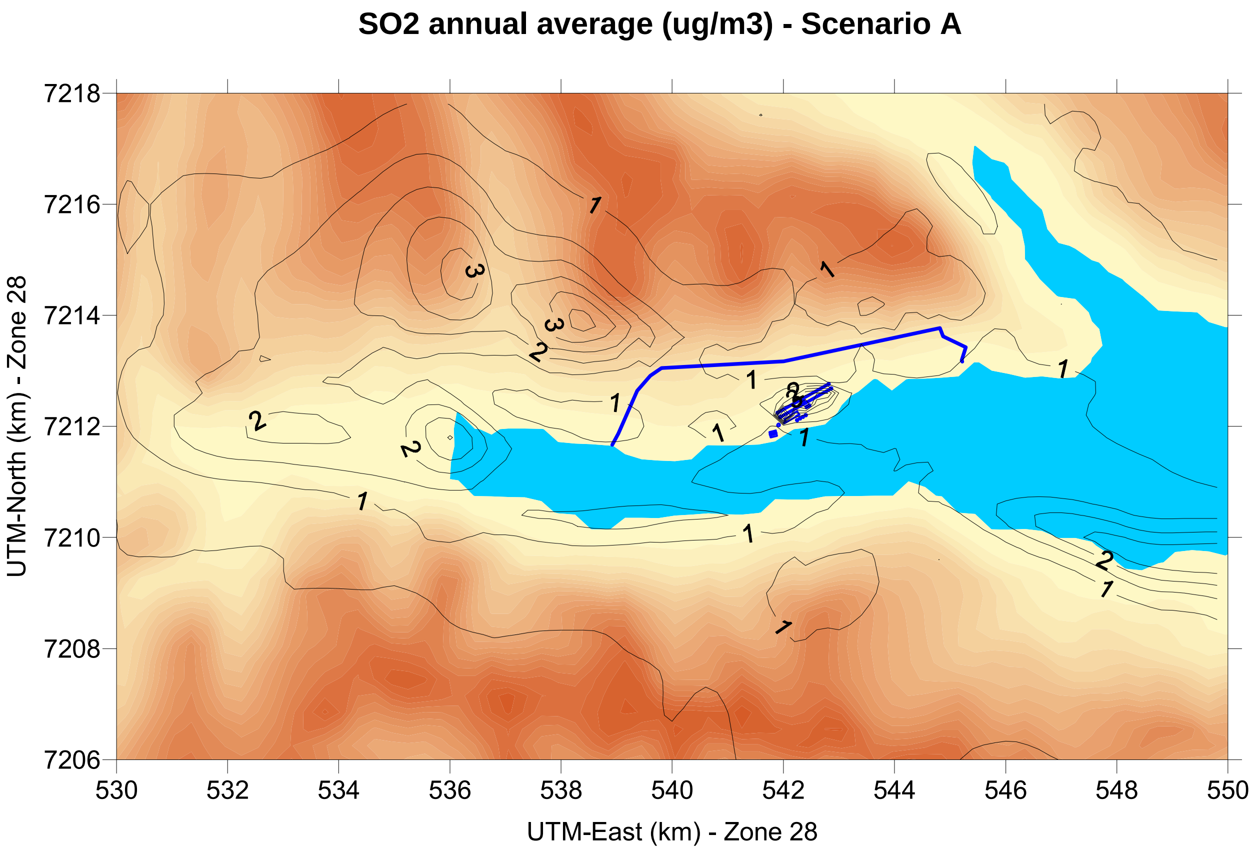


Figure 8-10. Predicted annual average SO_2 concentrations (μg/m^3) for Scenario A. The 20 μg/m^3 threshold is not reached.

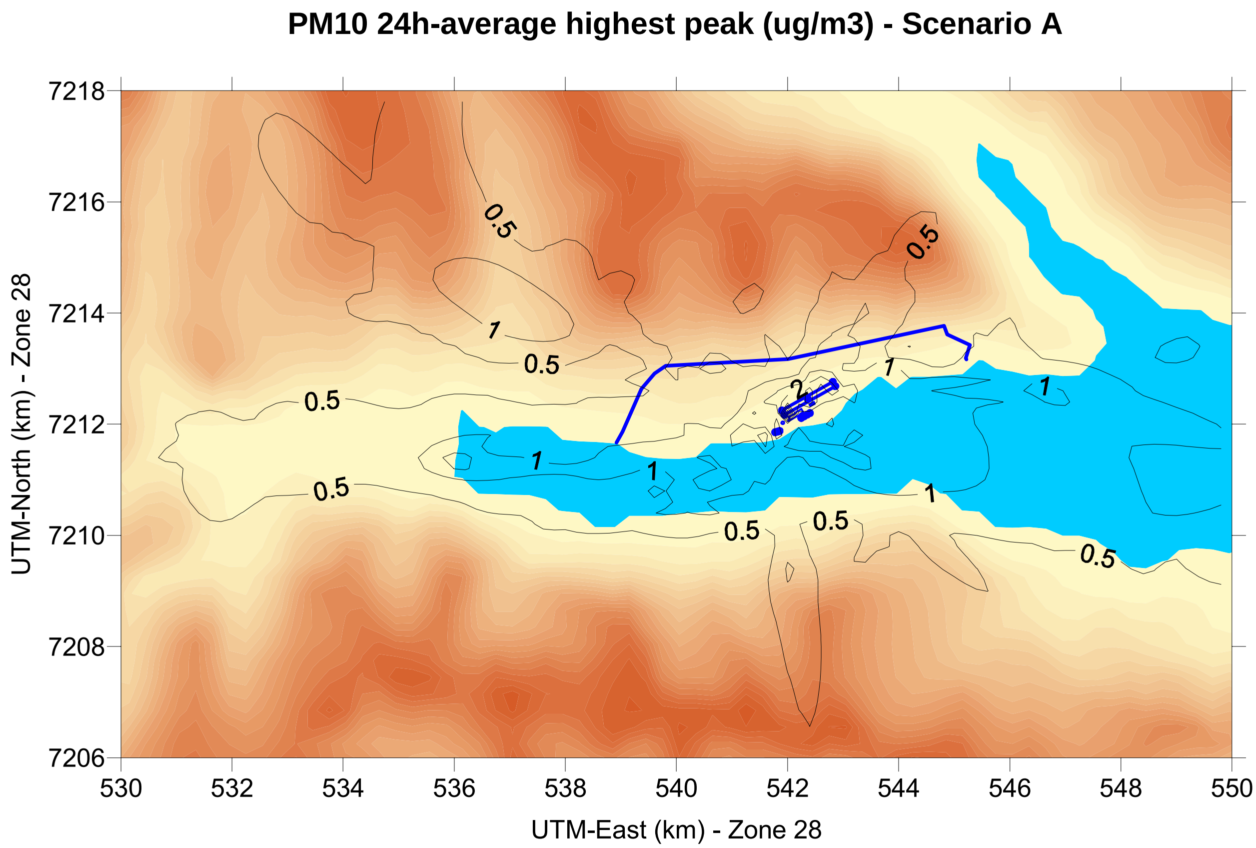


Figure 8-11. Predicted highest 24-hour average PM_{10} concentrations at each receptor ($\mu g/m^3$) for Scenario A. The 50 $\mu g/m^3$ threshold is not reached.

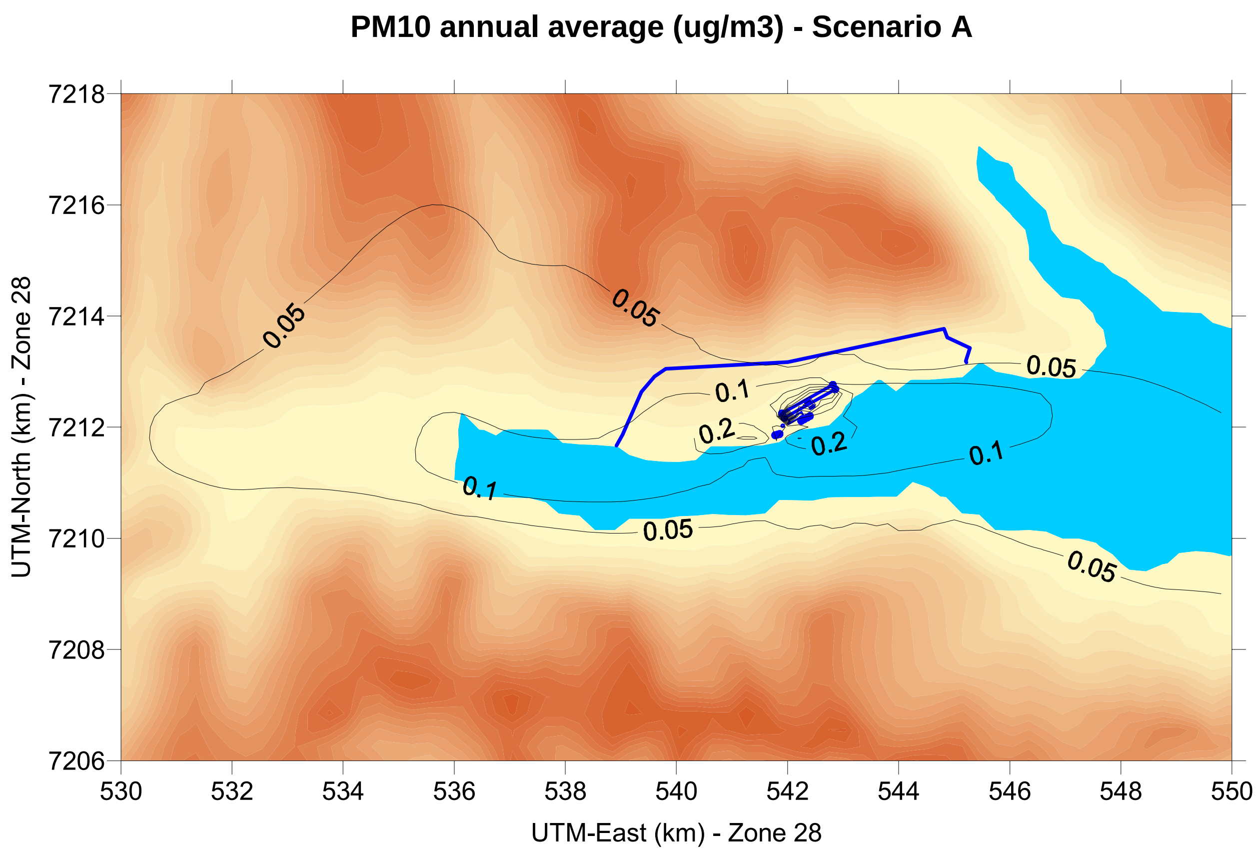


Figure 8-12. Predicted annual average PM_{10} concentrations (µg/m^3) for Scenario A. The 20 µg/m^3 threshold is not reached.

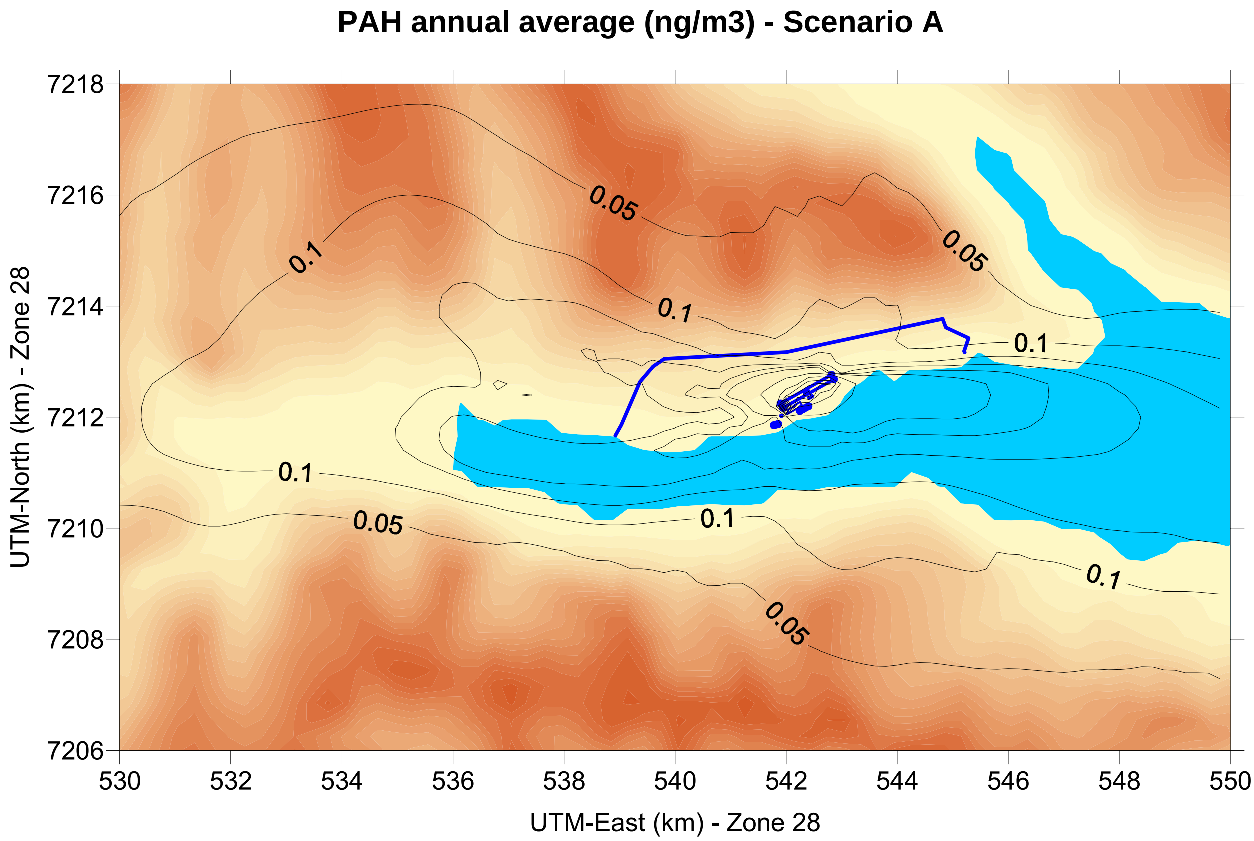


Figure 8-13. Predicted annual average PAH concentrations (ng/m^3) for Scenario A. The 10 ng/m^3 threshold is not reached

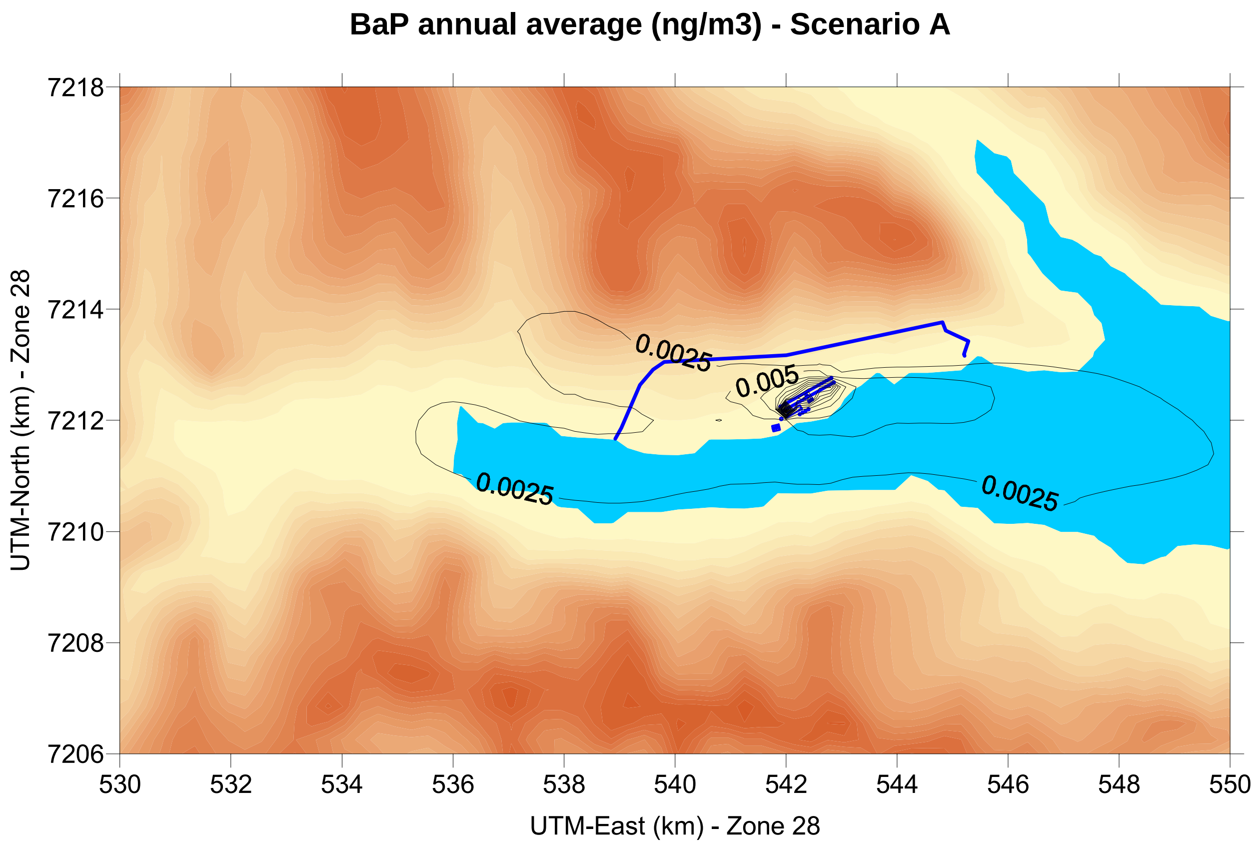


Figure 8-14. Predicted annual average BaP concentrations (ng/m^3) for Scenario A. The 0.1 ng/m^3 threshold is not reached.

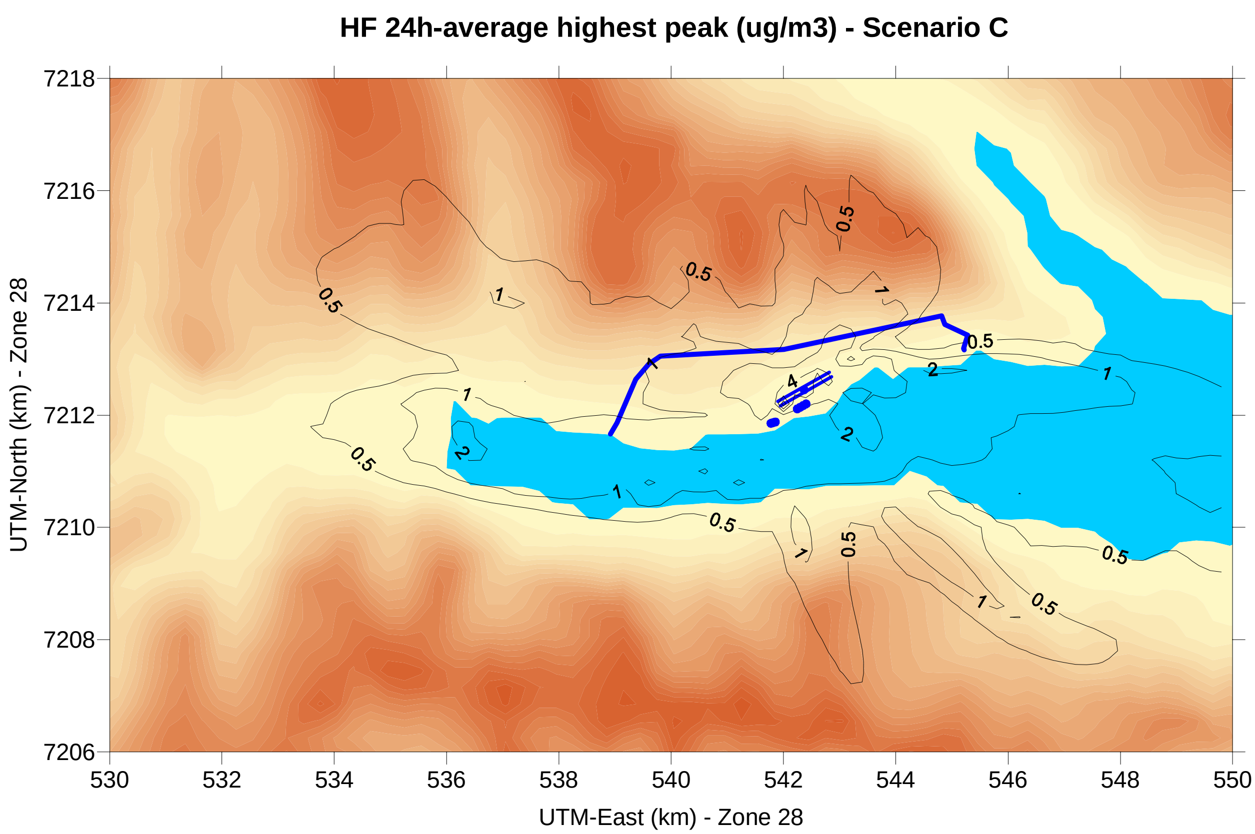


Figure 8-15. Predicted highest 24-hour average HF concentrations at each receptor (µg/m^3) for Scenario C. Threshold limit of 25 µg/m^3 not reached. [Contour Levels = 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0 µg/m^3]

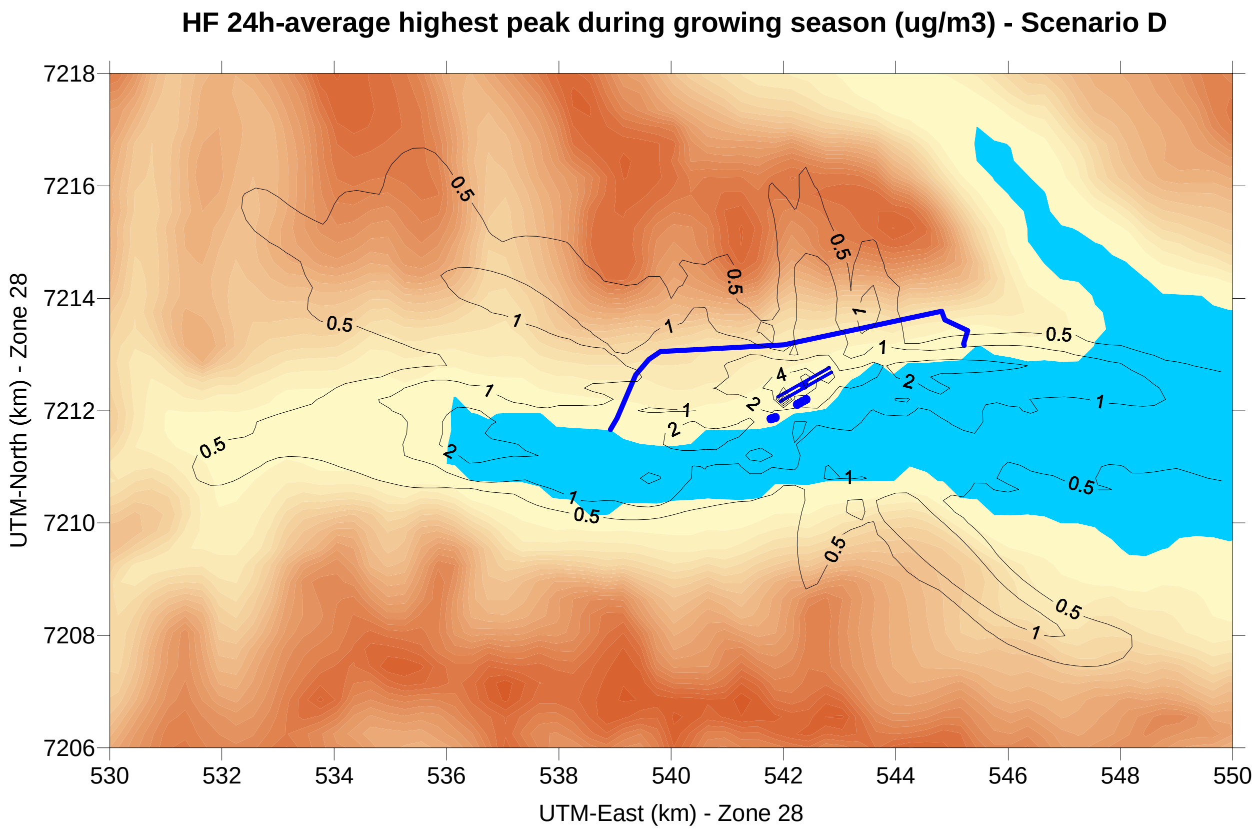


Figure 8-16. Predicted highest 24-hour average HF concentrations at each receptor during the growing season (μg/m^3) for Scenario D. Threshold limit of 25 μg/m^3 not reached. [Contour Levels = 0.5, 1.0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0 μg/m^3]

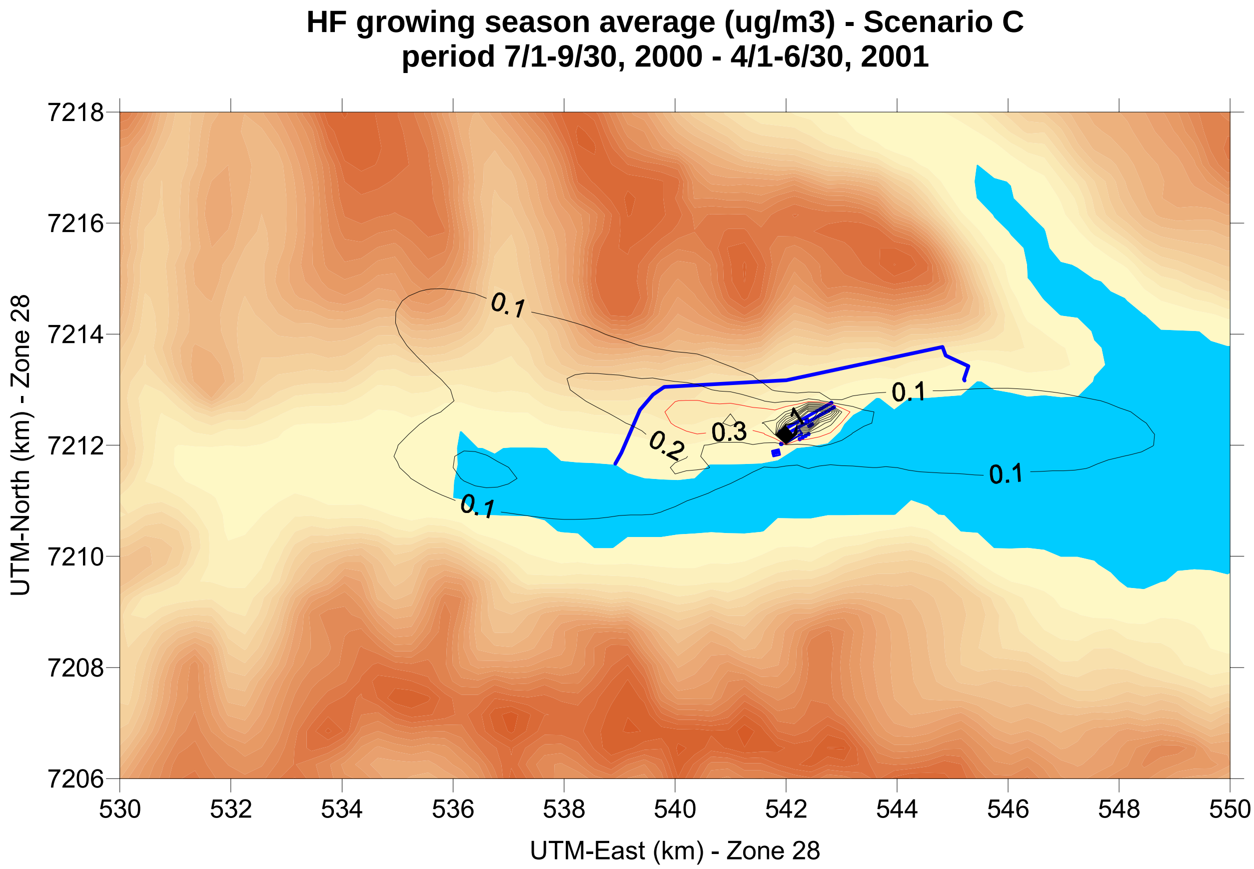


Figure 8-17. Predicted growing season average of HF concentrations (µg/m^3) for Scenario C. Growing season threshold of 0.3µg/m^3 is plotted in red.

