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Filer:	Alison Seel
Organization:	Sierra Club
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April 11, 2016

Via electronic and U.S. mail

Kerby E. Zozula
Manager, Engineering Division
Ventura County Air Pollution Control District
669 County Square Drive, 2nd Floor
Ventura, CA 93003
Email: kerby@vcapcd.org

Re: **Concerns with Reliance on Unapproved "Beta Option" in Air Quality Modelling for Puente Power Project**

Dear Mr. Zozula:

In advance of the issuance of the Preliminary Determination of Compliance for the Puente Power Project, Sierra Club, Environmental Coalition of Ventura County, and Environmental Defense Center ("EDC") would like to express our significant concerns with the modelling approach used for this Project. We understand that Ventura County Air Pollution Control District ("APCD") will model air quality impacts from the Puente Project using a non-standard "beta option" within the AERMET program, called "ADJ_U*."[1] This alternative modelling approach is less accurate than the standard model and improperly underestimates air quality impacts. It is not approved by the U.S. Environmental Protection Agency (EPA) for use as a primary air model without specific analysis showing that the alternative model is more accurate than the default. Sierra Club, Environmental Coalition, and EDC ask that any air quality permits for Puente issued by the Ventura County APCD be based on modelling using AERMOD and AERMET's standard parameters.

The ADJ_U* alternative is not an approved model for primary use, and it is inappropriate to elevate this alternative option to a regulatory standard. As the EPA has explained, beta options in AERMOD and AERMET are included for the limited purpose of "vetting of yet to be formally promulgated model options that are still undergoing research and development."[2] The EPA has clarified that "the inclusion by EPA of a beta option into any part of the AERMOD Modeling System . . . does not bestow any special status or implicit approval of that non-regulatory beta option."[3] In fact, options like ADJ_U* require formal approval before they can be used in EPA rulemaking, based on a determination that the alternate model is more accurate than the preferred model.[4] As the attached letter from the EPA

[1] Puente Power Project Application for Certification (April 15, 2015), Appendix C-4: Air Quality Monitoring Protocol, *Air Dispersion Modelling and Health Risk Assessment Protocol*, p. A-4.
[2] U.S. EPA Memorandum, "Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options," (Dec. 10, 2015), p. 1.
[3] *Id.*, pp. 1-2.
[4] 40 C.F.R. Part 51, Appendix W, Section 3.2.

rejecting a request to use the ADJ_U* model for a project in New Hampshire demonstrates, this analysis is not cursory, and must be based on a compelling demonstration that use of the alternate model is justified. Without this comparative analysis for the Puente Project, it is not justifiable to use an unapproved alternative model in place of the principal model.

The justification given in the Application for reliance on ADJ_U* for this project is brief and unpersuasive. The Application states that the model variant was chosen due to the concern that the default model parameters will under-predict air surface friction, or "u*," at low wind speeds.[5] The Application cites a presentation by the corporation AECOM for this critique.[6] However, AECOM's presentation qualifies its criticism by stating that the problem with the default model is "[n]ot likely an issue for winds greater than ~0.5 m/s."[7] According to the Application, the average wind speed at the Oxnard Airport—the monitoring site used to model wind at the project site—is 3.24 meters per second.[8] From 2009-2013, wind speed at the monitoring site was below 0.5 meters per second only about 2-3 percent of the time.[9] The Oxnard Airport is 2 miles inland from the project site, so it is conceivable that this data may under-estimate actual wind speed, and that winds directly at the coast may be higher.[10] Using an alternative model designed for use in areas with low wind speeds does not withstand scrutiny.

Use of the ADJ_U* beta option is further problematic because this variant is less accurate overall, and can substantially understate a project's air emissions. Compared to the default AERMOD inputs, model runs using the ADJ_U* beta option consistently under-predict air quality impacts. Sierra Club has been active on this issue nationally, and filed technical comments on this issue during EPA's rulemaking process on changes to AERMOD. As explained in the attached technical comments provided to EPA, an expert air modeler took the data sets used in the original validation testing for the AERMOD system, and compared measured air pollution to the predictions given using the ADJ_U* beta option with AERMOD, and using the AERMOD regulatory default. She found that using the ADJ_U* settings consistently under-estimated air quality impacts, in one case causing estimated air pollution to under-predict monitored values by 50%.[11] Notably, her analysis found that the default model was more accurate than the ADJ_U* even for data sets with wind speeds under 0.5 m/s.[12]

Reliance on an unreliable and unapproved model variant to predict air quality impacts from the Puente Project will likely under-estimate actual emissions, to the detriment of human and environmental health. The health impacts of impaired air quality in Ventura County are already acute enough. The area

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[5] Appendix C-4, p. A-4, ftn. 6.
[6] *Id.*, citing AECOM Presentation "AERMOD Low Wind Speed Issues:Review of New Model Release" (April 23, 2013), available at http://www.cleanairinfo.com/regionalstatelocalmodelingworkshop/archive/2013/Files/Presentations/Tuesday/105-Review_of_AERMOD_Low_Wind_Speed_Options_Paine.pdf.
[7] AECOM Presentation, p. 7.
[8] Puente Power Project Application for Certification (April 15, 2015), Section 4.1: Air Quality, p. 4.1-2. *See* Section 4.1, p. 4.1-2.
[9] Puente Power Project Application for Certification (April 15, 2015), Appendix C-1: Wind Roses, pp. 1-4.
[10] Puente Application, Section 4.1, p. 4.1-2.
[11] Technical Comments by Camille Sears to U.S. EPA re: Revision to the Guideline on Air Quality Models (Oct. 25, 2015), pp. 9, 20.
[12] *Id.*, p. 10.

is in nonattainment of state and federal ozone levels, and of state particulate matter standards.[13] We therefore ask the Ventura County Air Pollution Control District ensure its air quality modelling uses EPA's approved AERMOD model and not employ the non-regulatory default ADJ_U* beta option.

Sincerely,

/s/ ALISON SEEL

Alison Seel
Sierra Club
85 Second St., 2nd Floor
San Francisco, CA 94105
Telephone: (415) 977-5737
alison.seel@sierraclub.org

Brian Segee
Environmental Defense Center
111 W. Topa Topa Street
Ojai, CA 93023
Telephone: (805) 640-1832
bsegee@environmentaldefensecenter.org

Cc: Distribution list for CEC Docket 15-AFC-01

Encl:
1. U.S. EPA Memorandum, "Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options," (Dec. 10, 2015).
2. U.S. EPA Comments on New Hampshire's November 13, 2015 Modelling Protocol for the Schiller Station Title V Petition (Dec. 8, 2015).
3. Letter from Sierra Club to U.S. EPA re: Revisions to the Guideline on Air Quality Models (Oct. 25, 2015).
4. Technical Comments by Camille Sears to U.S. EPA re: Revision to the Guideline on Air Quality Models (Oct. 25, 2015).

[13] *See* Ventura County Air Pollution Control District Air Quality Standards at http://www.vcapcd.org/air_quality_standards.htm

Enclosure 1
U.S. EPA Memorandum, “Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options,” (Dec. 10, 2015)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

December 10, 2015

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Clarification on the Approval Process for Regulatory Application of the AERMOD Modeling System Beta Options

FROM: Richard A. Wayland, Director
Air Quality Assessment Division (C304-02)

TO: See Addressees

With the recent closure of the public comment period for the proposed "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" rulemaking, we wanted to clarify the approval process for regulatory application[1] of the AERMOD Modeling System beta options. It is vitally important to the integrity of the promulgation and application of the Environmental Protection Agency's (EPA's) preferred models and flexibility of alternative models in unique circumstances that the approval process for alternative models adhere to the requirements of Section 3.2 in the current 2005 version of the *Guideline on Air Quality Models* (Appendix W).

Beginning with version 06341, "beta options" have been incorporated into the AERMOD model code to allow for the public sharing and vetting of yet to be formally promulgated model options that are still undergoing research and development that can be applied in regulatory applications on a case-by-case basis with appropriate justification and formal approval under Section 3.2.2 of Appendix W. The incorporation of beta options is beneficial to the entire stakeholder community, because these new model options can be scientifically reviewed and fully evaluated by the community (thereby shortening the time it might take to otherwise formally propose and adopt the new model option into a preferred model), while also allowing for its use in the regulatory arena when it is appropriate and justified consistent with our existing processes and procedures under Appendix W. It should be noted that the inclusion by EPA of a beta option into any part of the AERMOD Modeling System or any other preferred model listed in Appendix A

[1] Prevention of Significant Deterioration (PSD) and nonattainment New Source Review (NA NSR)

to Appendix W does not bestow any special status or implicit approval of that non-regulatory beta option. If a beta option within an EPA preferred model is used in a regulatory application, then the status of the preferred model is changed to that of an alternative model.

The horizontal and capped stack beta options, some of the beta options for the more appropriate treatment of low wind conditions, and the alternative NO_2 Tier 2 option are currently proposed as future regulatory options in the proposed revisions to Appendix W rulemaking package. The first beta option in AERMOD version 06341 (released December 7, 2006) was specific to the consideration of dispersion from horizontal and capped stacks. This beta option was incorporated in response to an earlier Model Clearinghouse action[2] and the need for appropriate integration of that Model Clearinghouse response into the AERMOD framework to account for the PRIME plume rise algorithm. More recently, in AERMET and AERMOD versions beginning with version 12345 (released December 10, 2012), beta options that address concerns regarding model performance under low wind speed conditions have been incorporated. Additionally, AERMOD versions beginning with version 13350 (released December 16, 2013) have included a beta Ambient Ratio Method-2 option as an alternative to the existing Tier 2 Ambient Ratio Method[3] for modeling NO_2 applications.

Even with formal proposal as future regulatory options within the AERMOD Modeling System, the regulatory application of any of the beta options in AERMET or AERMOD versions 15181 require formal approval as an alternative model and are subject to the requirements of Appendix W, Section 3.2.2. This is applicable for compliance demonstrations in the PSD context and State Implementation Plan development for NAAQS criteria pollutants as well as the specific use for SO_2 designations and consent decree modeling. Given the need for national consistency on any interpretation of the Act, rule, regulation, or program directive[4] and aspects of certain beta options being proposed as future regulatory options in the proposed revisions to Appendix W rulemaking, the delegated approval of any alternative model to the Regional Offices that includes the application of a beta option must be done in consultation and concurrence with the Model Clearinghouse. The participation of the Model Clearinghouse allows for national consistency in approvals and complete transparency with the stakeholder community through the documentation and public provision of all decisions in the Model Clearinghouse Information Storage and Retrieval System[5] and the EPA's Support for Regulatory Atmospheric Modeling (SCRAM) website[6].

[2] http://cfpub.epa.gov/oarweb/MCHISRS/index.cfm?fuseaction=main.resultdetails&recnum=93-II%20%20-09
[3] 40 CFR Part 51 – Appendix W, Section 5.2.4
[4] 40 CFR Part 56 – Section 56.5 (2) (b)
[5] http://cfpub.epa.gov/oarweb/MCHISRS/
[6] http://www3.epa.gov/ttn/scram/

If you have additional questions regarding the approval and application of the beta options in the AERMOD Modeling System, version 15181, please feel free to contact George Bridgers, (919) 541-5563 or bridgers.george@epa.gov, or Tyler Fox, (919) 541-5562 or fox.tyler@epa.gov.

