UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MA 02109-3912

APR 0 7 2016

MEMORANDUM

SUBJECT: Request to approve the use of the beta alternative formulation of surface friction velocity (u_*) non-regulatory default option in AERMET version 15181; alternative refined model demonstration

FROM: Leiran Biton, Physical Scientist
Air Permits, Toxics and Indoor Programs Unit, Air Programs Branch, Region 1

TO: George Bridgers, Director of Model Clearinghouse
Air Quality Modeling Group, Office of Air Quality Planning and Standards

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

EPA Region 1 seeks concurrence from the Model Clearinghouse on approval of the use of the beta alternative formulation of surface friction velocity (u_*) non-regulatory default option (ADJ_U*) in AERMET version 15181. EPA Region 1 has concluded that the second condition of Section 3.2.2(b) of Appendix W has been satisfied by the submittal from the New Hampshire Department of Environmental Services (DES), and would like to approve the use of the beta ADJ_U* option (either with or without the Bulk Richardson option) in AERMET version 15181 as the meteorological preprocessor for AERMOD version 15181 for this modeling. In support of this requested approval, we have prepared a technical report that reviews the DES submittal and documents our basis for decision-making. The technical report is attached for your reference.

Thank you for your careful attention to this matter and we look forward to your response. Please feel free to contact me at 617-918-1267 with any questions about this request or the attachment.

Attachment

Technical Report

Evaluation of the request for use of the beta adjust u_* option in AERMET for modeling for the 2010 1-hour sulfur dioxide standard at Schiller Station in Portsmouth, New Hampshire

Leiran Biton
EPA Region 1 Modeling Contact
April 7, 2016

The New Hampshire Department of Environmental Services (DES) submitted a request for the use of an alternative model to the U.S. Environmental Protection Agency (EPA) Region 1 Office in a letter dated March 18, 2016. DES proposed to use an alternative formulation for the surface friction velocity (u_*) in the AERMET meteorological preprocessor (version 15181) to the AERMOD model (version 15181) in its modeling of Schiller Station, operated by Eversource Energy, LLC, in Portsmouth, New Hampshire. Specifically, DES has submitted the request for the adjusted surface friction velocity technique, known as the beta adjust u_* option, for modeling intended to demonstrate compliance with the 2010 1-hour sulfur dioxide (SO_2) National Ambient Air Quality Standards (NAAQS). The modeling demonstration would apply to the Response to Order on Title V Petition VI-2014-04 regarding the issuance of a proposed Title V Operating Permit TV-0053 for Schiller Station, and also to commitments made by DES in its January 5, 2016 submittal under the SO_2 Data Requirements Rule.

This technical report provides an assessment of the submitted request for use of the beta adjust u_* option in AERMET and describes the rationale for a recommendation regarding the request. The submittal by DES included an attachment prepared by Exponent Inc. on behalf of Eversource Energy. DES has explicitly stated that it concurs with the request for use of the beta adjust u_* option in AERMET as an alternative model; therefore, this report treats the Exponent attachment as DES's own justification. The DES submittal is attached to this report.

Project overview

Schiller is a 150-MW capacity wood and fossil fuel-fired electricity generating facility located in Portsmouth, New Hampshire. Schiller Station consists of three 50-MW capacity electric utility steam boilers, two of which (Units 4 and 6) burn coal or oil and one of which (Unit 5) burns biomass. Schiller is owned and operated by Eversource Energy, LLC, previously known as Public Service of New Hampshire. Emissions from Schiller are released through three tall stacks—one per boiler—ranging approximately 68-70 m in height at elevations of 6.4-7.3 m. The temperature of stack releases ranges from 431 K (316 °F) to 450 K (350 °F). Stack and emissions specifications are described in Table 1 of the DES submittal.

Terrain in the immediate area (within around 10 km) around Schiller is simple, consisting of water bodies and low-elevation, flat or gently rolling features. Beyond the immediate area, terrain becomes increasingly complex, with complex terrain features (i.e., features with elevations above the height of the stack) beginning at around 16 km from the source. Specifically, Mount Agamenticus (elevation 211 m; about 16 km from Schiller) in York, Maine is the nearest complex terrain feature, and some further features in the 50 km square domain around the source are even higher in elevation.

In addition to Schiller, it is anticipated that Newington Station will be included in the modeling. Newington, located within 1 km of Schiller, is a natural gas and oil-fired electricity generating facility with rated capacity of approximately 400 MW and stack height of 125 m.

Based on these project details, the releases from Schiller and Newington are well characterized as buoyant plumes emitted from tall stacks in a region with complex terrain.

Background on default surface friction velocity and the beta adjust u_* option

Starting in version 12345, AERMOD has included non-regulatory default options (identified with the "beta" keyword) to address concerns regarding model performance under low wind speed conditions. Specifically, in the current formulation, the model routinely underpredicts u_* during stable boundary layer conditions under low wind speeds. The u_* parameter is key in determining the height of mechanical mixing. Therefore, underestimating u_* results in underestimates in mixing layer height, leading to overestimates in concentrations in the mixed layer.

The beta adjust u_* option, designated by the beta ADJ_U* keyword introduced in version 12345 of the AERMET meteorological processor and augmented in subsequent versions, is one of the tools available to address these concerns. The beta adjust u_* option has been developed based on peer-reviewed work by Qian and Venkatram (2011) and Luhar and Rayner (2009), as described in the AERMOD Model Formulation Document Addendum (EPA 2015a). Additional non-regulatory default beta options—specifically LOWWIND1, LOWWIND2, and LOWWIND3—are also available as keywords in the AERMOD model. However, DES has requested only the use of the beta adjust u_* option for this modeling analysis, so the beta low wind options are not discussed further in this report.

EPA has conducted model performance evaluations of the beta adjust u_* option and the current regulatory default AERMOD system (EPA 2015b). The evaluations were performed against results from monitoring field studies to investigate diffusion under low wind speed conditions, and against results from a field study with a tall stack in complex terrain where stable and low wind speed conditions can also be important. The results of these evaluations indicated significant overprediction using the regulatory default AERMET/AERMOD, and better performance—though still somewhat overpredicting—using the beta adjust u_* option. Based in part on the results of these evaluations, EPA has proposed to designate the beta adjust u_* option as the default regulatory formulation in AERMET for estimating u_* under stable conditions with low wind speeds in the Guideline on Air Quality Models (i.e., 40 CFR Part 51 Appendix W; hereafter, Appendix W).[1]

[1] Revision to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches To Address Ozone and Fine Particulate Matter; Proposed Rule. Federal Register, Vol. 80, No. 145, 45340-45387, 2015 July 29.

Process for approving an alternative model

According to Section 3.2.2(a) of Appendix W, the EPA Regional Office is responsible for determining the acceptability of a model. Specifically,

> Where the Regional Administrator finds that an alternative model is more appropriate than a preferred model, that model may be used subject to the recommendations of this subsection. This finding will normally result from a determination that (1) a preferred air quality model is not appropriate for the particular application; or (2) a more appropriate model or analytical procedure is available and applicable.

Section 3.2.2(b) of Appendix W goes on to describe the approval process for an alternative model:

> There are three separate conditions under which such a model may normally be approved for use: (1) If a demonstration can be made that the model produces concentration estimates equivalent to the estimates obtained using the preferred model; (2) if a statistical performance evaluation has been conducted using measured air quality data and the results of that evaluation indicate the alternative model performs better for the given application than [the preferred model]; or (3) if the preferred model is less appropriate for the specific application, or there is no preferred model.

DES has indicated its intention to use the second condition as its justification, subject to the procedures for determining the acceptability of the alternative model using "established procedures and techniques" as described in Section 3.2.2(d) of Appendix W. This subsection also states that preparation and implementation of the evaluation protocol should be acceptable to the state regulatory agency and EPA, as well as the regulated entity. EPA Region 1 held a conference call on March 2, 2016 with representatives from the EPA Model Clearinghouse, DES, Eversource Energy, and Exponent Inc. to discuss the process for demonstrating appropriateness of an alternative model. This discussion satisfied the requirements for state, EPA, and industry participation in the development of an evaluation protocol described in Section 3.2.2(d) of Appendix W.

In December 2015, EPA issued a memorandum that clarified the approval process for non-regulatory beta options in AERMOD that have been proposed as regulatory options in the proposed revision to Appendix W (EPA 2015c). This memorandum confirmed that the use of all non-default beta options, including the beta adjust u_* option, in regulatory modeling must receive EPA Regional Office approval.

In response to a request for the use of the beta adjust u_* option by the Alaska Department of Conservation (ADEC) to characterize air quality resulting from the Donlin Mine, EPA Region 10 approved the request based on demonstration supplied by ADEC and the relevance of the model evaluations described in the previous sections (EPA 2015d). In its approval, EPA Region 10 supplied additional analysis of the influence of adjust u_* on other meteorological parameters. This analysis showed relatively moderate impacts on parameters for power plant sources compared to the effects on sources with lower release heights. Subsequently, the EPA Model Clearinghouse concurred on that approval and indicated that the justification was well-reasoned, thoroughly documented, and demonstrated that the beta adjust u_* option performed better than the regulatory default option for that application (EPA 2016).

Statistical performance evaluation

The DES submittal cites several published statistical analyses as the basis for justifying the use of the beta adjust u_* option in the Schiller modeling. Specifically, DES presents information from Paine et al. (2015) and EPA model evaluation studies presented at the 11th Conference on Air Quality Modeling,[2] specifically the Cordero Rojo surface coal mine fugitive dust study, the 1974 NOAA Oak Ridge study for low-level release, and the 1974 NOAA Idaho Falls tracer study for low-level release.

The Cordero Rojo, Oak Ridge, and Idaho Falls studies are less directly applicable to the Schiller scenario because the release heights from those studies are low-level, whereas Schiller (and Newington) release buoyant plumes from tall stacks. The evaluation for the Gibson Generating Station presented in Paine et al. (2015) is similarly limited in relevance to Schiller because of the flat terrain of the area around Gibson.

The Lovett evaluation database, which is not explicitly mentioned by DES, but which is presented in the most recent AERMOD model evaluation document (EPA 2015b), provides a more comparable scenario to that of Schiller. The Lovett database consists of 2,595 hours of ambient SO_2 monitoring data from 12 monitors near the Lovett Power Plant, located in a rural area with mountainous terrain along the Hudson River in New York. Some of the monitors had elevations above the release height of Lovett's 145 m stack, and at distances from the source of 2-3 km. For the Lovett evaluation database, correlation is better with the beta adjust u_* option than the regulatory default option at relevant concentrations.[3] In fact, the relevant modeled concentrations at Lovett are actually higher using the beta adjust u_* option compared with those using the regulatory default. This suggests greater modeled impacts using the beta adjust u_* option at near-source locations (i.e., within several kilometers) than at more remote locations, where impacts have been shown in the DES submittal to be lower. Therefore, it is likely that impacts at nearer source impacts would be higher using the beta adjust u_* option.