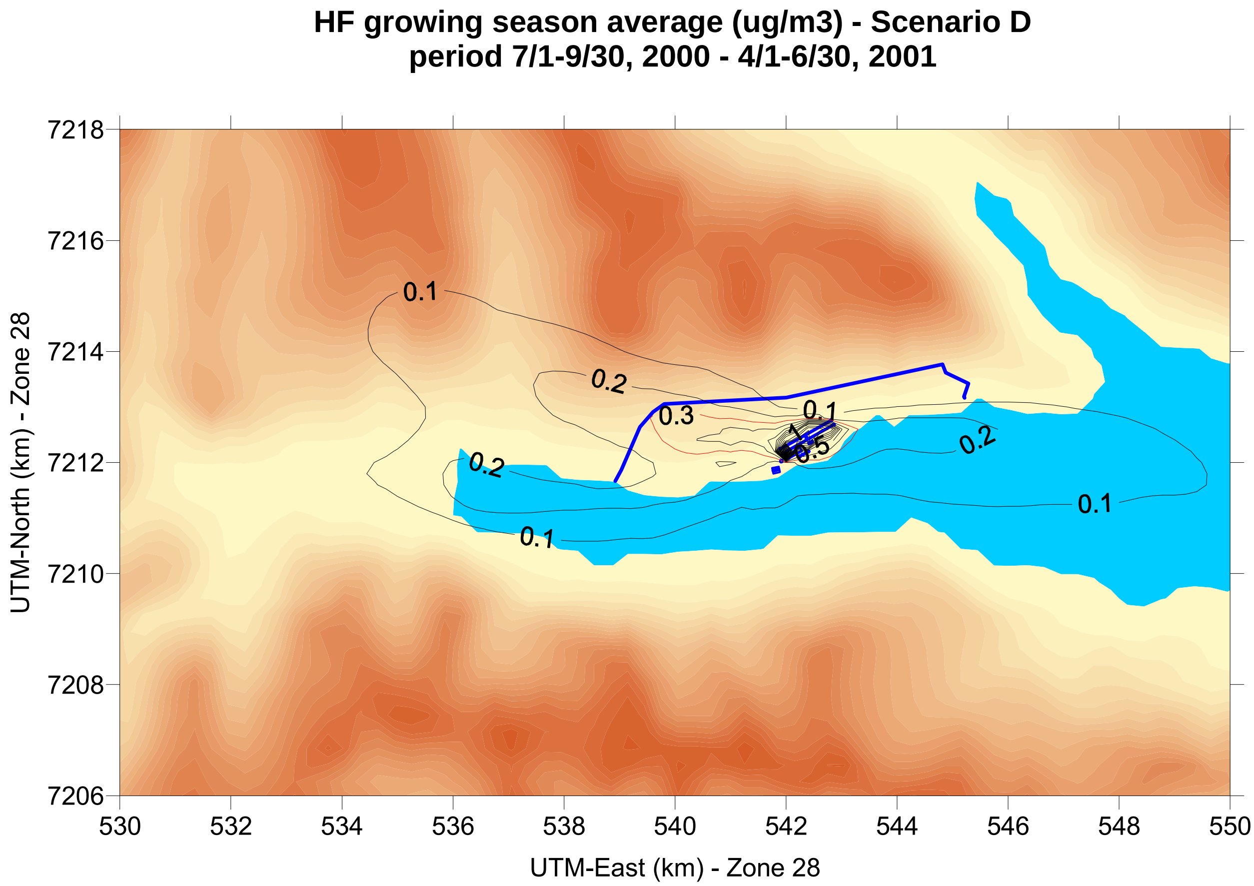


Figure 8-18. Predicted growing season average of HF concentrations (µg/m^3) for Scenario D. Growing season threshold of 0.3µg/m^3 is plotted in red.

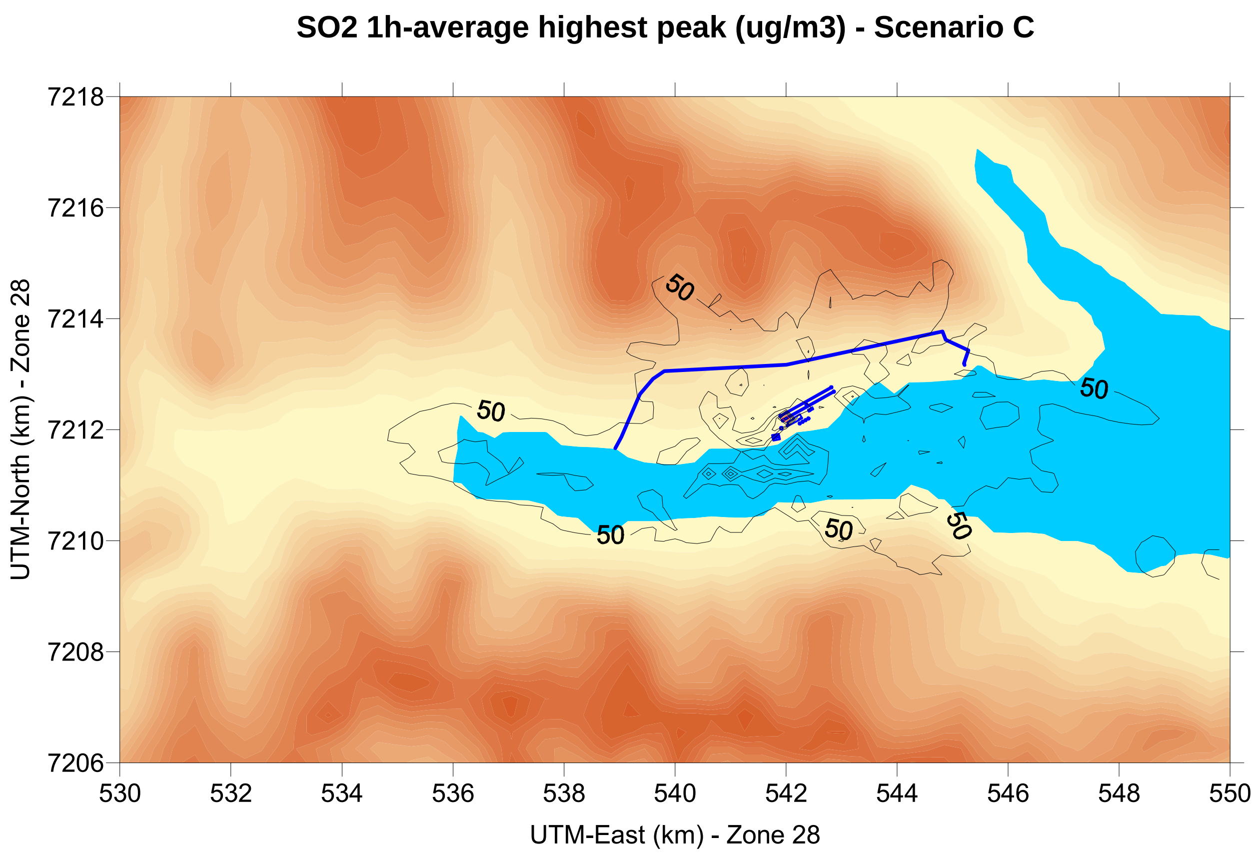


Figure 8-19. Predicted highest 1-hour average SO_2 concentrations at each receptor ($\mu g/m^3$) for Scenario C. The 350 $\mu g/m^3$ threshold is plotted in red.

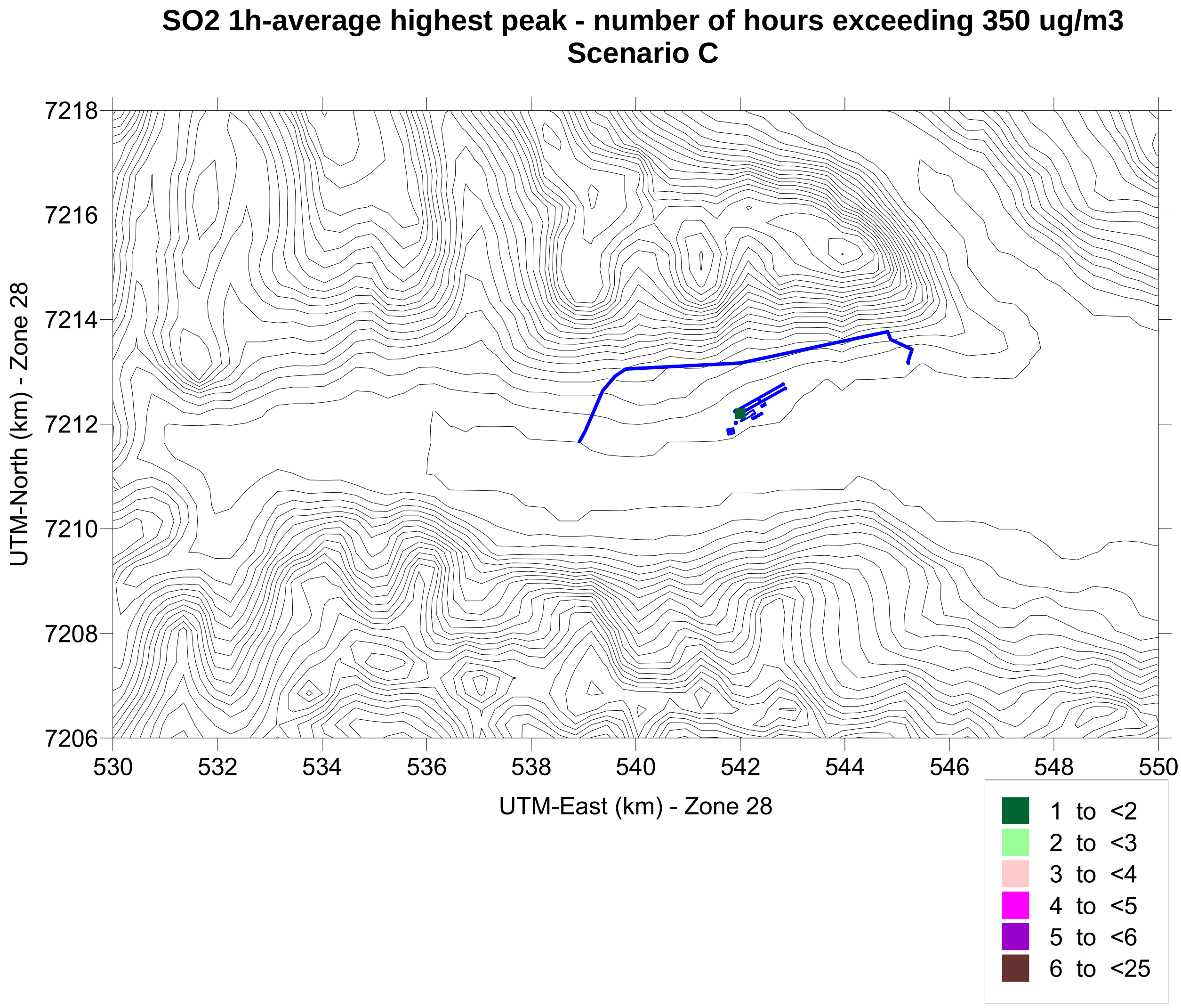


Figure 8-20. SO_2 1-hour averages: Number of exceedances of the 350 µg/m^3 threshold (in hours) for Scenario C.

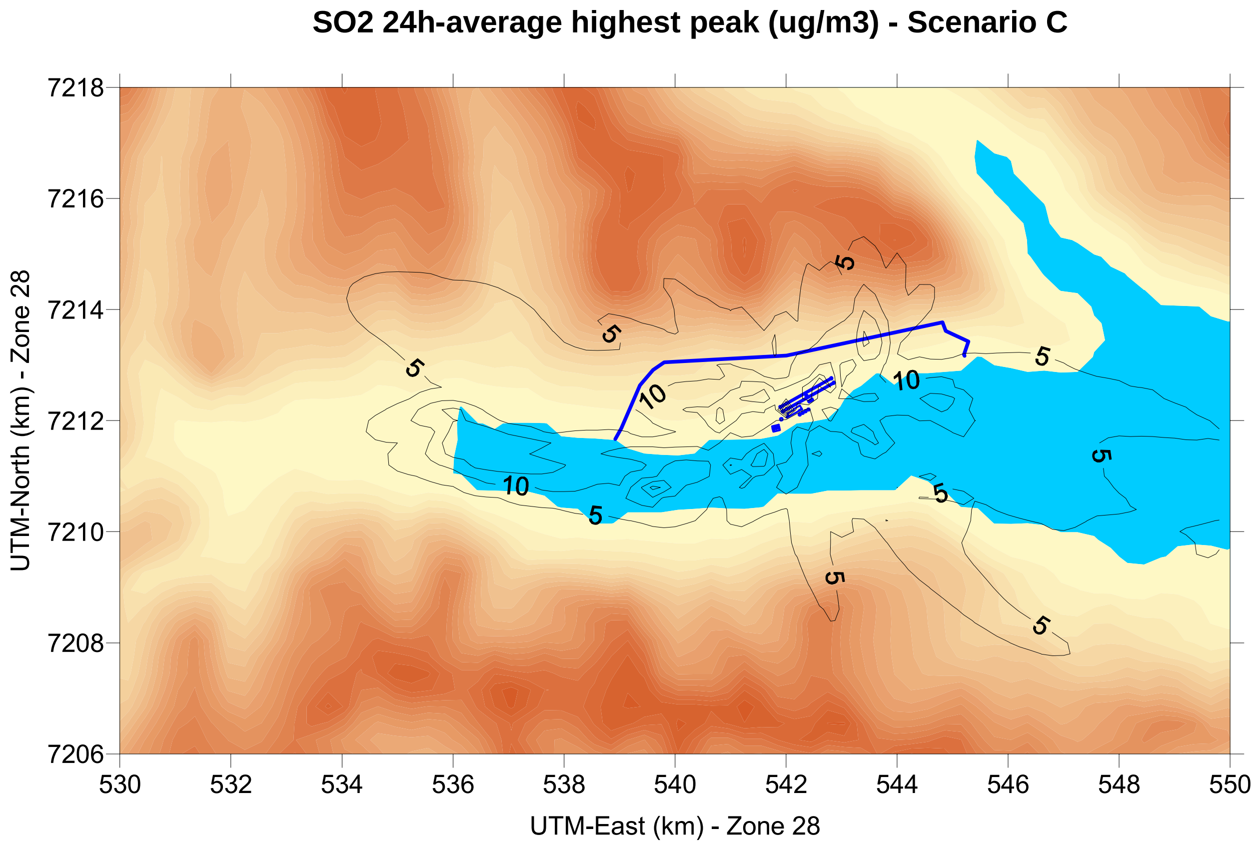


Figure 8-21. Predicted highest 24-hour average SO_2 concentrations at each receptor ($\mu g/m^3$) for Scenario C. The 50 $\mu g/m^3$ threshold is never reached.

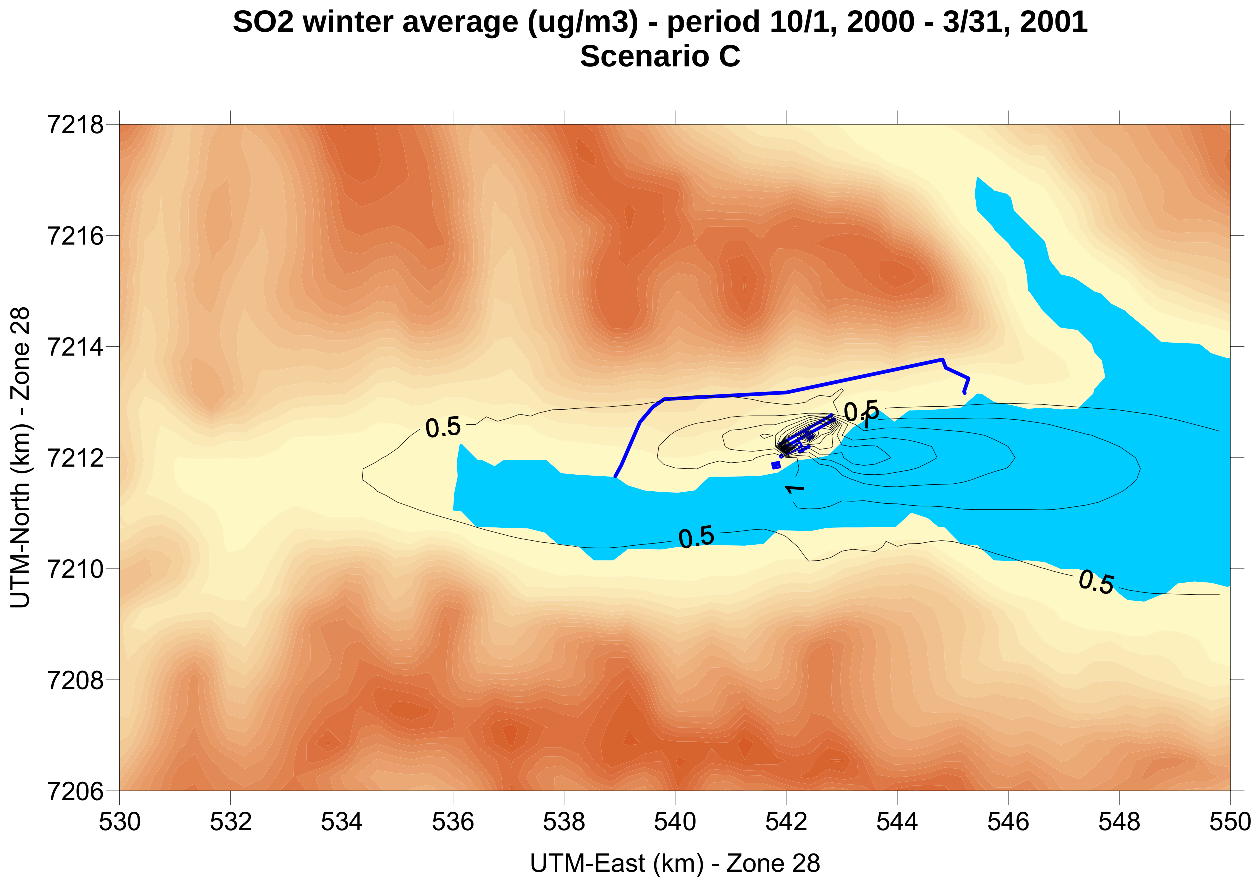


Figure 8-22. Predicted winter average SO_2 concentrations ($\mu g/m^3$) for Scenario C. The 20 $\mu g/m^3$ threshold is not reached.

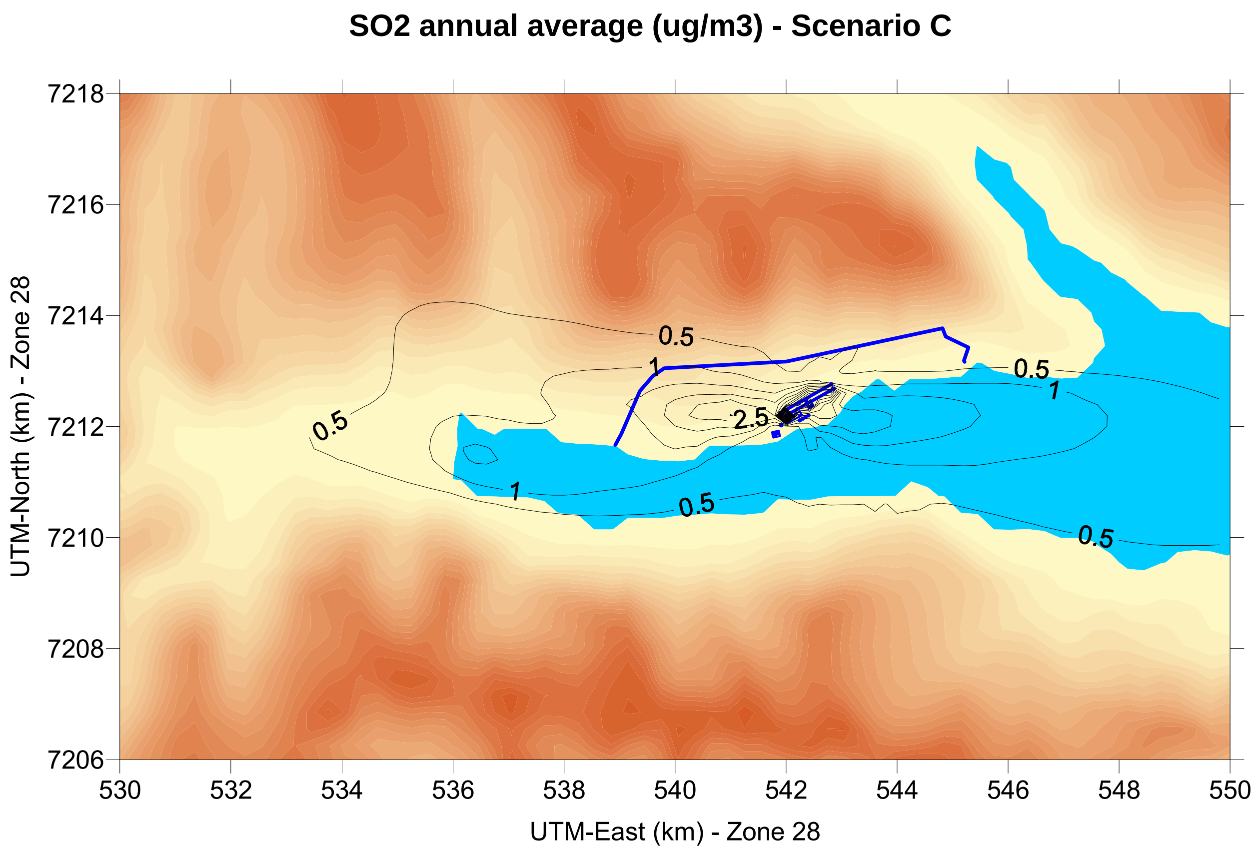


Figure 8-23. Predicted annual average SO_2 concentrations ($\mu g/m^3$) for Scenario C. The 20 $\mu g/m^3$ threshold is not reached.

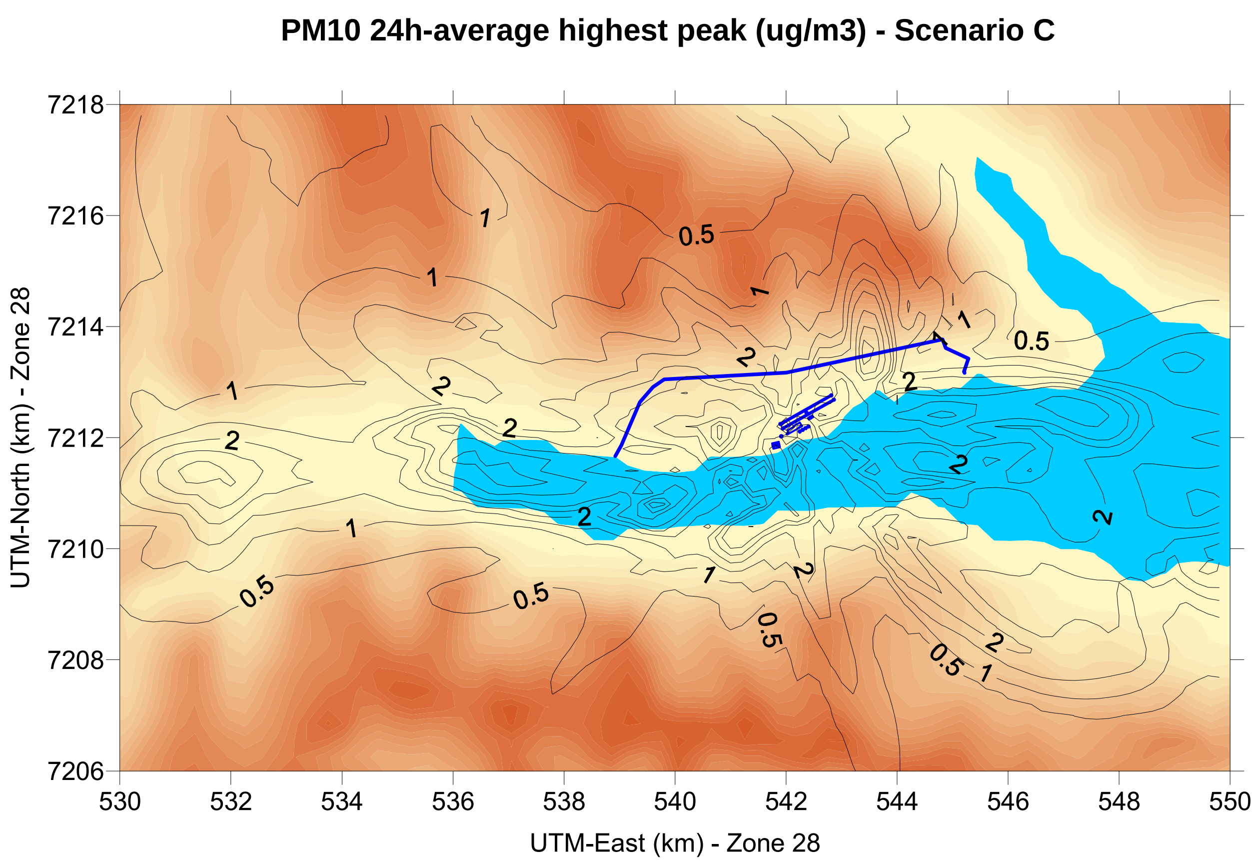


Figure 8-24. Predicted highest 24-hour average PM_{10} concentrations at each receptor ($\mu g/m^3$) for Scenario C. The 50 $\mu g/m^3$ threshold is not reached.