Addressees:

Mike Koerber, C404-04
Raj Rao, C504-01
Rhea Jones, C539-03
Megan Brachtl, C539-01
Tyler Fox, C439-01
Roger Brode, C439-01
Chris Owen, C439-01
James Thurman, C439-01
Air Program Managers
Air Division Directors
Regional Office Modeling Contacts

Enclosure 2
U.S. EPA Comments on New Hampshire's
November 13, 2015 Modelling Protocol for the
Schiller Station Title V Petition (Dec. 8, 2015)

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

December 8, 2015

Craig A. Wright
Director, Air Resources Division
New Hampshire Department of Environmental Services (NH DES)
29 Hazen Drive
Concord, NH 03302-0095

Dear Mr. Wright:

On November 13, 2015, EPA New England received the modeling protocol submitted by NH DES in response to the Schiller Title V Petition Order issued by EPA on July 28, 2015. NH DES is proposing to model Schiller Station and nearby Newington Station to ensure that Schiller Station does not have the potential to cause or contribute to a violation of the 1-hour national ambient air quality standard (NAAQS) for sulfur dioxide (SO_2). As specified in the modeling protocol submitted to EPA on November 13, 2015, NH DES is proposing to use an alternative model for which EPA approval is required. Requests for the use of an alternative model should adhere to the process outlined in Section 3.2 of Appendix W.

EPA has concerns with portions of the modeling protocol and have attached our comments. We request NH DES address our concerns in an amended modeling protocol. If you have any questions about these comments, please call me at (617) 918-1653 or Leiran Biton at (617) 918-1267.

Sincerely,

Ida E McDonnell

Ida E. McDonnell, Manager
Air Permits, Toxics and Indoor Programs Unit

Enclosure

Enclosure

EPA'S COMMENTS ON NEW HAMPSHIRE'S NOVEMBER 13, 2015 MODELING PROTOCOL FOR THE SCHILLER STATION TITLE V PETITION (VI-2014-04)

1. Section 3.2 of Appendix W *Guideline on Air Quality Models* to 40 CFR Part 51 describes the process for approval of an alternative model over the preferred model. NH DES has requested the use of an alternative model, i.e., the use of the beta options ADJ_U* in AERMET and LOWWIND3 in AERMOD. The ADJ_U* and LOWWIND3 beta options were designed to address overprediction of concentrations in the AERMOD modeling system for very low wind speed conditions. DES has not provided sufficient justification per Appendix W Section 3.2 for the use of the ADJ_U* or LOWWIND3 beta options. As such, EPA does not approve of the use of the ADJ_U* and LOWWIND3 beta options for this modeling.

2. To be consistent with the description of receptor placement in Section 7.2.2 of Appendix W, NH DES should extend the 100 m Cartesian receptor grid 7 to 10 km to the east to properly characterize maximum impacts.

3. The highest impact area (Mount Agamenticus) identified by NH DES is about 16 km from the source at a location where the distance between radials is approximately 2.8 km. The location of the maximum concentration may shift due to updates in model version or use of beta modeling options, and such a shift would render the single receptor at this location insufficient to capture the maximum expected impacts. Rather than placing discrete receptors to account for highest impacts in previous modeling for the site, NH DES should place high resolution receptor grids at areas expected to have the highest impacts, as described in Appendix W, Section 7.2.2. In this case, EPA recommends using 1 km by 1 km grids with 100 m resolution for such locations if they are beyond the bounds of the central Cartesian grids already proposed by NH DES. Alternately, NH DES could perform a preliminary round of modeling and identify areas for more refined analysis, and then perform an additional round of modeling with more refined receptor grids as described in the areas of maximum impact.

4. NH DES states that it will "reserve the right to examine more closely any cases in which a very high Peirce Island SO_2 concentration is measured with a wind direction slightly outside this exclusion sector and to eliminate the use of the Peirce Island SO_2 concentrations in cases where it can be justified" (12). The use of a 90° exclusion sector is described in Appendix W, Section 8.2.2(b). NH DES must clearly define what will constitute "justification" for eliminating any SO_2 concentrations outside the exclusion sector, and how "slightly" the wind direction may be different from the edges of the exclusion sector. Any exclusion of measurements outside of the exclusion sector must be accompanied by robust evidence that the monitor was significantly influenced by the source for that hour.

5. NH DES proposes to exclude all "invalid" hours at Peirce Island from consideration in the calculation of background 1-hour SO_2 concentrations (item 4 in the list on page 12). NH DES improperly characterizes calm hours as being "invalid" in this calculation. Section 8.2.2(b) of

Appendix W does describe the use of an exclusion sector based on wind direction, not based on wind speed. Because Peirce Island is sufficiently far from the source, the modeled sources are not expected to significantly impact Peirce Island during calm wind hours.

6. NH DES should preferentially rely on the wind direction at the Peirce Island monitor to determine whether the hour is in the exclusion sector (per 40 CFR Part 51 Appendix W Section 8.2.2(b)) for the calculation of background 1-hour SO_2 concentrations (item 6 in the list on page 12). The wind direction at PSM should only be examined for this calculation when the wind direction measurement is invalid (i.e., missing or erroneous) at Peirce Island.

Enclosure 3
Letter from Sierra Club to U.S. EPA
re: Revisions to the Guideline on Air Quality Models
(Oct. 25, 2015)

SIERRA CLUB

U.S. Environmental Protection Agency
Mail Code 28221T
1200 Constitution Ave. NW
Washington, D.C. 20460

George M. Bridgers
Air Quality Assessment Division
Office of Air Quality Planning and Standards
U.S. Environmental Protection Agency
Mail Code C439-01
Research Triangle Park, NC 27711

Via Regulations.gov Electronic Filing

Re: Revisions 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, Docket No. EPA-HQ-OAR-2015-0310

The Sierra Club submits the enclosed technical analysis and comments concerning EPA's proposed Revisions 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, demonstrating that the proposed changes to AERMOD will have the effect of undermining model efficacy, and causing the model to improperly underpredict air quality impacts. Accordingly, the proposed model changes should be abandoned.

Specifically, while EPA proposes elevating the AERMET ADJ_U* and AERMOD LOWWIND3 beta options to regulatory defaults, the enclosed technical analysis by expert air modeler Camille Sears demonstrates that use of these options—rather than improving model performance, as EPA claims—decrease model accuracy. As explained in greater detail in Ms. Sears's analysis, applying these options to the original validation studies performed for AERMOD erratically and in some cases quite significantly reduces modeled impacts, particularly so in the case of the Tracy validation study data.

Indeed, EPA's proposal is predicated not on these validation studies, but on testing the options against severely flawed and outdated datasets that are wholly inappropriate for evaluating model performance. The Idaho Falls Diffusion Study data is of *1974* vintage, for example, and both involved a very small sample size of low wind speed gas releases and as well as used improper wind speed measure methodologies. The Idaho Falls data is thus nearly irrelevant for the task of ascertaining the accuracy of the ADJ_U* and LOWWIND3 options. Similarly, the Cordero Rojo Mine study data is not based on emissions monitoring or tracer gas release rates that could be known and controlled; thus, the relationship between observed concentrations of air pollutants and emission rates is unknown, making the data set effectively useless for model evaluation.

Accordingly, even if EPA had made its ADJ_U* and LOWWIND3 model evaluation analyses available for public review (which it has not), these analyses are inherently flawed and cannot support changes to AERMOD's regulatory default. This is particularly so where validation trial analyses show the options undermine model accuracy.

In short, the proposed ADJ_U* and LOWWIND3 options do nothing to improve model performance, and EPA lacks justification for folding them into the AERMOD regulatory default. Indeed, doing so would cripple the efficacy of AERMOD, and lead to significant underprediction of air pollution impacts, to the detriment of the environment and public health. EPA should *not* give these options its regulatory blessing, and should at most retain them as mere beta options.

In addition to these serious concerns with the AERMOD-weakening, the Sierra Club also wishes to highlight issues with the proposal's treatment of ozone and fine particulate air pollution (PM2.5).

First, EPA needs to establish expedient time frames for developing the proposed tools and rulemaking for assessing single-source impacts on ozone and secondary PM2.5.

Second, as regards model emission rates for precursors (MERPs), any MERPs developed must be based on levels that protect PSD increments in all Class I and II impact areas affected by the evaluated source, and should further be considered on a location-specific basis, based on both near-field and long-range transport impacts. Because using MERPs as a screening method in PM2.5 and ozone nonattainment areas is likely to interfere with progress towards attaining national ambient air quality standards (NAAQS) for these pollutants, PM2.5 emissions as well as PM2.5 and ozone precursor emissions that impact unclassified and nonattainment areas should be offset by a ratio *greater* than 1:1.

Third, EPA should develop specific guidance for performing first tier assessments (i.e., for emissions greater than any established MERP). For such assessments, any empirical relationships between precursor pollutants and secondary impacts must be based on methods that protect PSD increments in all Class I and II impact areas affected by the subject source. Similarly, EPA should develop specific guidance for performing second tier assessments: allowing facilities or local permitting authorities which modeling system (and which inputs) to use allows "model-shopping," and is no improvement over the current situation.

Sincerely,

/s/

Zachary M. Fabish
Staff Attorney
The Sierra Club
50 F Street, NW - 8th Floor
Washington, DC 20001
(202) 675-7917
(202) 547-6009 (fax)
zachary.fabish@sierraclub.org

Enclosure 4
Technical Comments by Camille Sears to U.S. EPA
re: Revision to the Guideline on Air
Quality Models (Oct. 25, 2015).

Camille Sears 502 W. Lomita Ave., Ojai, CA 93023

Tel: (805) 646-2588 e-mail: camille.marie@sbcglobal.net

October 25, 2015

EPA Docket Center
1301 Constitution Ave., NW., Room 3334
Washington, DC 20004

Re: Docket#: EPA-HQ-OAR-2015-0310
Proposed Rulemaking and the 11th Conference on Air Quality Modeling:
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

Thank you for the opportunity to comment on the Proposed Revision to the Guideline on Air Quality Models and the associated 11th Conference on Air Quality Modeling, held August 12-13, 2015 at USEPA's RTP campus. On behalf of Sierra Club, I am submitting comments on the proposed AERMET ADJ_U* and AERMOD LOWWIND3 changes to the AERMOD Dispersion Modeling System (FR 80, 145, pp. 45340-45387).

As explained more fully below, the proposed AERMET ADJ_U* and AERMOD LOWWIND3 changes do not improve AERMOD performance, and in fact *decrease* model accuracy (unpredictably, and in some cases quite significantly underestimating impacts), based on testing those changes against the original AERMOD validation trial datasets. Moreover, the purported justification for EPA's proposal to include those changes is based on severely flawed and outdated datasets from the *1970s* that are wholly inappropriate for evaluating AERMOD performance. Finally, EPA has failed to make publicly available the AERMET ADJ_U* and AERMOD LOWWIND3 model evaluation analyses, significantly calling into question the transparency of a model revision process that has heavily incorporated input from regulated industry.

Accordingly, the proposed AERMET ADJ_U* and AERMOD LOWWIND3 changes should not be incorporated into the AERMOD modeling system as regulatory defaults.

I. Introduction

Among USEPA's proposed revisions to the Guideline on Air Quality Models, I am commenting on the following two AERMOD and AERMET updates:

> *2. Updates to EPA's AERMOD Modeling System*
>
> Based on studies presented and discussed at the Tenth Modeling Conference, and additional relevant research since 2010, the EPA and other researchers have conducted additional model evaluations and developed changes to the model formulation of the AERMOD modeling system to improve model performance in its regulatory applications. We propose the following updates to the AERMOD modeling system to address a number of technical concerns expressed by stakeholders:
>
> 1. A proposed option incorporated in AERMET to adjust the surface friction velocity (u*) to address issues with AERMOD model overprediction under stable, low wind speed conditions. This proposed option is selected by the user with the METHOD STABLEBL ADJ_U* record in the AERMET Stage 3 input file.
>
> 2. A proposed low wind option in AERMOD to address issues with model overprediction under low wind speed conditions. The low wind option will increase the minimum value of the lateral turbulence intensity (sigma-v) from 0.2 to 0.3 and adjusts the dispersion coefficient to account for the effects of horizontal plume meander on the plume centerline concentration. It also eliminates upwind dispersion which is incongruous with a straightline, steady-state plume dispersion model such as AERMOD. The proposed option is selected by specifying ''LOWWIND3'' on the CO MODELOPT keyword in the AERMOD input file.[1]

The notice of proposed rulemaking invites comments on these and other possible revisions to the Guideline on Air Quality Models:

> We invite comments on whether we have reasonably addressed the technical concerns expressed by the stakeholder community and are on sound footing to recommend these updates to the regulatory default version of the AERMOD modeling system which includes its replacement of BLP as an Appendix A model for the intended regulatory applications.[2]

[1] **Federal Register** / Vol. 80, No. 145 / Wednesday, July 29, 2015 / Proposed Rules, p. 45345. This document is available at: http://www3.epa.gov/ttn/scram/11thmodconf/EPA-HQ-OAR-2015-0310-0001.pdf.
[2] Id.