The Mercer County, ND evaluation described by Paine et al. (2015) is also highly relevant to the Schiller scenario. The Mercer County database consists of approximately four years of SO_2 monitoring data focused on two facilities in a region with complex terrain, and includes three monitors at elevations near or above some stack release heights at distances of nearly 10 km. For one of these monitoring locations (DGC#17), modeled concentrations were significantly closer to monitored values, though still somewhat overpredicting, with the use of the beta adjust u_* option as compared to the regulatory default options; predictions at other monitoring locations did change with use of the beta adjust u_* option for this study.

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[2] https://www3.epa.gov/scram001/11thmodconf.htm
[3] Because the form of the NAAQS is based on the three-year average of 99th percentile of daily maximum SO_2 concentrations, the 5-year average 4th highest modeled SO_2 concentration is the relevant comparison against the NAAQS. This process is described in detail in an EPA memorandum on the subject (EPA 2010).

At Schiller, the relevant distances for impacts in complex terrain are 16 km or greater away from the source. Though there is no evaluation database analysis for impacts in complex terrain at this distance that match the precise characteristics of the Schiller scenario, the analyses cited above provide a sufficient basis for making an assessment regarding the adequacy of the statistical performance evaluation. Better model performance in the near field may translate into better model performance at longer distances. However, no conclusive model performance evaluation was available at the time of this review to confirm this notion, and this represents a data gap in evidence provided for this alternative model justification.

Additional site-specific evidence

The DES submittal indicates that the regulatory default options in AERMET version 15181 and AERMOD version 15181 lead to controlling concentrations at receptors on Mount Agamenticus at elevations from 129 m to 147 m. These concentrations occur during low-wind speed and stable boundary conditions. Table 2 of the submittal indicates that u_* values are very low (0.033-0.077 m/s) for hours during which concentrations at the top ten receptors in the default modeling are highest. At those receptor locations, using the beta adjust u_* option increases 5-year average u_* values 62-96% (to 0.104-0.114 m/s). As a result of the increase in u_* from the use of the beta u_* option, 5-year average 4th highest concentrations at these receptors dropped by 57-64%, from 93.9-100.6 μg/m^3 to 35.4-41.0 μg/m^3.

Significantly, the use of the beta adjust u_* option shifted the controlling concentration from the more remote ten receptors at Mount Agamenticus to a cluster of ten receptors in Eliot, Maine, directly across the Piscatequa River within 1 km from Schiller (see Table 4 and Figure 3 in the submittal). At these receptors, there were insignificant changes in u_* and relevant concentration values between the regulatory default and alternative modeling configurations; this indicates that stable low wind speed conditions are not controlling at these receptors. For these ten receptors, the 5-year average u_* values are 0.62-0.76 m/s for relevant concentrations, which range from 51.4 to 54.1 μg/m^3.

The analysis in the DES submittal indicates that the beta adjust u_* option only has significant effects in the modeling domain at receptors with elevations at or above the height of release. Specifically, the analysis showed that stable conditions with low wind speeds are the controlling meteorological conditions for receptors with elevations above 85 m, and that concentrations at these receptors are often lower by more than 50% under the beta adjust u_* formulation than under the regulatory default formulation. For receptors below 85 m, in the analysis, there is little to no change in concentration indicating that stable conditions with low wind speeds are not controlling at elevations below the release height.

In addition to the analysis of the effects from terrain height on controlling meteorological conditions as described above, the DES submittal included a comparison of the results from the two modeling techniques at the locations of nearby monitoring stations. The two monitoring locations are the Pierce Island monitor, about 4 km from Schiller, and a temporary monitor at Sawgrass Lane in Eliot, Maine, about 2 km from Schiller. The submitted analysis compares the results of the model with regulatory default options versus with the beta adjust u_* option at these monitoring sites using Q-Q plots. The comparison presented in the submittal indicate nearly identical predictions at monitor locations at values above 10 μg/m^3 for both monitoring sites. A direct model to monitor comparison would provide an opportunity for direct model performance evaluation against observations; however, the submitted analysis suggests that such a monitor-to-model comparison would show nearly identical performance for each model.

The submittal included references to additional documents (i.e., Connors and Paine 2014, Warren 2016), but this technical report did not rely on the analyses discussed in those documents because they are not peer reviewed. The analyses discussed in this report comprise a sufficient basis for determining the appropriateness of the beta adjust u_* option for this modeling scenario without these additional citations.

Conclusions and recommendations

Based on the strength of the Lovett analysis available from EPA (2015b) and the Mercer County analysis described in Paine et al. (2015), and in light of the performance of the beta adjust u_* option as documented in other studies described by EPA (2015b, 2015d), and the additional case-specific evidence presented in the DES submittal, the statistical evaluation is sufficient to demonstrate that AERMET version 15181 with the beta adjust u_* option is superior to the regulatory default AERMET version 15181 for application in the Schiller Station modeling analysis.

The condition of Section 3.2.2(d) of Appendix W in 40 CFR 51 has been adequately addressed for justifying the use of the beta adjust u_* option (with or without the Bulk Richardson option) in AERMET version 15181 for the Schiller modeling for 1-hour SO_2 under the Data Requirements Rule and for the modeling demonstration in Response to Order on Title V Petition VI-2014-04.

References

EPA. 2010. Memorandum: Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard. From Tyler Fox, EPA Air Quality Modeling Group to EPA Regional Air Division Directors. August 23, 2010.

EPA. 2015a. AERMOD Model Formulation Document Addendum. Published online June 30, 2015.

EPA. 2015b. 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.

EPA. 2015c. Memorandum: Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options. From Richard A. Wayland, EPA Air Quality Assessment Division Director. December 10, 2015.

EPA. 2015d. Memorandum: Surface Friction Velocity (u_*) Non-Default/Beta Option in AERMET Version 15181; Alternative Refined Model Demonstration. From Herman Wong, EPA Region 10 Modeling Contact/Regional Atmospheric Scientist to Alan Schuler, ADEC Engineer. October 20, 2015.

EPA. 2016. Memorandum: Model Clearinghouse Review of the Use of the ADJ_U* Beta Option in the AERMET Meteorological Processor (version 15181) for the Donlin Mine Compliance Demonstration. From George Bridgers, EPA Model Clearinghouse Director to Janis Hastings, ADEC Office of Air, Waste, and Toxics Acting Director. February 10, 2016.

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.

Qian W and Venkatram A. 2011. "Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions." *Boundary-Layer Meteorology*. 138:475-491. DOI 10.1007/s10546-010-9565-1.

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

March 18, 2016

Mr. Leiran Biton
USEPA Region 1 – New England
5 Post Office Square, Suite 100
Mail Code OEP05-02
Boston, MA 02109-3912

Re: Response to Order – Title V Petition VI-2014-04
Public Service Company of New Hampshire d/b/a Eversource Energy
Schiller Station, Portsmouth, NH

Dear Mr. Biton:

The New Hampshire Department of Environmental Services ("NHDES") is requesting concurrence from the United States Environmental Protection Agency ("USEPA") Region 1 Office and the USEPA Model Clearinghouse on the use of the beta adjusted surface friction velocity (ADJ_U*) modeling technique. This technique is being proposed for use in modeling that will be performed in support of the Order on Title V Petition VI-2014-04 regarding the issuance of Proposed Title V Operating Permit TV-0053 for the Public Service Company of New Hampshire d/b/a Eversource Energy ("Eversource") Schiller Station located in Portsmouth, New Hampshire. Please note that this modeling will also be used to characterize 1-hour sulfur dioxide (SO_2) concentrations in the vicinity of Schiller Station as part of NHDES's obligations under the 2010 1-hour NAAQS SO_2 Data Requirements Rule.

In its proposed rule to revise the Guideline on Air Quality Models ("Appendix W")[1], USEPA has proposed to incorporate the ADJ_U* technique as a regulatory default option. However, until that rulemaking is final, the application of this beta option requires formal approval and is subject to the requirements of Section 3.2 of the current 2005 version of Appendix W (per USEPA's December 10, 2015 memorandum, "Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options" - https://www3.epa.gov/ttn/scram/guidance/clarification/AERMOD_Beta_Options_Memo-20151210.pdf).

Eversource has submitted a formal justification for the use the ADJ_U* option. That justification is enclosed here. NHDES has thoroughly reviewed Eversource's submittal, and NHDES agrees with its conclusions. As discussed in the Eversource submittal, the ADJ_U* option was coded into the AERMOD modeling system (specifically AERMET, the meteorological preprocessor to AERMOD) to address the underestimation of surface friction velocity (u*) under light wind stable conditions and the subsequent over-prediction of modeled concentrations during such conditions. In its submittal, Eversource has demonstrated that these

[1] 80 *Federal Register* 145, "Revision to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter; Proposed Rule" - https://www3.epa.gov/ttn/scram/11thmodconf/EPA-HQ-OAR-2015-0310-0001.pdf

DES Web Site: **www.des.nh.gov**
P.O. Box 95, 29 Hazen Drive, Concord, New Hampshire 03302-0095
Telephone: (603) 271-3503   Fax: (603) 271-2181   TDD Access: Relay NH 1-800-735-2964

conditions occur frequently enough to control the predicted 99th percentile 1-hour SO_2 values when AERMOD is run with default options for Schiller Station. Their submittal demonstrates that the use of the ADJ_U* option reduces predicted concentrations at complex terrain receptors during light wind stable conditions and reduces the number of very low predicted u* values. Eversource also performed an analysis of model predicted concentrations at two nearby SO_2 monitor locations (Peirce Island in Portsmouth, NH and Sawgrass Lane in Eliot, ME). Both of these monitors are located in simple terrain within 5 km of Schiller Station. Eversource's analysis demonstrates that the ADJ_U* option has little to no effect on model predicted concentrations at these receptor locations.

Lastly, Eversource's submittal cites several published, peer-reviewed studies which demonstrate that the AERMOD modeling system, when used with the beta ADJ_U* option in AERMET, outperforms AERMOD with default options in situations involving light wind stable conditions and complex terrain (as mentioned above, Eversouce has demonstrated that such situations are applicable to modeling for Schiller Station). For example, a recent 2015 study by Paine et al compared model predicted concentrations with default and beta low-wind options against monitored concentration databases. Of particular relevance to Schiller Station is a tall stack/complex terrain case in which AERMOD with default options over-predicted observed concentrations by a factor of 2.2. The use of the ADJ_U* option reduced this over-predicted to a more realistic, but still conservative, factor of 1.53. Please see Eversource's submittal for more details.

NHDES concurs with Eversource's conclusion that the use of the beta ADJ_U* option satisfies condition 2 of Appendix W, Section 3.2.2.b, specifically that "the alternative model performs better for the given application than a comparable model in Appendix A". Therefore, NHDES is seeking USEPA's concurrence that the use of the ADJ_U* option is justified in the above referenced modeling for Schiller Station. NHDES appreciates USEPA's prompt attention to this matter.

If you have any questions, please contact David Healy of my staff at (603) 271-0871 or david.healy@des.nh.gov.