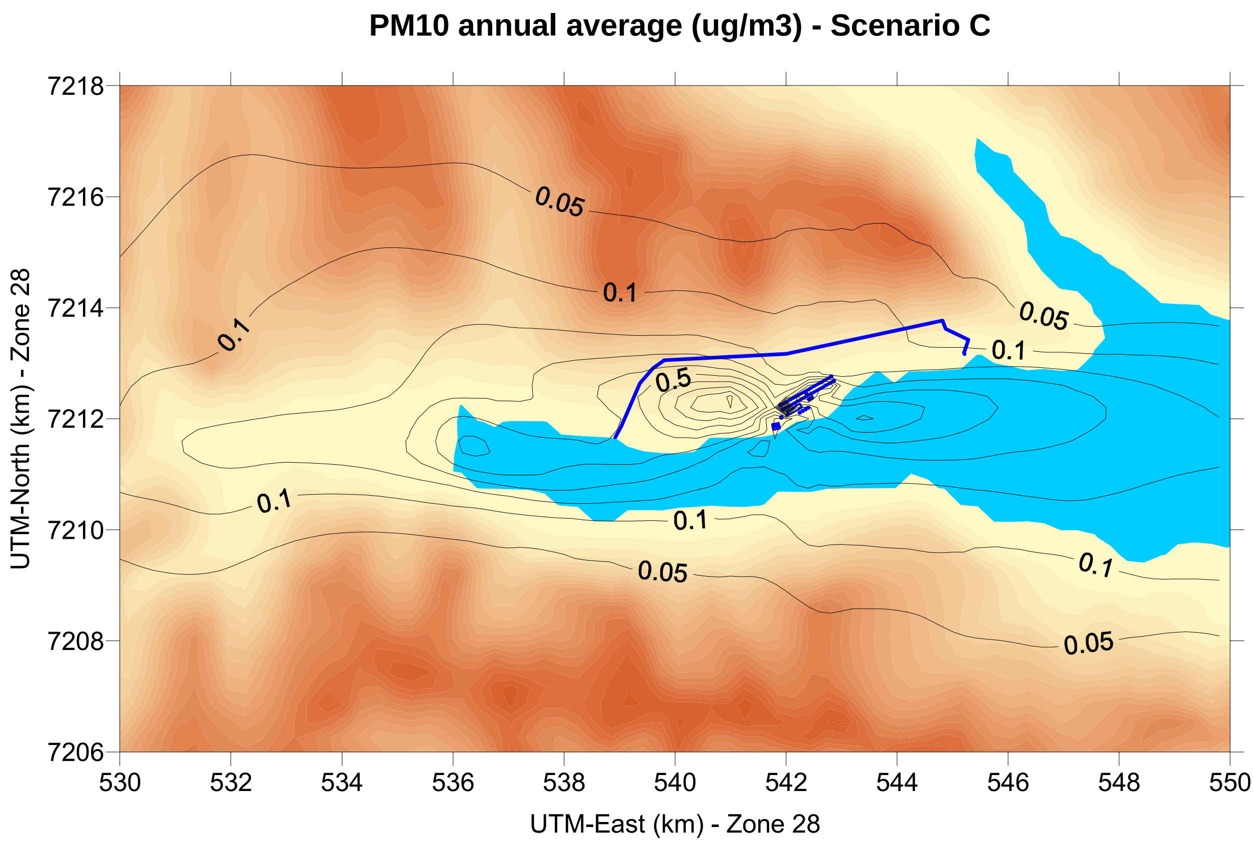


Figure 8-25. Predicted annual average PM_{10} concentrations ($\mu g/m^3$) for Scenario C. The 20 $\mu g/m^3$ threshold is not reached.

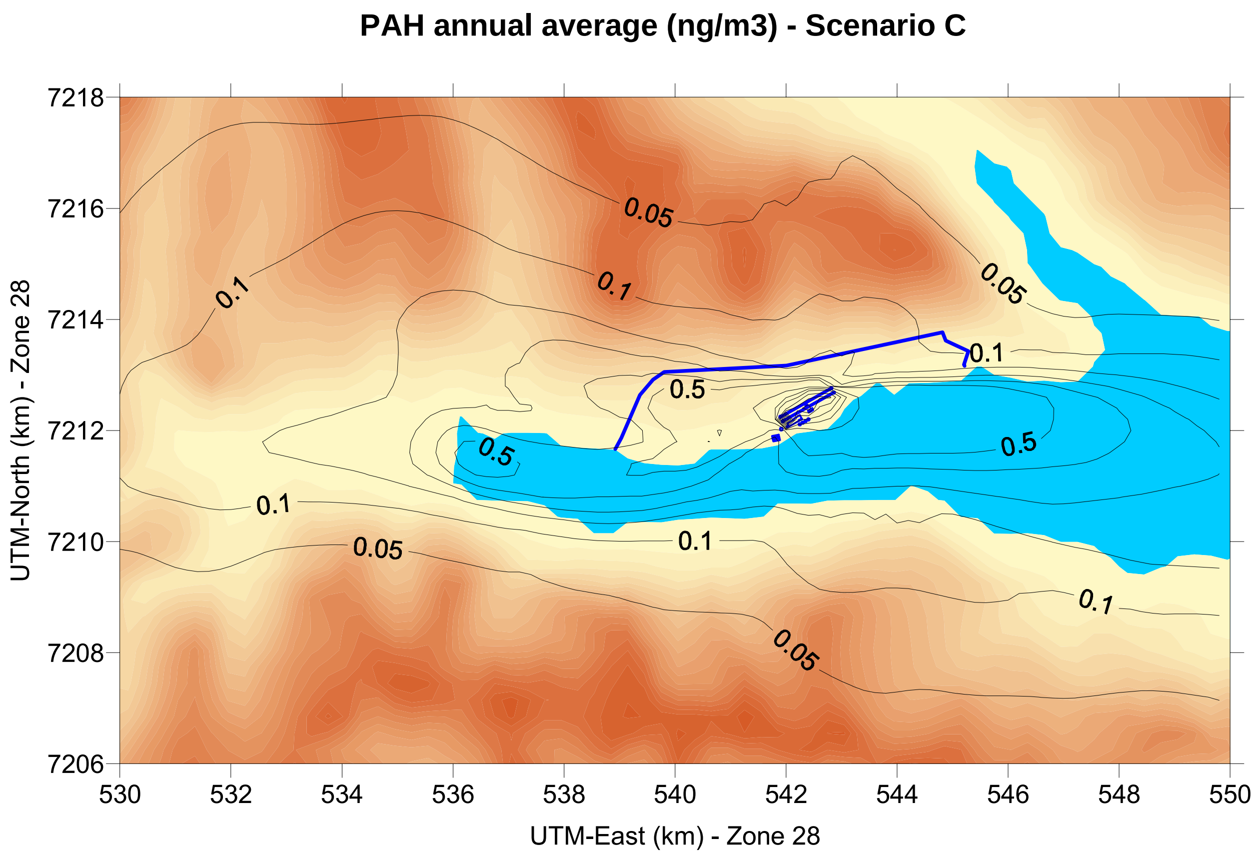


Figure 8-26. Predicted annual average PAH concentrations (ng/m^3) for Scenario C. The 10 ng/m^3 threshold is not reached

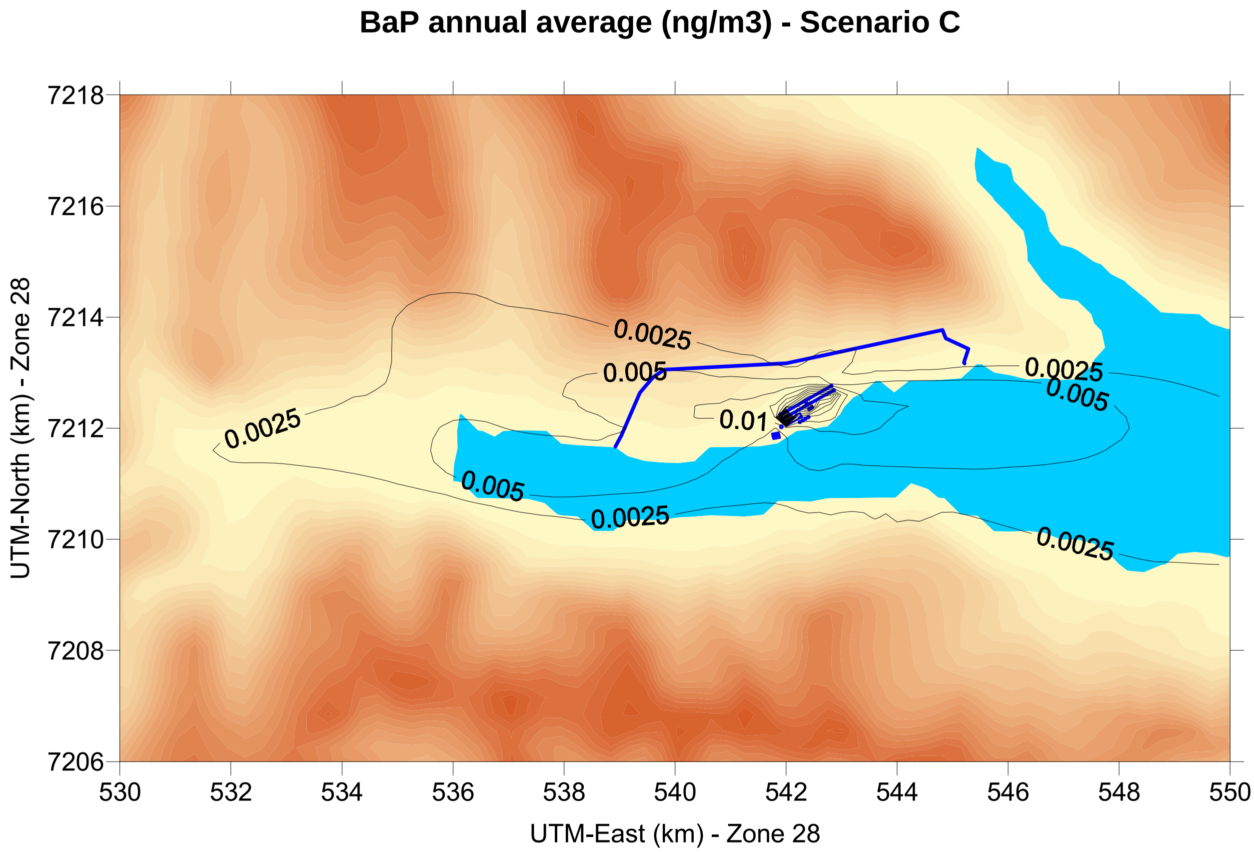


Figure 8-27. Predicted annual average BaP concentrations (ng/m^3) for Scenario C. The 0.1 ng/m^3 threshold is not reached.

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APPENDIX A

POTROOM TEMPERATURE MEASUREMENTS AT THE DESCHAMBAULT FACILITY

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
1/1/2001	13.17	-6.2	19.4
1/2/2001	8.66	-11.1	19.7
1/3/2001	11.05	-13.5	24.6
1/4/2001	10.13	-7.7	17.8
1/5/2001	8.79	-15.4	24.2
1/6/2001	14.68	-6.5	21.2
1/7/2001	12.68	-7.4	20.1
1/8/2001	11.18	-10.7	21.9
1/9/2001	5.29	-15.1	20.4
1/10/2001	5.03	-16.7	21.7
1/11/2001	7.95	-13.0	20.9
1/12/2001	6.02	-14.7	20.7
1/13/2001	8.28	-15.6	23.9
1/14/2001	10.71	-8.7	19.4
1/15/2001	11.29	-11.3	22.6
1/16/2001	14.04	-6.0	20.0
1/17/2001	5.36	-14.1	19.4
1/18/2001	8.53	-17.1	25.6
1/19/2001	10.59	-7.7	18.3
1/20/2001	1.91	-19.4	21.3
1/21/2001	3.14	-21.3	24.4
1/22/2001	4.48	-19.8	24.3
1/23/2001	16.28	-7.8	24.0
1/24/2001	17.19	-3.8	20.9
1/25/2001	7.89	-12.0	19.9
1/26/2001	11.04	-14.9	25.9
1/27/2001	14.57	-7.2	21.7
1/28/2001	6.1	-13.5	19.6
1/29/2001	8.39	-16.4	24.8
1/30/2001	14.49	-8.5	22.9
1/31/2001	10.99	-8.7	19.7
2/1/2001	12.74	-8.8	21.5
2/2/2001	15.27	-7.3	22.6
2/3/2001	7.93	-10.2	18.2
2/4/2001	7.81	-16.8	24.6
2/5/2001	15.54	-8.0	23.5
2/6/2001	18.44	-3.0	21.5
2/7/2001	14.67	-5.4	20.1
2/8/2001	12.39	-11.7	24.1
2/9/2001	17.28	-6.7	24.0
2/10/2001	7.45	-6.5	14.0
2/11/2001	3.82	-16.1	19.9
2/12/2001	6.37	-16.8	23.2
2/13/2001	10.36	-11.9	22.3
2/14/2001	14.08	-9.6	23.7
2/15/2001	12.2	-7.9	20.1
2/16/2001	12.05	-13.2	25.2
2/17/2001	7.06	-10.9	18.0
2/18/2001	7.82	-18.6	26.4
2/19/2001	17.47	-5.3	22.8
2/20/2001	20.84	0.1	20.8
2/21/2001	3.74	-11.8	15.6
2/22/2001	0.99	-21.5	22.4
2/23/2001	9.45	-12.2	21.6
2/24/2001	4.96	-15.7	20.7
2/25/2001	14.3	-10.2	24.5
2/26/2001	15.91	-1.6	17.5
2/27/2001	9.69	-10.2	19.9
2/28/2001	5.2	-16.8	22.0

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
3/1/2001	3.15	-19.5	22.7
3/2/2001	3.38	-18.7	22.1
3/3/2001	5.8	-18.8	24.6
3/4/2001	11.41	-13.4	24.8
3/5/2001	18.05	-6.3	24.3
3/6/2001	20.06	-0.7	20.8
3/7/2001	17.64	-3.4	21.1
3/8/2001	18.83	-5.2	24.0
3/9/2001	19.85	-1.7	21.5
3/10/2001	21.66	-1.1	22.7
3/11/2001	15.46	-3.1	18.6
3/12/2001	12.37	-10.2	22.6
3/13/2001	15.75	-4.7	20.4
3/14/2001	19.53	-1.8	21.4
3/15/2001	18.64	-1.4	20.0
3/16/2001	16.22	-4.3	20.5
3/17/2001	20.16	-7.0	27.1
3/18/2001	21.53	-0.6	22.2
3/19/2001	23.61	2.8	20.8
3/20/2001	21.28	0.0	21.3
3/21/2001	23.12	1.9	21.2
3/22/2001	19.15	1.1	18.1
3/23/2001	18.72	0.3	18.5
3/24/2001	14.88	-1.5	16.3
3/25/2001	11.45	-6.4	17.9
3/26/2001	12.85	-7.6	20.5
3/27/2001	15.55	-3.9	19.4
3/28/2001	16.3	-1.4	17.7
3/29/2001	18.29	-2.0	20.3
3/30/2001	20.81	1.4	19.4
3/31/2001	18.6	0.6	18.0
4/1/2001	18.49	-0.1	18.6
4/2/2001	18.63	-1.4	20.0
4/3/2001	20.61	1.6	19.0
4/4/2001	21.24	2.0	19.3
4/5/2001	21.11	2.0	19.1
4/6/2001	19.44	0.2	19.2
4/7/2001	21.35	1.9	19.4
4/8/2001	20.03	2.0	18.0
4/9/2001	22.36	4.3	18.1
4/10/2001	21.43	3.5	17.9
4/11/2001	22.16	3.6	18.5
4/12/2001	20.58	3.6	17.0
4/13/2001	19.72	4.1	15.6
4/14/2001	16.91	0.2	16.7
4/15/2001	20.41	1.8	18.6
4/16/2001	22.75	4.1	18.7
4/17/2001	20.03	2.2	17.9
4/18/2001	19.13	1.4	17.7
4/19/2001	19.63	1.4	18.2
4/20/2001	22.89	3.5	19.4
4/21/2001	30.83	9.5	21.3
4/22/2001	25.1	9.8	15.3
4/23/2001	24.34	5.7	18.7
4/24/2001	25.9	10.6	15.3
4/25/2001	21.12	4.3	16.8
4/26/2001	27.42	7.0	20.4
4/27/2001	22.55	7.5	15.0
4/28/2001	19.62	3.1	16.5
4/29/2001	24.86	4.7	20.2
4/30/2001	26.34	8.1	18.2

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
5/1/2001	34.29	14.7	19.6
5/2/2001	37.4	17.2	20.2
5/3/2001	37.29	14.0	23.2
5/4/2001	30.67	14.2	16.5
5/5/2001	24.3	7.5	16.8
5/6/2001	27.15	8.3	18.9
5/7/2001	30	10.4	19.6
5/8/2001	33.47	13.4	20.0
5/9/2001	33.33	13.8	19.6
5/10/2001	34.96	15.4	19.6
5/11/2001	35.67	16.2	19.5
5/12/2001	26.3	11.3	15.0
5/13/2001	26.08	8.8	17.3
5/14/2001	28.9	10.4	18.5
5/15/2001	28.1	10.0	18.1
5/16/2001	27.7	11.8	15.9
5/17/2001	29.16	11.5	17.7
5/18/2001	30.08	12.2	17.9
5/19/2001	30.21	12.9	17.3
5/20/2001	33.51	14.3	19.2
5/21/2001	36.18	17.6	18.6
5/22/2001	35.36	17.4	18.0
5/23/2001	34.43	16.8	17.6
5/24/2001	34.44	15.3	19.1
5/25/2001	36.54	18.5	18.0
5/26/2001	36.7	17.4	19.3
5/27/2001	31.76	14.1	17.6
5/28/2001	31.06	13.7	17.4
5/29/2001	28.01	12.6	15.4
5/30/2001	23.27	7.0	16.3
5/31/2001	26.96	10.3	16.7
6/1/2001	32.94	13.0	19.9
6/2/2001	28.35	11.7	16.6
6/3/2001	29.37	12.4	17.0
6/4/2001	29.72	13.0	16.7
6/5/2001	31.83	14.7	17.1
6/6/2001	32.05	15.2	16.8
6/7/2001	34.78	15.7	19.1
6/8/2001	34.43	15.2	19.2
6/9/2001	34.71	15.2	19.5
6/10/2001	35.29	16.9	18.4
6/11/2001	36.19	17.8	18.4
6/12/2001	35.71	16.8	18.9
6/13/2001	38.2	14.0	24.2
6/14/2001	41.29	21.2	20.1
6/15/2001	43.59	24.4	19.2
6/16/2001	41.93	23.7	18.3
6/17/2001	37.12	20.7	16.4
6/18/2001	36.23	17.2	19.0
6/19/2001	39.06	20.3	18.8
6/20/2001	36.04	19.0	17.0
6/21/2001	37.29	17.8	19.5
6/22/2001	33.2	15.3	17.9
6/23/2001	35.15	18.2	16.9
6/24/2001	36.9	19.3	17.6
6/25/2001	39.6	20.4	19.2
6/26/2001	41.63	23.2	18.4
6/27/2001	40.63	6.8	33.8
6/28/2001	34.57	17.4	17.2
6/29/2001	35.1	14.6	20.5
6/30/2001	38.46	20.0	18.5

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
7/1/2001	33.02	18.3	14.7
7/2/2001	30.78	13.2	17.6
7/3/2001	32.96	13.7	19.3
7/4/2001	34.71	16.9	17.8
7/5/2001	34.02	17.4	16.6
7/6/2001	30.98	12.9	18.1
7/7/2001	35.72	17.4	18.4
7/8/2001	34.66	16.8	17.8
7/9/2001	36.36	18.8	17.6
7/10/2001	35.38	17.4	17.9
7/11/2001	33.86	16.1	17.8
7/12/2001	31.98	15.0	17.0
7/13/2001	33.26	16.0	17.2
7/14/2001	34.87	16.7	18.2
7/15/2001	35.09	18.0	17.1
7/16/2001	33.95	16.6	17.4
7/17/2001	33.91	16.3	17.6
7/18/2001	35.45	17.9	17.5
7/19/2001	37.96	19.0	18.9
7/20/2001	39.29	19.7	19.6
7/21/2001	40.18	20.2	20.0
7/22/2001	38.78	20.9	17.8
7/23/2001	41.94	22.4	19.6
7/24/2001	40.62	22.7	17.9
7/25/2001	35.69	18.4	17.3
7/26/2001	31.06	12.6	18.4
7/27/2001	32.47	13.8	18.7
7/28/2001	35.21	15.8	19.4
7/29/2001	37.73	18.1	19.6
7/30/2001	38.38	19.3	19.1
7/31/2001	39.82	20.3	19.5
8/1/2001	40.93	21.0	19.9
8/2/2001	41.84	22.4	19.4
8/3/2001	39.88	21.9	18.0
8/4/2001	38.83	19.4	19.5
8/5/2001	41.23	20.2	21.1
8/6/2001	38.33	21.6	16.7
8/7/2001	34.55	23.0	11.5
8/8/2001	32.09	18.5	13.6
8/9/2001	37.15	25.1	12.1
8/10/2001	38.49	22.6	15.9
8/11/2001	35.37	15.7	19.6
8/12/2001	40.25	19.2	21.0
8/13/2001	36.7	18.3	18.4
8/14/2001	36.32	15.4	20.9
8/15/2001	38.43	17.1	21.3
8/16/2001	40.93	19.1	21.8
8/17/2001	39.22	19.4	19.8
8/18/2001	38.27	19.2	19.1
8/19/2001	39.08	19.1	20.0
8/20/2001	34.35	15.9	18.5
8/21/2001	36.96	18.0	19.0
8/22/2001	38.89	19.7	19.2
8/23/2001	36.49	17.0	19.5
8/24/2001	32.9	14.3	18.6
8/25/2001	33.15	13.9	19.3
8/26/2001	35.41	15.7	19.7
8/27/2001	36.62	18.3	18.3
8/28/2001	33.62	15.5	18.1
8/29/2001	30.47	8.2	22.2
8/30/2001	33.86	12.8	21.0
8/31/2001	36.59	18.3	18.3

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
9/1/2001	28.22	12.4	15.8
9/2/2001	30.05	10.0	20.1
9/3/2001	35.44	15.5	20.0
9/4/2001	31.83	15.3	16.6
9/5/2001	30.04	11.2	18.8
9/6/2001	32.25	12.2	20.1
9/7/2001	37.09	16.4	20.7
9/8/2001	41.37	21.8	19.5
9/9/2001	42.21	22.7	19.5
9/10/2001	37.74	20.0	17.7
9/11/2001	31.45	14.4	17.0
9/12/2001	32.22	12.8	19.5
9/13/2001	28.12	12.0	16.1
9/14/2001	26.27	8.3	18.0
9/15/2001	28.48	9.1	19.4
9/16/2001	30.56	12.1	18.4
9/17/2001	33.28	13.3	20.0
9/18/2001	31.02	14.1	16.9
9/19/2001	31.88	12.8	19.1
9/20/2001	32.43	14.4	18.0
9/21/2001	34.69	16.6	18.1
9/22/2001	34.3	16.4	17.9
9/23/2001	33.96	16.1	17.9
9/24/2001	35.75	17.3	18.5
9/25/2001	31.51	15.1	16.4
9/26/2001	30.34	13.3	17.0
9/27/2001	27.28	10.5	16.7
9/28/2001	26.92	9.5	17.4
9/29/2001	25.99	8.1	17.9
9/30/2001	26.42	7.6	18.8
10/1/2001	29.96	9.5	20.5
10/2/2001	30.57	11.7	18.8
10/3/2001	27.11	8.4	18.7
10/4/2001	30.61	12.8	17.8
10/5/2001	26.71	9.8	16.9
10/6/2001	23.1	6.8	16.3
10/7/2001	21.65	4.2	17.5
10/8/2001	19.73	2.3	17.5
10/9/2001	23.69	4.5	19.2
10/10/2001	25.53	8.0	17.5
10/11/2001	32.67	13.3	19.4
10/12/2001	30.98	13.8	17.2
10/13/2001	30.17	13.0	17.2
10/14/2001	33.25	15.2	18.0
10/15/2001	28.48	11.9	16.6
10/16/2001	28.29	9.5	18.8
10/17/2001	22.77	8.1	14.7
10/18/2001	18.82	3.1	15.7
10/19/2001	24.79	4.5	20.3
10/20/2001	25.93	7.4	18.6
10/21/2001	25.72	7.1	18.6
10/22/2001	21.81	5.2	16.7
10/23/2001	24.1	4.9	19.2
10/24/2001	29.21	11.4	17.8
10/25/2001	25.7	10.3	15.4
10/26/2001	21.79	6.2	15.6
10/27/2001	19.94	4.3	15.6
10/28/2001	17.69	0.6	17.0
10/29/2001	20.17	1.9	18.2
10/30/2001	16.71	-0.1	16.9
10/31/2001	16.73	-1.9	18.7

Date	Roof Temperature (degree C)	Ambiant Temperature (degree C)	Delta Temperature (degree C)
11/1/2001	23.33	4.0	19.3
11/2/2001	29.38	10.7	18.7
11/3/2001	24.74	8.3	16.5
11/4/2001	22.63	3.7	18.9
11/5/2001	22.8	5.2	17.6
11/6/2001	21.34	4.1	17.3
11/7/2001	19.72	3.8	15.9
11/8/2001	18.3	0.4	17.9
11/9/2001	16.6	1.5	15.1
11/10/2001	15.89	-0.8	16.7
11/11/2001	14.56	-1.5	16.1
11/12/2001	13.08	-2.6	15.7
11/13/2001	14.92	-4.5	19.5
11/14/2001	20	1.2	18.8
11/15/2001	25.5	5.3	20.2
11/16/2001	18.07	4.5	13.6
11/17/2001	16.4	-2.3	18.7
11/18/2001	20.36	1.4	19.0
11/19/2001	26.89	6.0	20.9
11/20/2001	16.47	1.6	14.9
11/21/2001	16.9	-2.0	18.9
11/22/2001	20.04	-0.1	20.1
11/23/2001	21.56	2.4	19.2
11/24/2001	26.61	5.6	21.1
11/25/2001	30.7	10.3	20.4
11/26/2001	26.52	9.4	17.1
11/27/2001	18.46	-0.3	18.8
11/28/2001	16.79	-1.6	18.4
11/29/2001	15.71	-4.3	20.0
11/30/2001	19.07	-0.7	19.8
12/1/2001	23.41	3.2	20.2
12/2/2001	21.66	2.0	19.6
12/3/2001	21.75	0.6	21.1
12/4/2001	22.41	2.2	20.2
12/5/2001	23.69	3.2	20.5
12/6/2001	25.49	7.1	18.4
12/7/2001	19.11	0.8	18.3
12/8/2001	16.12	-3.2	19.4
12/9/2001	16.15	-3.7	19.9
12/10/2001	19.19	-2.1	21.3
12/11/2001	19.4	-0.7	20.1
12/12/2001	19.02	-2.2	21.2
12/13/2001	22.42	0.2	22.2
12/14/2001	21.56	1.5	20.0
12/15/2001	15.11	-4.2	19.3
12/16/2001	13.77	-6.9	20.7
12/17/2001	17.38	-5.7	23.1
12/18/2001	19.14	-1.8	21.0
12/19/2001	20.14	-1.3	21.4
12/20/2001	18.97	-1.7	20.6
12/21/2001	16.03	-3.5	19.6
12/22/2001	11.82	-7.9	19.7
12/23/2001	14.91	-9.1	24.0
12/24/2001	19.4	-1.2	20.6
12/25/2001	18.84	-2.6	21.5
12/26/2001	18.8	-2.6	21.4
12/27/2001	14.48	-5.8	20.3
12/28/2001	13.48	-9.3	22.8
12/29/2001	13.13	-7.1	20.2
12/30/2001	12.2	-8.2	20.4
12/31/2001	9.89	-10.8	20.7
	========		
	24.61		
			19.2

APPENDIX B

PAH SPECIATION AT DESCHAMBAULT FACILITY FOR ROOF TOP AND STACKS

Table B-1. PAH speciation at Deschambault facility for Roof top sample.