To begin with, I suggest that the proposed rulemaking notice be modified and redistributed for additional public comment.[3] Taking this concern one step further, I suggest that the non-default beta AERMET ADJ_U* and AERMOD LOWWIND3 options in version 15181 should remain as non-default even after the proposed rulemaking is complete. My comments below provide evidence that the non-default beta AERMET ADJ_U* and AERMOD LOWWIND3 options in version 15181 actually decrease model performance in many situations, and that the bases for updating these options to regulatory default status are based on outdated, flawed, and very limited amounts of data.

I recommend that version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options should only be applied on a case-by-case basis, and only after an alternative model demonstration per Section 3.2.2 of the current Guideline on Air Quality Models. These options should not be updated to regulatory default status.

II. Application of the Proposed AERMET ADJ_U* and AERMOD LOWWIND3 Options Generally Degrades Model Performance

This comment addresses five field study evaluations of AERMOD v. 15181. The five field study evaluations include four tall-stack EGU evaluation databases and one low-level, non-buoyant release study. As discussed in Comment IV. below, the data necessary for modeling the Oak Ridge and Idaho Falls field study evaluations are not publicly available.

The primary purpose of these evaluations is to determine whether the proposed AERMET ADJ_U* and AERMOD LOWWIND3 options included in v. 15181 improve or degrade performance compared to the current regulatory default options. These model evaluations result in the following conclusions:

- For the four AERMOD EGU evaluation studies analyzed here, the proposed AERMET ADJ_U* and AERMOD LOWWIND3 options decrease model performance, and in one case, significantly under-predicts measured values.
- For the non-buoyant low-level Prairie Grass tracer release, the proposed AERMET ADJ_U* and AERMOD LOWWIND3 options slightly improve model performance.

[3] Of the six proposed AERMET/AERMOD updates, only the plume rise for horizontal and capped stacks and the AERMOD modeling system inclusion of BLP are explicitly recommended for regulatory default status. These two options are expressly described as regulatory default provisions in the proposed revision to Appendix W, while the other four options do not have this description. The proposed rulemaking notice should be revised to make it clear that USEPA intends to make all the proposed AERMOD updates as regulatory default. The proposed rulemaking notice should then be redistributed for additional public comment.

In December 2012, USEPA released revised versions of the AERMOD air dispersion model and AERMET, the meteorological data processor for AERMOD. These programs are known as AERMOD v. 12345 and AERMET v. 12345, as they were released on Julian day 345 of 2012.

Version 12345 of AERMOD includes non-default beta options to study the effect of varying minimum values of the standard deviation of the horizontal wind speed fluctuations (σ_v) and wind speed (WS). This version of AERMOD also includes the non-default beta option for varying the maximum meander component (FRANmax).

Version 12345 of AERMET includes the non-default beta option to adjust the calculated friction velocity under low wind speed and stable conditions (ADJ_U*). In summary, the non-default beta options are:

LOWWIND1:

- Minimum σ_v can be set from 0.01 to 1.0 m/s
- Minimum WS can be set from 0.01 to 1.0 m/s
- No horizontal meander component is included

LOWWIND2:

- Minimum σ_v can be set from 0.01 to 1.0 m/s
- Minimum WS can be set from 0.01 to 1.0 m/s
- FRANmax can be set from 0.5 to 1.0

AERMET ADJ_U*:

- Adjusts the calculated friction velocity under low wind speed and stable conditions

Numerous combinations of these non-default beta options can also be assessed.

In July 2015, USEPA released version 15181 of the AERMOD air dispersion model and AERMET, the meteorological data processor for AERMOD.[4] Version 15181 retains the non-default beta options LOWWIND1 and LOWWIND2, but also includes non-default beta option LOWWIND3 to study the effect of varying minimum values of the standard deviation of the horizontal wind speed fluctuations (σ_v) and wind speed (WS). The non-default beta option LOWWIND3 is similar to LOWWIND2, increasing the minimum value of sigma-v from 0.2 to 0.3 m/s, but LOWWIND3 eliminates upwind dispersion, consistent with the LOWWIND1 option.

[4] Between versions 12345 and 15181, USEPA released AERMOD versions 13350 and 14134, which have the same non-default beta options as v. 12345.

A. USEPA 2003 AERMOD Evaluations

USEPA prepared detailed performance evaluations prior to the release of AERMOD.[5] USEPA's evaluations included 17 different field studies. Using these 17 field studies, USEPA showed that AERMOD closely predicted monitored impacts based on the robust highest concentration (RHC) statistical method. The RHC is useful for determining whether modeled predictions are accurately reflecting the highest concentrations that will be used for verifying compliance with regulatory design concentrations (typically NAAQS or PSD increments). USEPA's evaluations were performed using AERMOD v. 02222.

The RHC "represents a smoothed estimate of the highest concentrations, based on a tail exponential fit to the upper end of the concentration distribution."[6] The RHC is calculated as follows

$RHC = \chi(n) + (\chi ave - \chi(n)) * \ln((3n-1)/2)$,
Where:

- $n = \min(m_o, m)$; m_o is the number of values used to characterize the upper end of the concentration distribution, m is the number of values exceeding a specified threshold value
- n = 26 for AERMOD evaluations
- $\chi(n) = n^{th}$ largest value
- χave = average of the n-1 largest values

The RHC is an appropriate analysis of AERMOD's utility and applicability. Using unpaired modeling and monitoring results ensures that the evaluation assesses the highest concentrations necessary for verifying compliance with regulatory design concentrations. From Cox and Tikvart:

> Because of the nature of some ambient standards, such as those for SO_2, models must accurately predict the highest 3-h or 24-h average concentration independent of exactly when or where they may occur.[7]

In addition, by using unpaired modeling and monitoring results, the RHC is not overly influenced by uncertainties in measured wind speed, wind direction, stability parameters, emission rates, and release parameters. Any uncertainty in these model inputs will result in

[5] USEPA, AERMOD: Latest Features and Evaluation Results, EPA-453/R-03-003, June 2003. This document is available at: http://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_mep.pdf.
[6] Id., p. 14.
[7] Cox, W. and Tikvart, J., A Statistical Procedure for Determining the Best Performing Air Quality Simulation Model. Atmospheric Environment, 1990, 24A: 2387-2388.

decreased model performance, particularly when trying to replicate measured impacts at a specific location and time. From the Guideline on Air Quality Models:

> As noted above, poor correlations between paired concentrations at fixed stations may be due to ‘‘reducible’’ uncertainties in knowledge of the precise plume location and to unquantified inherent uncertainties. For example, Pasquill estimates that, apart from data input errors, maximum ground-level concentrations at a given hour for a point source in flat terrain could be in error by 50 percent due to these uncertainties. Uncertainty of five to 10 degrees in the measured wind direction, which transports the plume, can result in concentration errors of 20 to 70 percent for a particular time and location, depending on stability and station location. Such uncertainties do not indicate that an estimated concentration does not occur, only that the precise time and locations are in doubt.[8]

Consistent with the Guideline on Air Quality Models, RHCs are an effective and accurate way to evaluate model performance.

For each field study, an RHC is calculated for both the modeled impacts and the monitoring results collected during the study. The ratio of the modeled RHC to the monitored RHC represents how well the model predicted the field study monitoring results.

Model performance can also be demonstrated using Quantile-Quantile (Q-Q) plots, which are line graphs of modeled concentrations versus predicted impacts. The Q-Q plots are based on the 26 highest modeled and monitored concentrations (applicable for regulatory design concentrations), and have the following characteristics:

- Concentrations are unpaired in space and time
- Predicted concentrations represent highest modeled impact across all receptors (monitor locations) for each data period – same as RANKFILE
- Observed concentrations represent highest impact across all monitors for each data period
- Model performance decreases as values move away from the middle 1:1 line

B. AERMOD/AERMET v. 15181 Evaluations

The non-default beta AERMET ADJ_U* and AERMOD LOWWIND3 options included in v. 15181 have the potential to change model performance when compared to the current regulatory default options. Using the AERMOD evaluation databases provided in USEPA’s SCRAM website, I evaluated model performance for the following AERMOD versions and options:

[8] USEPA, Revision to the Guideline on Air Quality Models: Adoption of a Preferred General Purpose (Flat and Complex Terrain) Dispersion Model and Other Revisions, Appendix W to 40 CFR Part 51, November 9, 2005, Section 9.1.2.b. This document is available at: http://www3.epa.gov/ttn/scram/guidance_permit.htm#appw.

- AERMOD v. 02222 (the same version used in USEPA's 2003 AERMOD evaluation)
- AERMOD v. 12345 (off-the-shelf: no beta options)
- AERMOD v. 15181 (off-the-shelf: no beta options)
- AERMOD v. 15181, beta ADJ_U*
- AERMOD v. 15181, beta ADJ_U*, with LOWWIND3, SVmin = 0.3 m/s; WSmin = 0.5 m/s; FRANmax = 0.95

The field studies I included in my evaluations are:

- Baldwin (1-hr SO_2): Rural, flat terrain, 3 stacks, HS = 184.4 m
- Kincaid (1-hr SO_2): Rural, flat terrain, 1 stack, HS = 187 m
- Lovett (1-hr SO_2): Rural, complex terrain, 1 stack, HS = 145 m
- Tracy (1-hr SF_6): Rural, complex terrain, 1 stack, HS = 90.95 m
- Prairie Grass (1-hr SF_6): Rural, flat terrain, 1 stack, HS = 0.46 m (no plume rise)

The Baldwin, Kincaid, Lovett, and Tracy field studies are useful for assessing model performance of tall Electric Generating Unit (EGU) stacks. These field studies are particularly important since the preliminary evaluations used in developing the non-default beta options all used non-buoyant low-level releases. The LOWWIND1, LOWWIND2, and LOWWIND3 non-default beta options were evaluated by USEPA using the Idaho Falls and Oak Ridge field studies.[9] These studies are not likely to be applicable to tall-stack EGU emissions.

The AERMET v. 15181 non-default ADJ_U* beta option was developed based on results from the Prairie Grass and Idaho Falls field studies.[10] These studies are non-buoyant, low-level releases that do not reflect dispersion for tall EGU stacks. Since the Idaho Falls evaluation study is not publicly available, I was limited to using the Prairie Grass SF_6 field study to evaluate AERMET ADJ_U* and AERMOD LOWWIND3 non-default beta options performance for low-level releases of non-buoyant emissions.

[9] USEPA, User's Guide for the AMS/EPA Regulatory Model – AERMOD, Addendum, Appendix F, Evaluation of Low Wind Beta Options, June, 2015. This document is available at: http://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

[10] Qian, Wenjun and Akula Venkatram, Performance of Steady-State Dispersion Models Under Low Wind-Speed Conditions, Boundary Layer Meteorology, 2011, 138:475–491.