Sincerely,

Craig A. Wright

Craig A. Wright
Director
Air Resources Division

Attachments

ec: David Conroy, EPA Region 1
Ida McDonnell, EPA Region 1
Sheila Burke, Eversource
Lloyd Schulman, Exponent
Zachary Fabish, Sierra Club

Exponent®

TECHNICAL MEMORANDUM

Request for Approval to Use ADJ_U* in AERMET

Eversource Energy's Schiller Station

Prepared by Exponent, Inc.

Maynard, MA
March 10, 2016

Introduction

This technical memorandum was prepared to request approval from the New Hampshire Department of Environmental Services (NHDES) and the U.S. Environmental Protection Agency (EPA) to use non-default option ADJ_U* in AERMET v15181 for AERMOD v15181 modeling of Eversource Energy's Schiller Station.

Section 3.2.2 in Appendix W of 40 CFR Part 51 identifies three conditions under which an alternative model may be approved for use. The second condition, listed in Section 3.2.2.b(2), is "if a statistical performance evaluation has been conducted using measured air quality data and the results of that evaluation indicate the alternative model performs better for the given application than a comparable model in Appendix A." As discussed in this technical memorandum, several studies using measured air quality data have clearly demonstrated that using AERMET v15181 with the non-default option ADJ_U* improves model performance for AERMOD, particularly when modeling emissions from tall stacks with buoyant releases in complex terrain, which is an accurate emissions characterization of Schiller Station. This technical memorandum demonstrates that Schiller Station encounters, with controlling frequency, the conditions for which the default version of AERMOD is known to over-predict concentrations, thereby justifying the use of the corrective non-default option ADJ_U* in AERMET.

Development of ADJ_U* to Address Over-Predictions in AERMOD

EPA has acknowledged that AERMOD over-predicts concentrations during low wind speed, stable conditions when run with default options (EPA, 2016). As early as 2007, EPA listed as their top mandatory work item for AERMOD: "*Revise AERMOD's treatment of light winds to avoid unrealistically high concentrations*" (Robinson and Brode, 2007).

To address this issue in part, EPA added non-default option ADJ_U* to AERMET based on the scientific peer-reviewed study of Qian and Venkatram (2010):

> "*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.*" (EPA, 2016)

Several studies have demonstrated that AERMET with default options tends to significantly underestimate surface friction velocity (u_*) (Qian and Venkatram, 2010; Connors and Paine, 2014; Paine et al., 2015) for low wind speed conditions. This results in underestimations of turbulence and mixing height in AERMOD for stable conditions, thus reducing dispersion and leading to over-predicted concentrations.

To address concerns regarding model over-predictions during low wind speed, stable conditions, EPA incorporated the non-default beta options LOWWIND in AERMOD and ADJ_U* in AERMET (EPA, 2015). Statistical evaluation studies have concluded that, during such low wind speed, stable conditions, the use of ADJ_U* in AERMET improves the accuracy of predicted concentrations (Paine et al., 2015; EPA, 2015).

In particular, the correction provided by the use of the ADJ_U* option is notable for tall stacks with buoyant releases located in areas of complex terrain, as is the case for Schiller Station. Connors et al. (2014) concluded that in complex terrain:

> "*Tall buoyant stacks…are quite sensitive to AERMOD's low-wind speed options; lower modeled concentrations are predicted with these options in complex terrain. When using the default model options, AERMOD's maximum impacts occur under light wind speed stable conditions. The use of the beta u_* option in AERMET increases effective wind speed, mechanical mixing, vertical dispersion, and plume rise, thus reducing the predicted concentrations.*"

In a recent evaluation of the sensitivity of 4th-highest maximum daily 1-hour concentrations from tall stacks in areas of high terrain to ADJ_U* in AERMET v15181, Paine et al. (2015) found that the use of ADJ_U* reduced the predicted concentrations in AERMOD from a large over-prediction of 184.48 μg/m^3 (2.2 times the observed concentration of 83.76 μg/m^3) to a more realistic, but still conservative, predicted concentration of 127.93 μg/m^3 (1.53 times the observed concentration).

Additionally, at the 11th Modeling Conference, EPA stated its intent to incorporate beta option ADJ_U* in AERMET into the regulatory version of the model: "*EPA has proposed in the NPRM that the ADJ_U* option (with or without BULKRN) be incorporated into the regulatory version of AERMET*" (EPA, 2015).

Project Description

The emissions from the boilers at Schiller Station are vented from tall stacks located in a region of complex terrain. The released gases are buoyant due to the temperature difference between the stack gases and the ambient atmosphere. As shown in Table 1, the project sources include three stacks that range in height from 68.9 m to 70.4 m with exit temperatures between 431 K and 450 K and base elevations of 6.4 m to 7.3 m. For the purposes of this demonstration, scaled emission rates which maintained the anticipated ratio of emissions between the three units were used in the modeling. However, these emission rates are not intended to be representative of either allowable or actual emissions and are for demonstration purposes only. The surrounding terrain within 50 km of the facility ranges in elevation from approximately 4 m to 720 m, as shown in Figure 1.

Table 1. Schiller Station Source Parameters and Emission Rates

Stack ID	UTM-19N [NAD-83] East (m)	UTM-19N [NAD-83] North (m)	Base Elev. (m)	Stack Ht. (m)	Exit Temp. (K)	Exit Velocity (m/s)	Stack Diam. (m)	Emission Rate (g/s)
SR4	354819.20	4773182.97	7.3	68.9	450	22.86	2.44	20.0
SR5	354832.59	4773134.78	6.4	70.4	431	16.15	2.44	3.0
SR6	354838.68	4773154.22	7.3	68.9	450	22.86	2.44	20.0

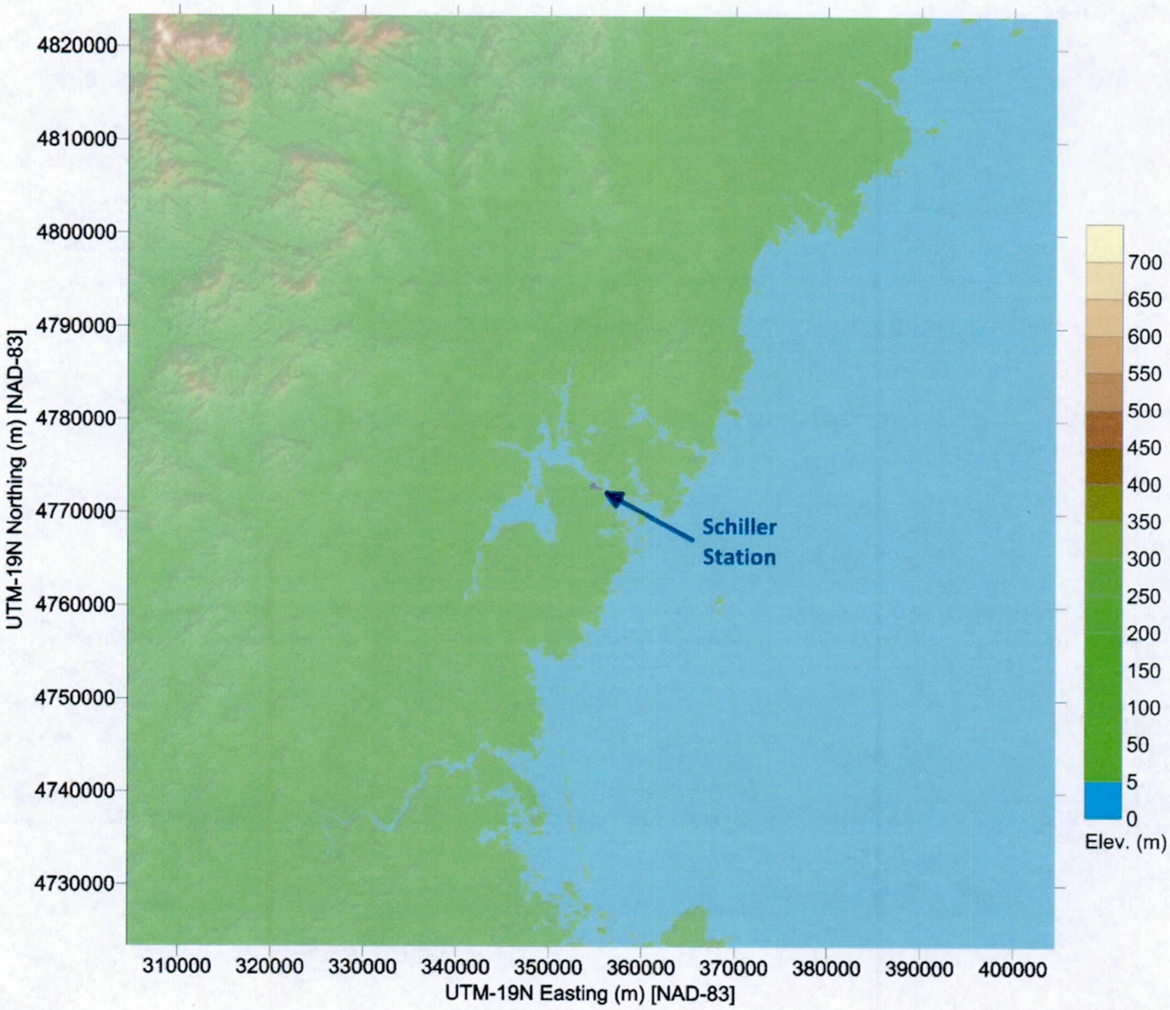

Figure 1. Terrain within 50 km of Schiller Station

Project Sensitivity to ADJ_U*: Predicted Controlling 99th Percentile Concentrations

Using default options in both AERMET v15181 and AERMOD v15181, the top ten 5-year average 4th-highest maximum daily 1-hour impacts were predicted to occur approximately 16 km northeast of Schiller Station near the peak of Mount Agamenticus, as shown in Figure 2, at locations with elevations ranging from 129 m to 147 m. The hours corresponding to these top ten impacts all occur during low wind speed, stable conditions, as shown in Table 2.

Table 3 compares the results with default options vs. with ADJ_U* for the top ten 5-year average 4th-highest maximum daily 1-hour impacts from the default run. With default options in AERMET, the five-year average u_* values corresponding to these top ten impacts are all less than 0.1 m/s and range from 0.057 m/s to 0.069 m/s. When the corrective non-default option ADJ_U* is used, the corresponding five-year average u* values increase to over 0.1 m/s, with values ranging from 0.101 m/s to 0.114 m/s. As a result, the predicted 5-year average 4^{th}-highest concentrations at the ten receptors around Mount Agamenticus are reduced by 57% - 64%.

With the application of ADJ_U*, the top ten 5-year average 4^{th}-highest maximum daily 1-hour impacts are predicted to occur within one kilometer of Schiller Station, as shown in Figure 3. Table 4 compares the results with default options vs. those with ADJ_U* for these top ten 5-year average 4^{th}-highest maximum daily 1-hour impacts from the run with ADJ_U*. At these ten receptors located within one kilometer of Schiller Station, use of beta option ADJ_U* has virtually no effect on the predicted concentrations compared to AERMET run with default options.