Deschambault Roof Sample - Total based on set of six simultaneous cassettes in potroom roof
Method detection limit is approximately 0.003 ug

	09/11/2001	23/11/2001			
Nom Hap (gaseous)					
Poids ug	**Total (ug)**	**Total (ug)**	**Average (ug)**	**With half detection limit**	**Percent of Total PAH**
Acénapthylène	0.09	0.11	0.10	0.1	0.3%
Chrysène	0	0.04	0.02	0.02	0.1%
Benzo(a)pyrène	0	0.00	0.00	0.3348	**1.0%**
Benzo(g,h,i) pérylène	0.03	0.00	0.02	0.015	0.04%
Fluorène	2.4	17.31	9.86	9.855	29.4%
Fluoranthène	0.66	8.00	4.33	4.33	12.9%
Benzo(b)+(j)+(k) Fluorenthène	0.01	0.00	0.01	0.005	0.01%
Indeno(1,2,3cd)pyrène	0	0.00	0.00	0.0015	0.004%
Pyrène	0	2.62	1.31	1.31	3.9%
Phénanthrène	5.62	29.32	17.47	17.4705	52.2%
Benzo(a) anthracène	0	0.00	0.00	0.0015	0.004%
Benzo (e) pyrène	0	0.00	0.00	0.0015	0.004%
Dibenzo(a,h)anthracène	0	0.00	0.00	0.0015	0.004%
Pérylène	0	0.00	0.00	0.0015	0.004%
Dibenzo(a,j)acridine	0	0.00	0.00	0.0015	0.004%
7H-dibenzo(c,g) carbazole	0	0.00	0.00	0.0015	0.004%
Dibenzo(a,i)pyrène	0.04	0.00	0.02	0.02	0.06%
Totaux (ug)	**8.85**	57.40	**33.13**	**33.47**	**100.0%**
Nos Cassettes					
Nom Hap (particulate)					
Poids ug					
Acénapthylène	0	0	0.00	0.0015	0.1%
Chrysène	0.01	0.3	0.16	0.155	15.0%
Benzo(a)pyrène	0	0	0.00	0.0103	**1.0%**
Benzo(g,h,i) pérylène	0.03	0.03	0.03	0.03	2.9%
Fluorène	0.03	0.08	0.06	0.055	5.3%
Fluoranthène	0.03	0.16	0.10	0.095	9.2%
Benzo(b)+(j)+(k) Fluorenthène	0	0.2	0.10	0.1	9.7%
Indeno(1,2,3cd)pyrène	0	0	0.00	0.0015	0.1%
Pyrène	0	0	0.00	0.0015	0.1%
Phénanthrène	0.37	0.49	0.43	0.43	41.6%
Benzo(a) anthracène	0.01	0.28	0.15	0.145	14.0%
Benzo (e) pyrène	0	0	0.00	0.0015	0.1%
Dibenzo(a,h)anthracène	0	0	0.00	0.0015	0.1%
Pérylène	0	0	0.00	0.0015	0.1%
Dibenzo(a,j)acridine	0	0	0.00	0.0015	0.1%
7H-dibenzo(c,g) carbazole	0	0	0.00	0.0015	0.1%
Dibenzo(a,i)pyrène	0	0	0.00	0.0015	0.1%
Totaux (ug)	**0.48**	**1.54**	**1.01**	**1.03**	**100.0%**
Nos Cassettes		Total ug			
Nom Hap (total)					
Poids ug					
Acénapthylène	0.09	0.11	0.10	0.1	0.3%
Chrysène	0.01	0.34	0.18	0.175	0.5%
Benzo(a)pyrène	0	0	0.00	0.3451	**1.0%**
Benzo(g,h,i) pérylène	0.06	0.03	0.05	0.045	0.1%
Fluorène	2.43	17.39	9.91	9.91	28.7%
Fluoranthène	0.69	8.16	4.43	4.425	12.8%
Benzo(b)+(j)+(k) Fluorenthène	0.01	0.2	0.11	0.105	0.3%
Indeno(1,2,3cd)pyrène	0	0	0.00	0.0015	0.004%
Pyrène	0	2.62	1.31	1.31	3.8%
Phénanthrène	5.99	29.811	17.90	17.9005	51.9%
Benzo(a) anthracène	0.01	0.28	0.15	0.145	0.4%
Benzo (e) pyrène	0	0	0.00	0.0015	0.004%
Dibenzo(a,h)anthracène	0	0	0.00	0.0015	0.004%
Pérylène	0	0	0.00	0.0015	0.004%
Dibenzo(a,j)acridine	0	0	0.00	0.0015	0.004%
7H-dibenzo(c,g) carbazole	0	0	0.00	0.0015	0.004%
Dibenzo(a,i)pyrène	0.04	0	0.02	0.02	0.1%
Totaux (ug)	**9.23**	**58.9**	**34.09**	**34.49**	**100.0%**

Table B-2. PAH speciation at Deschambault facility for Stack sample.

Deschambault GTC Stack - Total based on set of three test runs

Assume same breakdown of speciated PAH for both dry scrubber stack and wet scrubber stack

Method detection limit is approximately 0.0002 mg (0.0003 mg for some compounds)

03-00589
Aluminerie Alcoa - Deschambault
Fluorures (Particulaires & gazeux)
Sortie du Réacteur 330

HORAIRE DES ESSAIS					
ESSAI NUMERO	1	2	3		
DEBUT DE L'ESSAI (DATE & HEURE)	28/08/03 / 11:26	28/08/03 / 17:55	29/08/03 / 10:13		
FIN DE L'ESSAI (DATE & HEURE)	28/08/03 / 16:30	28/08/03 / 22:41	29/08/03 / 17:10	**Average**	**Percent of Total PAH**
HAP - Particulate (mg)					
Naphtalene	0.0001	**0.0002**	**0.0004**	**0.0002**	6.1%
Acénaphtylene	0.0001	0.0001	0.0001	0.0001	2.5%
Acénaphtene	0.0001	**0.0005**	**0.0009**	**0.0005**	12.3%
Fluorene	0.0001	**0.0004**	**0.0006**	**0.0004**	9.3%
Phenanthrene	0.0001	**0.0009**	**0.0017**	**0.0009**	23.1%
Anthracene	0.0001	0.0001	0.0001	0.0001	2.5%
Fluoranthene	0.0001	0.0001	**0.0004**	**0.0002**	4.6%
Pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (a) anthracene	0.0001	0.0001	0.0001	0.0001	2.5%
Chrysene	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (a) fluorène	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (b)(j)(k) fluoranthene	0.0002	0.0002	0.0002	0.0002	3.7%
Benzo (b) fluorène	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (e) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (a) pyrene	0.0001	0.0001	0.0001	0.00004	1.0%
Perylene	0.0001	0.0001	0.0001	0.0001	2.5%
Indeno (123-cd) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Dibenzo(ah)anthracene	0.0001	0.0001	0.0001	0.0001	2.5%
Benzo (ghi) perylene	0.0001	0.0001	0.0001	0.0001	2.5%
Dibenzo(al) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Dibenzo(ae) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Dibenzo(ai) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Dibenzo(ah) pyrene	0.0001	0.0001	0.0001	0.0001	2.5%
Total Particulate	**0.0024**	**0.0040**	**0.0059**	**0.0040**	**100.0%**
HAP - Gaseous (mg)					
Naphtalene	**0.0005**	0.0001	0.0001	**0.0002**	6.7%
Acénaphtylene	0.0001	0.0001	0.0001	0.0001	2.9%
Acénaphtene	0.0001	0.0001	0.0001	0.0001	2.9%
Fluorene	**0.0004**	**0.0006**	**0.0007**	**0.0006**	16.3%
Phenanthrene	0.0001	**0.0005**	**0.0012**	**0.0006**	17.4%
Anthracene	0.0001	0.0001	0.0001	0.0001	2.9%
Fluoranthene	0.0001	0.0001	**0.0003**	**0.0002**	5.3%
Pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (a) anthracene	0.0001	0.0001	0.0001	0.0001	2.9%
Chrysene	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (a) fluorène	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (b)(j)(k) fluoranthene	0.00015	0.00015	0.00015	0.00015	4.3%
Benzo (b) fluorène	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (e) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (a) pyrene	0.0001	0.0001	0.0001	0.000035	1.0%
Perylene	0.0001	0.0001	0.0001	0.0001	2.9%
Indeno (123-cd) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Dibenzo(ah)anthracene	0.0001	0.0001	0.0001	0.0001	2.9%
Benzo (ghi) perylene	0.0001	0.0001	0.0001	0.0001	2.9%
Dibenzo(al) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Dibenzo(ae) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Dibenzo(ai) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Dibenzo(ah) pyrene	0.0001	0.0001	0.0001	0.0001	2.9%
Total Gaseous	**0.0031**	**0.0032**	**0.0044**	**0.0035**	**100.0%**
HAP - TOTAL (mg)					
Naphtalene	**0.0006**	**0.0003**	**0.0005**	**0.0005**	6.4%
Acénaphtylene	0.0002	0.0002	0.0002	0.0002	2.7%
Acénaphtene	0.0002	**0.0006**	**0.0010**	**0.0006**	7.9%
Fluorene	**0.0005**	**0.0010**	**0.0014**	**0.0009**	12.5%
Phenanthrene	0.0002	**0.0014**	**0.0030**	**0.0015**	20.5%
Anthracene	0.0002	0.0002	0.0002	0.0002	2.7%
Fluoranthene	0.0002	0.0002	**0.0007**	**0.0004**	4.9%
Pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (a) anthracene	0.0002	0.0002	0.0002	0.0002	2.7%
Chrysene	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (a) fluorène	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (b)(j)(k) fluoranthene	0.0003	0.0003	0.0003	0.0003	4.0%
Benzo (b) fluorène	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (e) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (a) pyrene	0.0002	0.0002	0.0002	0.0001	1.0%
Perylene	0.0002	0.0002	0.0002	0.0002	2.7%
Indeno (123-cd) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Dibenzo(ah)anthracene	0.0002	0.0002	0.0002	0.0002	2.7%
Benzo (ghi) perylene	0.0002	0.0002	0.0002	0.0002	2.7%
Dibenzo(al) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Dibenzo(ae) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Dibenzo(ai) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Dibenzo(ah) pyrene	0.0002	0.0002	0.0002	0.0002	2.7%
Grand Total PAHs	**0.0054**	**0.0072**	**0.0102**	**0.0075**	**100.0%**

APPENDIX C

BPIP OUTPUT FILE

BPIP - Fjardaal - 08/18/2004

BPIP (Dated: 04112)

DATE : 8/18/2005
TIME : 12:35:10
BPIP - Fjardaal - 08/18/2004

============================
BPIP PROCESSING INFORMATION:
============================

The ST flag has been set for preparing downwash data for an ISCST run.

Inputs entered in METERS   will be converted to meters using a conversion factor of 1000.0000. Output will be in meters.

UTMP is set to UTMN. The input is assumed to be in a local X-Y coordinate system as opposed to a UTM coordinate system. True North is in the positive Y direction.

Plant north is set to   0.00 degrees with respect to True North.

BPIP - Fjardaal - 08/18/2004

PRELIMINARY* GEP STACK HEIGHT RESULTS TABLE
(Output Units: meters)

Stack Name	Stack Height	Stack-Building Base Elevation Differences	GEP** EQN1	Preliminary* GEP Stack Height Value
Anode	78.00	0.00	57.50	65.00
SeaScrb1	40.00	-5.00	90.00	90.00
SeaScrb2	40.00	-5.00	90.00	90.00
SeaScrb3	40.00	-5.00	90.00	90.00
SeaScrb4	40.00	-5.00	90.00	90.00
Furnace1	29.50	-2.00	132.38	132.38
Furnace2	29.50	-2.00	132.38	132.38
Furnace3	29.50	-2.00	132.38	132.38
smlt1_a	22.00	0.00	130.94	130.94
smlt1_b	22.00	0.00	56.25	65.00
smlt2_a	22.00	0.00	129.95	129.95
smlt2_b	22.00	0.00	56.25	65.00

* Results are based on Determinants 1 & 2 on pages 1 & 2 of the GEP Technical Support Document. Determinant 3 may be investigated for additional stack height credit. Final values result after Determinant 3 has been taken into consideration.

** Results were derived from Equation 1 on page 6 of GEP Technical Support Document. Values have been adjusted for any stack-building base elevation differences.

Note: Criteria for determining stack heights for modeling emission

limitations for a source can be found in Table 3.1 of the
GEP Technical Support Document.

```
                              BPIP (Dated: 04112)
DATE :  8/18/2005
TIME : 12:35:10


BPIP - Fjardaal - 08/18/2004

 BPIP output is in meters


    SO BUILDHGT Anode      22.50   22.50   22.50   22.50   22.50    0.00
    SO BUILDHGT Anode      22.50   22.50   22.50   22.50   22.50   22.50
    SO BUILDHGT Anode      22.50   22.50   22.50   22.50   22.50   22.50
    SO BUILDHGT Anode      22.50   22.50   22.50   22.50   22.50    0.00
    SO BUILDHGT Anode      22.50   22.50   22.50   22.50   22.50   22.50
    SO BUILDHGT Anode      22.50   23.00   23.00   23.00   23.00   22.50
    SO BUILDWID Anode     852.25  723.62  573.00  405.00  224.50    0.00
    SO BUILDWID Anode     200.50  382.00  552.00  705.00  837.00  943.00
    SO BUILDWID Anode    1020.50 1067.50 1081.50 1070.75 1028.62  955.00
    SO BUILDWID Anode     852.25  723.62  573.00  405.00  224.50    0.00
    SO BUILDWID Anode     200.50  382.50  552.00  705.00  836.50  943.50
    SO BUILDWID Anode    1020.50   44.50   38.50   42.75   47.62  955.00


    SO BUILDHGT SeaScrb1   34.00   34.00   34.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb1   25.00   25.00   25.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb1   25.00   25.00   34.00   34.00   34.00   34.00
    SO BUILDHGT SeaScrb1   34.00   34.00   34.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb1   25.00   25.00   25.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb1   25.00   25.00   34.00   34.00   34.00   34.00
    SO BUILDWID SeaScrb1   58.81   51.88   43.25   12.00   12.50   12.50
    SO BUILDWID SeaScrb1   12.50   13.00   13.00   13.00   13.00   12.50
    SO BUILDWID SeaScrb1   12.50   12.50   67.75   68.50   67.25   64.00
    SO BUILDWID SeaScrb1   58.88   52.00   43.25   12.00   12.00   12.50
    SO BUILDWID SeaScrb1   13.00   13.00   12.50   13.00   13.00   12.00
    SO BUILDWID SeaScrb1   12.00   12.50   67.75   68.25   67.12   64.00


    SO BUILDHGT SeaScrb2   25.00   25.00   25.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb2   25.00   25.00   25.00   25.00   34.00   34.00
    SO BUILDHGT SeaScrb2   34.00   34.00   34.00   34.00   34.00   34.00
    SO BUILDHGT SeaScrb2   25.00   25.00   25.00   25.00   25.00   25.00
    SO BUILDHGT SeaScrb2   25.00   25.00   25.00   25.00   34.00   34.00
    SO BUILDHGT SeaScrb2   34.00   34.00   34.00   34.00   34.00   34.00
    SO BUILDWID SeaScrb2   12.31   12.25   12.00   12.50   12.50   12.50
    SO BUILDWID SeaScrb2   12.50   12.50   12.50   13.00   58.00   63.50
    SO BUILDWID SeaScrb2   67.00   68.50   67.75   68.50   67.25   64.00
    SO BUILDWID SeaScrb2   12.25   12.25   12.00   12.50   12.00   12.50
    SO BUILDWID SeaScrb2   12.50   13.00   12.50   12.50   58.00   63.00
    SO BUILDWID SeaScrb2   67.00   68.50   67.75   68.25   67.12   64.00
```

```
SO BUILDHGT SeaScrb3   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb3   25.00   25.00   34.00   34.00   34.00   34.00
SO BUILDHGT SeaScrb3   34.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb3   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb3   25.00   25.00   34.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb3   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDWID SeaScrb3   12.25   12.25   12.25   12.50   12.50   12.00
SO BUILDWID SeaScrb3   13.00   13.00   42.00   51.00   58.00   63.50
SO BUILDWID SeaScrb3   67.00   12.00   12.25   12.25   12.25   12.50
SO BUILDWID SeaScrb3   12.25   12.25   12.25   12.50   12.50   12.50
SO BUILDWID SeaScrb3   13.00   12.50   42.00   13.00   12.50   12.50
SO BUILDWID SeaScrb3   12.00   12.00   12.25   12.25   12.38   12.44

SO BUILDHGT SeaScrb4   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb4   25.00   34.00   34.00   34.00   25.00   25.00
SO BUILDHGT SeaScrb4   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb4   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb4   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDHGT SeaScrb4   25.00   25.00   25.00   25.00   25.00   25.00
SO BUILDWID SeaScrb4   12.25   12.25   12.25   12.00   12.50   12.50
SO BUILDWID SeaScrb4   13.00   32.00   42.00   51.00   12.50   12.50
SO BUILDWID SeaScrb4   12.00   12.50   12.25   12.25   12.38   12.50
SO BUILDWID SeaScrb4   12.31   12.25   12.00   12.50   12.50   12.00
SO BUILDWID SeaScrb4   13.00   13.00   13.00   13.00   12.50   12.50
SO BUILDWID SeaScrb4   12.50   12.50   12.00   12.25   12.25   12.44

SO BUILDHGT Furnace1   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace1   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace1   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace1   22.00   22.00   55.00   55.00   55.00   22.00
SO BUILDHGT Furnace1   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace1   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDWID Furnace1  151.38  157.12  158.00  154.50  146.00  132.50
SO BUILDWID Furnace1  115.50  106.50  125.00  139.50  150.00  155.50
SO BUILDWID Furnace1  157.00  153.00  144.75  132.00  126.38  141.00
SO BUILDWID Furnace1  151.38  157.12   50.25   50.00   49.50  133.00
SO BUILDWID Furnace1  116.00  106.50  125.00  139.50  150.00  156.00
SO BUILDWID Furnace1  157.00  153.50  144.75  132.00  126.38  141.00

SO BUILDHGT Furnace2   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace2   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace2   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace2   22.00   55.00   55.00   55.00   22.00   22.00
SO BUILDHGT Furnace2   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace2   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDWID Furnace2  151.38  157.12  158.00  154.50  146.00  132.50
SO BUILDWID Furnace2  115.50  106.50  125.00  139.50  150.00  155.50
SO BUILDWID Furnace2  157.00  153.00  144.75  132.00  126.38  141.00
SO BUILDWID Furnace2  151.38   49.38   50.25   50.00  146.00  133.00
SO BUILDWID Furnace2  116.00  106.50  125.00  139.50  150.00  156.00
SO BUILDWID Furnace2  157.00  153.50  144.75  132.00  126.38  141.00
```

```
SO BUILDHGT Furnace3   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace3   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace3   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace3   55.00   55.00   55.00   22.00   22.00   22.00
SO BUILDHGT Furnace3   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDHGT Furnace3   22.00   22.00   22.00   22.00   22.00   22.00
SO BUILDWID Furnace3  151.38  157.12  158.00  154.50  146.00  132.50
SO BUILDWID Furnace3  115.50  106.50  125.00  139.50  150.00  155.50
SO BUILDWID Furnace3  157.00  153.00  144.75  132.00  126.38  141.00
SO BUILDWID Furnace3   49.88   49.38   50.25  154.00  146.00  133.00
SO BUILDWID Furnace3  116.00  106.50  125.00  139.50  150.00  156.00
SO BUILDWID Furnace3  157.00  153.50  144.75  132.00  126.38  141.00


SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_a    22.50   22.50   22.50   22.50   55.00   55.00
SO BUILDWID smlt1_a   852.25  723.62  573.00  405.00  224.50   37.50
SO BUILDWID smlt1_a   200.50  382.00  552.00  705.00  837.00  943.00
SO BUILDWID smlt1_a  1020.50 1067.50 1081.50 1070.75 1028.62  955.00
SO BUILDWID smlt1_a   852.25  723.62  573.00  405.00  224.50   37.50
SO BUILDWID smlt1_a   200.50  382.50  552.00  705.00  836.50  943.50
SO BUILDWID smlt1_a  1020.50 1067.50 1081.75 1070.75   50.62   50.00


SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt1_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDWID smlt1_b   852.25  723.62  573.00  405.00  224.50   37.50
SO BUILDWID smlt1_b   200.50  382.00  552.00  705.00  837.00  943.00
SO BUILDWID smlt1_b  1020.50 1067.50 1081.50 1071.25 1028.75  955.00
SO BUILDWID smlt1_b   852.25  723.62  573.00  405.00  224.50   37.50
SO BUILDWID smlt1_b   200.50  382.50  552.00  705.00  836.50  943.50
SO BUILDWID smlt1_b  1020.50 1067.50 1081.75 1070.75 1028.50  955.00


SO BUILDHGT smlt2_a    55.00   55.00   55.00   22.50   22.50   22.50
SO BUILDHGT smlt2_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_a    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_a    22.50   22.50   22.50   22.50   22.50   55.00
SO BUILDWID smlt2_a    49.81   49.38   49.97  405.00  224.50   38.50
SO BUILDWID smlt2_a   201.50  383.00  553.00  706.50  838.00  944.00
SO BUILDWID smlt2_a  1020.50 1067.50 1081.50 1070.75 1028.62  955.00
SO BUILDWID smlt2_a   852.25  723.62  573.00  405.00  224.50   38.50
SO BUILDWID smlt2_a   201.50  383.50  553.00  706.00  838.00  943.50
SO BUILDWID smlt2_a  1020.50 1067.50 1082.00 1070.75 1028.50   49.97
```

```
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDHGT smlt2_b    22.50   22.50   22.50   22.50   22.50   22.50
SO BUILDWID smlt2_b   852.44  724.00  573.50  406.00  225.50   38.50
SO BUILDWID smlt2_b   200.50  382.00  552.00  705.00  837.00  943.00
SO BUILDWID smlt2_b  1020.50 1067.50 1081.50 1070.75 1028.62  955.00
SO BUILDWID smlt2_b   852.44  724.00  573.50  405.50  225.50   38.50
SO BUILDWID smlt2_b   200.50  382.50  552.00  705.00  838.00  943.50
SO BUILDWID smlt2_b  1021.00 1068.00 1082.00 1070.75 1028.50  955.00
```