C. Evaluation Methods and Results

I evaluated the default and non-default beta options of AERMOD and AERMET described above using five field studies (Baldwin, Kincaid, Lovett, Tracy, and Prairie Grass). The evaluation methods I used and the results I obtained are discussed below.[11]

1. Meteorological data

I used the AERMET v. 02222 meteorological data prepared by USEPA in my evaluation runs for AERMOD v. 02222. These data were provided in model-ready form on the USEPA SCRAM website.[12] I created AERMET v. 12345 meteorological data and AERMET v. 12345 non-default ADJ_U* meteorological data using AERMET v. 12345 and the pertinent input data and options. I also created AERMET v. 15181 meteorological data and AERMET v. 15181 non-default ADJ_U* meteorological data using AERMET v. 15181 and the pertinent input data and options.

The necessary meteorological data for the Prairie Grass field study were not provided with USEPA's evaluation database. I contacted USEPA, attempting to obtain these missing data. I did not receive a reply. To complete the Prairie Grass evaluation, I used 1956 ISH data for North Platte, Nebraska. I processed these data with AERMET v. 12345 and v. 15181 using the same procedures as for the other evaluation databases.

2. Data Processing for RHC Calculations

I formatted the observed concentrations and modeled concentrations to facilitate RHC calculations. For the observed concentrations, I determined the maximum concentration across all receptors for each data period. For the modeled concentrations, I wrote a FORTRAN utility program to read AERMOD postfile concentrations and write the output such that all receptor concentrations for each data period occupy one record. I then extracted the maximum concentration across all receptors for each data period, as I did for the observed concentrations.

I then isolated and sorted the 26-highest observed and modeled concentrations. From these values, I calculated modeled RHC and observed (monitored) RHC values as discussed above.

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[11] It is important to note that my evaluations, although they used the evaluation field studies provided by USEPA (and the same equation for calculating RHC), did not always obtain precisely the same Modeled RHC/Monitored RHC values presented in USEPA's AERMOD: Latest Features and Evaluation Results, EPA-453/R-03-003, June 2003; minor discrepancies in the results occur. (This document is available at: http://www3.epa.gov/ttn/scram/7thconf/aermod/aermod_mep.pdf.) I discussed these differences with Roger Brode, USEPA; however, the reason for the differences was not determined. Nonetheless, these discrepancies do not detract from the main conclusions of my evaluation.

[12] http://www.epa.gov/ttn/scram/dispersion_prefrec.htm.

A summary of Modeled RHC/Monitored RHC values for these modeled scenarios and field studies is presented in the following table:

Scenario	Baldwin (1-hr SO_2)	Kincaid (1-hr SO_2)	Lovett (1-hr SO_2)	Tracy (1-hr SF_6)	Prairie Grass (1-hr SF_6)
v. 02222	1.42	0.84	0.90	1.05	1.19
v. 12345	1.56	0.83	0.78	1.12	1.16
v. 15181	1.55	0.83	0.77	1.12	1.17
v. 15181, ADJ_U*	1.55	0.83	0.91	0.53	1.19
v. 15181, ADJ_U*, LOWWIND3 (0.3, 0.5, 0.95)	1.40	0.72	0.79	0.42	0.95

For the Baldwin evaluation study, all versions of AERMOD and options tend to over-predict observed RHC values. Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options tend to improve model performance slightly, comparable to AERMOD v. 02222. Q-Q plots for each modeled scenario are included in Attachment 1.

For the Kincaid evaluation study, all versions of AERMOD and options tend to under-predict observed RHC values. Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options tend to decrease modeled impacts and model performance, when compared to all other regulatory default versions. Q-Q plots for each modeled scenario are included in Attachment 2.

For the Lovett evaluation study, all versions of AERMOD and options tend to under-predict observed RHC values. Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options only slightly affect modeled impacts and model performance. Using AERMET ADJ_U* increases modeled impacts compared to the regulatory default AERMOD v. 15181, while the combination of AERMET ADJ_U* and AERMOD LOWWIND3 does not. Q-Q plots for each modeled scenario are included in Attachment 3.

For the Tracy evaluation study, Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options tend to decrease modeled impacts and model performance, when compared to all other versions. For the Tracy evaluation, these options significantly under-predict modeled impacts compared to the current regulatory default versions. Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options present a considerable problem for verifying

compliance with regulatory design concentrations, as the predicted impacts are less than half of the measured values. Q-Q plots for each modeled scenario are included in Attachment 4.

For the Prairie Grass evaluation study, current regulatory default versions of AERMET and AERMOD approach 1:1 model accuracy. Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options tend to decrease modeled impacts and slightly improve model performance, when compared to other regulatory default versions. Q-Q plots for each modeled scenario are included in Attachment 5.

It is important to note that for four out of five evaluations I performed, Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options tend to decrease modeled impacts when compared to the regulatory default versions. This should be seen as a red flag, alerting USEPA that the AERMET ADJ_U* and AERMOD LOWWIND3 non-default options will likely degrade model performance in many instances. From Roger Brode's January 18, 2011 declaration:

> As shown in Tables 2 and 3 of EPA 2003 (AERMOD: Latest Features and Evaluation Results, EPA-453/R-03-003, June 2003), modeling and monitored results for 1-hour averages are in excellent correlation in these studies, with the ratio of predicted to observed performance approaching 1:1 in most instances.[13]

In many modeling applications, version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options will likely degrade performance compared to current regulatory default versions.

Furthermore, the above evaluation analyses included a number of site-specific meteorological data sets that incorporate low wind speed conditions. For example, the Tracy evaluation included meteorological data with wind speeds as low as 0.39 meter/second (m/s); the Kincaid SO_2 evaluation included wind speeds as low as 0.37 m/s; and the Lovett evaluation included wind speeds as low as 0.30 m/s.[14] Concerns expressed by industry that the regulatory default version of AERMOD v. 15181 does not accurately assess low wind speed conditions neglects the data used in these actual AERMOD evaluations.

[13] See attached file: brode-decl-2011-01-18.pdf.
[14] The AERMOD evaluations and modeled meteorological data are at: http://www.epa.gov/ttn/scram/dispersion_prefrec.htm.

III. EPA's Purported Justifications for the AERMET ADJ_U* and AERMOD LOWWIND3 Options are Based on Outdated and Flawed Monitoring Studies

AERMOD underwent over a dozen years of development, review, and evaluations before it was adopted as a Guideline Air Quality model in 2005. During this lengthy development period, USEPA used 17 different evaluation study databases to determine the "overall good performance of the AERMOD model." From Roger Brode's January 18, 2011 declaration:

> As part of the basis for EPA adopting the AERMOD model as the preferred model for near-field applications in the *Guideline on Air Quality Models,* Appendix W to 40 CFR Part 51, the performance of the AERMOD model was extensively evaluated based on a total of 17 field study data bases (AERMOD: Latest Features and Evaluation Results. EPA-454/R-03003. U.S. Environmental Protection Agency, Research Triangle Park (2003), portions of which are attached to this affidavit) ("EPA 2003"). The scope of the model evaluations conducted for AERMOD far exceeds the scope of evaluations conducted on any other model that has been adopted in Appendix W to Part 51. These evaluations demonstrate the overall good performance of the AERMOD model based on technically sound model evaluation procedures, and also illustrate the significant advancement in the science of dispersion modeling represented by the AERMOD model as compared to other models that have been used in the past.[15]

The Idaho Falls and Oak Ridge studies, which form the basis for developing the AERMET ADJ_U* and AERMOD LOWWIND3 non-default options, were never included in the over dozen years of AERMOD evaluation and development. These studies were certainly available during the 1991 through 2005 AERMOD development period, as they were both performed in 1974. It is unclear why these 40-year old studies were resurrected to develop the AERMET ADJ_U* and AERMOD LOWWIND3 non-default options. Indeed, it appears likely that without intense OAQPS lobbying from industry, these studies would still be in mothball status.

The Idaho Falls and Oak Ridge model evaluation studies are based on very limited and often flawed data collection. These model evaluation studies each comprise only 11 hours of data. Even if all the data collected during these studies could reliably be used to evaluate AERMET and AERMOD (see below for why they are not), this is a remarkably small data set for USEPA to be recommending such significant changes to the AERMOD modeling system.

A. Concerns with the 1974 Oak Ridge Diffusion Study

The Oak Ridge study includes 11 tracer gas releases from July and August, 1974. Throughout this study, the wind speeds measured during the tracer gas releases appear suspect. For example,

[15] See attached file: brode-decl-2011-01-18.pdf.

the August 7, 1974 release, occurring from 0715 through 0815 EDT, reports an average wind speed of 0.26 meter/second.[16] This translates to a travel distance of 936 meters/hour. The sampled concentrations for this period, however, detect SF_6 at distances of up to 2,663 meters away from the release point.[17] Samplers beyond hourly plume travel distances should not be measuring detectable tracer gas concentrations. This implies one of two conditions: either the measured wind speed for this hour is unrealistically low, or the sampled concentrations reflect a sampling period greater than one-hour. Both of these conditions raise questions about whether these data should be used for AERMET/AERMOD evaluation purposes.

These concerns also appear for other release/sampling periods during the Oak Ridge study.[18] During the August 8, 1974 release, occurring from 0645 through 0745 EDT, the reported hourly-average wind speed is 0.23 meter/second.[19] This translates to a travel distance of 828 meters/hour. The sampled concentrations for this period, however, detect SF_6 at distances of up to 3,100 meters away from the release point, which infers a 3 hours and 45 minutes travel time.

It should be noted that the Oak Ridge study ground samples were collected from sampling times of from one to three hours, with most of the tracer gas likely collected during the first hour. From NOAA's Oak Ridge report:

> Ground-level sampled values represent a mean integrated concentration resulting from sampling times of 1 to 3 hr (tracer releases were 60 min). Most of the tracer present in a given sample bag was probably collected during a 1-hr period. Therefore, ground-level sample bag concentrations have been normalized through multiplication by the time of sample collection and division by the length of tracer release.[20]

Unfortunately, the Oak Ridge report does not list the sampling time for each tracer gas release. This adds further uncertainty regarding the use of the Oak Ridge sampled values for converting the currently non-default beta AERMET ADJ_U* and AERMOD LOWWIND3 options to regulatory default status. Adding even more uncertainty, sampling times over one hour would require multiple hours of meteorological data, with changing wind conditions for each hour. For example, a two-hour sample cannot accurately be used to evaluate a model that has only one hour of meteorological data input.

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[16] NOAA Technical Memorandum ERL ARL-61, Diffusion Under Low Wind Speed Conditions near Oak Ridge, Tennessee, August 1976, p.13. Available at: http://www.arl.noaa.gov/documents/reports/ARL-61.pdf.
[17] Id., p. 52.
[18] Id., Appendix A.
[19] Id., p.13.
[20] Id., p.18.

The Oak Ridge study includes other concerns as well. The sample release periods occur during summer daylight hours, which are not conducive to assessing night-time conditions where the atmosphere is likely to be much more stable. This is made evident by the aerial samples taken during this study which detected tracer gases at levels several hundred meters above the ground surface.[21] This level of vertical mixing is not indicative of stable, low wind speed boundary layer conditions and should not be used for AERMET ADJ_U* or AERMOD LOWWIND3 development purposes.