Figure 4 compares the locations of the top ten 5-year average 4^{th}-highest maximum daily 1-hour impacts for AERMET run with default options vs. with ADJ_U*.

Table 2. 4th-highest maximum daily 1-hour concentration corresponding to the top ten 5-year averages for AERMET v15181 and AERMOD v15181 with default options

Rank	UTM-19N [NAD-83] East (m)	UTM-19N [NAD-83] North (m)	Year	4th-highest Max. Daily 1-hour Concentration (μg/m³)	u* (m/s)	Hour Of Day	Wind Speed (m/s)	Monin-Obukhov Length (m)
			2010	79.6	0.069	24	1.76	8.0
			2011	93.5	0.074	21	2.10	6.7
1st Highest	362300.00	4786600.00	2012	109.9	0.067	24	1.76	5.9
			2013	81.2	0.057	18	1.76	6.0
			2014	138.6	0.057	08	1.76	4.7
			2010	73.5	0.069	24	1.76	8.0
			2011	101.0	0.074	21	2.10	6.7
2nd Highest	362300.00	4786500.00	2012	115.3	0.069	21	1.76	6.3
			2013	84.2	0.067	18	1.76	5.9
			2014	124.5	0.067	01	1.76	5.9
			2010	77.0	0.057	21	1.76	4.5
			2011	85.6	0.074	21	2.10	6.7
3rd Highest	362400.00	4786600.00	2012	104.0	0.069	21	1.76	6.3
			2013	88.0	0.049	04	1.26	4.6
			2014	140.9	0.047	24	1.26	4.2
			2010	86.3	0.077	05	2.36	6.6
			2011	89.7	0.069	24	1.76	6.3
4th Highest	362200.00	4786700.00	2012	98.8	0.057	01	1.76	4.9
			2013	83.5	0.066	24	1.76	6.2
			2014	120.1	0.057	08	1.76	4.7
			2010	74.7	0.069	24	1.76	8.0
			2011	83.9	0.057	02	1.76	6.5
5th Highest	362200.00	4786800.00	2012	86.8	0.057	23	1.76	6.5
			2013	90.6	0.057	18	1.76	6.0
			2014	141.4	0.047	06	1.26	4.4
			2010	82.1	0.077	05	2.36	6.6
			2011	86.1	0.057	01	1.76	5.9
6th Highest	362200.00	4787000.00	2012	91.0	0.057	01	1.76	4.9
			2013	90.7	0.057	18	1.76	6.0
			2014	124.2	0.047	06	1.26	4.4
			2010	76.7	0.069	24	1.76	8.0
			2011	87.8	0.057	02	1.76	6.5
7th Highest	362300.00	4786700.00	2012	82.8	0.067	05	1.76	5.9
			2013	80.7	0.066	24	1.76	6.2
			2014	148.8	0.049	05	1.26	4.4
			2010	65.4	0.066	03	1.76	8.1
			2011	80.9	0.074	21	2.10	6.7
8th Highest	362500.00	4786600.00	2012	99.4	0.069	21	1.76	6.3
			2013	98.4	0.049	04	1.26	4.6
			2014	129.8	0.047	24	1.26	4.2
			2010	73.4	0.066	21	1.76	7.4
			2011	81.0	0.057	02	1.76	6.5
9th Highest	362200.00	4786900.00	2012	83.5	0.069	21	1.76	6.3
			2013	89.8	0.057	18	1.76	6.0
			2014	143.2	0.047	06	1.26	4.4
			2010	75.2	0.069	24	1.76	8.0
			2011	82.9	0.057	05	1.76	5.9
10th Highest	362800.00	4787500.00	2012	97.6	0.067	24	1.76	5.9
			2013	76.4	0.057	18	1.76	6.0
			2014	137.6	0.033	18	1.00	2.6

Table 3. Comparison of predicted concentrations with default options vs. with ADJ_U* at receptors with the top ten 5-year average 4th-highest maximum daily 1-hour concentrations for AERMET v15181 and AERMOD v15181 with default options.

Rank	UTM-19N [NAD-83] East (m)	UTM-19N [NAD-83] North (m)	Elev. (m)	5-Year Ave. Conc. AERMET w/Default (µg/m³)	5-Year Ave. Conc. AERMET w/ADJ_U* (µg/m³)	Decrease in Conc. (%)	AERMET w/Default Ave. u* (m/s)	AERMET w/ADJ_U* Ave. u* (m/s)
1st Highest	362300.00	4786600.00	**136.81**	100.6	37.7	**-62%**	0.065	0.114
2nd Highest	362300.00	4786500.00	**129.42**	99.7	36.0	**-64%**	0.069	0.113
3rd Highest	362400.00	4786600.00	**139.62**	99.1	38.3	**-61%**	0.059	0.114
4th Highest	362200.00	4786700.00	**128.65**	95.7	37.3	**-61%**	0.065	0.105
5th Highest	362200.00	4786800.00	**143.74**	95.5	41.0	**-57%**	0.057	0.101
6th Highest	362300.00	4786700.00	**146.89**	95.4	37.6	**-61%**	0.062	0.113
7th Highest	362200.00	4787000.00	**134.87**	94.8	37.6	**-60%**	0.059	0.104
8th Highest	362500.00	4786600.00	**139.20**	94.8	36.5	**-61%**	0.061	0.111
9th Highest	362200.00	4786900.00	**145.82**	94.2	38.2	**-59%**	0.059	0.106
10th Highest	362800.00	4787500.00	**139.86**	93.9	35.4	**-62%**	0.057	0.112

Table 4. Comparison of predicted concentrations with default options vs. with ADJ_U* at receptors with the top ten 5-year average 4th-highest maximum daily 1-hour concentrations for AERMET v15181 run with non-default option ADJ_U* and AERMOD v15181 run with default options.

Rank	UTM-19N [NAD-83] East (m)	UTM-19N [NAD-83] North (m)	Elev. (m)	5-Year Ave. Conc. AERMET w/Default (µg/m³)	5-Year Ave. Conc. AERMET w/ADJ_U* (µg/m³)	Decrease in Conc. (%)	AERMET w/Default Ave. u* (m/s)	AERMET w/ADJ_U* Ave. u* (m/s)
1st Highest	355555.80	4773180.00	**12.7**	54.1	54.1	**0%**	0.721	0.721
2nd Highest	355505.80	4773180.00	**13.5**	54.0	54.0	**0%**	0.756	0.756
3rd Highest	355605.80	4773180.00	**11.6**	53.4	53.4	**0%**	0.699	0.699
4th Highest	355555.80	4773130.00	**13.4**	52.8	52.8	**0%**	0.687	0.687
5th Highest	355605.80	4773130.00	**12.0**	52.4	52.4	**0%**	0.687	0.687
6th Highest	355655.80	4773180.00	**10.6**	52.1	52.1	**0%**	0.661	0.661
7th Highest	355455.80	4773180.00	**10.3**	52.1	52.0	**0%**	0.621	0.709
8th Highest	355505.80	4773130.00	**12.4**	52.0	52.0	**0%**	0.645	0.645
9th Highest	355705.80	4773180.00	**9.6**	51.5	51.5	**0%**	0.635	0.635
10th Highest	355605.80	4773230.00	**12.3**	51.5	51.4	**0%**	0.636	0.649

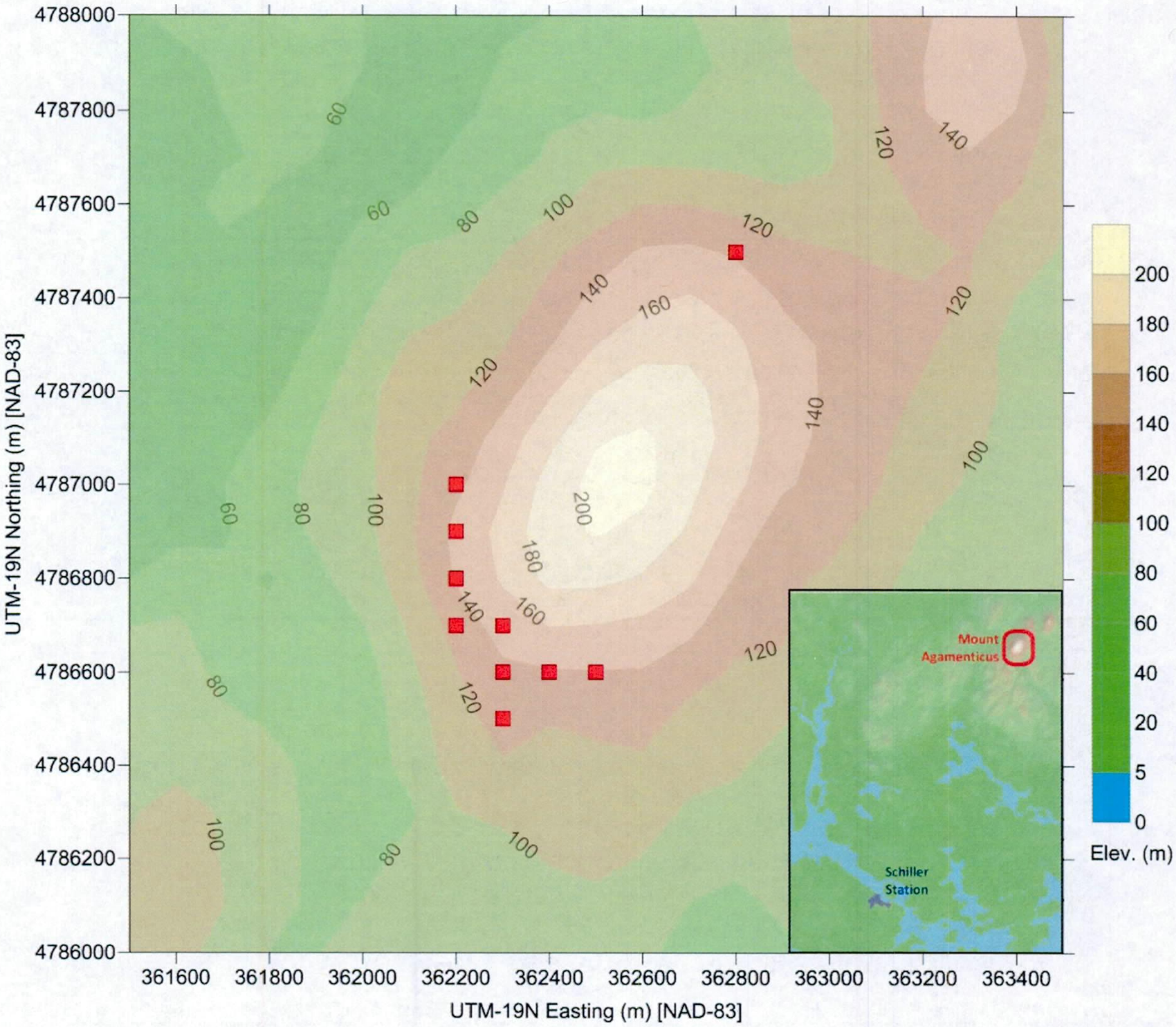

Figure 2. Locations of the top ten predicted 5-year average 4th-highest maximum daily 1-hour impacts near Mount Agamenticus for AERMET v15181 and AERMOD v15181 run with default options