APPENDIX D

COPY OF NCAR E-MAIL REGARDING MM5 CODING ERROR IN CCM2 SCHEME

```
Subject: Re: CCM2 on Linux Machines
To: mphadnis@src.com (Mahesh Phadnis)
Date: Tue, 11 Feb 2003 13:00:57 -0700 (MST)
Cc: mesouser@ucar.edu (meso)
From: mesouser@ucar.edu
Reply-To: mesouser@ucar.edu
X-Mailer: ELM [version 2.5 PL2]

Dear Mahesh,

First, I am sorry this took so long, but it was quite a search
to find it, specially since only linux seems to pick up the problem.
This does not mean that it is only wrong for linux, but that linux
is not so forgiving as the other computers.

Please replace
MM5/MPP/RSL/Makefile.RSL with the one below.

Be careful when replacing this file, this is a Makefile, so there
are tabs in that you should not replace with spaces. If you simply
want to edit your file, look for the changes I made to the compiling
of the routines: wheneq and whenfgt

Do a
        make uninstall
        make mpp

and try the code then. Please let me know the result

Mesouser
```

```
##############################################################################
#
# This is the makefile for generating the MPP version of MM5 automatically
# using FLIC and mapping down to the RSL runtime communication and
# parallelization library.
#
##############################################################################
#
# Macros to locate position in the source tree.
#
DEVTOP = ../..
MPPTOP = $(DEVTOP)/MPP
RSLLOC = $(MPPTOP)/RSL/RSL
# this next can be overridden
FLIC_MACROS = LMexp.m4
#
# Include configuration information derived from the configure.user file
#
include $(DEVTOP)/MPP/conf.mpp
include $(DEVTOP)/include/config.INCL
#
# Directories to search to resolve CPP includes
#
INCLUDES = -I$(MPPTOP) -I$(MPPTOP)/$(MPP_LAYER)  \
           -I$(DEVTOP)/pick -I$(MPPTOP)/debug -I$(RSLLOC)
```

```
#
# Command line options to CPP
#
C_CPP_FLAGS = -DMPP1 -DIOR=2           \
            -DIWORDSIZE=$(IWORDSIZE) \
            -DRWORDSIZE=$(RWORDSIZE) \
            -DLWORDSIZE=$(LWORDSIZE) \
            -
DASSUME_HOMOGENEOUS_ENVIRONMENT=$(ASSUME_HOMOGENEOUS_ENVIRONMENT)

CPP_FLAGS = $(C_CPP_FLAGS) \
            $(CPPFLAGS)

#
# Command line options to C compiler for compiling .c files
#
CC_FLAGS = $(INCLUDES) $(C_CPP_FLAGS) $(CFLAGS)
LINK_FLAGS = $(RSLLOC)/librsl.a $(LDOPTIONS) $(LOCAL_LIBRARIES)
#
# Preprocessing and run-time library support
#
M4_FLIC = $(M4) $(MPPTOP)/$(MPP_LAYER)/$(FLIC_MACROS)
FLICFLAGS = -F=$(MPPTOP)/FLICFILE -CPP='include<rsl.inc>' \
            -CPP='include<rslcom.inc>' -H='FLIC_RUN_DECL' -STOP=FKILL_MODEL
FLIC = $(MPPTOP)/FLIC/FLIC/flic $(FLICFLAGS)
CUTTER = $(MPPTOP)/col_cutter
#
# Redefine RM if you want to preserve the intermediary files
RM = echo
#
##########

.SUFFIXES: .F .o .c

include .tmpobjs

all : parame.incl $(OBJS) $(ARCH_OBJS)
        $(MLD) -o mm5.mpp $(OBJS) $(ARCH_OBJS) $(LINK_FLAGS)
        /bin/mv mm5.mpp $(DEVTOP)/Run/mm5.mpp

####### generic make rules (covers most source files) #######

.F.o:
        $(CUT) -c1-72 $*.F | $(SED) -e 's/`//' -e 's/  *$$//' |\
           $(EXPAND) | $(CPP) $(INCLUDES) $(CPP_FLAGS) | $(M4) - > $*.b
        $(FLIC) $*.b > $*.dm
        $(M4_FLIC) $*.dm | sed '/^$$/d' | $(CPP) $(INCLUDES) | $(CUTTER)
>$*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.b $*.dm $*.f

.c.o:
        $(MCC) -c $(CC_FLAGS) $<

####### special cases #######

parame.incl :
```

```
	@echo '      INTEGER MAXNES  ' > parame.incl
	@echo '      INTEGER MAXMV   ' >> parame.incl
	@echo '      INTEGER MIX_G   ' >> parame.incl
	@echo '      INTEGER MJX_G   ' >> parame.incl
	@echo '      INTEGER MKX_G   ' >> parame.incl
	@echo '      INTEGER MIX     ' >> parame.incl
	@echo '      INTEGER MJX     ' >> parame.incl
	@echo '      INTEGER MKX     ' >> parame.incl
	@echo '      INTEGER MLX     ' >> parame.incl
	@echo '      INTEGER IEXMS   ' >> parame.incl
	@echo '      INTEGER IARASC  ' >> parame.incl
	@echo '      INTEGER IRDDIM  ' >> parame.incl
	@echo '      INTEGER ISLDIM  ' >> parame.incl
	@echo '      INTEGER ILDDIM  ' >> parame.incl
	@echo '      INTEGER INAV    ' >> parame.incl
	@echo '      INTEGER INAV2   ' >> parame.incl
	@echo '      INTEGER INAV3   ' >> parame.incl
	@echo '      INTEGER IGSPBL  ' >> parame.incl
	@echo '      INTEGER IICE    ' >> parame.incl
	@echo '      INTEGER IICEG   ' >> parame.incl
	@echo '      INTEGER IKFFC   ' >> parame.incl
	@echo '      INTEGER IFDDAG  ' >> parame.incl
	@echo '      INTEGER IFDDAO  ' >> parame.incl
	@echo '      INTEGER INHYD   ' >> parame.incl
	@echo '      INTEGER PROCMIN_NS,PROCMIN_EW' >> parame.incl
	@echo '      PARAMETER(MAXNES = $(MAXNES))' >> parame.incl
	@echo '      PARAMETER(MAXMV  = 10 )' >> parame.incl
	@echo '      PARAMETER(MIX_G  = $(MIX))' >> parame.incl
	@echo '      PARAMETER(MJX_G  = $(MJX))' >> parame.incl
	@echo '      PARAMETER(MKX_G  = $(MKX))' >> parame.incl
	@ RDP=`fgrep RSL_DEFAULT_PADAREA $(RSLLOC)/rsl.h | cut -f 3 -d ' '` ;
export RDP ; \
	  if [ $(MPP_TARGET) = vpp -o $(MPP_TARGET) = sx -o $(MPP_TARGET) =
alphavector ] ; then \
	   echo '      PARAMETER(MIX=MIX_G+2)' >>parame.incl ;\
	   else \
	   echo "      PARAMETER(MIX=MIX_G/$(PROCMIN_NS)+2*$$RDP+2)"
>>parame.incl ;\
	  fi ; \
	  echo "      PARAMETER(MJX=MJX_G/$(PROCMIN_EW)+2*$$RDP+2)"
>>parame.incl
	@echo '      PARAMETER(MKX  = $(MKX))' >> parame.incl
	@echo '      PARAMETER(MLX  = $(MLX))' >> parame.incl
	@echo '      PARAMETER(IEXMS   = $(EXMS))' >> parame.incl
	@echo '      PARAMETER(IARASC  = $(ARASC))' >> parame.incl
	@echo '      PARAMETER(IRDDIM  = $(RDDIM))' >> parame.incl
	@echo '      PARAMETER(ISLDIM  = $(SLDIM))' >> parame.incl
	@echo '      PARAMETER(ILDDIM  = $(LDDIM))' >> parame.incl
	@echo '      PARAMETER(INAV    = $(NAV))' >> parame.incl
	@echo '      PARAMETER(INAV2   = $(NAV2))' >> parame.incl
	@echo '      PARAMETER(INAV3   = $(NAV3))' >> parame.incl
	@echo '      PARAMETER(IGSPBL  = $(GSPBL))' >> parame.incl
	@echo '      PARAMETER(IICE    = $(ICE))' >> parame.incl
	@echo '      PARAMETER(IICEG   = $(ICEG))' >> parame.incl
	@echo '      PARAMETER(IKFFC   = $(KFFC))' >> parame.incl
	@echo '      PARAMETER(IFDDAG  = $(FDDAGD))' >> parame.incl
	@echo '      PARAMETER(IFDDAO  = $(FDDAOBS))' >> parame.incl
```

```
        @echo '      PARAMETER(INHYD   = 1         )' >> parame.incl
        @echo '      PARAMETER(PROCMIN_NS = $(PROCMIN_NS))' >> parame.incl
        @echo '      PARAMETER(PROCMIN_EW = $(PROCMIN_EW))' >> parame.incl
        $(CUT) -c1-72 $(DEVTOP)/include/parame >> parame.incl
        /bin/mv parame.incl $(DEVTOP)/pick

#
# This module deals with namelists.  On most architectures, one processor
# reads in the namelist and then broadcasts the settings to the others.
# Packing and unpacking code for such operations is usually the most
# error prone and tedious to write.  Therefore, generation of pack and
# unpack code for the namelists has been automated using 'awk' and tables
# in the file MPP/namelist.data .  The mechanism for this is limited to
# this one routine, param.F.
#

param.o : param.F
        $(SED) '/^#/d' $(MPPTOP)/namelist.data |\
          $(AWK) -f $(MPPTOP)/namedata.awk DIR=f DECLFILE=read_config1.h \
                  PACKFILE=read_config2.h -
        /bin/mv read_config2.h $(DEVTOP)/pick
        $(SED) '/^#/d' $(MPPTOP)/namelist.data |\
        $(AWK) -f $(MPPTOP)/namedata.awk DIR=b DECLFILE=read_config1.h \
                  PACKFILE=read_config3.h -
        /bin/mv read_config1.h $(DEVTOP)/pick
        /bin/mv read_config3.h $(DEVTOP)/pick
        $(CUT) -c1-72 $*.F | $(EXPAND) |\
          $(CPP) $(INCLUDES) $(CPP_FLAGS) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

#
# This module defines communication (stencils and inter-domain).  M4 is
# called to allow the use of useful stencil and message definition
# macros, contained in this file only.  This file source file appears
# only in the MPP version of the code when RSL is used as a comm layer.
#
define_comms.o : define_comms.F
        $(M4_FLIC) $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

#
# This routine contains FLIC macros already inserted.  Don't run through
FLIC.
#
mp_initdomain.o : mp_initdomain.F
        $(M4_FLIC) $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

dm_io.o : dm_io.F
        $(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f
```

```
#
# These modules are column callable as written, and do not need FLIC.
#
initpb.o : initpb.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
	$(RM) $*.f

hoskeep.o : hoskeep.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
	$(RM) $*.f

bound.o : bound.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
	$(RM) $*.f

schultz_mic.o : schultz_mic.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis

mm5atm.o : mm5atm.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis

rrtm_setcoef.o : rrtm_setcoef.F
	$(CUT) -c1-72 $*.F | $(M4_FLIC) - | $(CPP) $(INCLUDES) $(CPP_FLAGS) >
$*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis

#
# These modules have to do with nesting and interdomain communication
# between processors for nest forcing and feedback.  They do not use FLIC.
# They do use M4 macros to automate and simplify packing and unpacking
# of messages for interdomain communcation.
#
mp_stotndt.o : mp_stotndt.F
	$(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F | \
	    $(CUT) -c1-72 | \
	    $(M4_FLIC) - | \
	    $(CPP) |\
	    $(EXPAND) |\
	    $(SED) 's/qv \(.b[t(]\)/q \1/' | \
	    $(CUTTER) > $*.f
	$(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
	$(RM) $*.f

vpp_stotndt.o : vpp_stotndt.F
	$(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F | \
	    $(CUT) -c1-72 | \
	    $(M4_FLIC) - | \
```

```
            $(CPP) |\
            $(EXPAND) |\
            $(SED) 's/qv \(.b[t(]\)/q \1/' | \
            $(CUTTER) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

mp_feedbk.o : mp_feedbk.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F | \
            $(CUT) -c1-72 | \
            $(M4_FLIC) - | \
            $(CPP) |\
            $(EXPAND) |\
            $(SED) 's/qv \(.b[t(]\)/q \1/' | \
            $(CUTTER) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

bcast_size.o : bcast_size.F
        $(M4_FLIC) $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

merge_size.o : merge_size.F
        $(M4_FLIC) $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

#
# These are functions.  They do not need to be run through FLIC.
#

tp.o : tp.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

rslf.o : rslf.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

gamma.o : gamma.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

dtfrz.o : dtfrz.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

dtfrznew.o : dtfrznew.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f
```

```
tpdd.o : tpdd.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

tpfc.o : tpfc.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

# block data... no need for flic

rrtm_k_g.o : rrtm_k_g.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

avplank.o : avplank.F
        $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

#
# These are parts of CCM radiation, and need to be handled a little
# differently
#
wheneq.o : wheneq.F
        $(CUT) -c1-72 $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) | \
            $(SED) 's/  *$$//' |\
            $(M4_FLIC) - | \
            $(CPP) |\
            $(EXPAND) |\
            $(CUTTER) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

whenfgt.o : whenfgt.F
        $(CUT) -c1-72 $*.F | $(CPP) $(INCLUDES) $(CPP_FLAGS) | \
            $(SED) 's/  *$$//' |\
            $(M4_FLIC) - | \
            $(CPP) |\
            $(EXPAND) |\
            $(CUTTER) > $*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.f

##
## Special ; experimental version of exmoisr for fujitsu; no flic
##
#exmoisr.o : exmoisr.F
#       $(CPP) $(INCLUDES) $(CPP_FLAGS) $*.F > $*.f
#       $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
#       $(RM) $*.f

#
# This one differs from the generic rule only in that it does not
# include the call to SED to remove back-quotes.  These are left
```

```
# in this routine because the routine has M4 macros inside.
#
initnest.o: initnest.F
        $(CUT) -c1-72 $*.F | $(EXPAND) |\
           $(CPP) $(INCLUDES) $(CPP_FLAGS) | $(M4) - > $*.b
        $(FLIC) $*.b > $*.dm
        $(M4_FLIC) $*.dm | $(SED) '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) >$*.f
        $(MFC) -c $(FCFLAGS) $*.f 2> $*.lis
        $(RM) $*.b $*.dm $*.f

#
# The Blackadar PBL scheme is somewhat problematic in the MPP code
# because of the way in which the number mitre steps are computed and
# sometimes recomputed in the original vector code.  The vector version
# computes a number of mitre steps for an entire NS strip, chosing the
# maximum number necessary for any one point on the NS strip.  Unfortunately,
# in the MPP code, this would necessitate a NS communication (for computation
# of a maximum).  Rather, the MPP version, computes the number of mitre
# steps individually for each point and does that number.  Meteorologically,
# these are equivalent in that it doesn't hurt for the vector code to do
# more, smaller steps than necessary for some of the points (but the answers
# do differ slightly).
#
# The special rules below for HIRPBL and the routines that it calls are
# used to generate column-callable versions of the routines, taking advantage
# of the -Cm option (collapse loops and data in M) in FLIC.
# NOTE: The -Cm option was changed to -cm per request by J. Michalakes.
Mar23.1998 dlh
#
# Note that some of these routines (slab, for example) are also used in their
# non-column-callable form.  The routines in their normall form are
# compiled from the normal file names; the routines in the column-callable
# form are compiled from intermediate files, generated here, named
# file_col.F  (the _col is added).  Since these _col files are generated
# automatically during compilation, they are temporary, and there is no
# need to save them.
#

hirpbl.o: hirpbl.F
        $(CUT) -c1-72 hirpbl.F | $(SED) 's/`//' | $(EXPAND) |\
           $(CPP) -DMPP1_COLUMNWISE $(INCLUDES) $(CPP_FLAGS) |\
           $(M4) - > hirpbl.b
        $(FLIC) -cm hirpbl.b > hirpbl.dm
        $(M4_FLIC) hirpbl.dm | sed '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) \
            | sed 's/CMPP1//' >hirpbl.f
        $(MFC) -c $(FCFLAGS) hirpbl.f 2> $*.lis
        $(RM) hirpbl.b hirpbl.dm hirpbl.f

slab_col.o: slab.F
        $(CUT) -c1-72 slab.F | $(SED) 's/`//' | $(EXPAND) |\
           $(CPP) -DMPP1_COLUMNWISE $(INCLUDES) $(CPP_FLAGS) |\
           $(M4) - > slab_col.b
        $(FLIC) -cm slab_col.b > slab_col.dm
        $(M4_FLIC) slab_col.dm | sed '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) \
```

```
            | sed 's/CMPP1//' > slab_col.f
        $(MFC) -c $(FCFLAGS) slab_col.f 2> $*.lis
        $(RM) slab_col.b slab_col.dm slab_col.f

sfcrad_col.o: sfcrad.F
        $(CUT) -c1-72 sfcrad.F | $(SED) 's/`//' | $(EXPAND) |\
           $(CPP) -DMPP1_COLUMNWISE $(INCLUDES) $(CPP_FLAGS) |\
           $(M4) - > sfcrad_col.b
        $(FLIC) -cm sfcrad_col.b > sfcrad_col.dm
        $(M4_FLIC) sfcrad_col.dm | sed '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) \
            | sed 's/CMPP1//' > sfcrad_col.f
        $(MFC) -c $(FCFLAGS) sfcrad_col.f 2> $*.lis
        $(RM) sfcrad_col.b sfcrad_col.dm sfcrad_col.f

transm_col.o: transm.F
        $(CUT) -c1-72 transm.F | $(SED) 's/`//' | $(EXPAND) |\
           $(CPP) -DMPP1_COLUMNWISE $(INCLUDES) $(CPP_FLAGS) |\
           $(M4) - > transm_col.b
        $(FLIC) -cm transm_col.b > transm_col.dm
        $(M4_FLIC) transm_col.dm | sed '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) \
            | sed 's/CMPP1//' > transm_col.f
        $(MFC) -c $(FCFLAGS) transm_col.f 2> $*.lis
        $(RM) transm_col.b transm_col.dm transm_col.f

gspbl.o: gspbl.F
        $(CUT) -c1-72 gspbl.F | $(SED) 's/`//' | $(EXPAND) |\
           $(CPP) -DMPP1_COLUMNWISE $(INCLUDES) $(CPP_FLAGS) |\
           $(M4) - > gspbl.b
        $(FLIC) -cm gspbl.b > gspbl.dm
        $(M4_FLIC) gspbl.dm | sed '/^$$/d' \
            | $(CPP) $(INCLUDES) | $(CUTTER) \
            | sed 's/CMPP1//' >gspbl.f
        $(MFC) -c $(FCFLAGS) gspbl.f 2> $*.lis
        $(RM) gspbl.b gspbl.dm gspbl.f

#
# No optimization for this routine -- it times the processor.
#
mhz.o:
        $(MCC) -c $(CC_FLAGS) mhz.c

#
# clean rule
#
clean:
        /bin/rm -f *.f *.o *.b *.dm \
                   read_config1.h read_config2.h read_config3.h parame.incl
```

--
mesouser@ncar.ucar.edu
http://www.mmm.ucar.edu/mm5/mm5-home.html
Mesoscale and Microscale Meteorology Division

National Center for Atmospheric Research
Boulder CO 80307-3000, USA

Mahesh Phadnis, Ph.D.
EARTH TECH, Inc.
196 Baker Avenue
Concord, MA 01742. USA
telephone: 978.371.4178
fax: 978.371.2468
Internet: mphadnis@src.com

APPENDIX E

SUMMER WIND ROSES FOR MORNING HOURS AND MID-DAY HOURS

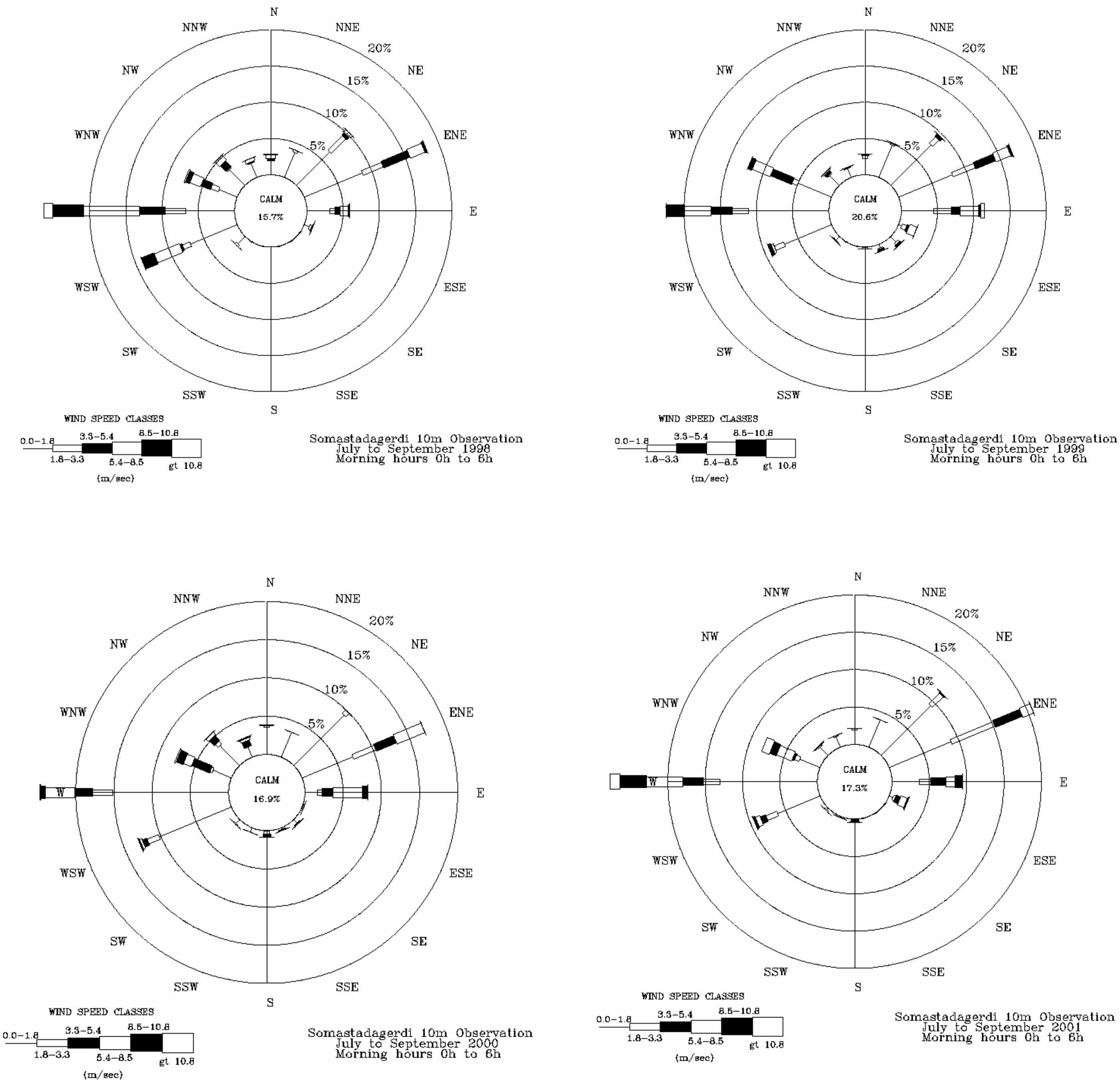

Figure E-1. Early morning wind roses average of summer months (July to September) for each year of the period 1998-2001.

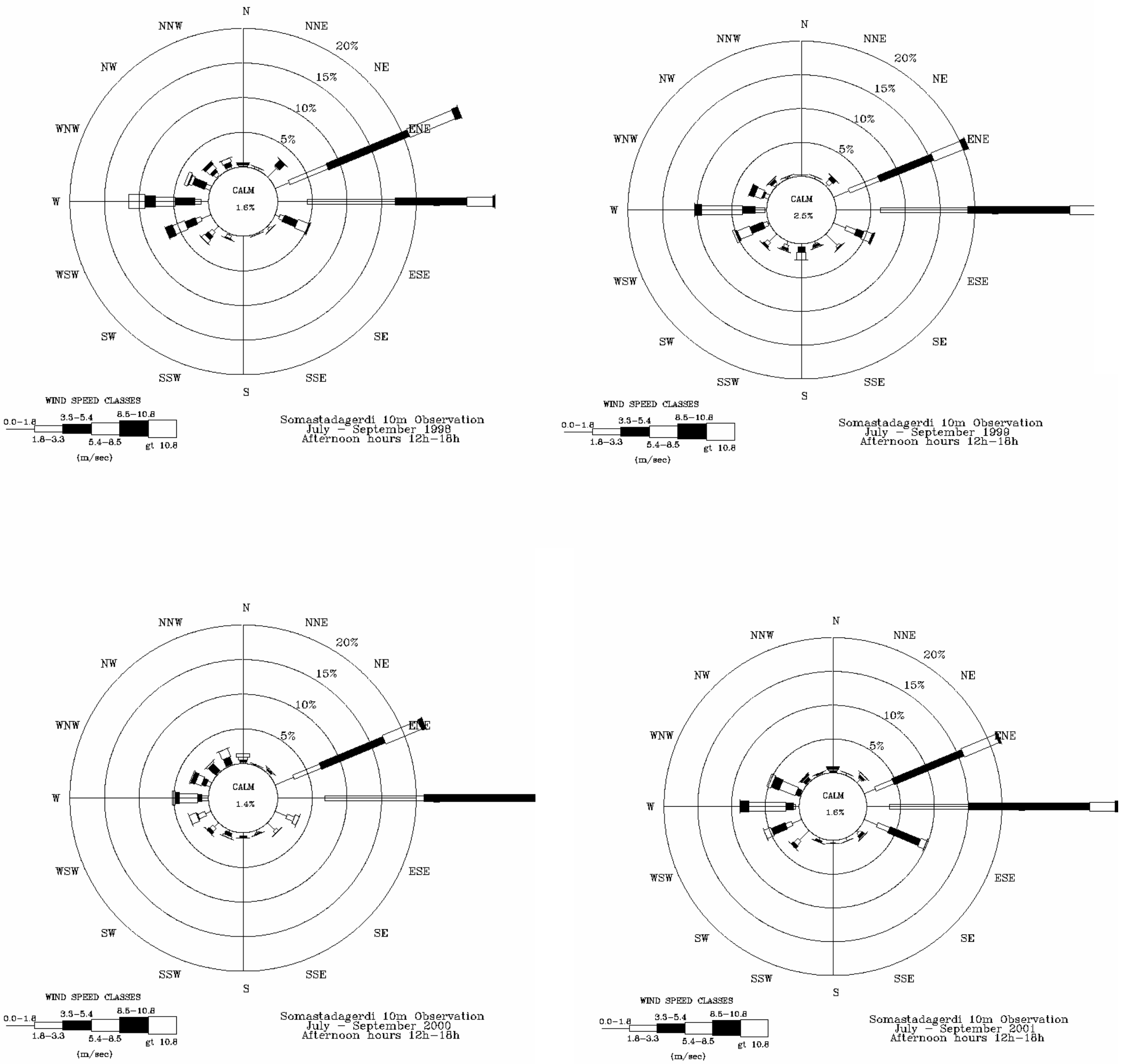

Figure E-2. Mid-morning wind roses average of summer months (July to September) for each year of the period 1998-2001.

