Meteorological Determinations and Application of Dispersion Models

When a source is required to perform air quality modeling to demonstrate compliance with the National Ambient Air Quality Standards (NAAQS), the Environmental Protection Agency (EPA) requires the use of AERMOD. AERMOD is an atmospheric dispersion model developed to determine the ground level impacts from a proposed source and nearby sources. AERMOD uses meteorological data from a single location in its calculations.

EPA requires that the meteorological data input to AERMOD be "Adequately Representative". What is "Adequately Representative"? Broadly, this means that the dispersion and transport conditions of the meteorological data are similar to the dispersion and transport conditions the source will experience once it is built. If the meteorological data are adequately representative, then the design concentration predicted by the modeling should be located in the same general area that it will occur when the source is operating. The magnitude of the design concentration will also be similar to the magnitude of the design concentration once the site is operating at or near its potential to emit.

For NAAQS compliance demonstrations, AERMOD modeling also needs to include background concentrations and any nearby sources not accounted for in the background concentration.

The following are considered by the Division when determining if the meteorological data are adequately representative for a given project site:

- Terrain, e.g., is the meteorological data collected in terrain that is similar to the terrain at the proposed source location.
    - Meteorological data measured on a hill top will be different than data measured in a valley.
    - If a meteorological tower is in a valley, is the orientation of the valley similar to the valley a source is proposed to be in?
    - Are the valleys similar in size and drainage? These attributes affect height and the speed of the diurnal terrain-induced airflow.
    - Does the local terrain cause mesoscale weather systems like in western Colorado on ridge tops or northwest Colorado where the system that causes the winds in Laramie and Cheyenne starts?
    - Will the meteorological data cause impacts that are unrealistic, i.e., modeled plume terrain impacts that would not occur in reality?
- Will the provided meteorological data cause the plume(s) from nearby sources (emissions not represented by the background used in the modeling) to interact with the emissions of the proposed source in a manner similar to what will happen once the source is built?
- The height of the meteorological sensors versus the release height of the pollutant(s). Winds at 10 m (height of NWS meteorological tower) may be very different in speed and direction than winds at the top of a 150 m tower at a power plant.
- Land use, does the proposed source location have surface characteristics similar to the meteorological tower location? The surface characteristics affect roughness and albedo which affect sigma of the wind, gustiness, and stability.

- Instrument siting. A meteorological tower surrounded by buildings and concrete will have different temperatures, stability, and winds than one in and open field in the same area.
- Data capture and quality, 1 year of on-site, 3 years of prognostic modeled (Weather Research Forecasting model (WRF)), 5 years of National Weather Service (NWS)
    - Does the data meet EPA QA/QC standards?
    - Currently, prognostic modeled data from Colorado is not modeled on a small enough grid cell size to capture the local diurnal winds,
    - At NWS sites, is one minute data available? Not all AWOS sites in Colorado archive 1-minute data and without the 1-minute data, the data generally has a high frequency of calm and missing data, making it unusable for AERMOD modeling.
    - How are missing data handled, i.e., are data from a different location used to replace missing data?

Major source (i.e., PSD) applicants should work with Division staff early in the permitting process to determine monitoring and meteorological data requirements.

For minor sources, meteorological data for AERMOD modeling will be provided to an applicant by the Division when requested. The meteorological data request from the applicant should include:

- Coordinates (UTM or latitude/longitude) of the source location, including datum
- Source location identified on a 1:24,000-scale topographic map
- Brief description of the source emissions (i.e., stack (point) vs fugitive, stack heights, source types)
- Name of the source/project

The Division Staff will do a meteorological determination following the procedures described above and select which meteorological dataset available to the Division is most representative of the dispersion conditions at the source site.   The Division will provide its determination of data representativeness to the applicant in writing. The Division will process the meteorological data using current EPA approved methods and provide the meteorological data to the applicant. The meteorological dataset may be:

1. 5 years of National Weather Service (NWS) data,
2. at least 1 year of site-specific meteorological data, or
3. 3 years of prognostic meteorological data.