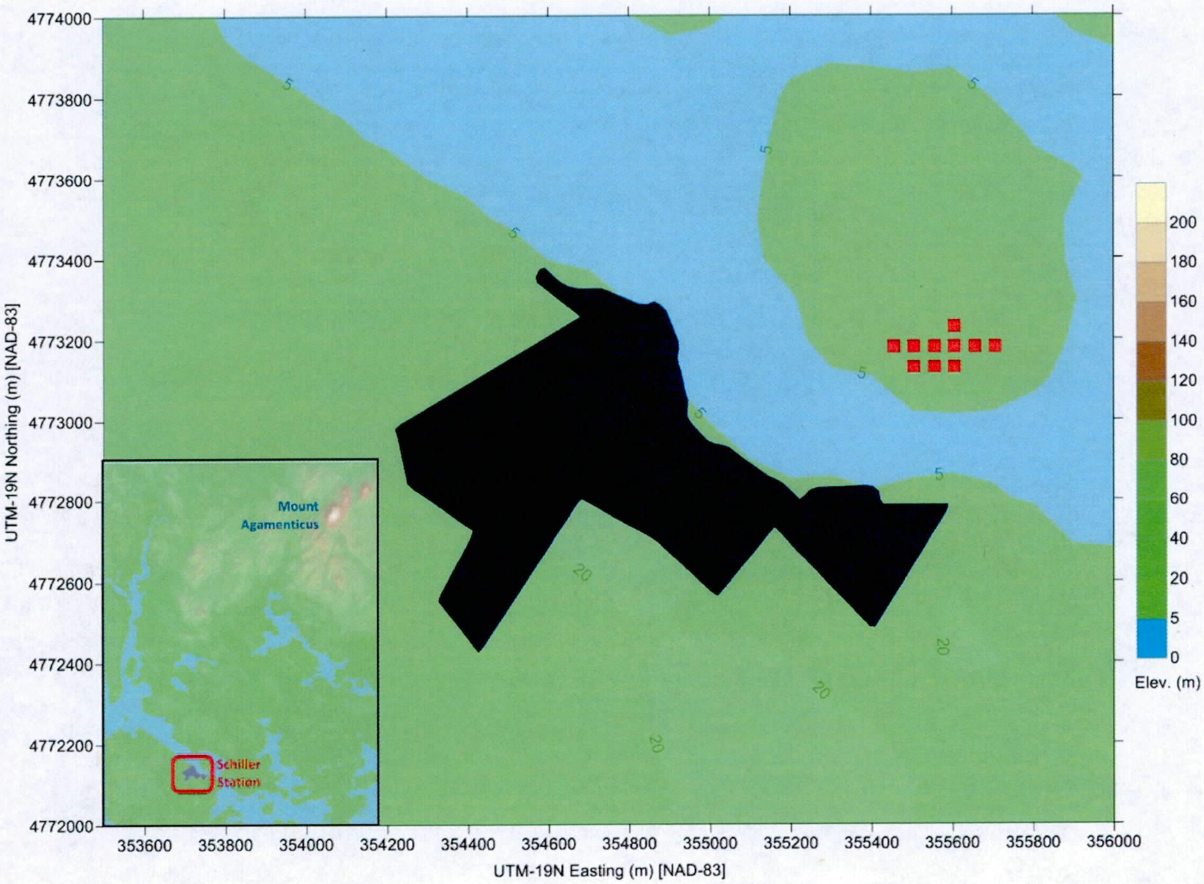

Figure 3. Locations of the top ten predicted 5-year average 4th-highest maximum daily 1-hour impacts for AERMET v15181 run with non-default option ADJ_U* and AERMOD v15181 run with default options

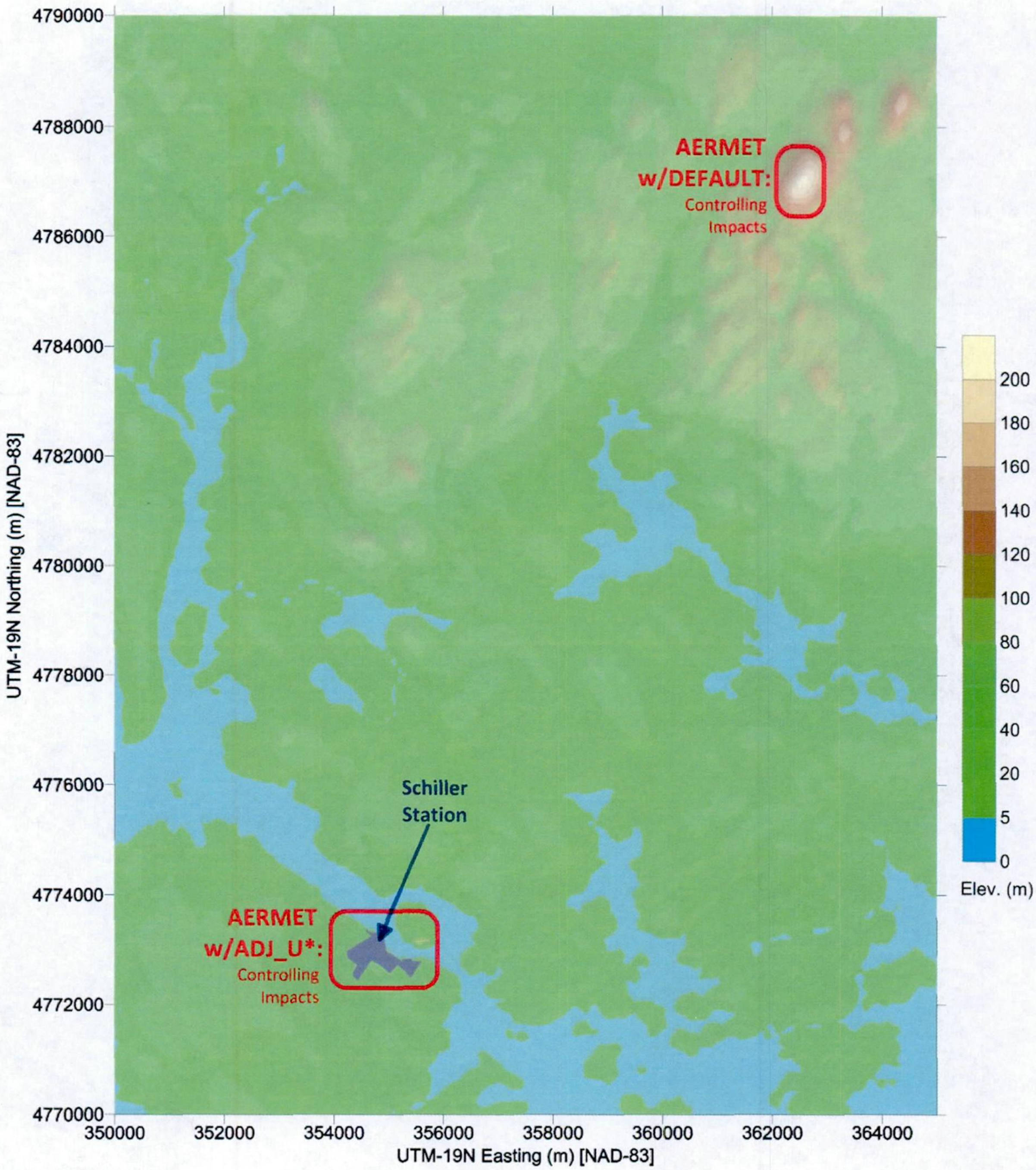

Figure 4. Locations of the top ten predicted 5-year average 4th-highest maximum daily 1-hour impacts for AERMET v15181 run with default vs. AERMET v15181 run with the ADJ_U* option

Project Sensitivity to ADJ_U*: Predicted 99th Percentile Concentrations within 50 km

An analysis of predicted daily maximum 1-hour impacts at the 10,311 model receptors located within 50 km of Schiller Station showed that the effect of option ADJ_U* was markedly different depending on receptor height. Figure 5 distinguishes between model receptors above and below an elevation of 85 meters. Figure 6 is a quantile-quantile (Q-Q) plot of the 5-year average 4th-highest maximum predicted 1-hour impacts paired by receptor.

At the 9,398 receptors with elevations less than 85 m, ADJ_U* had virtually no effect on the resulting 99th percentile concentrations with essentially a one-to-one correlation between the model run with default vs. ADJ_U* options. In contrast, at the 913 modeled receptors with elevations above 85 m, the use of ADJ_U* reduced the 99th percentile concentrations by approximately a factor of two. Stack top elevations at Schiller Station for the three modeled sources are approximately 76 m. Accounting for plume rise, the 85 m elevation can be used to approximately demarcate simple and complex terrain receptors.

Since the distance of the receptors with elevations above 85 m are between 10 km and 50 km from the facility, as shown in Figure 5, it is reasonable to assume that the controlling 99th percentile concentrations at these receptors occur during low wind speed, stable conditions.

This clearly demonstrates that for Schiller Station, characterized by tall stacks with buoyant releases, the use of beta option ADJ_U* in AERMET v15181 has a significant effect on the highest predicted concentrations at receptors located in complex terrain with little or no effect at receptors in simple terrain.