APPENDIX F

CALMET INPUT CONTROL FILE

```
ALCOA - Iceland Plant - 170 X170, 0.3 km resolution  - CCM radiation scheme
with MM5.dat domain 3 - 24levs - newBC, 17 surface station. no upper air data
NOOBS=1  - ITPROG=1 -  - ICLOUD=0  - IPROG=14 -ISTEPPG=1 -  Apr 12-16, 2001
---------------- Run title (3 lines) ----------------------------------------

                    CALMET MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names


Subgroup (a)
------------
Default Name  Type          File Name
------------  ----          ---------
GEO.DAT       input    ! GEODAT=gsumlast.DAT       !
SURF.DAT      input    ! SRFDAT=SRF17CLD.DAT      !
CLOUD.DAT     input    * CLDDAT=            *
PRECIP.DAT    input    ! PRCDAT=prec_icel.dat    !
MM4.DAT       input    ! MM4DAT=M4000701.DAT     !
WT.DAT        input    * WTDAT=             *

CALMET.LST    output   ! METLST=MT240701.LST     !
CALMET.DAT    output   ! METDAT=MT240701.DAT    !
PACOUT.DAT    output   * PACDAT=            *

All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE

NUMBER OF UPPER AIR & OVERWATER STATIONS:

    Number of upper air stations (NUSTA)  No default     ! NUSTA =  0  !
    Number of overwater met stations
                                 (NOWSTA) No default     ! NOWSTA =  1  !

                       !END!
--------------------------------------------------------------------------------
Subgroup (b)
---------------------------------
Upper air files (one per station)
---------------------------------
Default Name  Type       File Name
------------  ----       ---------
--------------------------------------------------------------------------------
Subgroup (c)
-----------------------------------------
Overwater station files (one per station)
-----------------------------------------
Default Name  Type       File Name
------------  ----       ---------
SEA1.DAT       input     1  ! SEADAT=SEANN.DAT!    !END!
--------------------------------------------------------------------------------
Subgroup (d)
----------------
Other file names
----------------

Default Name  Type       File Name
------------  ----       ---------
DIAG.DAT      input      * DIADAT=                 *
PROG.DAT      input      * PRGDAT=                 *

TEST.PRT      output     * TSTPRT=                 *
TEST.OUT      output     * TSTOUT=                 *
TEST.KIN      output     * TSTKIN=                 *
TEST.FRD      output     * TSTFRD=                 *
TEST.SLP      output     * TSTSLP=                 *
```

```
-------------------------------------------------------------------------------
NOTES: (1) File/path names can be up to 70 characters in length
       (2) Subgroups (a) and (d) must have ONE 'END' (surround by
           delimiters) at the end of the group
       (3) Subgroups (b) and (c) must have an 'END' (surround by
           delimiters) at the end of EACH LINE

                         !END!


-------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

     Starting date:   Year (IBYR) -- No default       ! IBYR=  2000  !
                     Month (IBMO) -- No default       ! IBMO=  7  !
                       Day (IBDY) -- No default       ! IBDY=  1  !
                      Hour (IBHR) -- No default       ! IBHR=  0  !

     Base time zone        (IBTZ) -- No default       ! IBTZ=  0  !
        PST = 08, MST = 07
        CST = 06, EST = 05

     Length of run (hours) (IRLG) -- No default       ! IRLG=  120  !

     Run type            (IRTYPE) -- Default: 1       ! IRTYPE=  1  !

        0 = Computes wind fields only
        1 = Computes wind fields and micrometeorological variables
            (u*, w*, L, zi, etc.)
        (IRTYPE must be 1 to run CALPUFF or CALGRID)

     Compute special data fields required
     by CALGRID (i.e., 3-D fields of W wind
     components and temperature)
     in additional to regular            Default: T    ! LCALGRD = T !
     fields ? (LCALGRD)
     (LCALGRD must be T to run CALGRID)

      Flag to stop run after
      SETUP phase (ITEST)             Default: 2       ! ITEST=  2   !
      (Used to allow checking
      of the model inputs, files, etc.)
      ITEST = 1 - STOPS program after SETUP phase
      ITEST = 2 - Continues with execution of
                  COMPUTATIONAL phase after SETUP

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                     Default: UTM    ! PMAP = UTM  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
```

```
(FEAST)                    Default=0.0     ! FEAST  = 0.000  !
(FNORTH)                   Default=0.0     ! FNORTH = 0.000  !

UTM zone (1 to 60)
(Used only if PMAP=UTM)
(IUTMZN)                   No Default      ! IUTMZN =  28   !

Hemisphere for UTM projection?
(Used only if PMAP=UTM)
(UTMHEM)                   Default: N      ! UTMHEM = N  !
    N   :  Northern hemisphere projection
    S   :  Southern hemisphere projection

Latitude and Longitude (decimal degrees) of projection origin
(Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
(RLAT0)                    No Default      ! RLAT0 = 40.000N  !
(RLON0)                    No Default      ! RLON0 = 90.000W  !

    TTM :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    LCC :  RLON0 identifies central (true N/S) meridian of projection
           RLAT0 selected for convenience
    PS  :  RLON0 identifies central (grid N/S) meridian of projection
           RLAT0 selected for convenience
    EM  :  RLON0 identifies central meridian of projection
           RLAT0 is REPLACED by 0.0N (Equator)
    LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
           RLAT0 identifies latitude of tangent-point of mapping plane

Matching parallel(s) of latitude (decimal degrees) for projection
(Used only if PMAP= LCC or PS)
(XLAT1)                    No Default      ! XLAT1 = 30.000N  !
(XLAT2)                    No Default      ! XLAT2 = 60.000N  !

    LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
    PS  :  Projection plane slices through Earth at XLAT1
           (XLAT2 is not used)

----------
Note:  Latitudes and longitudes should be positive, and include a
       letter N,S,E, or W indicating north or south latitude, and
       east or west longitude.  For example,
       35.9  N Latitude  =  35.9N
       118.7 E Longitude = 118.7E


Datum-region
------------

The Datum-Region for the coordinates is identified by a character
string.  Many mapping products currently available use the model of the
Earth known as the World Geodetic System 1984 (WGS-G ).  Other local
models may be in use, and their selection in CALMET will make its output
consistent with local mapping products.  The list of Datum-Regions with
official transformation parameters is provided by the National Imagery and
Mapping Agency (NIMA).

NIMA Datum - Regions(Examples)
------------------------------------------------------------------------------
WGS-G     WGS-84 GRS 80 Spheroid, Global coverage (WGS84)
NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
NWS-27    NWS 6370KM Radius, Sphere
NWS-84    NWS 6370KM Radius, Sphere
ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

Datum-region for output coordinates
(DATUM)                    Default: WGS-G     ! DATUM = NWS-84  !


Horizontal grid definition:
---------------------------
```

```
     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =   170  !
            No. Y grid cells (NY)      No default     ! NY =   170  !

     Grid spacing (DGRIDKM)            No default     ! DGRIDKM = 0.3 !
                                       Units: km

     Reference grid coordinate of
     SOUTHWEST corner of grid cell (1,1)

        X coordinate (XORIGKM)         No default     ! XORIGKM = 521.000 !
        Y coordinate (YORIGKM)         No default     ! YORIGKM = 7192.000 !
                                       Units: km


     Vertical grid definition:
     -------------------------

        No. of vertical layers (NZ)    No default     ! NZ =  10  !

        Cell face heights in arbitrary
        vertical grid (ZFACE(NZ+1))    No defaults
                                       Units: m
        ! ZFACE = 0.,20.,40.,80.,160.,320.,600.,1000.,1500.,2200.,3000. !

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 3 -- Output Options
--------------


    DISK OUTPUT OPTION

       Save met. fields in an unformatted
       output file ?             (LSAVE)  Default: T     ! LSAVE = T !
       (F = Do not save, T = Save)

       Type of unformatted output file:
       (IFORMO)                           Default: 1    ! IFORMO =  1  !

            1 = CALPUFF/CALGRID type file (CALMET.DAT)
            2 = MESOPUFF-II type file     (PACOUT.DAT)


    LINE PRINTER OUTPUT OPTIONS:

       Print met. fields ?  (LPRINT)      Default: F     ! LPRINT = F !
       (F = Do not print, T = Print)
       (NOTE: parameters below control which
              met. variables are printed)

       Print interval
       (IPRINF) in hours                  Default: 1     ! IPRINF =  1  !
       (Meteorological fields are printed
        every  1  hours)


       Specify which layers of U, V wind component
       to print (IUVOUT(NZ)) -- NOTE: NZ values must be entered
       (0=Do not print, 1=Print)
       (used only if LPRINT=T)        Defaults: NZ*0
       ! IUVOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !
       -----------------------
```

```
Specify which levels of the W wind component to print
(NOTE: W defined at TOP cell face --  10  values)
(IWOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! IWOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !


Specify which levels of the 3-D temperature field to print
(ITOUT(NZ)) -- NOTE: NZ values must be entered
(0=Do not print, 1=Print)
(used only if LPRINT=T & LCALGRD=T)
-----------------------------------
                                     Defaults: NZ*0
 ! ITOUT =  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0 ,  0  !

Specify which meteorological fields
to print
(used only if LPRINT=T)             Defaults: 0 (all variables)
-----------------------


  Variable           Print ?
                  (0 = do not print,
                   1 = print)
  --------        ------------------

!  STABILITY  =          0           ! - PGT stability class
!  USTAR      =          0           ! - Friction velocity
!  MONIN      =          0           ! - Monin-Obukhov length
!  MIXHT      =          0           ! - Mixing height
!  WSTAR      =          0           ! - Convective velocity scale
!  PRECIP     =          0           ! - Precipitation rate
!  SENSHEAT   =          0           ! - Sensible heat flux
!  CONVZI     =          0           ! - Convective mixing ht.


Testing and debug print options for micrometeorological module

   Print input meteorological data and
   internal variables (LDB)         Default: F       ! LDB = F !
   (F = Do not print, T = print)
   (NOTE: this option produces large amounts of output)

   First time step for which debug data
   are printed (NN1)                Default: 1       ! NN1 =  1  !

   Last time step for which debug data
   are printed (NN2)                Default: 1       ! NN2 =  1  !


Testing and debug print options for wind field module
(all of the following print options control output to
 wind field module's output files: TEST.PRT, TEST.OUT,
 TEST.KIN, TEST.FRD, and TEST.SLP)

   Control variable for writing the test/debug
   wind fields to disk files (IOUTD)
   (0=Do not write, 1=write)        Default: 0       ! IOUTD =  0  !

   Number of levels, starting at the surface,
   to print (NZPRN2)                Default: 1       ! NZPRN2 =  0  !

   Print the INTERPOLATED wind components ?
   (IPR0) (0=no, 1=yes)             Default: 0       !  IPR0 =  0  !

   Print the TERRAIN ADJUSTED surface wind
   components ?
   (IPR1) (0=no, 1=yes)             Default: 0       !  IPR1 =  0  !
```

```
          Print the SMOOTHED wind components and
          the INITIAL DIVERGENCE fields ?
          (IPR2) (0=no, 1=yes)             Default: 0       !  IPR2 =  0  !

          Print the FINAL wind speed and direction
          fields ?
          (IPR3) (0=no, 1=yes)             Default: 0       !  IPR3 =  0  !

          Print the FINAL DIVERGENCE fields ?
          (IPR4) (0=no, 1=yes)             Default: 0       !  IPR4 =  0  !

          Print the winds after KINEMATIC effects
          are added ?
          (IPR5) (0=no, 1=yes)             Default: 0       !  IPR5 =  0  !

          Print the winds after the FROUDE NUMBER
          adjustment is made ?
          (IPR6) (0=no, 1=yes)             Default: 0       !  IPR6 =  0  !

          Print the winds after SLOPE FLOWS
          are added ?
          (IPR7) (0=no, 1=yes)             Default: 0       !  IPR7 =  0  !

          Print the FINAL wind field components ?
          (IPR8) (0=no, 1=yes)             Default: 0       !  IPR8 =  0  !

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 4 -- Meteorological data options
--------------

    NO OBSERVATION MODE             (NOOBS)  Default: 0     ! NOOBS =  1   !
          0 = Use surface, overwater, and upper air stations
          1 = Use surface and overwater stations (no upper air observations)
              Use MM5 for upper air data
          2 = No surface, overwater, or upper air observations
              Use MM5 for surface, overwater, and upper air data

    NUMBER OF SURFACE & PRECIP. METEOROLOGICAL STATIONS

       Number of surface stations   (NSSTA)  No default     ! NSSTA =  17  !

       Number of precipitation stations
       (NPSTA=-1: flag for use of MM5 precip data)
                                    (NPSTA)  No default     ! NPSTA =  4  !

    CLOUD DATA OPTIONS
       Gridded cloud fields:
                                   (ICLOUD)  Default: 0     ! ICLOUD =  0  !
       ICLOUD = 0 - Gridded clouds not used
       ICLOUD = 1 - Gridded CLOUD.DAT generated as OUTPUT
       ICLOUD = 2 - Gridded CLOUD.DAT read as INPUT
       ICLOUD = 3 - Gridded cloud cover from Prognostic Rel. Humidity

    FILE FORMATS

       Surface meteorological data file format
                                   (IFORMS)  Default: 2     ! IFORMS =  2  !
       (1 = unformatted (e.g., SMERGE output))
       (2 = formatted   (free-formatted user input))

       Precipitation data file format
                                   (IFORMP)  Default: 2     ! IFORMP =  2  !
       (1 = unformatted (e.g., PMERGE output))
       (2 = formatted   (free-formatted user input))

       Cloud data file format
```

```
                            (IFORMC)  Default: 2     ! IFORMC =  2  !
       (1 = unformatted - CALMET unformatted output)
       (2 = formatted   - free-formatted CALMET output or user input)

!END!


-------------------------------------------------------------------------------

INPUT GROUP: 5 -- Wind Field Options and Parameters
--------------


    WIND FIELD MODEL OPTIONS
       Model selection variable (IWFCOD)     Default: 1      ! IWFCOD =  1  !
          0 = Objective analysis only
          1 = Diagnostic wind module

       Compute Froude number adjustment
       effects ? (IFRADJ)                    Default: 1      ! IFRADJ =  1  !
       (0 = NO, 1 = YES)

       Compute kinematic effects ? (IKINE)   Default: 0      ! IKINE  =  0  !
       (0 = NO, 1 = YES)

       Use O'Brien procedure for adjustment
       of the vertical velocity ? (IOBR)     Default: 0      ! IOBR =  0  !
       (0 = NO, 1 = YES)

       Compute slope flow effects ? (ISLOPE) Default: 1      ! ISLOPE  =  1  !
       (0 = NO, 1 = YES)

       Extrapolate surface wind observations
       to upper layers ? (IEXTRP)            Default: -4     ! IEXTRP = -4  !
       (1 = no extrapolation is done,
        2 = power law extrapolation used,
        3 = user input multiplicative factors
            for layers 2 - NZ used (see FEXTRP array)
        4 = similarity theory used
        -1, -2, -3, -4 = same as above except layer 1 data
            at upper air stations are ignored

       Extrapolate surface winds even
       if calm? (ICALM)                      Default: 0      ! ICALM  =  0  !
       (0 = NO, 1 = YES)

       Layer-dependent biases modifying the weights of
       surface and upper air stations (BIAS(NZ))
         -1<=BIAS<=1
       Negative BIAS reduces the weight of upper air stations
         (e.g. BIAS=-0.1 reduces the weight of upper air stations
       by 10%; BIAS= -1, reduces their weight by 100 %)
       Positive BIAS reduces the weight of surface stations
         (e.g. BIAS= 0.2 reduces the weight of surface stations
       by 20%; BIAS=1 reduces their weight by 100%)
       Zero BIAS leaves weights unchanged (1/R**2 interpolation)
       Default: NZ*0
                         ! BIAS = -1 , -1 , -1 , -1 , -1 , -1 , -1 , -.5 ,  .5 ,  1  !

       Minimum distance from nearest upper air station
       to surface station for which extrapolation
       of surface winds at surface station will be allowed
       (RMIN2: Set to -1 for IEXTRP = 4 or other situations
        where all surface stations should be extrapolated)
                                              Default: 4.    ! RMIN2 = -1.0 !

       Use gridded prognostic wind field model
       output fields as input to the diagnostic
       wind field model (IPROG)              Default: 0      ! IPROG =  14  !
       (0 = No, [IWFCOD = 0 or 1]
        1 = Yes, use CSUMM prog. winds as Step 1 field, [IWFCOD = 0]
```

```
 2 = Yes, use CSUMM prog. winds as initial guess field [IWFCOD = 1]
 3 = Yes, use winds from MM4.DAT file as Step 1 field [IWFCOD = 0]
 4 = Yes, use winds from MM4.DAT file as initial guess field [IWFCOD = 1]
 5 = Yes, use winds from MM4.DAT file as observations [IWFCOD = 1]
 13 = Yes, use winds from MM5.DAT file as Step 1 field [IWFCOD = 0]
 14 = Yes, use winds from MM5.DAT file as initial guess field [IWFCOD = 1]
 15 = Yes, use winds from MM5.DAT file as observations [IWFCOD = 1]

Timestep (hours) of the prognostic
model input data   (ISTEPPG)          Default: 1      ! ISTEPPG =  1   !

RADIUS OF INFLUENCE PARAMETERS

Use varying radius of influence       Default: F      ! LVARY =  F!
(if no stations are found within RMAX1,RMAX2,
 or RMAX3, then the closest station will be used)

Maximum radius of influence over land
in the surface layer (RMAX1)          No default      ! RMAX1 = 10. !
                                      Units: km
Maximum radius of influence over land
aloft (RMAX2)                         No default      ! RMAX2 = 10. !
                                      Units: km
Maximum radius of influence over water
(RMAX3)                               No default      ! RMAX3 = 30. !
                                      Units: km


OTHER WIND FIELD INPUT PARAMETERS

Minimum radius of influence used in
the wind field interpolation (RMIN)   Default: 0.1    ! RMIN = 0.1 !
                                      Units: km
Radius of influence of terrain
features (TERRAD)                     No default      ! TERRAD = 8. !

                                      Units: km
Relative weighting of the first
guess field and observations in the
SURFACE layer (R1)                    No default      ! R1 = 2. !
(R1 is the distance from an           Units: km
observational station at which the
observation and first guess field are
equally weighted)

Relative weighting of the first
guess field and observations in the
layers ALOFT (R2)                     No default      ! R2 = 2. !
(R2 is applied in the upper layers    Units: km
in the same manner as R1 is used in
the surface layer).

Relative weighting parameter of the
prognostic wind field data (RPROG)    No default      ! RPROG = 0. !
(Used only if IPROG = 1)              Units: km
------------------------

Maximum acceptable divergence in the
divergence minimization procedure
(DIVLIM)                              Default: 5.E-6  ! DIVLIM= 5.0E-06 !

Maximum number of iterations in the
divergence min. procedure (NITER)     Default: 50     ! NITER =  50  !

Number of passes in the smoothing
procedure (NSMTH(NZ))
NOTE: NZ values must be entered
     Default: 2,(mxnz-1)*4 ! NSMTH =
2 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4 ,  4  !

Maximum number of stations used in
```

```
      each layer for the interpolation of
      data to a grid point (NINTR2(NZ))
      NOTE: NZ values must be entered       Default: 99.    ! NINTR2 =
 5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5 ,  5  !

      Critical Froude number (CRITFN)       Default: 1.0    ! CRITFN = 1. !

      Empirical factor controlling the
      influence of kinematic effects
      (ALPHA)                               Default: 0.1    ! ALPHA = 0.1 !

      Multiplicative scaling factor for
      extrapolation of surface observations
      to upper layers (FEXTR2(NZ))          Default: NZ*0.0
      ! FEXTR2 = 0., 0., 0., 0., 0., 0., 0., 0., 0., 0. !
      (Used only if IEXTRP = 3 or -3)


   BARRIER INFORMATION

      Number of barriers to interpolation
      of the wind fields (NBAR)             Default: 0      ! NBAR =  0  !

      THE FOLLOWING 4 VARIABLES ARE INCLUDED
      ONLY IF NBAR > 0
      NOTE: NBAR values must be entered     No defaults
            for each variable               Units: km

         X coordinate of BEGINNING
         of each barrier (XBBAR(NBAR))      ! XBBAR = 0. !
         Y coordinate of BEGINNING
         of each barrier (YBBAR(NBAR))      ! YBBAR = 0. !

         X coordinate of ENDING
         of each barrier (XEBAR(NBAR))      ! XEBAR = 0. !
         Y coordinate of ENDING
         of each barrier (YEBAR(NBAR))      ! YEBAR = 0. !


   DIAGNOSTIC MODULE DATA INPUT OPTIONS

      Surface temperature (IDIOPT1)         Default: 0      ! IDIOPT1 =  0  !
         0 = Compute internally from
             hourly surface observations
         1 = Read preprocessed values from
             a data file (DIAG.DAT)

         Surface met. station to use for
         the surface temperature (ISURFT)   No default     ! ISURFT =  5  !
         (Must be a value from 1 to NSSTA)
         (Used only if IDIOPT1 = 0)
         --------------------------

      Domain-averaged temperature lapse
      rate (IDIOPT2)                        Default: 0     ! IDIOPT2 =  0  !
         0 = Compute internally from
             twice-daily upper air observations
         1 = Read hourly preprocessed values
             from a data file (DIAG.DAT)

         Upper air station to use for
         the domain-scale lapse rate (IUPT) No default     ! IUPT   =  1  !
         (Must be a value from 1 to NUSTA)
         (Used only if IDIOPT2 = 0)
         --------------------------

         Depth through which the domain-scale
         lapse rate is computed (ZUPT)      Default: 200.  ! ZUPT = 200. !
         (Used only if IDIOPT2 = 0)         Units: meters
         --------------------------
```

```
      Domain-averaged wind components
      (IDIOPT3)                             Default: 0     ! IDIOPT3 =  0  !
         0 = Compute internally from
             twice-daily upper air observations
         1 = Read hourly preprocessed values
             a data file (DIAG.DAT)

         Upper air station to use for
         the domain-scale winds (IUPWND)    Default: -1    ! IUPWND = -1  !
         (Must be a value from -1 to NUSTA)
         (Used only if IDIOPT3 = 0)
         --------------------------

         Bottom and top of layer through
         which the domain-scale winds
         are computed
         (ZUPWND(1), ZUPWND(2))        Defaults: 1., 1000. ! ZUPWND= 1., 1000. !
         (Used only if IDIOPT3 = 0)    Units: meters
         --------------------------

      Observed surface wind components
      for wind field module (IDIOPT4)  Default: 0     ! IDIOPT4 =  0  !
         0 = Read WS, WD from a surface
             data file (SURF.DAT)
         1 = Read hourly preprocessed U, V from
             a data file (DIAG.DAT)

      Observed upper air wind components
      for wind field module (IDIOPT5)  Default: 0     ! IDIOPT5 =  0  !
         0 = Read WS, WD from an upper
             air data file (UP1.DAT, UP2.DAT, etc.)
         1 = Read hourly preprocessed U, V from
             a data file (DIAG.DAT)

      LAKE BREEZE INFORMATION

         Use Lake Breeze Module  (LLBREZE)
                                           Default: F      ! LLBREZE = F !

          Number of lake breeze regions (NBOX)            ! NBOX =  0  !

       X Grid line 1 defining the region of interest
                                                       ! XG1 = 0. !
       X Grid line 2 defining the region of interest
                                                       ! XG2 = 0. !
       Y Grid line 1 defining the region of interest
                                                       ! YG1 = 0. !
       Y Grid line 2 defining the region of interest
                                                       ! YG2 = 0. !

        X Point defining the coastline (Straight line)
                  (XBCST)  (KM)   Default: none    ! XBCST = 0. !

        Y Point defining the coastline (Straight line)
                  (YBCST)  (KM)   Default: none    ! YBCST = 0. !

        X Point defining the coastline (Straight line)
                  (XECST)  (KM)   Default: none    ! XECST = 0. !

        Y Point defining the coastline (Straight line)
                  (YECST)  (KM)   Default: none    ! YECST = 0. !


      Number of stations in the region     Default: none ! NLB =  0 !
      (Surface stations + upper air stations)

      Station ID's  in the region   (METBXID(NLB))
      (Surface stations first, then upper air stations)
        ! METBXID =  0 !

!END!
```

```
-------------------------------------------------------------------------------

INPUT GROUP: 6 -- Mixing Height, Temperature and Precipitation Parameters
--------------

    EMPIRICAL MIXING HEIGHT CONSTANTS

       Neutral, mechanical equation
       (CONSTB)                             Default: 1.41   ! CONSTB = 1.41 !
       Convective mixing ht. equation
       (CONSTE)                             Default: 0.15   ! CONSTE = 0.15 !
       Stable mixing ht. equation
       (CONSTN)                             Default: 2400.  ! CONSTN = 2400.!
       Overwater mixing ht. equation
       (CONSTW)                             Default: 0.16   ! CONSTW = 0.16 !
       Absolute value of Coriolis
       parameter (FCORIOL)                  Default: 1.E-4  ! FCORIOL = 1.0E-04!
                                            Units: (1/s)

    SPATIAL AVERAGING OF MIXING HEIGHTS

       Conduct spatial averaging
       (IAVEZI)  (0=no, 1=yes)              Default: 1      ! IAVEZI =  1  !

       Max. search radius in averaging
       process (MNMDAV)                     Default: 1      ! MNMDAV =  1  !
                                            Units: Grid
                                                   cells
       Half-angle of upwind looking cone
       for averaging (HAFANG)               Default: 30.    ! HAFANG = 30. !
                                            Units: deg.
       Layer of winds used in upwind
       averaging (ILEVZI)                   Default: 1      ! ILEVZI =  1  !
       (must be between 1 and NZ)

    OTHER MIXING HEIGHT VARIABLES

       Minimum potential temperature lapse
       rate in the stable layer above the
       current convective mixing ht.        Default: 0.001  ! DPTMIN = 0.001 !
       (DPTMIN)                             Units: deg. K/m
       Depth of layer above current conv.
       mixing height through which lapse    Default: 200.   ! DZZI = 200. !
       rate is computed (DZZI)              Units: meters

       Minimum overland mixing height       Default:  50.   ! ZIMIN = 50. !
       (ZIMIN)                              Units: meters
       Maximum overland mixing height       Default: 3000.  ! ZIMAX = 2500. !
       (ZIMAX)                              Units: meters
       Minimum overwater mixing height      Default:   50.  ! ZIMINW = 50. !
       (ZIMINW) -- (Not used if observed    Units: meters
       overwater mixing hts. are used)
       Maximum overwater mixing height      Default: 3000.  ! ZIMAXW = 2500. !
       (ZIMAXW) -- (Not used if observed    Units: meters
       overwater mixing hts. are used)


    TEMPERATURE PARAMETERS

       3D temperature from observations or
       from prognostic data? (ITPROG)       Default:0         !ITPROG =  2   !

          0 = Use Surface and upper air stations
              (only if NOOBS = 0)
          1 = Use Surface stations (no upper air observations)
              Use MM5 for upper air data
              (only if NOOBS = 0,1)
          2 = No surface or upper air observations
              Use MM5 for surface and upper air data
```

```
            (only if NOOBS = 0,1,2)

       Interpolation type
       (1 = 1/R ; 2 = 1/R**2)              Default:1         ! IRAD =  1  !

       Radius of influence for temperature
       interpolation (TRADKM)              Default: 500.     ! TRADKM = 500. !
                                           Units: km

       Maximum Number of stations to include
       in temperature interpolation (NUMTS)  Default: 5        ! NUMTS = 5  !

       Conduct spatial averaging of temp-
       eratures (IAVET)  (0=no, 1=yes)        Default: 1     ! IAVET =  1  !
       (will use mixing ht MNMDAV,HAFANG
        so make sure they are correct)

       Default temperature gradient        Default: -.0098 ! TGDEFB = -0.0098 !
       below the mixing height over
       water (K/m) (TGDEFB)

       Default temperature gradient        Default: -.0045 ! TGDEFA = -0.0045 !
       above the mixing height over
       water (K/m) (TGDEFA)

       Beginning (JWAT1) and ending (JWAT2)
       land use categories for temperature                   ! JWAT1 =  55  !
       interpolation over water -- Make                      ! JWAT2 =  55  !
       bigger than largest land use to disable

   PRECIP INTERPOLATION PARAMETERS

       Method of interpolation (NFLAGP)      Default = 2    ! NFLAGP =  2  !
        (1=1/R,2=1/R**2,3=EXP/R**2)
       Radius of Influence (km) (SIGMAP)     Default = 100.0  ! SIGMAP = 50. !
        (0.0 => use half dist. btwn
         nearest stns w & w/out
         precip when NFLAGP = 3)
       Minimum Precip. Rate Cutoff (mm/hr)   Default = 0.01  ! CUTP = 0.01 !
        (values < CUTP = 0.0 mm/hr)
!END!

-------------------------------------------------------------------------------

INPUT GROUP: 7 -- Surface meteorological station parameters
--------------

     SURFACE STATION VARIABLES
     (One record per station --  17  records in all)


             1     2
         Name   ID            X coord.   Y coord.   Time   Anem.
                               (km)       (km)      zone   Ht.(m)
       ----------------------------------------------------------
! SS1  ='SS1'    5993       569.976     7207.188    0    10  !
! SS2  ='SS2'    5975       535.790     7212.601    0    10  !
! SS3  ='SS3'    5977       539.440     7213.348    0    10  !
! SS4  ='SS4'    5988       562.175     7201.886    0    10  !
! SS5  ='SS5'    7078       541.871     7212.234    0    10  !
! SS6  ='SS6'    4271       527.769     7239.153    0    10  !
! SS7  ='SS7'    4193       566.523     7238.882    0    10  !
! SS8  ='SS8'     615       546.274     7237.826    0    10  !
! SS9  ='SS9'    4180       546.661     7239.950    0    10  !
! SS10 ='S10'    5990       562.412     7225.637    0    10  !
! SS11 ='S11'    5981       545.283     7217.077    0    10  !
! SS12 ='S12'   34087       550.855     7215.830    0    10  !
! SS13 ='S13'   34073       531.306     7222.470    0    10  !
! SS14 ='S14'    5960       515.281     7217.161    0    10  !
! SS15 ='S15'    5885       555.013     7186.586    0    10  !
```

```
! SS16 ='S16'   34175       534.596     7238.111    0    10  !
! SS17 ='S17'    4275       534.652     7233.319    0    10  !
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 8 -- Upper air meteorological station parameters
--------------

     UPPER AIR STATION VARIABLES
     (One record per station --  0  records in all)

             1     2
         Name    ID      X coord.   Y coord.  Time zone
                           (km)       (km)
        -----------------------------------------------
-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Five digit integer for station ID

!END!


--------------------------------------------------------------------------------

INPUT GROUP: 9 -- Precipitation station parameters
--------------

     PRECIPITATION STATION VARIABLES
     (One record per station --  0  records in all)
     (NOT INCLUDED IF NPSTA = 0)

            1          2
         Name   Station    X coord.  Y coord.
                  Code       (km)      (km)
         ------------------------------------
! PS1  ='P01'    4271       527.769     7239.153  !
! PS2  ='P02'    5981       545.283     7217.077  !
! PS3  ='P03'    5990       562.412     7225.637  !
! PS4  ='P04'    4180       546.661     7239.950  !

-------------------
      1
        Four character string for station name
        (MUST START IN COLUMN 9)

      2
        Six digit station code composed of state
        code (first 2 digits) and station ID (last
        4 digits)

!END!
```

