Overview of LOWWIND options

Background

In an effort to improve model predictions during low wind conditions, the EPA has developed several beta options within the AERMOD modeling system that explore various adjustments to some of the dispersion parameters in AERMOD. The first low wind options were released with version 12345 of AERMOD, which included LOWWIND1 and LOWWIND2. A third low wind option, LOWWIND3, was included in the version 15181 of AERMOD. These are each mutually exclusive, non-default beta options focused on the minimum value of σ_v (the lateral turbulence intensity) being used in the AERMOD dispersion model, and also address the model's treatment of horizontal plume meander. A brief description of the current low wind options is provided below:

1. LOWWIND1: This option increases the default minimum σ_v value of 0.2 m/s to 0.5 m/s, but eliminates the horizontal meander component of lateral dispersion and also eliminates upwind dispersion.

2. LOWWIND2: This option increases the default minimum σ_v value of 0.2 m/s to 0.3 m/s, and includes an upper limit of 0.95 on FRAN, the horizontal meander component. The LOWWIND2 option includes upwind concentrations due to horizontal meander, but also includes some adjustments to the horizontal meander component, e.g., a value of 12 hrs is used for the BIGT parameter (a time scale at which mean wind information at the source is no longer correlated with the location of plume material at a downwind receptor), instead of the "default" value of 24 hrs.

3. LOWWIND3 option: This option increases the default minimum σ_v value of 0.2 m/s to 0.3 m/s, consistent with the LOWWIND1 option, but uses the non-default FASTALL approach that matches the centerline concentration for the LOWWIND2 option, based on an effective σ_y. It also eliminates upwind dispersion as being incongruous with a steady-state plume model. This may result in higher concentrations for receptors that are located "near" the plume centerline than with the LOWWIND2 option.

LOWWIND3 and the Update to Appendix W

As part of the 2015 NPRM update to Appendix W, the EPA sought public comment on the adoption of LOWWIND3 as a preferred regulatory option in the AERMOD dispersion model. While the EPA received public comments during the rule making process that were both supportive and against the adoption, the EPA ultimately determined that there may be a possibility that the LOWWIND3 option, both alone and when combined with the ADJ_U* option, could lead to model under predictions in some cases. As a result, in the final rulemaking, the EPA decided to defer promulgating the LOWWIND3 option as a preferred regulatory option and continue to engage with the modeling community on additional research that would refine the model formulation and better address the model performance issues under low wind conditions.

EPA white papers on LOWWIND options

To facilitate discussion on the components of the LOWWIND options and provide clarity on the state of the science of these components, the EPA has prepared two white papers detailing low wind issues:

1. Plume meander: discusses the treatment of plume meander within AERMOD and the modifications to the meander components that have been examined with previous LOWWIND options and the modifications the EPA is considering for future analysis and research, and

2. Minimum sigma-v value: discusses the minimum σ_v parameter, which was modified in all three of the previous LOWWIND options, and the modifications the EPA is considering for future analysis and research.

These papers also present a brief review of the state of the science on each model adjustment and considerations for future updates to these potential model adjustments.

Planned next steps with LOWWIND options within AERMOD

The combination of several adjustments to the underlying model science in a packaged "LOWWIND" option makes it difficult to isolate the impact of each adjustment on overall model predictions, and thus determine when interactions between the adjustments made in LOWWIND3 (or any other LOWWIND option) may lead to under predictions especially when used in conjunction with ADJ_U*. In order to isolate the impacts of individual adjustments and clarify the role of current and future research on addressing model performance under low wind conditions, the EPA intends to remove all three existing low wind options and replace them with a new general LOW_WIND option that allows individual adjustment of each of the relevant parameters from the original low wind options. The current plans for this new LOW_WIND model option will allow for adjustments to the following parameters[1,2]:

- **Minimum σ_v value**. The default value in AERMOD is 0.2 m/s. LOWWIND1 used a value of 0.5 m/s, LOWWIND2 and LOWWIND3 used a value of 0.3 m/s.
- **Plume meander/Upper limit of FRAN**. The default upper limit in AERMOD is 1.0, while LOWWIND2 set this value at 0.95.
- **Minimum wind speed**. The default value in AERMOD is 0.2828 m/s, consistent with the default applied in previous versions based on SQRT(2*SVmin*SVmin) with SVmin=0.2. While this value was not adjusted in any of the LOWWIND packages, the minimum wind speed can be adjusted under the existing LOW_WIND keyword.

By separating these adjustments as individual options that may be examined individually or as a group (including the ability to recreate the original LOWWIND options), each can be studied separately and evaluated on the merit of any advancements in the state of the science around these specific parameters as well as independent evaluations of their impact on model performance. White papers on

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[1] The adjustment to BIGT that was included as part of the LOWWIND2 options is currently not slated to be included in the LOW_WIND model option update but may be considered for further evaluation in future model updates, depending on the changes in available literature, EPA evaluations, or other feedback from the community.

[2] The elimination of upwind dispersion that was included as part of the LOWWIND3 option is currently not slated to be part of the LOW_WIND model option update but may be considered for further evaluation in future model updates, depending on the changes in available literature, EPA evaluations, or other feedback from the community.

each of these options are provided as part of this package to provide the groundwork for discussion by the modeling community and to inform the research and evaluation efforts by the EPA and by external stakeholders.