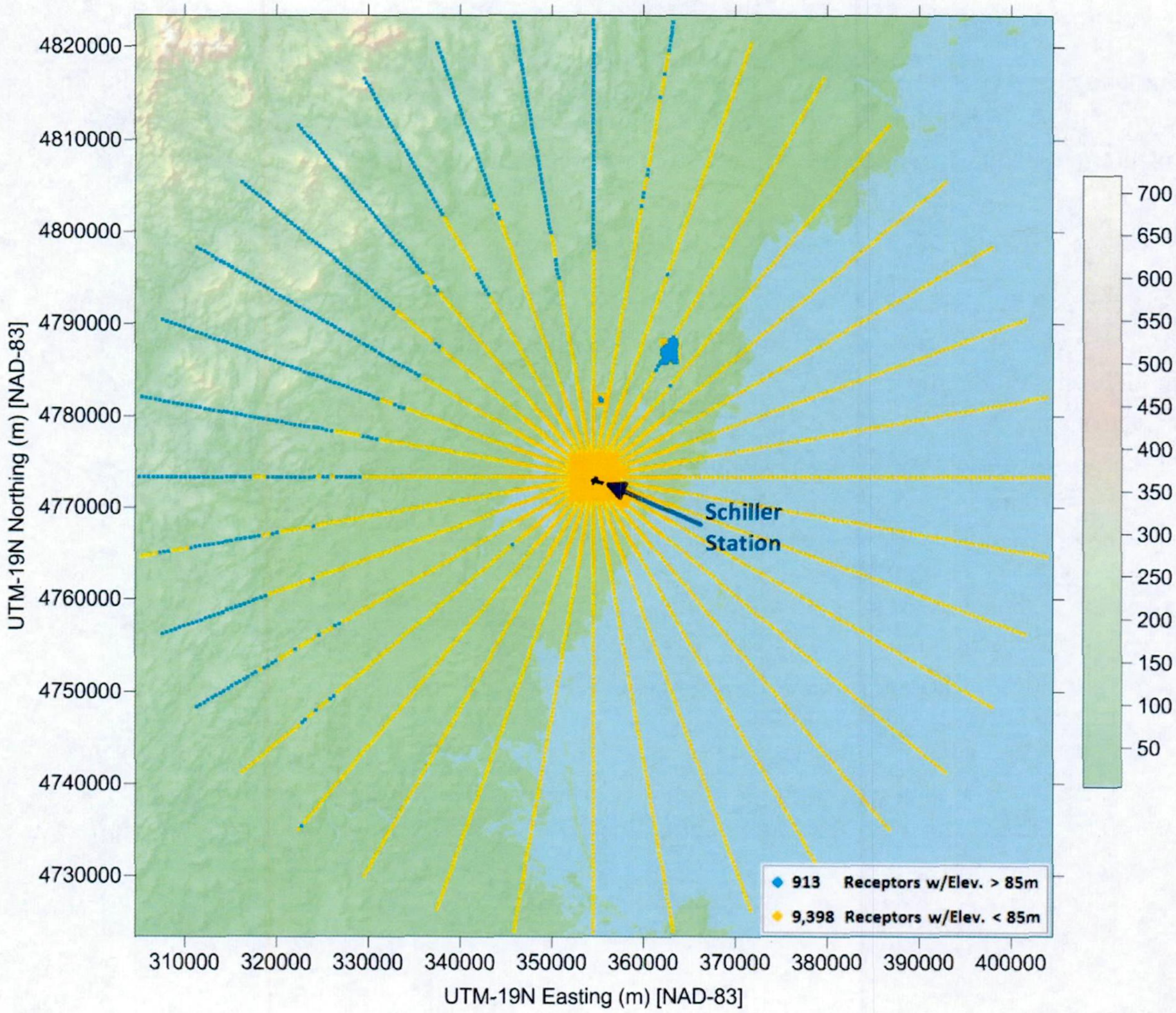

Figure 5. 10,311 receptors within 50 km of Schiller Station with the 913 receptors with elevations above 85 m shown in blue and the 9,398 receptors with elevations below 85 m shown in orange

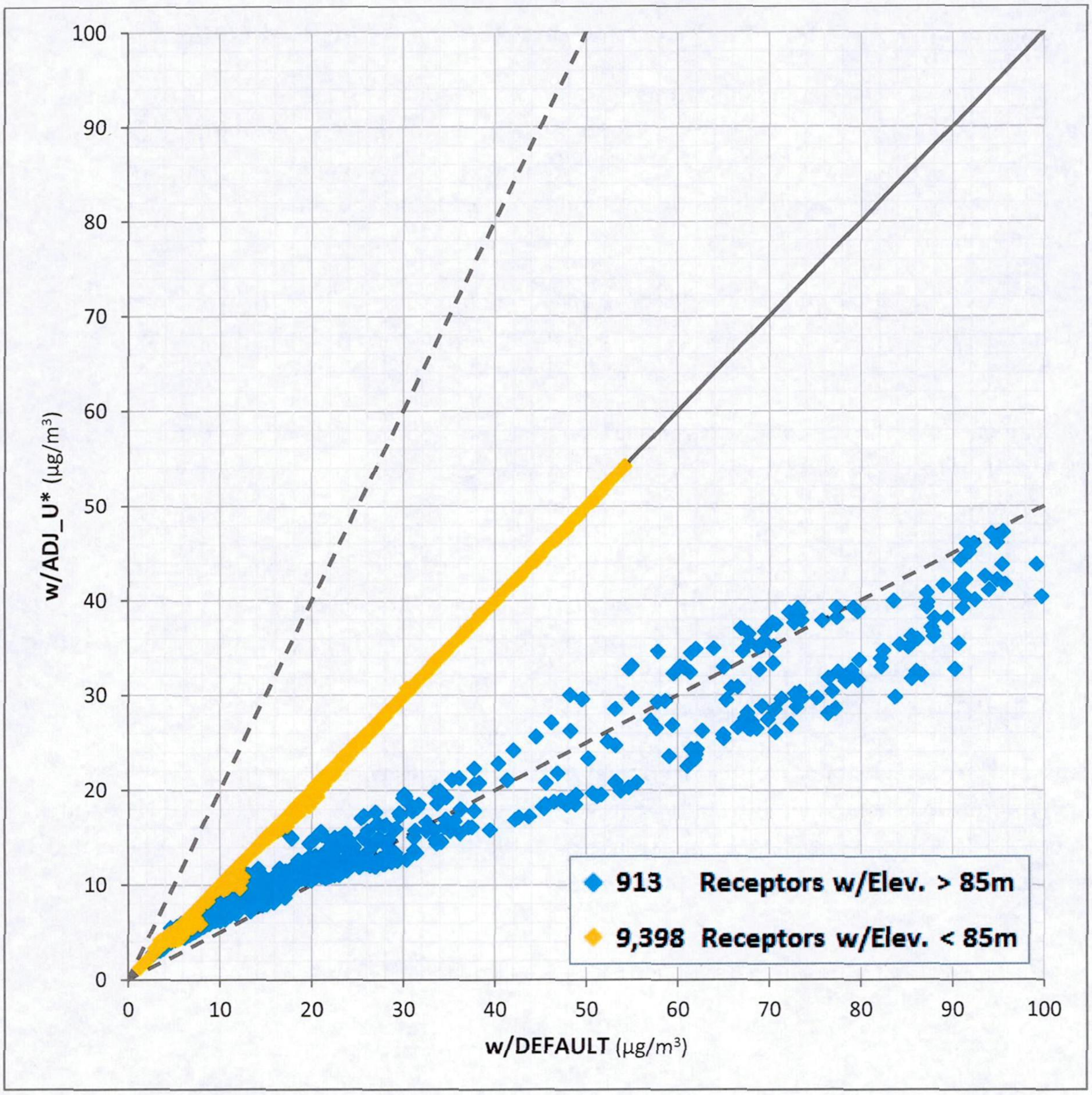

Figure 6. Q-Q plot paired by receptor of predicted 5-year average 4th-highest maximum daily 1-hour concentrations with AERMET v15181 with default options vs. AERMET v15181 with the ADJ_U* option

Project Sensitivity to ADJ_U*: Predicted Concentrations at Monitor Locations

Analyses of predicted 1-hour concentrations over five modeled years at the locations of the two nearest SO_2 monitors in the vicinity of Schiller Station, shown in Table 5 and Figure 7, illustrate that the use of ADJ_U* in AERMET v15181 has little to no effect compared to AERMET run with default options. The monitors are located in simple terrain at distances of approximately 2 km and 4 km from Schiller Station.

Q-Q plots of 1-hour concentrations paired in space and time over 2010-2014 with default vs. ADJ_U* options in AERMET v15181 for receptors placed at the locations of the Eliot (Sawgrass Lane) and Peirce Island monitors are shown in Figure 8 and Figure 9 respectively.

At the location of the Eliot (Sawgrass Lane) monitor, the predicted 1-hour concentrations with the use of ADJ_U* in AERMET v15181 are nearly the same as the predicted 1-hour concentrations for AERMET run with default options.

At the location of the Peirce Island monitor, the highest predicted 1-hour concentrations with the ADJ_U* option in AERMET v15181 are nearly the same as the concentrations for AERMET run with default options. For smaller 1-hour concentrations, the use of ADJ_U* in AERMET results in reductions or increases of the predicted 1-hour concentrations within a factor of two compared to AERMET run with default options.

This analysis demonstrates that the maximum predicted 1-hour concentrations at these two monitor locations are essentially equivalent for AERMET run with default vs. ADJ_U* options. In other words, the use of ADJ_U* in AERMET has little to no effect on the highest predicted concentrations at the locations of these two monitors.

Table 5. Eliot (Sawgrass Lane) and Peirce Island Monitor Locations

Monitor	UTM-19N [NAD-83] East (m)	UTM-19N [NAD-83] North (m)	Elev. (m)
Eliot (Sawgrass Lane)	356007.00	4774707.00	14.16
Peirce Island	357695.00	4770667.00	4.0