B. Concerns with the 1974 Idaho Falls Diffusion Study

The Idaho Falls study includes 11 tracer gas releases from February through May, 1974. Of these 11 tracer gas release, only four were for wind speeds less than one meter/second.[22] This is an extremely small sample size for evaluating low wind speed, stable conditions. Moreover, these wind speeds are measured at four meters above the ground. This is substantially less than the standard 10 meter anemometer height recommended by USEPA, and when scaled to 10 meters these measured wind speeds would likely increase.[23]

Several of the Idaho Falls sample release periods occurred during daylight hours, which are less conducive to assessing night-time conditions where the atmosphere is much more likely to be more stable. This is expressed by the tilted oil fog plumes observed during this study, depicting mixing at levels considerably above the ground surface.[24]

From NOAA's Idaho Falls report:

> These results imply that the SF_6 and the oil fog plumes were coincident and partially elevated. The tower samples taken on the 200-m arc during tests 10 through 14 also confirmed that the plumes were elevated.[25]

This level of vertical mixing is not typically seen during stable, low wind speed boundary layer situations and should not be used for AERMET ADJ_U* or AERMOD LOWWIND3 evaluations for these types of meteorological conditions. Furthermore, periods of stagnation were observed during the Idaho Falls tests:

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[21] Id., Appendix A.
[22] NOAA Technical Memorandum ERL ARL-52, Diffusion Under Low Wind Speed, Inversion Conditions, December 1974, p. 6. Available at: http://www.arl.noaa.gov/documents/reports/ARL-52.pdf.
[23] USEPA, Meteorological Monitoring Guidance for Regulatory Modeling Applications, EPA-454/R-99-015, February 2000, p. 3-4. This document is available at: http://www3.epa.gov/ttn/scram/guidance/met/mmgrma.pdf.
[24] NOAA Technical Memorandum ERL ARL-52, Diffusion Under Low Wind Speed, Inversion Conditions, December 1974, pp. 20-21.
[25] Id., p. 13.

> It may be noted from tables 8 and 9 that during tests 1, 8, and 11 higher centerline concentrations were measured at 400 than at 200 m. Stagnation or "puddling" may have been responsible.[26]

These stagnant conditions can lead to elevated ground-level concentrations remaining in the vicinity of the emission source for longer than one-hour (the duration of the sampling during the Idaho Falls study).[27] Stagnation and sloshing effects can lead to elevated pollutant concentrations for several hours, even though plume models, such as AERMOD, erase any carryover concentrations from one hour to the next. This can lead to model under-predictions during stagnant and sloshing conditions. In such conditions, a puff model would likely be more applicable. USEPA's recommendation that AERMET ADJ_U* and AERMOD LOWWIND3 be adopted as regulatory default options fails to consider these situations.

C. Concerns with the 1993 Cordero Rojo Mine PM_{10} Study

It appears that USEPA has relied on the Cordero Rojo Mine PM_{10} analysis for their recommended updates to the AERMOD modeling system. Although not included in Appendix F of the AERMOD User's Guide, USEPA includes this study as part of their AERMET/AERMOD beta option evaluations presented at the 11th Conference on Air Quality Modeling.[28] USEPA also includes a portion of the Cordero Rojo Mine PM_{10} analysis in the available AERMOD test cases. There are, however, significant concerns with USEPA's use of this analysis.

About 75% of Cordero Rojo Mine PM_{10} emissions come from roadways, but it is unclear whether the roads are paved, unpaved, or some combination of the two.[29] Whatever the roadway types, it is often difficult to get an accurate emission inventory for haul roads. Silt loading for paved roads, or silt percentage for unpaved roads, must be accurately measured. Otherwise the calculated emissions will be unreliable for model evaluation purposes. Furthermore, the AP-42 emission factors for unpaved roads were updated in November, 2006.[30] The AP-42 emission factors for paved roads were last updated in January, 2011.[31] It is not evident which emission factors were used to calculate the 1993 Cordero Rojo Mine roadway PM_{10} emissions, since the emission rate calculations and associated inputs are not part of USEPA's test case.

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[26] Id., p. 28.
[27] Id., p. 12.
[28] Proposed Updates to AERMOD Modeling System, Roger Brode, OAQPS, 11th Conference on Air Quality Modeling, Research Triangle Park, NC, August 12, 2015, pp. 12-16. This document is available at: http://www3.epa.gov/ttn/scram/11thmodconf/presentations/1-5_Proposed_Updates_AERMOD_System.pdf
[29] Id.
[30] http://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf.
[31] http://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf.

In essence, the reviewing public does not know how the Cordero Rojo Mine PM_{10} emission rates used by USEPA were calculated, or if these emission calculations are accurate. This is not a normal or acceptable situation for a model evaluation study, where emissions are determined using continuous emission monitoring or known tracer gas release rates. The level of uncertainty associated with roadway and other fugitive PM_{10} emissions should exclude the Cordero Rojo Mine PM_{10} study for AERMET ADJ_U* or AERMOD LOWWIND3 evaluation purposes. If USEPA intends to use the Cordero Rojo Mine PM_{10} study for this purpose, then all model inputs, emission rate calculations, and model performance analyses should be made publicly available. An additional time period for public review and comment would then be warranted.

Also, the Cordero Rojo Mine PM_{10} test case models roadway sources with area sources.[32] The Haul Road Workgroup Final Report Submission to EPA-OAQPS recommends that these sources should be modeled with volume sources, not area sources.[33] This alone would likely improve model performance. Furthermore, wind erosion PM_{10} emissions are not included in the test case modeling, even though some hourly-average wind speeds are greater than 15 meters/second. These wind speeds would cause substantial fugitive dust emissions not accounted for in the Cordero Rojo Mine PM_{10} study.

For the above reasons, USEPA should not rely on the Cordero Rojo Mine PM_{10} study for AERMET ADJ_U* or AERMOD LOWWIND3 evaluation and development purposes.

IV. The AERMET ADJ_U* and AERMOD LOWWIND3 Model Evaluation Analyses are not Available for Public Review

The primary model evaluation analyses used to support the AERMET ADJ_U* and AERMOD LOWWIND3 non-default options are the Idaho Falls, Idaho and Oak Ridge, Tennessee studies.[34] The reports that describe the studies are publicly available. The modeling evaluations themselves, including input data, model results, and analysis of the model results, are not publicly available. To my knowledge, the modeling evaluations and associated data are currently limited to OAQPS, the API (the American Petroleum Institute), and API's consultants.

This lack of access to the Idaho falls and Oak Ridge model evaluations and associated data has severely limited my ability to review and comment on the proposed AERMOD updates and rule making. I believe others have been similarly affected.

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[32] Available at: http://www.epa.gov/ttn/scram/models/aermod/aermet_ustar_15181_aermod_15181_lowwind3.zip.
[33] http://www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf.
[34] USEPA, User's Guide for the AMS/EPA Regulatory Model – AERMOD, Addendum, Appendix F, Evaluation of Low Wind Beta Options, June, 2015. This document is available at: http://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

Moreover, the notice of proposed rulemaking misinforms the public stating that the essential model evaluation test cases are publicly available for review and comment. Indeed, the two most essential evaluation test cases, Idaho Falls and Oak Ridge, are not on EPA's SCRAM Web site. From the notice of proposed rulemaking:

> Model performance evaluation and peer scientific review references for the updated AERMOD modeling system are cited, as appropriate. An updated user's guide and model formulation documents for version 15181 have been placed in the docket. We have updated the summary description of the AERMOD modeling system to appendix A of the *Guideline* to reflect these proposed updates. The essential codes, preprocessors, and test cases have been updated and posted to the EPA's SCRAM Web site, http://www.epa.gov/ttn/scram.[35]

And from EPA's SCRAM Web site:

> 9/14/15 The presentations, transcripts, and audio recordings from the 11th Conference on Air Quality Modeling are now available. Additionally, all of the model code, technical support documentation, draft guidance, IWAQM reports, supporting docket material, etc. related to the proposed Guideline on Air Quality Models rulemaking are accessible through the 11th Conference on Air Quality Modeling informational website.[36]

Again, missing from this docket material are the actual model evaluations for the Idaho Falls and Oak Ridge studies, which form the basis for developing the AERMET ADJ_U* and AERMOD LOWWIND3 non-default options. The 17 original model evaluation databases used to develop AERMOD are available on EPA's SCRAM Web site, but the Idaho Falls and Oak Ridge studies are not. Without all the model inputs, outputs, and associated data used for the Idaho Falls and Oak Ridge evaluation studies, the proposed AERMET ADJ_U* and AERMOD LOWWIND3 options remain unsupported and impossible for complete public review and comment.

USEPA should make the Idaho Falls and Oak Ridge evaluation studies publicly accessible on EPA's SCRAM Web site, complete with everything needed to replicate Appendix F of the AERMOD v. 15181 User's Guide Addendum.[37] Currently, the Idaho Falls and Oak Ridge evaluation studies are "black boxes," opaque to virtually all aspects of public review and analysis. USEPA should extend the proposed rulemaking public comment period to provide for additional input once these essential materials are made publicly accessible.

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[35] **Federal Register** / Vol. 80, No. 145 / Wednesday, July 29, 2015 / Proposed Rules, p. 45345. This document is available at: http://www3.epa.gov/ttn/scram/11thmodconf/EPA-HQ-OAR-2015-0310-0001.pdf.
[36] http://www3.epa.gov/scram001/.
[37] USEPA, User's Guide for the AMS/EPA Regulatory Model – AERMOD, Addendum, Appendix F, Evaluation of Low Wind Beta Options, June, 2015. This document is available at: http://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

USEPA should also make any evaluation studies that they consider, or rely upon, publicly accessible on EPA's SCRAM Web site, complete with everything needed to replicate the entire analysis performed by USEPA. This is particularly important given the ongoing publicly-obscure interactions between USEPA and industry.

V. The Proposed AERMET ADJ_U* and AERMOD LOWWIND3 Options Should Not Be Elevated to Regulatory Defaults, and should at Most Remain as Alternate Models per Section 3.2 of the Guideline on Air Quality Models

Current regulatory guidance allows using version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options to be used in permitting analyses, providing there is an appropriate alternative model demonstration per Section 3.2.2 of the current Guideline on Air Quality Models. This involves collection of site-specific meteorological data and other model inputs to verify whether the alternate model performs better than the current regulatory default version.

It important to note, again, that the AERMET ADJ_U* and AERMOD LOWWIND3 revisions will in key instances greatly reduce modeled impacts and model performance compared to the current regulatory default versions. The proposed update of these currently beta non-default options to regulatory default status is based on very limited, and often flawed, data.

Due to model performance concerns outlined in Section II above, version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options should at most be applied on a case-by-case basis, and then only after a detailed, alternative model demonstration per Section 3.2.2 of the current Guideline on Air Quality Models. In addition, any alternative model demonstrations that USEPA proposes to use for approving revisions to the AERMOD modeling system should be made fully available to the reviewing public. This information should include all meteorological data, model inputs, test data, and all other data needed to replicate any alternative model demonstrations.

Based on existing model evaluation performance, and the lack of evaluations performed using current technology, version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options should not be converted to regulatory default status.

VI. Call for an OAQPS Ombudsman

I am concerned that industry and their consultants may have developed a distorting relation with OAQPS in areas of model development. This is evident in the "collaboration" between industry and OAQPS that is touted at recent conferences on air quality modeling and at the Regional/State/Local modelers workshops.

This collaboration between industry and OAQPS misses an obvious group that is virtually absent from technical model development activities – the US citizens that are exposed to the air pollutants emitted by industry. When budget allows, these citizens are represented by environmental groups, but funding is never anywhere close to the amount spent by industry in model review, development, and revision efforts.

