UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

January 27, 1988

MEMORANDUM

SUBJECT: Meteorological Preprocessor Program

FROM: Joseph A. Tikvart, Chief /S/
Source Receptor Analysis Branch (MD-14)

TO: Michael Koerber, Regional Meteorologist
Region V

In response to your request, the Model Clearinghouse has reviewed your three questions relating to procedures used by the State of Indiana for preprocessing on-site meteorological data for model input. Our comments are as follows.

Question 1. For calculating the mixing height, where should the surface temperature value be obtained, at the radiosonde station, at the nearest NWS station, or from on-site?

We agree with you that a consistent national approach is desirable. As you recall, you raised this issue to the Clearinghouse in October, 1985. At that time we believed that the issue had both technical and national consistency aspects that needed to be resolved with all the Regions involved. We still believe that this is the case. It also appears that there are some technical differences of opinion on which is the best approach. On one hand it seems logical to use the on-site data (or the nearest NWS site if no on-site data are available), since it is clearly more representative of the surface environment being experienced by the plume(s). On the other hand an argument can be made that the integrity of the temperature profile is compromised by using surface temperature data at a location other than where the sounding was taken.

As a consequence of these issues we believe that more time is needed to study the problem before providing a definitive answer. Our proposal is to bring up the issue, from a technical perspective, at the next On-site Meteorological Data Work Group meeting. Such a meeting is under consideration for early Spring 1988. Among other items, this work group would explore the the technical aspects of the issue and hopefully reach a consensus position. This position can then be discussed at the next Regional/State Modelers Workshop in May 1988. In the meantime we recommend that you try to be as consistent as possible within the State of Indiana and within Region V in dealing with problems as they come up.

Question 2. If the primary site measures a valid calm hour, then should the hour be discarded via the calms treatment in CALMPRO or should the wind direction and wind speed from another site be substituted?

We recommend that the calm hours be processed with CALMPRO in all circumstances. Data substitutions should not be made for calms. For most onsite data we would expect that there would be few calms since the instrument thresholds are generally quite low compared to NWS instrumentation. In that regard we are concerned that the State may be designating all onsite wind data less than 1.0 m/s as calms. Consistent with the Guideline on Air Quality Models (Revised), such data should not be regarded as calm unless the wind speed is truly below the instrument threshold. If the wind is above the instrument threshold but less than 1.0 m/s, the direction should be used and the speed reset to 1.0 m/s.

In a related issue, we are concerned that there be a standard procedure for data substitution for missing data. It is our understanding based on conversations with you that the State does indeed have a "reasoned" hierarchy for data substitution and that spatial representativeness is taken into account. If this is the case, Region V should review that hierarchy from a technical standpoint.

Question 3. Can surface roughness be varied on a directional basis?

The second footnote on page 9-21 of the Guideline on Air Quality Models (Revised) discusses the z_0 concept briefly, indicating that z_0 should represent the average surface roughness within 1-3 km of the source. The reference at the end of the footnote is to be used to help estimate the z_0 values. This particular reference does indicate that it is appropriate to specify z_0 as a function of upwind direction for rural sites but cautions against doing so in urban areas.

Pages 6-16 to 6-18 of "On-Site Meteorological Program Guidance for Regulatory Modeling Applications" provides additional guidance on the selection of z_0. This guidance does indicate that it is technically supportable for z_0 to be varied provided that data exist to calculate z_0 from Equation 6.4.2, especially sigma-u data. It is our understanding that where this z_0 adjustment to Sigma-A was used (Gibson Power Plant), the requisite data were available and that the method outlined in the guidance was followed.

In general, varying z_0 by direction should be treated with caution and should only be done on a case-by-case basis. As explained in the guidance document, Equation 6.4.2 determines the effective roughness length and should only be applied to sectors of at least 30 degrees in width to account for major variations in surface roughness element. To eliminate any seasonal bias in determining effective roughness lengths, Equation 6.4.2 should be applied

to a full year of data. Table 6-1 of the guidance document may be used to to make an initial estimate of z_o for the sole purpose of determining an an appropriate measurement height for the data to be used in Equation 6.4.2 (between $20z_o$ and the $100z_o$). Table 6-1 should not be used to determine a direction-varying z_o for use in diffusion analyses. Once a table of effective roughness lengths by sector has been established, these values may be used to adjust the stability category boundaries in Table 9-3 of the Guideline on Air Quality Models (Revised) (also Tables 6-5 and 6-6 of the on-site guidance document). The surface roughness factor of $(z_o/15\ cm)^{0.2}$ would have to be applied to the stability category boundaries on an hour-by-hour basis depending on the observed hourly wind direction.

To answer your specific question, we agree that the wind direction data used to select the appropriate surface roughness value for a given hour should be taken from the same measurement height as the sigma-u data used to determine the effective roughness lengths. This will normally also be the measurement height used for stability classification, and is typically the 10m level. The measurement height should be within the range of $20z_o$ to $100z_o$.

General.

One other comment is that it appears to us that the State may be using the on-site data recorded to 10 degree intervals and then using a random number generator to specify down to one degree. We believe that, for on-site measurements, the wind direction data should be resolved to the nearest degree and input directly to the model.

Given the status of the Indiana SO_2 SIP, it seems wise at this time to accept what the State has done regarding preprocessing of meteorological data (to the extent that these data are used in the SIP). However Indiana should not get locked into their system until some of the above mentioned issues are resolved.

If you have any further questions at this time, please contact Dean Wilson.

cc: R. Brode
S. Reinders

FY 89 MODEL CLEARINGHOUSE MEMORANDA

Date	Region	Subject
10/11/88	VI	Use of ISC UNAMAP 6, Change 7
11/07/88	VI	Compilation of Most Recent, Available 5-Year Meteorological Data By Texas
11/08/88	V	State of Indiana Meteorological Preprocessor Program