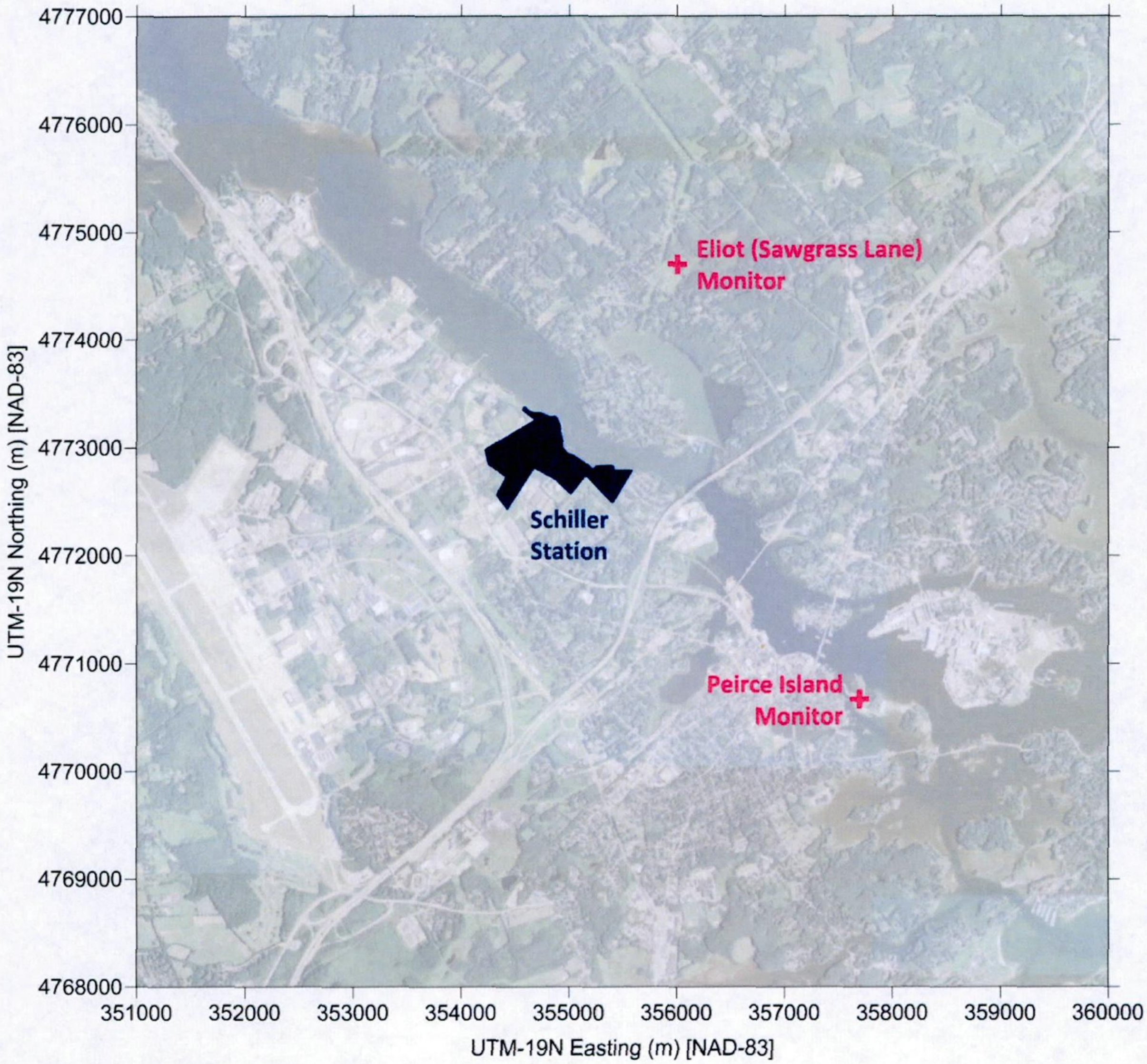

Figure 7. Locations of the Eliot (Sawgrass Lane) and Peirce Island monitors

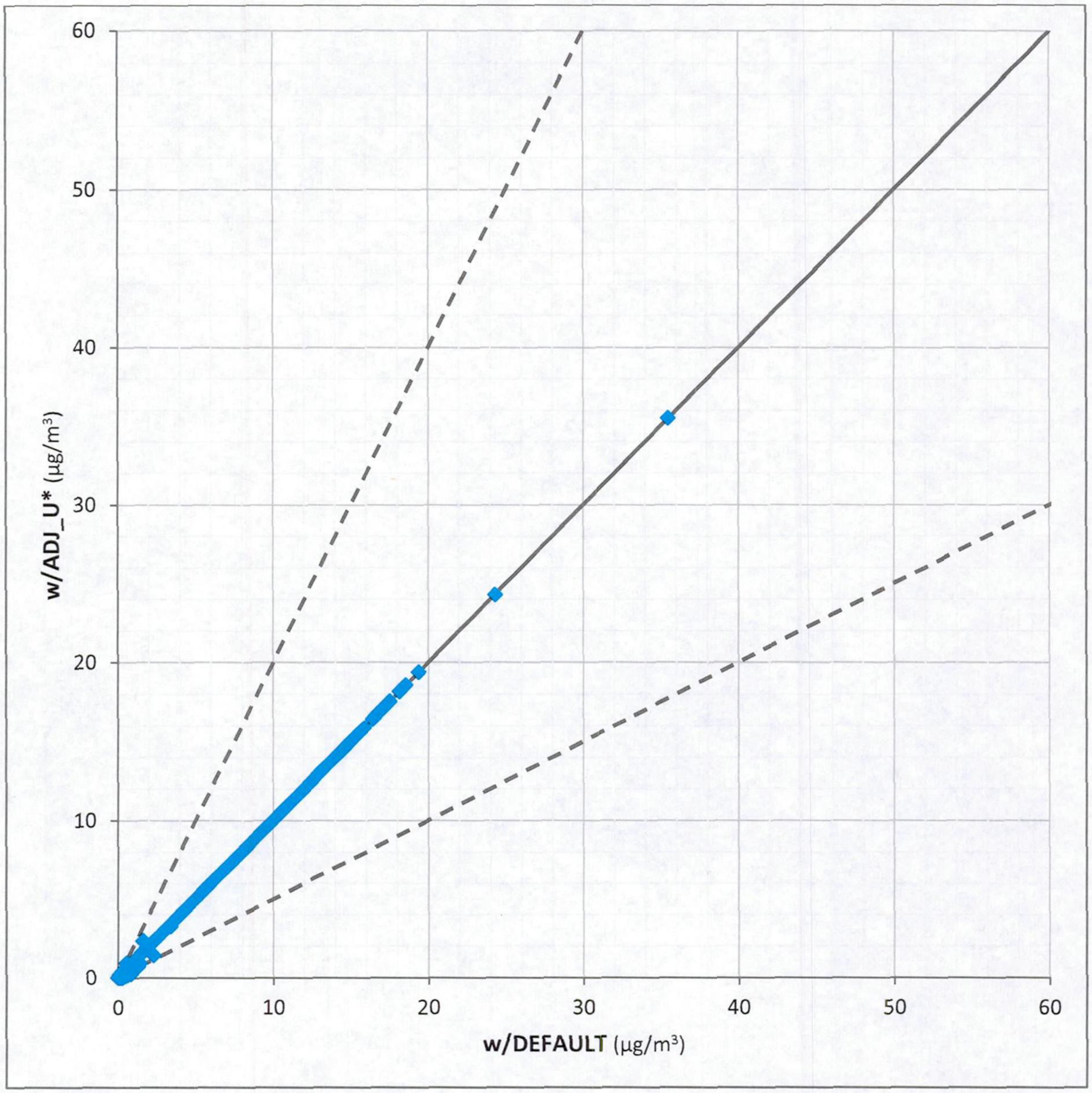

Figure 8. Q-Q plot paired in time of 1-hour concentrations over 2010-2014 for AERMET v15181 run with default vs. ADJ_U* options at the location of the Eliot (Sawgrass Lane) monitor

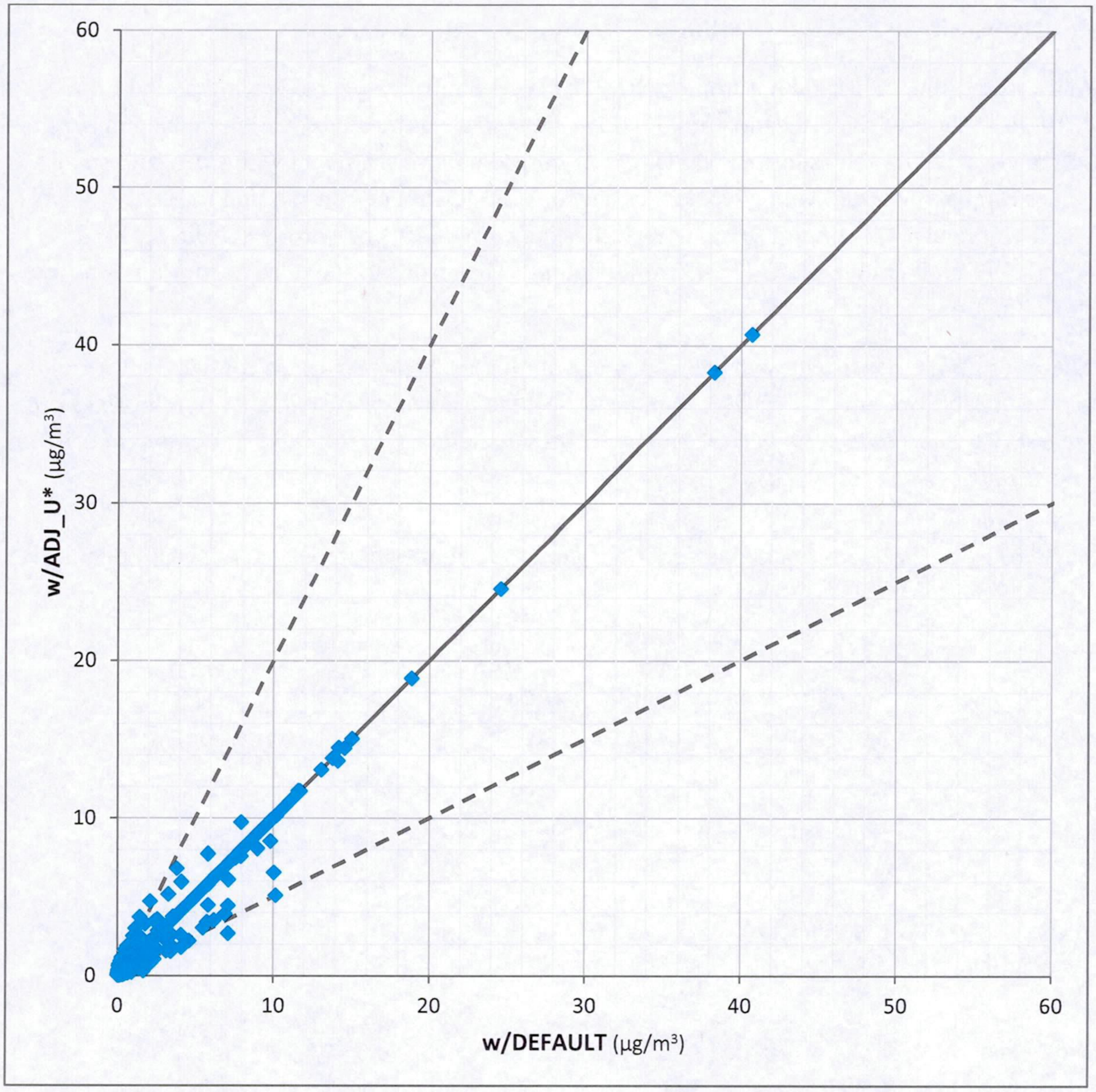

Figure 9. Q-Q plot paired in time of 1-hour concentrations over 2010-2014 for AERMET v15181 run with default vs. ADJ_U* options at the location of the Peirce Island monitor

Project Sensitivity to ADJ_U*: Surface Friction Velocity Values

Analysis of all u* values output from AERMET over the full five-year modeling period from 2010-2014 shows that application of ADJ_U* results in a significant reduction in the number of extremely small u* values in AERMOD. As discussed previously, hours with extremely small u* values can be associated with over-predictions in AERMOD. For non-missing hours, the number of hours with extremely small u* values between 0.0-0.1 m/s dropped from 6,114 (15.57% of all hours) to 1,153 (2.94% of all hours). The results of the u* frequency analysis are shown in Table 6 and Figure 10.

These results are consistent with the results of a similar analysis performed for the Donlin Gold Limited Liability Company (DGLLC) mine project that showed that "*[T]he u• option values are generally greater than 0.10 meters per second (m/sec) and ... [i]n the Default Method, u• are as low as 0.04 m/sec,*" (EPA, 2016).