At the 11th Conference on Air Quality Modeling, both OAQPS and industry acknowledge this mutual collaboration, without mentioning that other stakeholders, with even smaller financial resources than OAQPS, are missing from the discussion. From a presentation by Mr. George Bridges at the 11th Conference on Air Quality Modeling:

> **1** And in this case, you know, there's been a lot of
> **2** collaboration already from the beginning. I think it's--I
> **3** was talking to Jeff Masters just before I came up here, and
> **4** you know, we talked about in the old days how there used to
> **5** be a lot of collaboration on the science, and I think we're
> **6** trying to get back to that. And where we are with this
> **7** proposal, there has been a fair amount of collaboration
> **8** leading up to this--this proposal between stakeholders and
> **9** the EPA here so that we can actually try to put the best
> **10** science forward in our guideline models.
> **11** There's a lot of people that have been involved.
> **12** I know Pete Pagano at Iron and Steel, Cathe Kalisz at API--
> **13** those folks have all worked with us on various, you know,
> **14** field studies or data sets and things that we've been able to
> **15** use as we've gone through and tried to upgrade the model and
> **16** improve the *Guideline*. And so I want to thank you guys for
> **17** that contribution.
> **18** I mean we're all at a place today, I think private
> **19** sector and public sector, where resources aren't what they
> **20** used to be, and so where we can work together and leverage, I
> **21** think we can develop a better product.[38]

And from a presentation by Mr. Rob Kaufmann, Koch Industries, at the 11th Conference on Air Quality Modeling:

> **17** For the record I want to note that I am not
> **18** related to Andy Kaufman, so I'm not planning to sing or lip

[38] Transcript from the 11th Conference on Air Quality Modeling, Wednesday, August 12, 2015, p. 12. Available at: http://www3.epa.gov/ttn/scram/11thmodconf/presentations/2015_Eleventh_Modeling_Conference-Transcripts_08-12-2015.pdf.

19 synch the words to the Mighty Mouse theme. However, I think
20 it might be appropriate, if you are familiar with the Mighty
21 Mouse them (sic), with a couple of subtle changes, it could have
22 been the theme song for this conference, "Here we come to
23 save the day. EPA's Appendix W fixes are on the way."
24 Audience member: Sing it.[39]

Mr. Kaufmann further adds:

4 We are pleased to see that some of the--that based
5 on our preliminary reviews some of those changes have
6 resulted in significant improvements, but we believe that
7 there is a continued need for collaboration between industry
8 and EPA as we go forward with some of those model fixes, and
9 AWMA presentations noted that as well. So we concur with
10 that finding. And we will be providing some more in depth
11 comments for the record once we've had time to fully dive
12 into the Appendix W *Federal Register* notice.[40]

While collaboration between industry and OAQPS may provide worthwhile results at times, this process can be taken too far. For example, if industry and USEPA persistently recommend model revisions that tend to reduce modeled impacts, then a systematic model under-prediction bias will result. Based on technical reasons, I do not believe that the proposed non-default beta AERMET ADJ_U* and AERMOD LOWWIND3 options warrant being upgraded to regulatory default status (see comments above).

In April 2013, I gave a presentation at the RSL Modelers Workshop in Dallas, Texas. Immediately after my presentation, and before the next presentation, two State modelers came up to me and expressed their gratitude that someone other than industry was providing information to OAQPS. I believe they were concerned with the intense lobbying that industry provides in matters of air dispersion modeling. Based on the number of recent AERMET and AERMOD revisions proposed by industry, I believe this to be a serious problem. And not surprisingly, industry's proposed revisions tend to decrease modeled impacts virtually across-the-board.

The ultimate stakeholders, US citizens made to breathe air pollutants emitted by industry, seem to be excluded from the model development collaboration between OAQPS and industry. I suggest that USEPA appoint an Ombudsman to oversee the exchanges between OAQPS and industry, and to help make these exchanges transparent to the general public.

[39] Id., p. 242.
[40] Id., p. 245.

VII. Concluding Remarks

Industry has been intensely lobbying USEPA to modify the AERMOD modeling system to "fix" alleged over-prediction problems during low wind speed, stable conditions. This persistent pressure has developed into a worrisome collaborative model development process between industry and USEPA. The reviewing public, however, has been excluded from this two-party model development process. For example, as noted above, the Oak Ridge and Idaho Falls model evaluations are not even available for the public to review.

Nonetheless, based largely on the Oak Ridge and Idaho Falls studies, USEPA is recommending that the AERMOD modeling system be modified to include regulatory default AERMET ADJ_U* and AERMOD LOWWIND3 options. These studies are based on very limited, flawed, and outdated data, and should never have been used by USEPA for assessing AERMOD performance.

The AERMET ADJ_U* and AERMOD LOWWIND3 options often lead to substantial model under-predictions. For the Tracy power plant evaluation shown above, *these options cause AERMOD results to be less than 50% of the monitored values*. This is a serious concern not addressed by USEPA.

Version 15181 AERMET ADJ_U* and AERMOD LOWWIND3 non-default options should not be adopted as regulatory default in the AERMOD modeling system. These options, if retained at all, should at best only be applied on a case-by-case basis, and only after a detailed, public-reviewed alternative model demonstration per Section 3.2.2 of the current Guideline on Air Quality Models.

Thank you for the opportunity to submit these comments on the Proposed Revision to the Guideline on Air Quality Models and the associated 11th Conference on Air Quality Modeling.

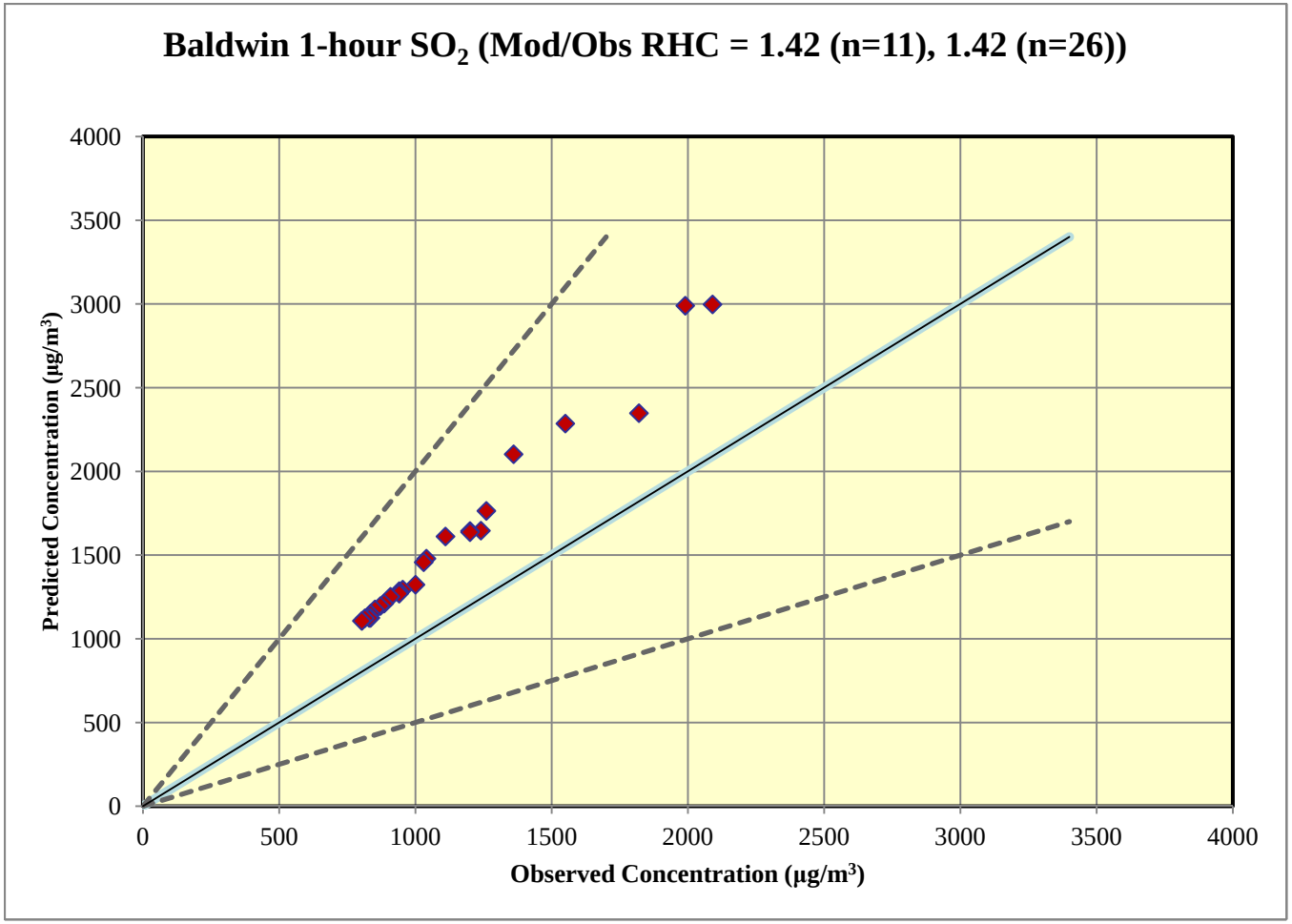
Sincerely,

Camille Sears

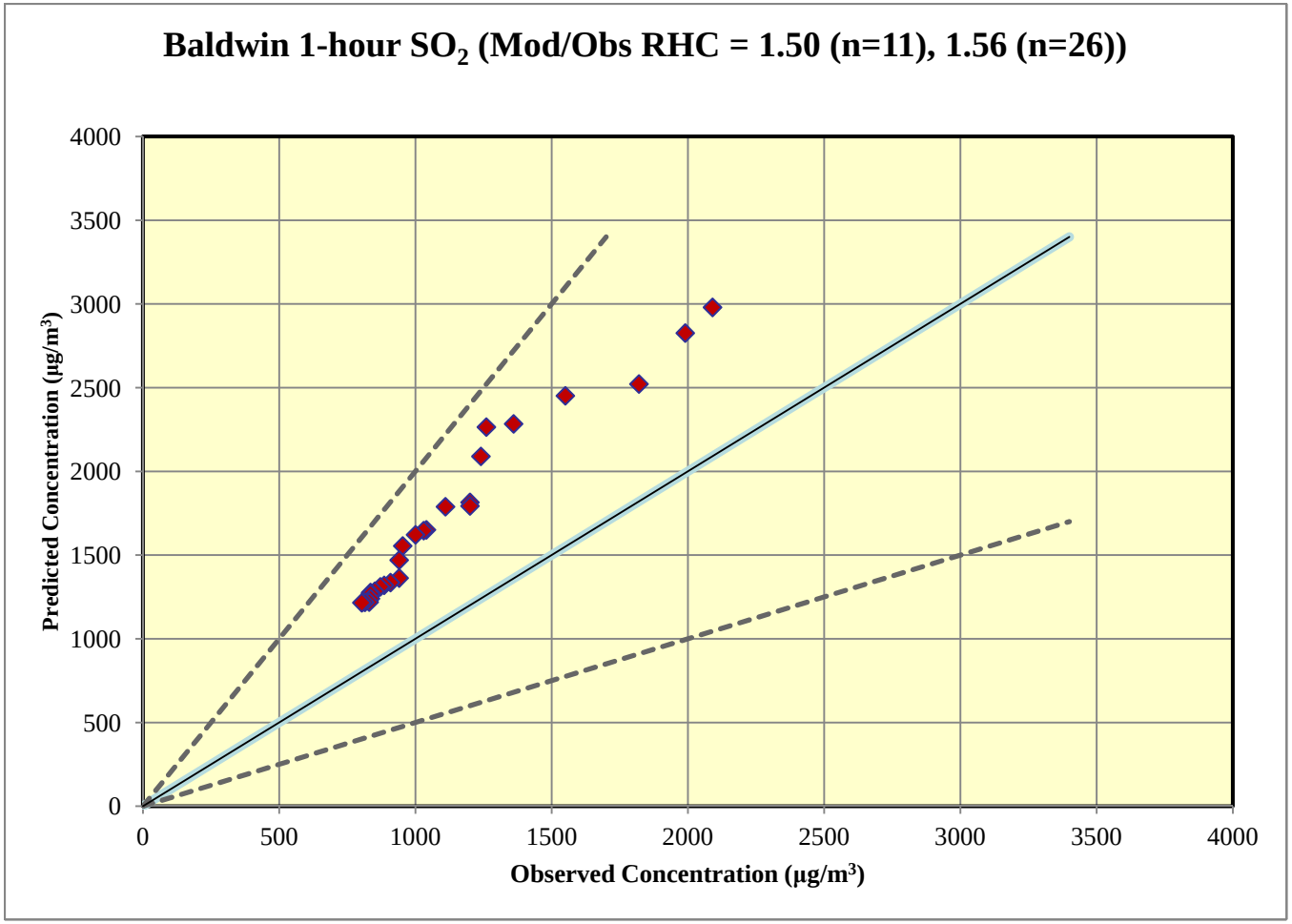
Attachment 1:

Quantile-Quantile Plots for Baldwin EGU Evaluation

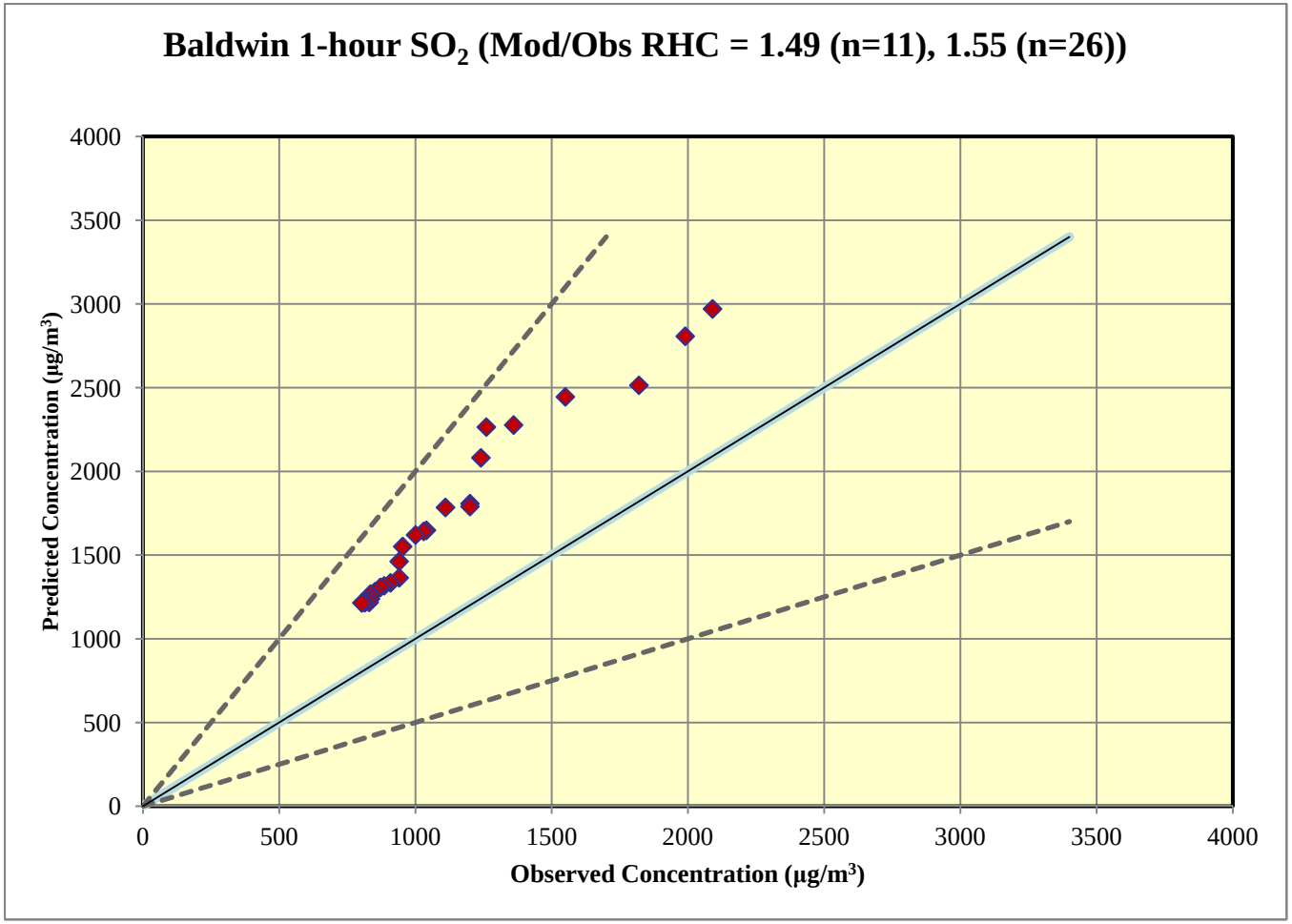
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 02222



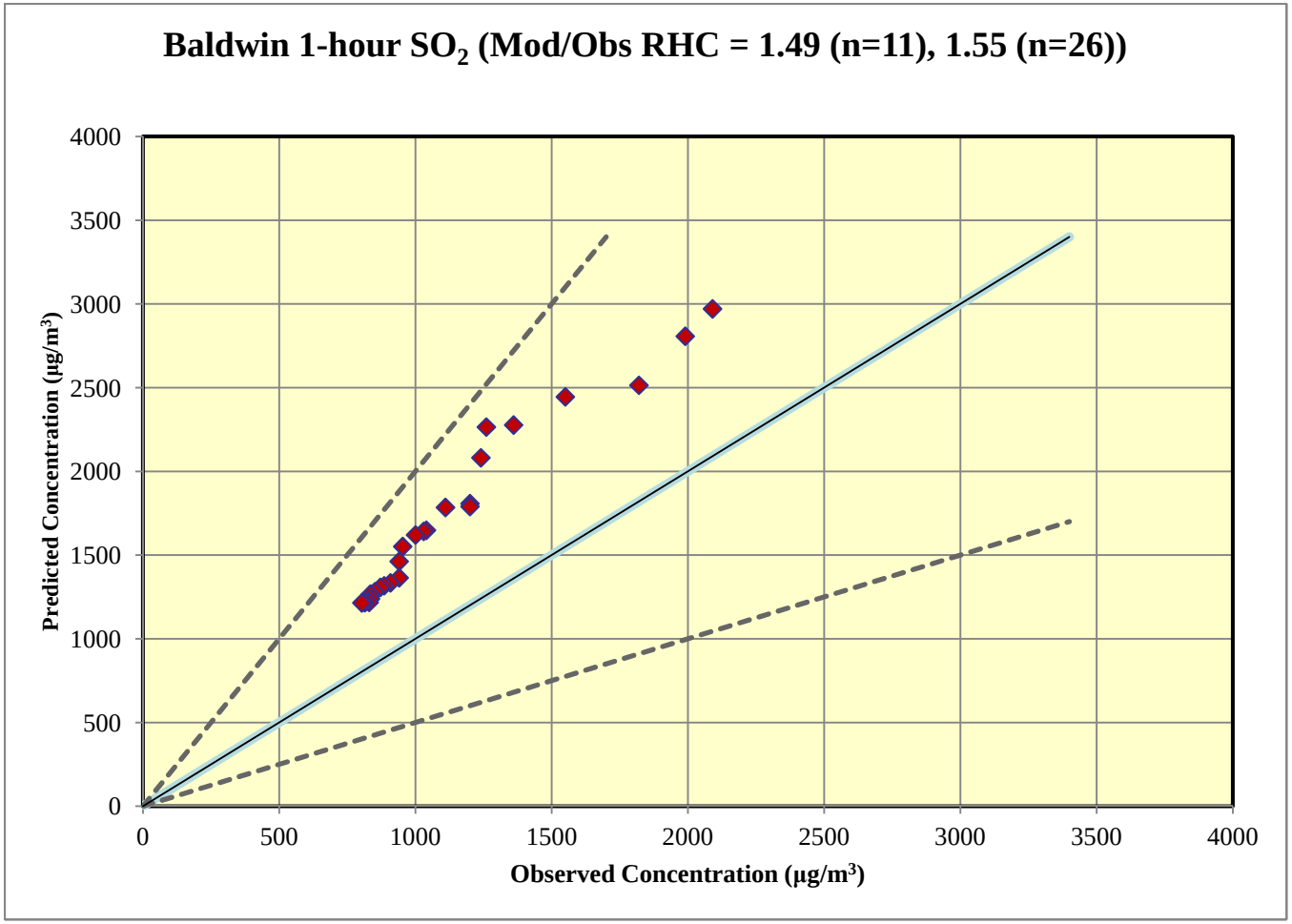
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 12345



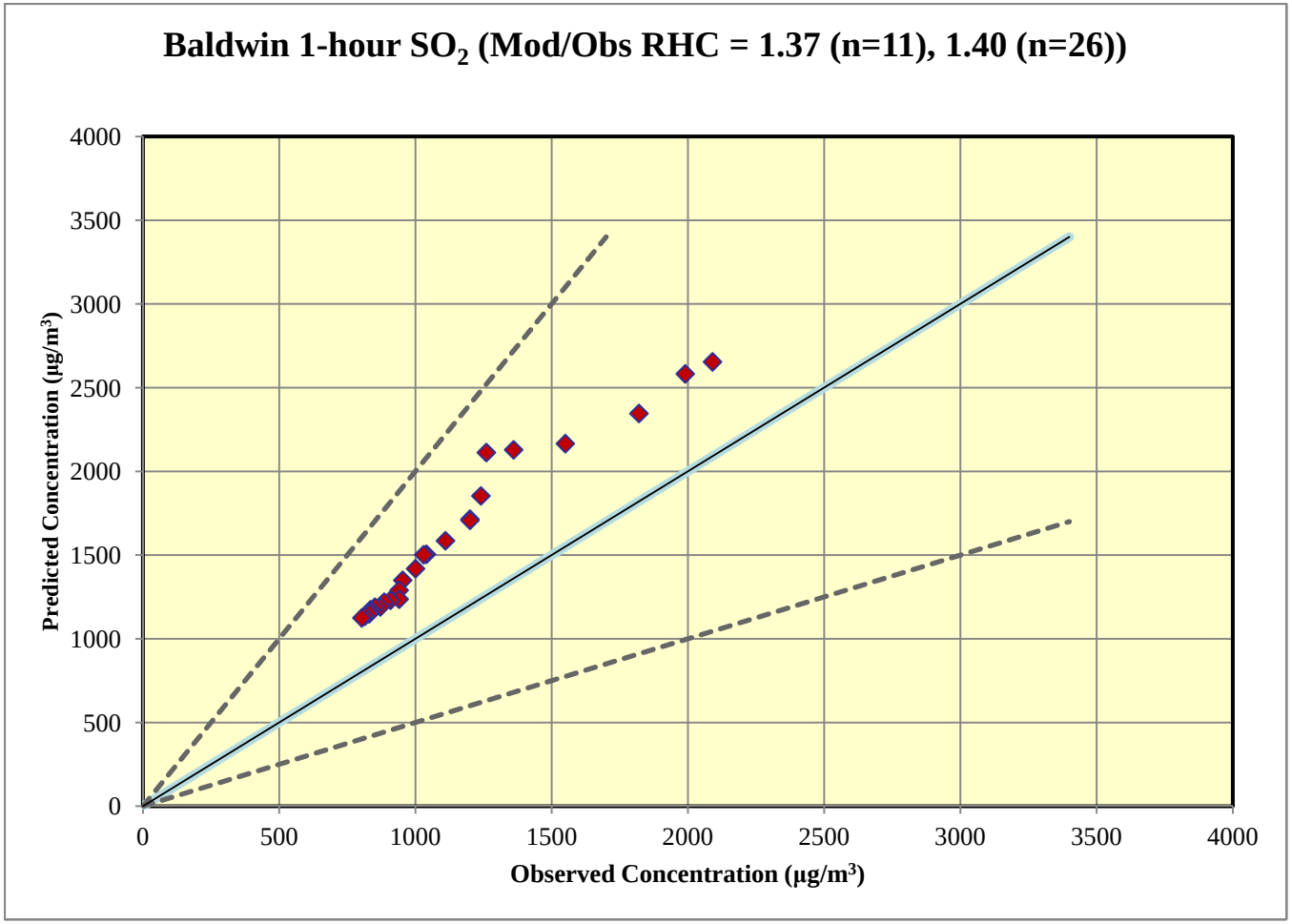
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*



