UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

MEMORANDUM

APR 2 9 2016

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

SUBJECT: Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (Version 15181) for the Schiller Station Modeling Demonstration

FROM: George Bridgers, Model Clearinghouse Director
Air Quality Modeling Group, C439-01

TO: David Conroy, Chief
Air Programs Branch, Region 1

INTRODUCTION

In response to your April 7, 2016 concurrence request memorandum, the Model Clearinghouse has reviewed Region 1's position on the proposed use of the ADJ_U* Beta option in the AERMET meteorological processor (version 15181) for the Schiller Station energy generating facility (Schiller Station) located in Portsmouth, New Hampshire. As noted in our February 10, 2016 response memorandum to Region 10[1], the ADJ_U* Beta option was incorporated in AERMET to address concerns regarding potential underprediction of the surface friction velocity (u*) during low-wind/stable conditions that could contribute to overprediction of ambient air impacts by the AERMOD dispersion model (version 15181) for some applications. In the case of the Shiller Station energy generating facility, excessive 1-hour SO_2 concentrations on distant terrain, 16km from the source, were projected by the regulatory default version of the AERMOD Modeling System specifically during low-wind/stable conditions when u* values were relatively small. Given this model response, it was appropriate for the ADJ_U* Beta option in AERMET to be considered for this regulatory modeling application.

MODEL CLEARINGHOUSE RESPONSE

Application of ADJ_U* Beta Option in AERMET

Appendix W, Section 3.2.2 provides three different conditions for which an alternative model is approvable. These three conditions are briefly summarized as:

1) The alternative and preferred model provide equivalent estimates;
2) The alternative model outperforms the preferred model when comparing the results to actual air quality data; or

[1] http://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=16-X-01

3) The preferred model is less appropriate or there is no preferred model for the given scenario.

In reviewing the April 7. 2016 concurrence request memorandum from Region 1 and the attached material from the New Hampshire Department of Environmental Services (NHDES), it is noted that Region 1 and NHDES were following the second condition[2] for the basis of this alternative model approval. The Model Clearinghouse concurs that a well-reasoned justification was thoroughly documented and demonstrates that the ADJ_U* Beta option in AERMET selected for the Schiller Station modeling demonstration performs better than the default regulatory version of AERMET for the given application, i.e., a tall stack located near complex terrain, where high modeled concentrations are likely to occur under low wind, stable conditions. In this case, an isolated terrain feature, Mt. Agamenticas, is located about 15km north-northeast from the Schiller Station with a peak elevation about 200m above the stack base, with relatively flat terrain between the source and the mountain.

We appreciate the efforts of Region 1 in the Model Clearinghouse concurrence request memorandum to highlight the additional evaluation databases, namely the Lovett[3] and Mercer County, ND[4], that more directly represent the Schiller Station and surrounding terrain circumstances. In both cases, the Lovett and Mercer County, ND evaluations demonstrate a significant improvement of the modeled concentrations with the use of the ADJ_U* Beta option for a facility with tall stacks located near complex terrain, particularly during low wind, stable conditions. Combined with the Qian and Venkatram[5] and the Luhar and Rayner[6] journal article references in the NHDES alternative model submittal that provide a scientific basis for the adjustment to u*, there is a reasonable justification for the application of the ADJ_U* Beta option in the Schiller Station modeling demonstration.

The NHDES alternative model submittal package included an additional source specific model sensitivity and monitor evaluation that is worth noting in our concurrence memorandum. A model sensitivity analysis was performed to further demonstrate the appropriateness and applicability of the ADJ_U* Beta option in the Schiller Station case. The sensitivity analysis indicated that the most critical impacts at receptors on the distant terrain were only occurring at hours with the u* values were substantially low, which is indicative of low wind, stable conditions. These receptors were all at or above the emissions release height at the Shiller Station. The application of the ADJ_U* Beta option resulted in comparable increases in the u*

[2] Appendix W to 40 CFR, Part 51, Section 3.2.2.b(2).

[3] EPA's Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD. September 2004, updated June 2015. EPA-454/B-03-001. Appendix F. Evaluation of Low Wind Beta Options.

[4] Paine. R., O. Samani. M. Kaplan, E. Knipping and N. Kumar. 2015. Evaluation of low wind modeling approaches for two tall-stack databases", Journal of the Air & Waste Management Association, 65:11, 1341-1353, DOI: 10.1080/10962247.2015.1085924.

[5] Qian, W. and A. Venkatram. 2010. "Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions." Boundary-Layer Meteorology (2011) 138:475–491 DOI 10.1007/s10546-010-9565-1. Published online December 3, 2010. Accessed August 24, 2015.

[6] Luhar AK and Rayner KN. 2009. "Methods to Estimate Surface Fluxes of Momentum and Heat from Routine Weather Observations for Dispersion Applications under Stable Stratification." Boundary-Layer Meteorology. 132:437-454. DOI 10.1007/s10546-009-9409-z.

values and reductions to the concentrations at these receptors as demonstrated in the representative Lovett and Mercy County, ND evaluations. For the receptors below the emissions release height, there was little to no change in concentrations with the application of the ADJ_U* Beta option. Additionally for the nearby controlling receptors not associated with the distant terrain feature, the critical impacts were occurring at times of much higher u* values, and these u* values were relatively unchanged with the application of the ADJ_U* Beta option. Therefore, we support that the model sensitivity analysis is providing further evidence of the relevance and appropriateness of the ADJ_U* Beta option for the Schiller Station modeling demonstration.

Lastly, there was indication in our aforementioned February 10, 2016 response memorandum to Region 10 that EPA has concerns that the use of the ADJ_U* Beta option in combination with site-specific meteorological data that includes the sigma-theta and/or sigma-w turbulence parameters may introduce a bias toward concentration underprediction. We continue to evaluate the potential for this concentration underprediction bias and caution anyone considering the use of both the ADJ_U* Beta option and meteorological data that includes the derived sigma-theta and/or sigma-w turbulence parameters in regulatory applications without consultation and approval from the appropriate permitting authority and the respective EPA Regional Office. However, it is noted that the meteorological data used in the Schiller Station modeling application were not site-specific and did not include any derived sigma-theta or sigma-w turbulence information. So, the underprediction bias concern is not a factor in this case.

cc: Leiran Biton, EPA Region 1
Richard Wayland, C304-02
Anna Wood, C504-01
Tyler Fox, C439-01
Raj Rao, C504-01
EPA Air Program Managers
EPA Regional Modeling Contacts