Table 6. Frequency of u* values for non-missing hours with default vs. ADJ_U* options in AERMET v15181

u* (m/s)	# of Hours AERMET w/Default	# of Hours AERMET w/ADJ_U*	% Hours AERMET w/Default	% Hours AERMET w/ ADJ_U*
0.0 - 0.1	6114	1153	**15.57%**	**2.94%**
0.1 - 0.2	7495	9864	19.08%	25.11%
0.2 - 0.3	9185	11164	23.39%	28.42%
0.3 - 0.4	7442	7896	18.95%	20.10%
0.4 - 0.5	4377	4461	11.14%	11.36%
0.5 - 0.6	2361	2431	6.01%	6.19%
0.6 - 0.7	1302	1301	3.31%	3.31%
0.7 - 0.8	566	546	1.44%	1.39%
0.8 - 0.9	260	279	0.66%	0.71%
0.9 - 1.0	116	122	0.30%	0.31%
1.0 - 1.1	43	42	0.11%	0.11%
1.1 - 1.2	12	14	0.03%	0.04%
1.2 - 1.3	4	4	0.01%	0.01%
1.3 - 1.4	2	2	0.01%	0.01%

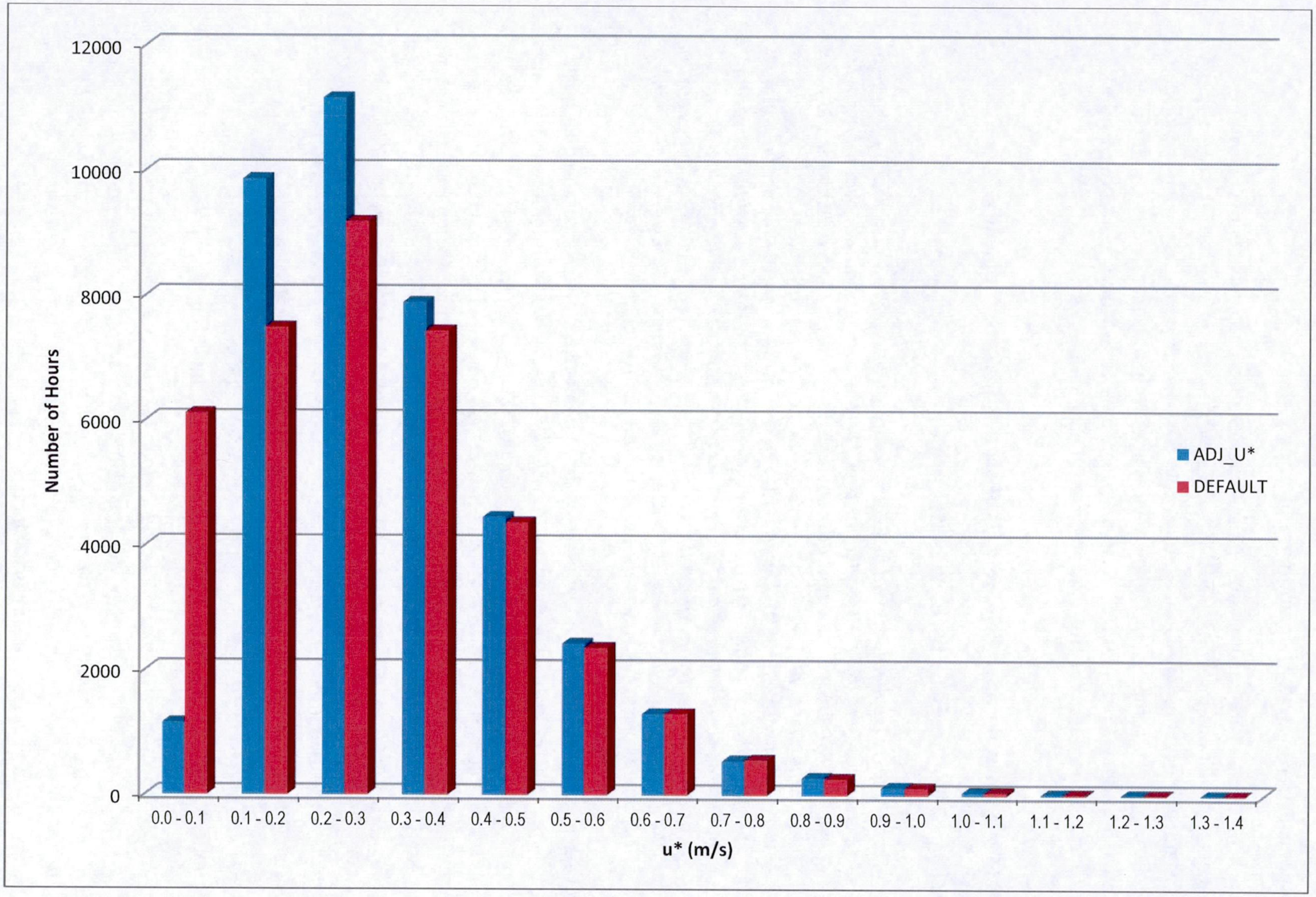

Figure 10. Histogram of u_* values with ADJ_U* vs. default options in AERMET v15181

Project Sensitivity to ADJ_U*: Summary of Analyses

These analyses demonstrate that modeling of Schiller Station encounters with controlling frequency the conditions for which AERMOD is known to over-predict, i.e., the controlling predicted impacts occur as a result of small calculated u_* values during low wind speed, stable conditions in areas of complex terrain due to tall stacks with buoyant releases. As intended, application of ADJ_U* provides a correction to the computed u_* values to improve model performance and produce more realistic predicted concentrations.

Request for Approval Under Condition (2) of Section 3.2.2.b in Appendix W

Per Section 3.2.2 in Appendix W (EPA, 2005):

> b. *An alternative model should be evaluated from both a theoretical and a performance perspective before it is selected for use. There are three separate conditions under which such a model may normally be approved for use: (1) If a demonstration can be made that the model produces concentration estimates equivalent to the estimates obtained using a preferred model;* ***(2) if a statistical performance evaluation has been conducted using measured air quality data and the results of that evaluation indicate the alternative model performs better for the given application than a comparable model in Appendix A;*** *or (3) if the preferred model is less appropriate for the specific application, or there is no preferred model. Any one of these three separate conditions may make use of an alternative model acceptable.*

Several statistical performance evaluations have been published that used measured air quality data to compare the results of AERMOD with AERMET run with default options vs. with non-default option ADJ_U*. These studies have concluded that AERMOD model performance improves when used with AERMET run with non-default option ADJ_U*. Of note, modeling studies involving tall stacks with buoyant releases in areas of complex terrain (the setting for Schiller Station) showed that AERMOD over-predicted observed concentrations due to the use of unrealistically low computed surface friction velocities by AERMET. The use of non-default option ADJ_U* in AERMET, which was coded based on a scientific peer-reviewed study (Qian and Venkatram, 2010), provides correction to these unrealistically low computed u_* values and results in better model performance when compared against observations.

Paine et al. (2015) tested AERMOD v15181 with default and various low wind speed non-default options *"focusing upon tall-stack field databases"* including:

> *"…Mercer County, North Dakota [which] features five SO_2 monitors in the vicinity of the Dakota Gasification Company plant and the Antelope Valley Station power plant in an area of both flat and elevated terrain. In addition to the Mercer County, ND, database, this study considers an additional field database for the Gibson Generating Station tall stack in flat terrain in southwest Indiana."*

Of particular relevance to Schiller Station are the tall stack case study results with and without ADJ_U* in AERMET v15181 against observations from the North Dakota database monitor DGC #17 located in complex terrain. As shown in Figure 11, with default options selected in both AERMET v15181 and AERMOD v15181, the resulting modeled 99th percentile 1-hour value of 184.48 μg/m^3 over-predicted the observed concentration of 83.76 μg/m^3 by a factor of 2.20. Use of non-default option ADJ_U* in AERMET v15181 (with default options in AERMOD v15181) significantly improved model performance, while still remaining conservative, and reduced the over-prediction to a factor of 1.53 with a predicted concentration of 127.93 μg/m^3.

Table 4. North Dakota ratio of monitored to modeled design concentrations.

Test case	Monitor	Observed	Predicted	Ratio
Test Case 1	DGC#12	91.52	109.96	1.20
(Default AERMET, Default	DGC#14	95.00	116.84	1.23
AERMOD)	DGC#16	79.58	119.94	1.51
	DGC#17	83.76	184.48	2.20
	Beulah	93.37	119.23	1.28
Test Case 2	DGC#12	91.52	109.96	1.20
(Beta AERMET, Default	DGC#14	95.00	116.84	1.23
AERMOD)	DGC#16	79.58	119.94	1.51
	DGC#17	83.76	127.93	1.53
	Beulah	93.37	119.23	1.28

Figure 11. Table of results from Paine et al. (2015)

Warren (2016) concluded that, for tall stacks, the use of ADJ_U* alone would not result in an under-prediction of modeled concentrations:

> "*Based on these results, we conclude for the four tall-stack databases reviewed in this study that the use of low wind options (ADJ_U* and LOWWIND3) will modestly over-predict the 1-hour SO_2 design concentration if observed horizontal turbulence data is not used.*"

This is relevant to the modeling being proposed here for Schiller Station and indicates that the use of ADJ_U* in AERMET v15181 coupled with AERMOD v15181 with default options should still be conservative.

At the 11th Modeling Conference in August 2015, EPA presented model evaluation results of the non-default ADJ_U* and LOWWIND options based on several relevant field studies (EPA, 2015), including:

- *"The 1993 Cordero Rojo surface coal mine fugitive dust study in eastern Wyoming based on 24-hr PM10 concentrations (using v14134);*
- *The 1974 NOAA Oak Ridge, TN, tracer study for a low-level release on the Oak Ridge peninsula with sampling arcs at 100m, 200m, and 400m, and wind speeds ranging from 0.15 to 0.73m/s (10 of 11 cases < 0.5m/s);*
- *The 1974 NOAA Idaho Falls, ID, tracer study for a low-level release with sampling arcs at 100m, 200m, and 400m, and wind speeds ranging from 0.75 to 1.93m/s (4 of 11 cases < 1.0m/s);"*

In the Cordero Rojo study, EPA concluded that "*[u]se of the proposed ADJ_U* option in AERMET appears to significantly improve model performance*". Note that although the study was based on AERMET v14134, EPA stated that the results "*are likely to be similar for v15181*". For both the Oak Ridge and Idaho Falls studies, use of ADJ_U* in AERMET v15181 brought the default AERMOD v15181 predicted concentrations closer to observed values while still remaining conservative. In conclusion, EPA proposed that the ADJ_U* option be incorporated into the regulatory version of AERMET.

The published model performance evaluations listed above should satisfy the requirements of condition (2) of Section 3.2.2.b for Eversource Energy's request for approval to use non-default option ADJ_U* in AERMET v15181 for modeling Schiller Station with AERMOD v15181.

Conclusion

When modeled with default options in AERMET v15181 and AERMOD v15181, the controlling predicted impacts for Schiller Station, characterized by tall stacks with buoyant releases, occur in complex terrain under low wind speed, stable conditions. A number of published statistical performance evaluations have demonstrated that AERMOD over-predicts for tall stacks with buoyant releases in complex terrain and that use of beta option ADJ_U* in AERMET results in better model performance for these situations. Therefore, modeling Schiller Station with the use of beta option ADJ_U* in AERMET v15181 with default options in AERMOD v15181 is justified under condition (2) of Section 3.2.2.b in Appendix W.

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