Note, the Division believes that currently available prognostic meteorological data are based on large grid cell sizes that do not adequately capture local diurnal wind speed and direction in Colorado. Therefore, prognostic meteorological data is not currently allowed for permitting by the Division. The Division plans to create prognostic data based on suitable grid spacing once funds and resources become available in the future.

The sections below provide guidance to applicants on using available meteorological data based on whether or not such data have been deemed to be representative. If the available meteorological data are determined to be not adequately representative, the Modeling and Emissions Inventory Unit (MEIU) will provide the applicant with two meteorological datasets. They will be rated best (the most representative dataset available) and second best (the next most representative dataset available).

Option 1 (Representative Data)

If there is representative meteorological data, the Division will provide the representative data set. Modeling will be conducted using the representative data set and the design concentration for each averaging time and pollutant will be based on the form of the National Ambient Air Quality Standard (NAAQS) for each pollutant being modeled.

Option 2 (Non-Representative Data)

If the available meteorological data is deemed not adequately representative of dispersion conditions at the source site, the Division will provide two meteorological datasets to the applicant. These meteorological datasets will be the two most representative datasets available to the Division and will be ranked by the Division; i.e. #1 (most representative) and #2 (second-most representative). These selected meteorological data could be any combination of NWS data, site-specific data, or prognostic data (once prognostic data become available). The applicant will then model with both data sets.

For the annual standard, the design concentration will be determined using the appropriate modeled concentration using only the #1 (most representative) meteorological data set.

For short-term standards, both meteorological data sets will be modeled. The design concentration will be ascertained from the modeled meteorological data set with the highest impacts using the form of the NAAQS for the pollutant and averaging period being modeled.

Example: based on 1-hour modeling for nitrogen dioxide (NO_2), where the form of the standard is the 98th percentile concentration, or the highest-eighth-highest (H8H) concentration for one-year of modeling data. The form of the standard will vary based on the specific pollutant of interest.

> Met Data 1 H8H: 75
> Met Data 2 H8H: 100
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> 100 > 75, therefore, use 100 as the design concentration (Maximum H8H value from the two data sets).
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> There is one exception to the above rule, which would occur when the design value from the second-ranked data set exceeds the maximum value based on the first-ranked data set, e.g., H8H (2nd data set) > H1H (1st data set). In this case, the H1H value from the 1st-ranked data set would be selected as the design value.   This exception assures that the two-station approach adopted by the Division does not return a higher design value compared to the Division's former modeling approach.
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> Met Data 1 H1H: 90
> Met Data 1 H8H: 75
> Met Data 2 H8H: 100
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> Met Data 2 H8H (100) > Met Data 1 H1H (90), therefore, use 90 as the design value (Met Data 1 H1H)

Option 3

In lieu of requesting a formal meteorological determination from the Division, the applicant may apply pre-selected meteorological data based on the source location. The Division will identify two suitable meteorological data sets for locations in Colorado and will make this information available on the Division's website using a map or similar tool. Under this option, the applicant will model with AERMOD using the two meteorological data sets pre-selected by the Division. However, where applicants select this alternative, the pre-selected meteorological data will be deemed "not representative" and the applicant will apply the modeling procedures outlined above under Option 2.

Please Note: Option 3 is presently under development by the Division and it not yet available to applicants.

Option 4

The applicant/consultant has the following options if they want to question or contest the Division's meteorological determination:

- Work with the MEIU to show why one of the meteorological datasets is adequately representative,
- Work with the MEIU to show a different meteorological dataset is adequately representative,
- Provide to MEIU a representative meteorological dataset,
- Collect one year of on-site meteorological data. If this alternative is selected, the MEIU highly encourages the applicant to work with MEIU on site placement of the meteorological tower, data collection requirements, and QA/QC plan to avoid possible delays.
- If the modeling results in predicted impacts that are unrealistic, for example the meteorological dataset has conditions generating high ambient impacts that most likely will not occur at the proposed source's location, the applicant can work with MEIU to remove these impacts from the NAAQS compliance demonstration.