APPENDIX G

CALPUFF INPUT CONTROL FILE

```
CALPUFF ICELAND with MM5 data domain 4 - 2km + CCM radiation scheme
September 2005 -  2 lines  - PM10- SO2 -PF - HF- PAHGAS - PAHPM - deposition included
July 2000 -  receptor resolution 100m and 200m
---------------- Run title (3 lines) ------------------------------------------

                    CALPUFF MODEL CONTROL FILE
                    --------------------------

-------------------------------------------------------------------------------

INPUT GROUP: 0 -- Input and Output File Names

--------------
Default Name  Type          File Name
------------  ----          ---------
CALMET.DAT    input    * METDAT =             *
    or
ISCMET.DAT    input    * ISCDAT =             *
    or
PLMMET.DAT    input    * PLMDAT =             *
    or
PROFILE.DAT   input    * PRFDAT =             *
SURFACE.DAT   input    * SFCDAT =             *
RESTARTB.DAT  input    * RSTARTB=             *
--------------------------------------------------------------------------------
CALPUFF.LST   output   ! PUFLST =PF0007aS3.LST  !
CONC.DAT      output   ! CONDAT =PF0007aS3.CON     !
DFLX.DAT      output   ! DFDAT  =PF0007aS3.DRY  !
WFLX.DAT      output   ! WFDAT  =PF0007aS3.WET  !

VISB.DAT      output   * VISDAT =             *
RESTARTE.DAT  output   ! RSTARTE=PF0007aS3.RST     !
--------------------------------------------------------------------------------
Emission Files
--------------
PTEMARB.DAT   input    * PTDAT  =             *
VOLEMARB.DAT  input    * VOLDAT =             *
BAEMARB.DAT   input    * ARDAT  =             *
LNEMARB.DAT   input    * LNDAT  =             *
--------------------------------------------------------------------------------
Other Files
-----------
OZONE.DAT     input    * OZDAT  =             *
VD.DAT        input    * VDDAT  =             *
CHEM.DAT      input    * CHEMDAT=             *
H2O2.DAT      input    * H2O2DAT=             *
HILL.DAT      input    * HILDAT=             *
HILLRCT.DAT   input    * RCTDAT=             *
COASTLN.DAT   input    ! CSTDAT=t0p1_cst.dat !
FLUXBDY.DAT   input    * BDYDAT=             *
BCON.DAT      input    * BCNDAT=             *
DEBUG.DAT     output   * DEBUG =             *
MASSFLX.DAT   output   * FLXDAT=             *
MASSBAL.DAT   output   * BALDAT=             *
FOG.DAT       output   * FOGDAT=             *
--------------------------------------------------------------------------------
All file names will be converted to lower case if LCFILES = T
Otherwise, if LCFILES = F, file names will be converted to UPPER CASE
         T = lower case      ! LCFILES = T !
         F = UPPER CASE
NOTE: (1) file/path names can be up to 70 characters in length


Provision for multiple input files
----------------------------------

     Number of CALMET.DAT files for run (NMETDAT)
                                     Default: 1       ! NMETDAT =   4   !

     Number of PTEMARB.DAT files for run (NPTDAT)
                                     Default: 0       ! NPTDAT =  0  !
```

```
     Number of BAEMARB.DAT files for run (NARDAT)
                                    Default: 0       ! NARDAT =  0  !

     Number of VOLEMARB.DAT files for run (NVOLDAT)
                                    Default: 0       ! NVOLDAT =  0  !

!END!

-------------
Subgroup (0a)
-------------

  The following CALMET.DAT filenames are processed in sequence if NMETDAT>1

Default Name  Type          File Name
------------  ----          ---------
 none         input    ! METDAT=../calmet/MT240701.DAT     !  !END!
 none         input    ! METDAT=../calmet/MT240706.DAT     !  !END!
 none         input    ! METDAT=../calmet/MT240711.DAT     !  !END!
 none         input    ! METDAT=../calmet/MT240716.DAT     !  !END!


--------------------------------------------------------------------------------

INPUT GROUP: 1 -- General run control parameters
--------------

    Option to run all periods found
    in the met. file     (METRUN)   Default: 0       ! METRUN =   0  !

         METRUN = 0 - Run period explicitly defined below
         METRUN = 1 - Run all periods in met. file

     Starting date:   Year (IBYR) -- No default       ! IBYR =  2000  !
     (used only if   Month (IBMO) -- No default       ! IBMO =  7  !
      METRUN = 0)      Day (IBDY) -- No default       ! IBDY =  1  !
                      Hour (IBHR) -- No default       ! IBHR =  0  !

     Base time zone        (XBTZ) -- No default       ! XBTZ = 0.0  !
        PST = 8., MST = 7.
        CST = 6., EST = 5.

     Length of run (hours) (IRLG) -- No default       ! IRLG =  480  !

     Number of chemical species (NSPEC)
                                    Default: 5       ! NSPEC =  6   !

     Number of chemical species
     to be emitted  (NSE)           Default: 3       ! NSE =  6   !

     Flag to stop run after
     SETUP phase (ITEST)            Default: 2       ! ITEST =  2   !
     (Used to allow checking
     of the model inputs, files, etc.)
           ITEST = 1 - STOPS program after SETUP phase
           ITEST = 2 - Continues with execution of program
                       after SETUP

     Restart Configuration:

        Control flag (MRESTART)      Default: 0       ! MRESTART =  2   !

           0 = Do not read or write a restart file
           1 = Read a restart file at the beginning of
               the run
           2 = Write a restart file during run
           3 = Read a restart file at beginning of run
               and write a restart file during run

        Number of periods in Restart
```

```
        output cycle (NRESPD)        Default: 0       ! NRESPD =  48   !

           0 = File written only at last period
          >0 = File updated every NRESPD periods

     Meteorological Data Format (METFM)
                                     Default: 1       ! METFM =  1   !

           METFM = 1 - CALMET binary file (CALMET.MET)
           METFM = 2 - ISC ASCII file (ISCMET.MET)
           METFM = 3 - AUSPLUME ASCII file (PLMMET.MET)
           METFM = 4 - CTDM plus tower file (PROFILE.DAT) and
                       surface parameters file (SURFACE.DAT)

     PG sigma-y is adjusted by the factor (AVET/PGTIME)**0.2
     Averaging Time (minutes) (AVET)
                                     Default: 60.0    ! AVET = 60. !
     PG Averaging Time (minutes) (PGTIME)
                                     Default: 60.0    ! PGTIME = 60. !


!END!


-------------------------------------------------------------------------------

INPUT GROUP: 2 -- Technical options
--------------


     Vertical distribution used in the
     near field (MGAUSS)                   Default: 1     ! MGAUSS =  1   !
        0 = uniform
        1 = Gaussian

     Terrain adjustment method
     (MCTADJ)                              Default: 3     ! MCTADJ =  3   !
        0 = no adjustment
        1 = ISC-type of terrain adjustment
        2 = simple, CALPUFF-type of terrain
            adjustment
        3 = partial plume path adjustment

     Subgrid-scale complex terrain
     flag (MCTSG)                          Default: 0     ! MCTSG =  0   !
        0 = not modeled
        1 = modeled

     Near-field puffs modeled as
     elongated 0 (MSLUG)                   Default: 0     ! MSLUG =  0   !
        0 = no
        1 = yes (slug model used)

     Transitional plume rise modeled ?
     (MTRANS)                              Default: 1     ! MTRANS =  1   !
        0 = no  (i.e., final rise only)
        1 = yes (i.e., transitional rise computed)

     Stack tip downwash? (MTIP)            Default: 1     ! MTIP =  1  !
        0 = no  (i.e., no stack tip downwash)
        1 = yes (i.e., use stack tip downwash)

     Method used to simulate building
     downwash? (MBDW)                      Default: 1     ! MBDW =   1  !
        1 = ISC method
        2 = PRIME method

     Vertical wind shear modeled above
     stack top? (MSHEAR)                   Default: 0     ! MSHEAR =  0  !
        0 = no  (i.e., vertical wind shear not modeled)
        1 = yes (i.e., vertical wind shear modeled)
```

```
Puff splitting allowed? (MSPLIT)      Default: 0     ! MSPLIT =  0  !
   0 = no (i.e., puffs not split)
   1 = yes (i.e., puffs are split)

Chemical mechanism flag (MCHEM)       Default: 1     ! MCHEM =  0   !
   0 = chemical transformation not
       modeled
   1 = transformation rates computed
       internally (MESOPUFF II scheme)
   2 = user-specified transformation
       rates used
   3 = transformation rates computed
       internally (RIVAD/ARM3 scheme)
   4 = secondary organic aerosol formation
       computed (MESOPUFF II scheme for OH)

Aqueous phase transformation flag (MAQCHEM)
(Used only if MCHEM = 1, or 3)        Default: 0     ! MAQCHEM =  0   !
   0 = aqueous phase transformation
       not modeled
   1 = transformation rates adjusted
       for aqueous phase reactions

Wet removal modeled ? (MWET)          Default: 1     ! MWET =  1   !
   0 = no
   1 = yes

Dry deposition modeled ? (MDRY)       Default: 1     ! MDRY =  1   !
   0 = no
   1 = yes
   (dry deposition method specified
    for each species in Input Group 3)

Method used to compute dispersion
coefficients (MDISP)                  Default: 3     ! MDISP =  3   !

   1 = dispersion coefficients computed from measured values
       of turbulence, sigma v, sigma w
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.
   5 = CTDM sigmas used for stable and neutral conditions.
       For unstable conditions, sigmas are computed as in
       MDISP = 3, described above.  MDISP = 5 assumes that
       measured values are read

Sigma-v/sigma-theta, sigma-w measurements used? (MTURBVW)
(Used only if MDISP = 1 or 5)         Default: 3     ! MTURBVW =  3  !
   1 = use sigma-v or sigma-theta measurements
       from PROFILE.DAT to compute sigma-y
       (valid for METFM = 1, 2, 3, 4)
   2 = use sigma-w measurements
       from PROFILE.DAT to compute sigma-z
       (valid for METFM = 1, 2, 3, 4)
   3 = use both sigma-(v/theta) and sigma-w
       from PROFILE.DAT to compute sigma-y and sigma-z
       (valid for METFM = 1, 2, 3, 4)
   4 = use sigma-theta measurements
       from PLMMET.DAT to compute sigma-y
       (valid only if METFM = 3)

Back-up method used to compute dispersion
when measured turbulence data are
missing (MDISP2)                      Default: 3     ! MDISP2 =  3  !
(used only if MDISP = 1 or 5)
```

```
   2 = dispersion coefficients from internally calculated
       sigma v, sigma w using micrometeorological variables
       (u*, w*, L, etc.)
   3 = PG dispersion coefficients for RURAL areas (computed using
       the ISCST multi-segment approximation) and MP coefficients in
       urban areas
   4 = same as 3 except PG coefficients computed using
       the MESOPUFF II eqns.

PG sigma-y,z adj. for roughness?      Default: 0     ! MROUGH =  0  !
(MROUGH)
   0 = no
   1 = yes

Partial plume penetration of          Default: 1     ! MPARTL =  1  !
elevated inversion?
(MPARTL)
   0 = no
   1 = yes

Strength of temperature inversion     Default: 0     ! MTINV =  0  !
provided in PROFILE.DAT extended records?
(MTINV)
   0 = no (computed from measured/default gradients)
   1 = yes

PDF used for dispersion under convective conditions?
                                      Default: 0     ! MPDF =  0  !
(MPDF)
   0 = no
   1 = yes

Sub-Grid TIBL module used for shore line?
                                      Default: 0     ! MSGTIBL = 1  !
(MSGTIBL)
   0 = no
   1 = yes

Boundary conditions (concentration) modeled?
                                      Default: 0     ! MBCON = 0  !
(MBCON)
   0 = no
   1 = yes, using formatted BCON.DAT file
   2 = yes, using unformatted CONC.DAT file


Analyses of fogging and icing impacts due to emissions from
arrays of mechanically-forced cooling towers can be performed
using CALPUFF in conjunction with a cooling tower emissions
processor (CTEMISS) and its associated postprocessors.  Hourly
emissions of water vapor and temperature from each cooling tower
cell are computed for the current cell configuration and ambient
conditions by CTEMISS. CALPUFF models the dispersion of these
emissions and provides cloud information in a specialized format
for further analysis. Output to FOG.DAT is provided in either
'plume mode' or 'receptor mode' format.

Configure for FOG Model output?
                                      Default: 0     ! MFOG =  0   !
(MFOG)
   0 = no
   1 = yes  - report results in PLUME Mode format
   2 = yes  - report results in RECEPTOR Mode format


Test options specified to see if
they conform to regulatory
values? (MREG)                        Default: 1     ! MREG =  0   !

   0 = NO checks are made
   1 = Technical options must conform to USEPA
```

```
            Long Range Transport (LRT) guidance
                       METFM    1 or 2
                       AVET     60. (min)
                       PGTIME   60. (min)
                       MGAUSS   1
                       MCTADJ   3
                       MTRANS   1
                       MTIP     1
                       MCHEM    1 or 3 (if modeling SOx, NOx)
                       MWET     1
                       MDRY     1
                       MDISP    2 or 3
                       MPDF     0 if MDISP=3
                                1 if MDISP=2
                       MROUGH   0
                       MPARTL   1
                       SYTDEP   550. (m)
                       MHFTSZ   0

!END!

-------------------------------------------------------------------------------

INPUT GROUP: 3a, 3b -- Species list
-------------------

------------
Subgroup (3a)
------------

  The following species are modeled:

! CSPEC =          SO2 !         !END!
! CSPEC =         PM10 !         !END!
! CSPEC =           HF !         !END!
! CSPEC =           PF !         !END!
! CSPEC =       PAHGAS !         !END!
! CSPEC =        PAHPM !         !END!

                                                         Dry                OUTPUT GROUP
    SPECIES          MODELED          EMITTED       DEPOSITED                  NUMBER
     NAME         (0=NO, 1=YES)    (0=NO, 1=YES)    (0=NO,                  (0=NONE,
   (Limit: 12                                        1=COMPUTED-GAS          1=1st CGRUP,
    Characters                                       2=COMPUTED-PARTICLE     2=2nd CGRUP,
    in length)                                       3=USER-SPECIFIED)       3= etc.)

!          SO2  =         1,               1,           1,                  0   !
!         PM10  =         1,               1,           2,                  0   !
!           HF  =         1,               1,           1,                  0   !
!           PF  =         1,               1,           2,                  0   !
!       PAHGAS  =         1,               1,           1,                  0   !
!        PAHPM  =         1,               1,           2,                  0   !

!END!

-------------
Subgroup (3b)
-------------
  The following names are used for Species-Groups in which results
  for certain species are combined (added) prior to output.  The
  CGRUP name will be used as the species name in output files.
  Use this feature to model specific particle-size distributions
  by treating each size-range as a separate species.
  Order must be consistent with 3(a) above.



-------------------------------------------------------------------------------
```

```
INPUT GROUP: 4 -- Map Projection and Grid control parameters
--------------

     Projection for all (X,Y):
     -------------------------

     Map projection
     (PMAP)                    Default: UTM    ! PMAP = UTM  !

         UTM :  Universal Transverse Mercator
         TTM :  Tangential Transverse Mercator
         LCC :  Lambert Conformal Conic
          PS :  Polar Stereographic
          EM :  Equatorial Mercator
        LAZA :  Lambert Azimuthal Equal Area

     False Easting and Northing (km) at the projection origin
     (Used only if PMAP= TTM, LCC, or LAZA)
     (FEAST)                   Default=0.0     ! FEAST  = 0.000  !
     (FNORTH)                  Default=0.0     ! FNORTH = 0.000  !

     UTM zone (1 to 60)
     (Used only if PMAP=UTM)
     (IUTMZN)                  No Default      ! IUTMZN =  28   !

     Hemisphere for UTM projection?
     (Used only if PMAP=UTM)
     (UTMHEM)                  Default: N      ! UTMHEM = N  !
         N   :  Northern hemisphere projection
         S   :  Southern hemisphere projection

     Latitude and Longitude (decimal degrees) of projection origin
     (Used only if PMAP= TTM, LCC, PS, EM, or LAZA)
     (RLAT0)                   No Default      ! RLAT0 = 0.0N  !
     (RLON0)                   No Default      ! RLON0 = 0.0E  !

         TTM :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         LCC :  RLON0 identifies central (true N/S) meridian of projection
                RLAT0 selected for convenience
         PS  :  RLON0 identifies central (grid N/S) meridian of projection
                RLAT0 selected for convenience
         EM  :  RLON0 identifies central meridian of projection
                RLAT0 is REPLACED by 0.0N (Equator)
         LAZA:  RLON0 identifies longitude of tangent-point of mapping plane
                RLAT0 identifies latitude of tangent-point of mapping plane

     Matching parallel(s) of latitude (decimal degrees) for projection
     (Used only if PMAP= LCC or PS)
     (XLAT1)                   No Default      ! XLAT1 = 0.0N  !
     (XLAT2)                   No Default      ! XLAT2 = 0.0N  !

         LCC :  Projection cone slices through Earth's surface at XLAT1 and XLAT2
         PS  :  Projection plane slices through Earth at XLAT1
                (XLAT2 is not used)

     ----------
     Note:  Latitudes and longitudes should be positive, and include a
            letter N,S,E, or W indicating north or south latitude, and
            east or west longitude.  For example,
            35.9  N Latitude  =  35.9N
            118.7 E Longitude = 118.7E


     Datum-region
     ------------

     The Datum-Region for the coordinates is identified by a character
     string.  Many mapping products currently available use the model of the
     Earth known as the World Geodetic System 1984 (WGS-84).  Other local
```

```
     models may be in use, and their selection in CALMET will make its output
     consistent with local mapping products.  The list of Datum-Regions with
     official transformation parameters is provided by the National Imagery and
     Mapping Agency (NIMA).

     NIMA Datum - Regions(Examples)
     ------------------------------------------------------------------------------
     WGS-84    WGS-84 Reference Ellipsoid and Geoid, Global coverage (WGS84)
     NAS-C     NORTH AMERICAN 1927 Clarke 1866 Spheroid, MEAN FOR CONUS (NAD27)
     NAR-C     NORTH AMERICAN 1983 GRS 80 Spheroid, MEAN FOR CONUS (NAD83)
     NWS-84    NWS 6370KM Radius, Sphere
     ESR-S     ESRI REFERENCE 6371KM Radius, Sphere

     Datum-region for output coordinates
     (DATUM)                   Default: WGS-84    ! DATUM = NWS-84  !


METEOROLOGICAL Grid:

     Rectangular grid defined for projection PMAP,
     with X the Easting and Y the Northing coordinate

            No. X grid cells (NX)      No default     ! NX =  170   !
            No. Y grid cells (NY)      No default     ! NY =  170   !
         No. vertical layers (NZ)      No default     ! NZ =  10   !

           Grid spacing (DGRIDKM)      No default     ! DGRIDKM = 0.3 !
                                       Units: km

                Cell face heights
                    (ZFACE(nz+1))      No defaults
                                       Units: m
   ! ZFACE = 0., 20., 40., 80., 160., 320., 600., 1000., 1500., 2200.,
              3000. !

            Reference Coordinates
           of SOUTHWEST corner of
                 grid cell(1, 1):

            X coordinate (XORIGKM)     No default     ! XORIGKM = 521. !
            Y coordinate (YORIGKM)     No default     ! YORIGKM = 7192. !
                                      Units: km


COMPUTATIONAL Grid:

     The computational grid is identical to or a subset of the MET. grid.
     The lower left (LL) corner of the computational grid is at grid point
     (IBCOMP, JBCOMP) of the MET. grid.  The upper right (UR) corner of the
     computational grid is at grid point (IECOMP, JECOMP) of the MET. grid.
     The grid spacing of the computational grid is the same as the MET. grid.

        X index of LL corner (IBCOMP)      No default     ! IBCOMP =  1   !
                  (1 <= IBCOMP <= NX)

        Y index of LL corner (JBCOMP)      No default     ! JBCOMP =  25   !
                  (1 <= JBCOMP <= NY)


        X index of UR corner (IECOMP)      No default     ! IECOMP =  170   !
                  (1 <= IECOMP <= NX)

        Y index of UR corner (JECOMP)      No default     ! JECOMP =  130   !
                  (1 <= JECOMP <= NY)



SAMPLING Grid (GRIDDED RECEPTORS):

     The lower left (LL) corner of the sampling grid is at grid point
     (IBSAMP, JBSAMP) of the MET. grid.  The upper right (UR) corner of the
```

```
     sampling grid is at grid point (IESAMP, JESAMP) of the MET. grid.
     The sampling grid must be identical to or a subset of the computational
     grid.  It may be a nested grid inside the computational grid.
     The grid spacing of the sampling grid is DGRIDKM/MESHDN.

        Logical flag indicating if gridded
        receptors are used (LSAMP)         Default: T     ! LSAMP = F !
        (T=yes, F=no)

        X index of LL corner (IBSAMP)      No default     ! IBSAMP =  25   !
         (IBCOMP <= IBSAMP <= IECOMP)

        Y index of LL corner (JBSAMP)      No default     ! JBSAMP =  25   !
         (JBCOMP <= JBSAMP <= JECOMP)


        X index of UR corner (IESAMP)      No default     ! IESAMP =  170   !
         (IBCOMP <= IESAMP <= IECOMP)

        Y index of UR corner (JESAMP)      No default     ! JESAMP =  130   !
         (JBCOMP <= JESAMP <= JECOMP)


       Nesting factor of the sampling
        grid (MESHDN)                      Default: 1     ! MESHDN =  1  !
        (MESHDN is an integer >= 1)

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 5 -- Output Options
--------------
                                             *                          *
     FILE                       DEFAULT VALUE             VALUE THIS RUN
     ----                       -------------             --------------

   Concentrations (ICON)              1                   !  ICON =  1   !
   Dry Fluxes (IDRY)                  1                   !  IDRY =  1   !
   Wet Fluxes (IWET)                  1                   !  IWET =  1   !
   Relative Humidity (IVIS)           1                   !  IVIS =  0   !
    (relative humidity file is
     required for visibility
     analysis)
   Use data compression option in output file?
   (LCOMPRS)                           Default: T         ! LCOMPRS = T !

   *
    0 = Do not create file, 1 = create file


    DIAGNOSTIC MASS FLUX OUTPUT OPTIONS:

       Mass flux across specified boundaries
       for selected species reported hourly?
       (IMFLX)                         Default: 0         ! IMFLX =  0  !
         0 = no
         1 = yes (FLUXBDY.DAT and MASSFLX.DAT filenames
                  are specified in Input Group 0)

       Mass balance for each species
       reported hourly?
       (IMBAL)                         Default: 0         ! IMBAL =  0  !
         0 = no
         1 = yes (MASSBAL.DAT filename is
              specified in Input Group 0)


    LINE PRINTER OUTPUT OPTIONS:
```

```
       Print concentrations (ICPRT)    Default: 0          ! ICPRT =  0   !
       Print dry fluxes (IDPRT)        Default: 0          ! IDPRT =  0   !
       Print wet fluxes (IWPRT)        Default: 0          ! IWPRT =  0   !
       (0 = Do not print, 1 = Print)

       Concentration print interval
       (ICFRQ) in hours                Default: 1          ! ICFRQ =  1   !
       Dry flux print interval
       (IDFRQ) in hours                Default: 1          ! IDFRQ =  1   !
       Wet flux print interval
       (IWFRQ) in hours                Default: 1          ! IWFRQ =  1   !

       Units for Line Printer Output
       (IPRTU)                         Default: 1          ! IPRTU =  1   !
                       for            for
                  Concentration    Deposition
           1 =       g/m**3         g/m**2/s
           2 =      mg/m**3        mg/m**2/s
           3 =      ug/m**3        ug/m**2/s
           4 =      ng/m**3        ng/m**2/s
           5 =     Odour Units

       Messages tracking progress of run
       written to the screen ?
       (IMESG)                         Default: 2          ! IMESG =  2   !
         0 = no
         1 = yes (advection step, puff ID)
         2 = yes (YYYYJJJHH, # old puffs, # emitted puffs)


     SPECIES (or GROUP for combined species) LIST FOR OUTPUT OPTIONS

                 ---- CONCENTRATIONS ----   ------ DRY FLUXES ------   ------ WET FLUXES ------
-- MASS FLUX --
   SPECIES
   /GROUP        PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?   PRINTED?  SAVED ON DISK?
SAVED ON DISK?
   -------       ------------------------   ------------------------   ------------------------
---------------
!         SO2 =     0,           1,           0,           1,           0,           1,
0   !
!        PM10 =     0,           1,           0,           1,           0,           1,
0   !
!          HF =     0,           1,           0,           1,           0,           1,
0   !
!          PF =     0,           1,           0,           1,           0,           1,
0   !
!      PAHGAS =     0,           1,           0,           1,           0,           1,
0   !
!       PAHPM =     0,           1,           0,           1,           0,           1,
0   !

     OPTIONS FOR PRINTING "DEBUG" QUANTITIES (much output)

       Logical for debug output
       (LDEBUG)                                 Default: F     ! LDEBUG = F !

       First puff to track
       (IPFDEB)                                 Default: 1     ! IPFDEB =  1  !

       Number of puffs to track
       (NPFDEB)                                 Default: 1     ! NPFDEB =  10  !

       Met. period to start output
       (NN1)                                    Default: 1     ! NN1 =  1   !

       Met. period to end output
       (NN2)                                    Default: 10    ! NN2 =  10  !

!END!
```

```
-------------------------------------------------------------------------------


INPUT GROUP: 6a, 6b, & 6c -- Subgrid scale complex terrain inputs
-------------------------

---------------
Subgroup (6a)
---------------
       Number of terrain features (NHILL)       Default: 0     ! NHILL =  0   !

       Number of special complex terrain
       receptors  (NCTREC)                      Default: 0     ! NCTREC =  0   !

       Terrain and CTSG Receptor data for
       CTSG hills input in CTDM format ?
       (MHILL)                                  No Default     ! MHILL =  2   !
       1 = Hill and Receptor data created
           by CTDM processors & read from
           HILL.DAT and HILLRCT.DAT files
       2 = Hill data created by OPTHILL &
           input below in Subgroup (6b);
           Receptor data in Subgroup (6c)

       Factor to convert horizontal dimensions  Default: 1.0   ! XHILL2M = 1. !
       to meters (MHILL=1)

       Factor to convert vertical dimensions    Default: 1.0   ! ZHILL2M = 1. !
       to meters (MHILL=1)

       X-origin of CTDM system relative to      No Default     ! XCTDMKM = 0.0E00 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

       Y-origin of CTDM system relative to      No Default     ! YCTDMKM = 0.0E00 !
       CALPUFF coordinate system, in Kilometers (MHILL=1)

! END !

---------------
Subgroup (6b)
---------------

                      1 **
     HILL information


HILL           XC        YC       THETAH  ZGRID  RELIEF    EXPO 1    EXPO 2   SCALE 1    SCALE 2
AMAX1     AMAX2
 NO.          (km)      (km)      (deg.)   (m)     (m)      (m)       (m)       (m)        (m)
(m)       (m)
----          ----      ----      ------  -----  ------    ------    ------   -------    -------
-----     -----

---------------
Subgroup (6c)
---------------

    COMPLEX TERRAIN RECEPTOR INFORMATION

                      XRCT         YRCT        ZRCT          XHH
                      (km)         (km)         (m)
                     ------        -----      ------         ----


-------------------
1
     Description of Complex Terrain Variables:
          XC, YC  = Coordinates of center of hill
          THETAH  = Orientation of major axis of hill (clockwise from
```

```
                    North)
          ZGRID   = Height of the  0  of the grid above mean sea
                    level
          RELIEF  = Height of the crest of the hill above the grid elevation
          EXPO 1  = Hill-shape exponent for the major axis
          EXPO 2  = Hill-shape exponent for the major axis
          SCALE 1 = Horizontal length scale along the major axis
          SCALE 2 = Horizontal length scale along the minor axis
          AMAX    = Maximum allowed axis length for the major axis
          BMAX    = Maximum allowed axis length for the major axis

          XRCT, YRCT = Coordinates of the complex terrain receptors
          ZRCT    = Height of the ground (MSL) at the complex terrain
                    Receptor
          XHH     = Hill number associated with each complex terrain receptor
                    (NOTE: MUST BE ENTERED AS A REAL NUMBER)

   **
     NOTE: DATA for each hill and CTSG receptor are treated as a separate
           input subgroup and therefore must end with an input group terminator.

-------------------------------------------------------------------------------


INPUT GROUP: 7 -- Chemical parameters for dry deposition of gases
--------------

      SPECIES     DIFFUSIVITY      ALPHA STAR      REACTIVITY    MESOPHYLL RESISTANCE     HENRY'S
LAW COEFFICIENT
       NAME        (cm**2/s)                                               (s/cm)
(dimensionless)
      -------     -----------      ----------      ----------    --------------------     -------
----------------
!          SO2 =     0.1509,         1000.,            8.,                0.,
0.04 !
!           HF =     0.1628,            1.,           18.,                0.,
0.00000008 !
!       PAHGAS =      0.087,            1.,            4.,                1.,
0.152 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 8 -- Size parameters for dry deposition of particles
--------------

     For SINGLE SPECIES, the mean and standard deviation are used to
     compute a deposition velocity for NINT (see group 9) size-ranges,
     and these are then averaged to obtain a mean deposition velocity.

     For GROUPED SPECIES, the size distribution should be explicitly
     specified (by the 'species' in the group), and the standard deviation
     for each should be entered as 0.  The model will then use the
     deposition velocity for the stated mean diameter.

      SPECIES      GEOMETRIC MASS MEAN        GEOMETRIC STANDARD
       NAME             DIAMETER                   DEVIATION
                        (microns)                  (microns)
      -------      -------------------        ------------------
!        PM10  =         0.48,                      2.   !
!       PAHPM  =         0.48,                      2.   !
!          PF  =         0.48,                      2.   !

!END!


