

Usibelli – Wishbone Hill – Cloud Cover Sensitivity Analysis and Procedure to Fill Missing Cloud Cover Data – 1990 Year of Meteorological Data

In support of the Wishbone Hill minor source air quality permit application, dispersion modeling has been completed using a meteorological data set obtained from on-site measurements at Wishbone Hill and the nearby Palmer airport. As not all data was readily available at the Wishbone Hill location, some representative data from Palmer was used in the preparation of the model ready meteorological data.

The procedures described below are based on a series of discussions with the ADEC on best methods to ascertain the sensitivity of the use of Palmer cloud cover data for periods of missing Wishbone Hill data, and to describe an approach for filling in missing cloud cover data.

Cloud Cover Sensitivity Analysis

Processing in AERMET requires certain parameters for on-site data to allow the calculation of surface heat fluxes. These parameters were not measured during the Wishbone Hill meteorological data collection. Therefore, cloud cover data from the Palmer airport was used to allow AERMET to calculate necessary surface parameters for AERMOD.

In discussions with the ADEC, the agency suggested that cloud cover could vary between the mine site and the Palmer airport. Therefore, a sensitivity assessment was completed whereby cloud cover was set to either zero (0) to simulate clear skies or ten (10) to simulate overcast skies. These values were varied in AERMET through the TSKC keyword in stage 1 onsite meteorological data processing of the on-site meteorological data.

For the clear skies scenario, the TSKC values were set to 0 for each of the hours of available cloud cover from the Palmer airport data set used in the original AERMET processing. This process was repeated for the overcast case wherein a 10 was substituted for the 0. New AERMET surface and profile files were generated for both the clear sky and overcast sky cases and the original PM₁₀ files re-run for each of these new cases (clear sky and overcast). Little difference was found between the cases, especially the overcast case. The conclusion is that sky cover was not an overly sensitive parameter to calculated ambient modeled concentrations.

The results of the comparison are shown in Table 1.

Table 1. Usibelli Coal Mine – Wishbone Hill Comparative Sky Cover Sensitivity Assessment

Comparative Sky Cover Analysis	Normalized Modeled PM₁₀ Concentration Relative to Original Palmer Cloud Cover Data (µg/m³)
Original Assessment – Palmer Cloud Cover	1.0
Clear Skies – TSKC = 0	1.1
Overcast Skies – TSKC = 10	1.0

Procedure to Fill Missing Cloud Cover Data

The Usibelli Wishbone Hill on-site meteorological data has been deemed complete and representative of site-specific conditions, was collected in an appropriate manner, has been approved for dispersion modeling at the Wishbone Hill site, and fulfills the requirements of one-year of on-site meteorological data in accordance with the Guideline on Air Quality Modeling.

Cloud cover data needed to process surface boundary parameters in AERMET are obtained from Palmer airport but those data contain gaps of time where no observations are available. The ADEC and Usibelli have discussed a number of ways to fill in these missing periods but a specific approach has yet to be agreed upon.

As shown above, Usibelli provided a sensitivity analysis of the variability in cloud cover data by using the existing Palmer cloud cover and replacing the existing cloud cover data with either a zero to simulate clear skies or a ten to simulate overcast skies.

Based on this assessment which indicated that slightly higher concentrations occurred under the clear sky assumption, the ADEC suggested filling all missing periods with a value of zero to simulate clear skies for each hour missing cloud cover.

Usibelli suggested filling with the missing periods with the weighted average value of all the existing 1990 Palmer cloud cover data which was calculated to be equal to seven (7) representing 7/10 sky cover.

In the 1990 Palmer sky cover data there are 4767 missing hours of cloud cover and of the remaining valid hours there are 822 hours of clear skies, 494 hours labeled as 3/10 cover, 731 hours labeled as 9/10 cover, and 1946 hours noted as overcast. Based on the existing data, clearly the assumption of clear skies for the remaining hours would be unrealistic as clear skies account for only 20 percent of the valid periods.

Usibelli has examined 9 other years of Palmer data and is proposing the following approach to fill in the missing periods:

- for each year of the period 1986-1995, process the Palmer surface and Anchorage upper air data in AERMET to obtain sky cover values;
- for each hour of a valid sky cover value over the 10 year period determine the minimum sky cover value;
- substitute the valid minimum sky cover value for any missing value in the 1990 sky cover record; and
- calculate the average sky cover for each year of the 10 year period and apply the minimum calculated average sky cover to the remaining missing periods of data.

Using this approach for the 1990 period will replace approximately 1900 hours of missing data with valid hourly sky cover data from the coincident hour from one of the other 9 years of sky cover data. This leaves approximately 2885 hours of missing sky cover. The average sky cover value from each of the 10 years of Palmer data ranges from 6.89 to 7.92 for a sky cover value of between 7 and 8. Therefore the value of 7 would be used to fill in the missing hours.

The revised and filled hourly sky cover were processed in stage 1 AERMET on the on-site data record and consisted of valid 1990 Palmer sky cover data, augmented with minimum recorded coincident hour sky cover data from one of the other 9 years of data to fill in missing values, and a minimum average annual sky cover value to fill in the remaining cloud cover data.

This revised meteorological data set was used in AERMOD to model the emission profile associated with planned mining operations at Usibelli Wishbone Hill.