-------------------------------------------------------------------------------
```

```
INPUT GROUP: 9 -- Miscellaneous dry deposition parameters
--------------

     Reference cuticle resistance (s/cm)
     (RCUTR)                         Default: 30    !  RCUTR = 30.0 !
     Reference ground resistance  (s/cm)
     (RGR)                           Default: 10    !    RGR = 5.0 !
     Reference pollutant reactivity
     (REACTR)                        Default: 8     ! REACTR = 8.0 !

     Number of particle-size intervals used to
     evaluate effective particle deposition velocity
     (NINT)                          Default: 9     !   NINT =  9  !

     Vegetation state in unirrigated areas
     (IVEG)                          Default: 1     !   IVEG =  1   !
        IVEG=1 for active and unstressed vegetation
        IVEG=2 for active and stressed vegetation
        IVEG=3 for inactive vegetation

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 10 -- Wet Deposition Parameters
---------------


                      Scavenging Coefficient -- Units: (sec)**(-1)

       Pollutant      Liquid Precip.       Frozen Precip.
       ---------      --------------       --------------
!          SO2 =         3.0E-05,             0.0E00 !
!           HF =        7.06E-05,             0.0E00 !
!       PAHGAS =        3.52E-05,             0.0E00 !
!         PM10 =         1.0E-04,            3.0E-05 !
!        PAHPM =         1.0E-04,            3.0E-05 !
!           PF =         1.0E-04,            3.0E-05 !

!END!


-------------------------------------------------------------------------------


INPUT GROUP: 11 -- Chemistry Parameters
---------------

     Ozone data input option (MOZ)     Default: 1            ! MOZ =  0   !
     (Used only if MCHEM = 1, 3, or 4)
        0 = use a monthly background ozone value
        1 = read hourly ozone concentrations from
            the OZONE.DAT data file

     Monthly ozone concentrations
     (Used only if MCHEM = 1, 3, or 4 and
      MOZ = 0 or MOZ = 1 and all hourly O3 data missing)
     (BCKO3) in ppb                  Default: 12*80.
     !  BCKO3 = 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00, 80.00,
80.00 !

     Monthly ammonia concentrations
     (Used only if MCHEM = 1, or 3)
     (BCKNH3) in ppb                 Default: 12*10.
     !  BCKNH3 = 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00, 10.00,
10.00 !

     Nighttime SO2 loss rate (RNITE1)
```

```
     in percent/hour                  Default: 0.2          ! RNITE1 = .2 !

     Nighttime NOx loss rate (RNITE2)
     in percent/hour                  Default: 2.0          ! RNITE2 = 2.0 !

     Nighttime HNO3 formation rate (RNITE3)
     in percent/hour                  Default: 2.0          ! RNITE3 = 2.0 !

     H2O2 data input option (MH2O2)    Default: 1            ! MH2O2 =  1   !
     (Used only if MAQCHEM = 1)
        0 = use a monthly background H2O2 value
        1 = read hourly H2O2 concentrations from
            the H2O2.DAT data file

     Monthly H2O2 concentrations
     (Used only if MQACHEM = 1 and
      MH2O2 = 0 or MH2O2 = 1 and all hourly H2O2 data missing)
     (BCKH2O2) in ppb                  Default: 12*1.
     !  BCKH2O2 = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !


 --- Data for SECONDARY ORGANIC AEROSOL (SOA) Option
     (used only if MCHEM = 4)

     The SOA module uses monthly values of:
          Fine particulate concentration in ug/m^3 (BCKPMF)
          Organic fraction of fine particulate     (OFRAC)
          VOC / NOX ratio (after reaction)         (VCNX)
     to characterize the air mass when computing
     the formation of SOA from VOC emissions.
     Typical values for several distinct air mass types are:

        Month    1    2    3    4    5    6    7    8    9   10   11   12
                Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec

     Clean Continental
        BCKPMF   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.   1.
        OFRAC  .15  .15  .20  .20  .20  .20  .20  .20  .20  .20  .20  .15
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Clean Marine (surface)
        BCKPMF  .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5   .5
        OFRAC  .25  .25  .30  .30  .30  .30  .30  .30  .30  .30  .30  .25
        VCNX    50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.  50.

     Urban - low biogenic (controls present)
        BCKPMF  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.  30.
        OFRAC  .20  .20  .25  .25  .25  .25  .25  .25  .20  .20  .20  .20
        VCNX     4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.   4.

     Urban - high biogenic (controls present)
        BCKPMF  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.  60.
        OFRAC  .25  .25  .30  .30  .30  .55  .55  .55  .35  .35  .35  .25
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Regional Plume
        BCKPMF  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.  20.
        OFRAC  .20  .20  .25  .35  .25  .40  .40  .40  .30  .30  .30  .20
        VCNX    15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.  15.

     Urban - no controls present
        BCKPMF 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100. 100.
        OFRAC  .30  .30  .35  .35  .35  .55  .55  .55  .35  .35  .35  .30
        VCNX     2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.   2.

     Default: Clean Continental
     !  BCKPMF = 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00, 1.00 !
     !  OFRAC  = 0.15, 0.15, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.20, 0.15 !
     !  VCNX   = 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00, 50.00,
50.00 !
```

```
!END!

-------------------------------------------------------------------------------

INPUT GROUP: 12 -- Misc. Dispersion and Computational Parameters
---------------

     Horizontal size of puff (m) beyond which
     time-dependent dispersion equations (Heffter)
     are used to determine sigma-y and
     sigma-z (SYTDEP)                           Default: 550.   ! SYTDEP = 5.5E02 !

     Switch for using Heffter equation for sigma z
     as above (0 = Not use Heffter; 1 = use Heffter
     (MHFTSZ)                                   Default: 0      ! MHFTSZ =  0   !

     Stability class used to determine plume
     growth rates for puffs above the boundary
     layer (JSUP)                               Default: 5      ! JSUP =  5   !

     Vertical dispersion constant for stable
     conditions (k1 in Eqn. 2.7-3)  (CONK1)     Default: 0.01   ! CONK1 = .01 !

     Vertical dispersion constant for neutral/
     unstable conditions (k2 in Eqn. 2.7-4)
     (CONK2)                                    Default: 0.1    ! CONK2 = .1 !

     Factor for determining Transition-point from
     Schulman-Scire to Huber-Snyder Building Downwash
     scheme (SS used for Hs < Hb + TBD * HL)
     (TBD)                                      Default: 0.5    ! TBD = .5 !
        TBD < 0   ==> always use Huber-Snyder
        TBD = 1.5 ==> always use Schulman-Scire
        TBD = 0.5 ==> ISC Transition-point

     Range of land use categories for which
     urban dispersion is assumed
     (IURB1, IURB2)                             Default: 10     ! IURB1 =  10  !
                                                         19     ! IURB2 =  19  !

     Site characterization parameters for single-point Met data files ---------
     (needed for METFM = 2,3,4)

        Land use category for modeling domain
        (ILANDUIN)                              Default: 20     ! ILANDUIN =  20  !

        Roughness length (m) for modeling domain
        (Z0IN)                                  Default: 0.25   ! Z0IN = .25 !

        Leaf area index for modeling domain
        (XLAIIN)                                Default: 3.0    ! XLAIIN = 3.0 !

        Elevation above sea level (m)
        (ELEVIN)                                Default: 0.0    ! ELEVIN = .0 !

        Latitude (degrees) for met location
        (XLATIN)                                Default: -999.  ! XLATIN = -999.0 !

        Longitude (degrees) for met location
        (XLONIN)                                Default: -999.  ! XLONIN = -999.0 !

     Specialized information for interpreting single-point Met data files -----

        Anemometer height (m) (Used only if METFM = 2,3)
        (ANEMHT)                                Default: 10.    ! ANEMHT = 10.0 !

        Form of lateral turbulance data in PROFILE.DAT file
        (Used only if METFM = 4 or MTURBVW = 1 or 3)
```

```
   (ISIGMAV)                              Default: 1      ! ISIGMAV =  1  !
       0 = read sigma-theta
       1 = read sigma-v

   Choice of mixing heights (Used only if METFM = 4)
   (IMIXCTDM)                             Default: 0      ! IMIXCTDM =  0  !
       0 = read PREDICTED mixing heights
       1 = read OBSERVED mixing heights

Maximum length of a slug (met. grid units)
(XMXLEN)                                  Default: 1.0    ! XMXLEN = 1.0 !

Maximum travel distance of a puff/slug (in
grid units) during one sampling step
(XSAMLEN)                                 Default: 1.0    ! XSAMLEN = 1.0 !

Maximum Number of slugs/puffs release from
one source during one time step
(MXNEW)                                   Default: 99     ! MXNEW =  99   !

Maximum Number of sampling steps for
one puff/slug during one time step
(MXSAM)                                   Default: 99     ! MXSAM =  99   !

Number of iterations used when computing
the transport wind for a sampling step
that includes gradual rise (for CALMET
and PROFILE winds)
(NCOUNT)                                  Default: 2      ! NCOUNT =  2   !

Minimum sigma y for a new puff/slug (m)
(SYMIN)                                   Default: 1.0    ! SYMIN = 1.0  !

Minimum sigma z for a new puff/slug (m)
(SZMIN)                                   Default: 1.0    ! SZMIN = 1.0  !

Default minimum turbulence velocities
sigma-v and sigma-w for each
stability class (m/s)
(SVMIN(6) and SWMIN(6))     Default SVMIN : .50,  .50,  .50,  .50,  .50,  .50
                            Default SWMIN : .20,  .12,  .08,  .06,  .03,  .016

                          Stability Class :  A     B     C     D     E     F
                                            ---   ---   ---   ---   ---   ---
                                  ! SVMIN = 0.500, 0.500, 0.500, 0.500, 0.500, 0.500!
                                  ! SWMIN = 0.200, 0.120, 0.080, 0.060, 0.030, 0.016!

Divergence criterion for dw/dz across puff
used to initiate adjustment for horizontal
convergence (1/s)
Partial adjustment starts at CDIV(1), and
full adjustment is reached at CDIV(2)
(CDIV(2))                                 Default: 0.0,0.0  ! CDIV = .0, .0 !

Minimum wind speed (m/s) allowed for
non-calm conditions. Also used as minimum
speed returned when using power-law
extrapolation toward surface
(WSCALM)                                  Default: 0.5    ! WSCALM = .5 !

Maximum mixing height (m)
(XMAXZI)                                  Default: 3000.  ! XMAXZI = 3000.0 !

Minimum mixing height (m)
(XMINZI)                                  Default: 50.    ! XMINZI = 50.0 !

Default wind speed classes --
5 upper bounds (m/s) are entered;
the 6th class has no upper limit
(WSCAT(5))                      Default   :
                                ISC RURAL : 1.54, 3.09, 5.14, 8.23, 10.8 (10.8+)
```

```
                         Wind Speed Class :  1     2     3     4     5
                                            ---   ---   ---   ---   ---
                                  ! WSCAT = 1.54, 3.09, 5.14, 8.23, 10.80 !

Default wind speed profile power-law
exponents for stabilities 1-6
(PLX0(6))                      Default   : ISC RURAL values
                               ISC RURAL : .07, .07, .10, .15, .35, .55
                               ISC URBAN : .15, .15, .20, .25, .30, .30

                          Stability Class :  A     B     C     D     E     F
                                            ---   ---   ---   ---   ---   ---
                                   ! PLX0 = 0.07, 0.07, 0.10, 0.15, 0.35, 0.55 !

Default potential temperature gradient
for stable classes E, F (degK/m)
(PTG0(2))                      Default: 0.020, 0.035
                                   ! PTG0 = 0.020,   0.035 !

Default plume path coefficients for
each stability class (used when option
for partial plume height terrain adjustment
is selected -- MCTADJ=3)
(PPC(6))                  Stability Class :  A     B     C     D     E     F
                             Default  PPC : .50,  .50,  .50,  .50,  .35,  .35
                                            ---   ---   ---   ---   ---   ---
                                   !  PPC = 0.50, 0.50, 0.50, 0.50, 0.35, 0.35 !

Slug-to-puff transition criterion factor
equal to sigma-y/length of slug
(SL2PF)                              Default: 10.        ! SL2PF = 5.0 !

Puff-splitting control variables ------------------------

  VERTICAL SPLIT
  --------------

  Number of puffs that result every time a puff
  is split - nsplit=2 means that 1 puff splits
  into 2
  (NSPLIT)                           Default:   3        ! NSPLIT =  3  !

  Time(s) of a day when split puffs are eligible to
  be split once again; this is typically set once
  per day, around sunset before nocturnal shear develops.
  24 values: 0 is midnight (00:00) and 23 is 11 PM (23:00)
  0=do not re-split    1=eligible for re-split
  (IRESPLIT(24))                     Default:  Hour 17 = 1
  !  IRESPLIT = 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,0,0,0,0,0,0 !

  Split is allowed only if last hour's mixing
  height (m) exceeds a minimum value
  (ZISPLIT)                          Default: 100.       ! ZISPLIT = 100.0 !

  Split is allowed only if ratio of last hour's
  mixing ht to the maximum mixing ht experienced
  by the puff is less than a maximum value (this
  postpones a split until a nocturnal layer develops)
  (ROLDMAX)                          Default: 0.25       ! ROLDMAX = 0.25 !


  HORIZONTAL SPLIT
  ----------------

  Number of puffs that result every time a puff
  is split - nsplith=5 means that 1 puff splits
  into 5
  (NSPLITH)                          Default:   5        ! NSPLITH =  5  !

  Minimum sigma-y (Grid Cells Units) of puff
```

```
       before it may be split
       (SYSPLITH)                         Default:  1.0       ! SYSPLITH = 1.0 !

       Minimum puff elongation rate (SYSPLITH/hr) due to
       wind shear, before it may be split
       (SHSPLITH)                         Default:  2.        ! SHSPLITH = 2.0 !

       Minimum concentration (g/m^3) of each
       species in puff before it may be split
       Enter array of NSPEC values; if a single value is
       entered, it will be used for ALL species
       (CNSPLITH)                         Default:  1.0E-07   ! CNSPLITH = 1.0E-07 !

     Integration control variables ------------------------

       Fractional convergence criterion for numerical SLUG
       sampling integration
       (EPSSLUG)                          Default:   1.0e-04  ! EPSSLUG = 1.0E-04 !

       Fractional convergence criterion for numerical AREA
       source integration
       (EPSAREA)                          Default:   1.0e-06  ! EPSAREA = 1.0E-06 !

       Trajectory step-length (m) used for numerical rise
       integration
       (DSRISE)                           Default:   1.0      ! DSRISE = 1.0 !

       Boundary Condition (BC) Puff control variables ------------------------

       Minimum height (m) to which BC puffs are mixed as they are emitted
       (MBCON=2 ONLY).  Actual height is reset to the current mixing height
       at the release point if greater than this minimum.
       (HTMINBC)                          Default:   500.     ! HTMINBC = 500.0 !

       Search radius (in BC segment lengths) about a receptor for sampling
       nearest BC puff.  BC puffs are emitted with a spacing of one segment
       length, so the search radius should be greater than 1.
       (RSAMPBC)                          Default:   4.      ! RSAMPBC = 10.0 !

       Near-Surface depletion adjustment to concentration profile used when
       sampling BC puffs?
       (MDEPBC)                           Default:   1        ! MDEPBC =  1  !
          0 = Concentration is NOT adjusted for depletion
          1 = Adjust Concentration for depletion

!END!


-------------------------------------------------------------------------------


INPUT GROUPS: 13a, 13b, 13c, 13d -- Point source parameters
--------------------------------

---------------
Subgroup (13a)
---------------

     Number of point sources with
     parameters provided below      (NPT1)  No default  !  NPT1 =  0  !

     Units used for point source
     emissions below                (IPTU)  Default: 1  !  IPTU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr
```

```
     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (13d)        (NSPT1) Default: 0  !  NSPT1 =  0  !

     Number of point sources with
     variable emission parameters
     provided in external file      (NPT2)  No default  !  NPT2 =  0  !

     (If NPT2 > 0, these point
     source emissions are read from
     the file: PTEMARB.DAT)

!END!

---------------
Subgroup (13b)
---------------
                                             a
          POINT SOURCE: CONSTANT DATA
          -----------------------------
                                                                               b          c
  Source       X         Y       Stack    Base     Stack    Exit  Exit    Bldg.  Emission
   No.     Coordinate Coordinate Height Elevation Diameter  Vel.  Temp.   Dwash   Rates
              (km)      (km)       (m)      (m)       (m)  (m/s) (deg. K)
  ------   ---------- ---------- ------  ------   -------- ----- -------- ----- --------

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

     SRCNAM  is a 12-character name for a source
             (No default)
     X       is an array holding the source data listed by the column headings
             (No default)
     SIGYZI  is an array holding the initial sigma-y and sigma-z (m)
             (Default: 0.,0.)
     FMFAC   is a vertical momentum flux factor (0. or 1.0) used to represent
             the effect of rain-caps or other physical configurations that
             reduce momentum rise associated with the actual exit velocity.
             (Default: 1.0  -- full momentum used)

    b
     0. = No building downwash modeled, 1. = downwash modeled
     NOTE: must be entered as a REAL number (i.e., with decimal point)

    c
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IPTU
     (e.g. 1 for g/s).

---------------
Subgroup (13c)
---------------

           BUILDING DIMENSION DATA FOR SOURCES SUBJECT TO DOWNWASH
           -------------------------------------------------------
Source                                                                    a
 No.       Effective building height, width, length and X/Y offset (in meters)
           every 10 degrees.  LENGTH, XBADJ, and YBADJ are only needed for
           MBDW=2 (PRIME downwash option)
------     --------------------------------------------------------------------


--------

    a
     Building height, width, length, and X/Y offset from the source are treated
```

```
     as a separate input subgroup for each source and therefore must end with
     an input group terminator.  The X/Y offset is the position, relative to the
     stack, of the center of the upwind face of the projected building, with the
     x-axis pointing along the flow direction.

---------------
Subgroup (13d)
---------------
                                                a
          POINT SOURCE: VARIABLE EMISSIONS DATA
          ---------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 13b.  Factors entered multiply the rates in 13b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use PTEMARB.DAT and NPT2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------


INPUT GROUPS: 14a, 14b, 14c, 14d -- Area source parameters
--------------------------------

---------------
Subgroup (14a)
---------------

     Number of polygon area sources with
     parameters specified below (NAR1)       No default  !  NAR1 =  0   !

     Units used for area source
     emissions below            (IARU)       Default: 1  !  IARU =   1  !
           1 =        g/m**2/s
           2 =       kg/m**2/hr
           3 =       lb/m**2/hr
           4 =     tons/m**2/yr
           5 =     Odour Unit * m/s  (vol. flux/m**2 of odour compound)
           6 =     Odour Unit * m/min
           7 =     metric tons/m**2/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (14d)        (NSAR1) Default: 0  !  NSAR1 =  0  !

     Number of buoyant polygon area sources
     with variable location and emission
```

```
     parameters (NAR2)                      No default  !  NAR2 =  0   !
     (If NAR2 > 0, ALL parameter data for
     these sources are read from the file: BAEMARB.DAT)

!END!

---------------
Subgroup (14b)
---------------
                                     a
          AREA SOURCE: CONSTANT DATA
          ----------------------------
                                                         b
Source           Effect.    Base      Initial    Emission
 No.             Height   Elevation   Sigma z     Rates
                   (m)       (m)        (m)
-------          ------    ------     --------   ---------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.
    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IARU
     (e.g. 1 for g/m**2/s).

---------------
Subgroup (14c)
---------------

           COORDINATES (km) FOR EACH VERTEX(4) OF EACH POLYGON
           --------------------------------------------------------
Source                                                               a
 No.       Ordered list of X followed by list of Y, grouped by source
------     ------------------------------------------------------------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.


---------------
Subgroup (14d)
---------------
                                               a
          AREA SOURCE: VARIABLE EMISSIONS DATA
          --------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 14b.  Factors entered multiply the rates in 14b.
     Skip sources here that have constant emissions.  For more elaborate
     variation in source parameters, use BAEMARB.DAT and NAR2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                                Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
```

```
                                        0, 5, 10, 15, 20, 25, 30, 35, 40,
                                        45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------

INPUT GROUPS: 15a, 15b, 15c -- Line source parameters
---------------------------

---------------
Subgroup (15a)
---------------

     Number of buoyant line sources
     with variable location and emission
     parameters (NLN2)                             No default  !  NLN2 =  0   !

     (If NLN2 > 0, ALL parameter data for
      these sources are read from the file: LNEMARB.DAT)

     Number of buoyant line sources (NLINES)       No default   ! NLINES =  2  !

     Units used for line source
     emissions below               (ILNU)          Default: 1  !  ILNU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (15c)       (NSLN1) Default: 0  !  NSLN1 =  0  !

     Maximum number of segments used to model
     each line (MXNSEG)                            Default: 7   ! MXNSEG =  7  !

     The following variables are required only if NLINES > 0.  They are
     used in the buoyant line source plume rise calculations.

        Number of distances at which               Default: 6   ! NLRISE =  6  !
        transitional rise is computed

        Average building length (XL)               No default   ! XL = 1081.2 !
                                                   (in meters)

        Average building height (HBL)              No default   ! HBL = 22.5 !
                                                   (in meters)

        Average building width (WBL)               No default   ! WBL = 25.80 !
                                                   (in meters)

        Average line source width (WML)            No default   ! WML = 2.9 !
                                                   (in meters)

        Average separation between buildings (DXL) No default   ! DXL = 64.36 !
                                                   (in meters)

        Average buoyancy parameter (FPRIMEL)       No default   ! FPRIMEL = 1813.0 !
                                                   (in m**4/s**3)
```

```
!END!

---------------
Subgroup (15b)
---------------

          BUOYANT LINE SOURCE: CONSTANT DATA
          ----------------------------------
                                                                                           a
Source     Beg. X      Beg. Y      End. X    End. Y     Release    Base         Emission
 No.     Coordinate  Coordinate  Coordinate Coordinate  Height    Elevation      Rates
            (km)        (km)        (km)       (km)       (m)       (m)
------   ----------  ----------  ---------  ----------  -------   ---------    ---------
   1! SRCNAM = L1 !
   1! X =   541.899,  7212.247,   542.815,  7212.762,    22.500,    14.000, 1.0E00, 1.0E00,
1.0E00,
 1.0E00, 0.97E00, 0.03E00 !
!END!
   2! SRCNAM = L2 !
   2! X =   541.943,  7212.168,   542.859,  7212.683,    22.500,    14.000, 1.0E00, 1.0E00,
1.0E00,
 1.0E00, 0.97E00, 0.03E00 !
!END!

--------

    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by ILNTU
     (e.g. 1 for g/s).

---------------
Subgroup (15c)
---------------
                                                        a
          BUOYANT LINE SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 15b.  Factors entered multiply the rates in 15b.
     Skip sources here that have constant emissions.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                         Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)



--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.
```

```
-------------------------------------------------------------------------------


INPUT GROUPS: 16a, 16b, 16c -- Volume source parameters
---------------------------

---------------
Subgroup (16a)
---------------

     Number of volume sources with
     parameters provided in 16b,c (NVL1)     No default  !  NVL1 =  0   !

     Units used for volume source
     emissions below in 16b       (IVLU)     Default: 1  !  IVLU =   1  !
           1 =        g/s
           2 =       kg/hr
           3 =       lb/hr
           4 =     tons/yr
           5 =     Odour Unit * m**3/s  (vol. flux of odour compound)
           6 =     Odour Unit * m**3/min
           7 =     metric tons/yr

     Number of source-species
     combinations with variable
     emissions scaling factors
     provided below in (16c)      (NSVL1)    Default: 0  !  NSVL1 =  0  !

     Number of volume sources with
     variable location and emission
     parameters                   (NVL2)     No default  !  NVL2 =   0   !

     (If NVL2 > 0, ALL parameter data for
      these sources are read from the VOLEMARB.DAT file(s) )

!END!

---------------
Subgroup (16b)
---------------
                                         a
           VOLUME SOURCE: CONSTANT DATA
           ------------------------------
                                                                              b
         X           Y        Effect.    Base     Initial    Initial    Emission
     Coordinate  Coordinate   Height  Elevation  Sigma y    Sigma z     Rates
        (km)       (km)         (m)       (m)       (m)       (m)
     ----------  ----------   ------    ------    --------   --------   --------


--------
    a
     Data for each source are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
     An emission rate must be entered for every pollutant modeled.
     Enter emission rate of zero for secondary pollutants that are
     modeled, but not emitted.  Units are specified by IVLU
     (e.g. 1 for g/s).

---------------
Subgroup (16c)
---------------
                                                  a
          VOLUME SOURCE: VARIABLE EMISSIONS DATA
          ----------------------------------------

     Use this subgroup to describe temporal variations in the emission
     rates given in 16b.  Factors entered multiply the rates in 16b.
     Skip sources here that have constant emissions.  For more elaborate
```

```
     variation in source parameters, use VOLEMARB.DAT and NVL2 > 0.

     IVARY determines the type of variation, and is source-specific:
     (IVARY)                             Default: 0
           0 =       Constant
           1 =       Diurnal cycle (24 scaling factors: hours 1-24)
           2 =       Monthly cycle (12 scaling factors: months 1-12)
           3 =       Hour & Season (4 groups of 24 hourly scaling factors,
                                    where first group is DEC-JAN-FEB)
           4 =       Speed & Stab. (6 groups of 6 scaling factors, where
                                    first group is Stability Class A,
                                    and the speed classes have upper
                                    bounds (m/s) defined in Group 12
           5 =       Temperature   (12 scaling factors, where temperature
                                    classes have upper bounds (C) of:
                                    0, 5, 10, 15, 20, 25, 30, 35, 40,
                                    45, 50, 50+)


--------
    a
     Data for each species are treated as a separate input subgroup
     and therefore must end with an input group terminator.


-------------------------------------------------------------------------------

INPUT GROUPS: 17a & 17b -- Non-gridded (discrete) receptor information
-----------------------

---------------
Subgroup (17a)
---------------

     Number of non-gridded receptors (NREC)  No default  !  NREC =  10784   !

!END!

---------------
Subgroup (17b)
---------------
                                                a
           NON-GRIDDED (DISCRETE) RECEPTOR DATA
           ------------------------------------

                   X            Y          Ground        Height   b
Receptor       Coordinate   Coordinate    Elevation   Above Ground
  No.             (km)         (km)          (m)           (m)
--------       ----------   ----------    ---------   ------------
     1 ! X =       535.0,     7210.0,     255.750,       0.000!   !END!
     2 ! X =       535.0,     7210.1,     218.500,       0.000!   !END!
     3 ! X =       535.0,     7210.2,     185.500,       0.000!   !END!
     4 ! X =       535.0,     7210.3,     154.500,       0.000!   !END!
     5 ! X =       535.0,     7210.4,      99.000,       0.000!   !END!
     6 ! X =       535.0,     7210.5,      81.000,       0.000!   !END!
     7 ! X =       535.0,     7210.6,      71.500,       0.000!   !END!
     8 ! X =       535.0,     7210.7,      53.000,       0.000!   !END!
...........
 10782 ! X =       549.8,     7217.4,     803.667,       0.000!   !END!
 10783 ! X =       549.8,     7217.6,     803.750,       0.000!   !END!
 10784 ! X =       549.8,     7217.8,     798.500,       0.000!   !END!


-------------
    a
     Data for each receptor are treated as a separate input subgroup
     and therefore must end with an input group terminator.

    b
```

```
Receptor height above ground is optional.  If no value is entered,
the receptor is placed on the ground.
```