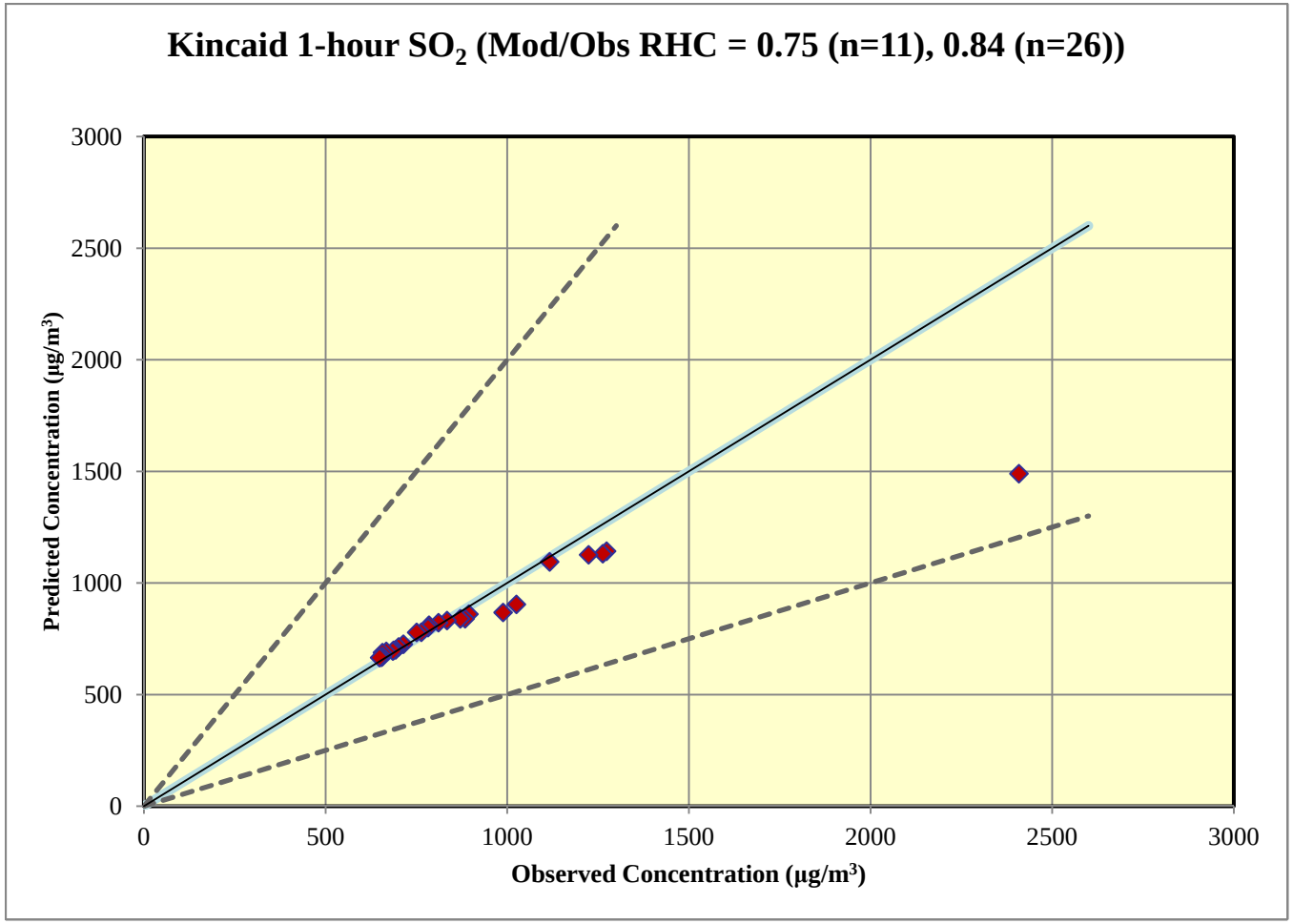
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*, LOWWIND3 (0.3 0.5 0.95)



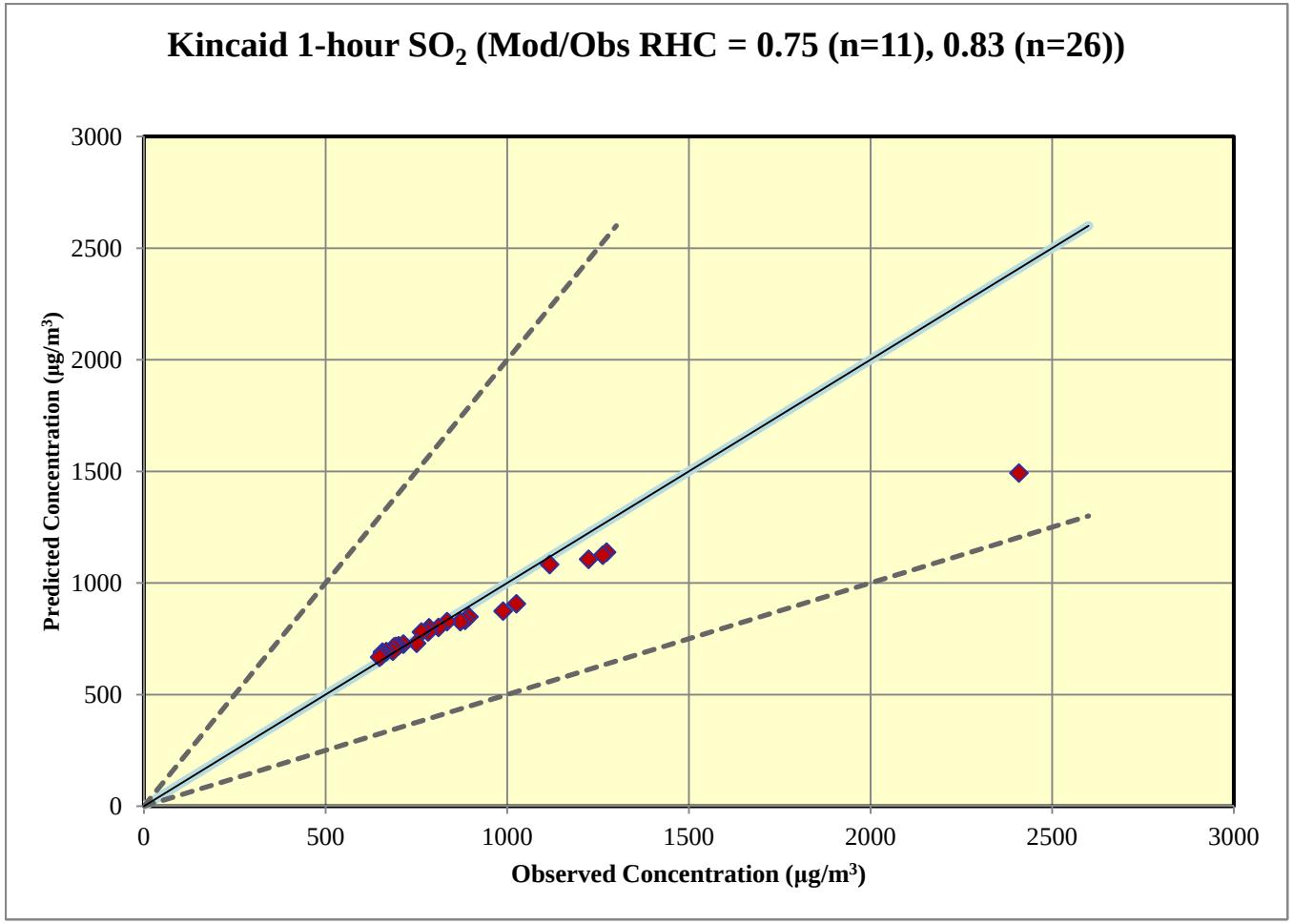
Attachment 2:

Quantile-Quantile Plots for Kincaid EGU Evaluation

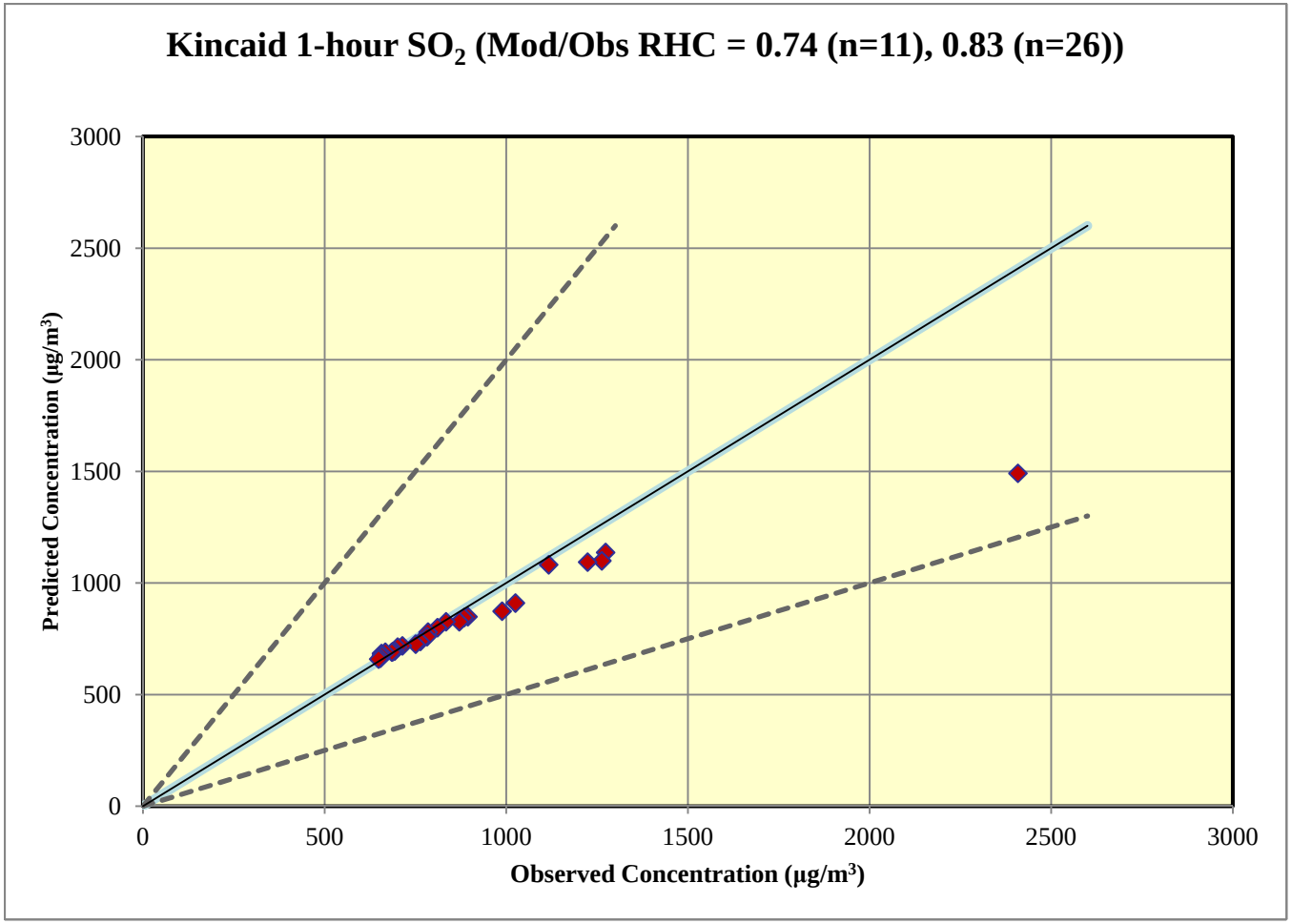
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 02222



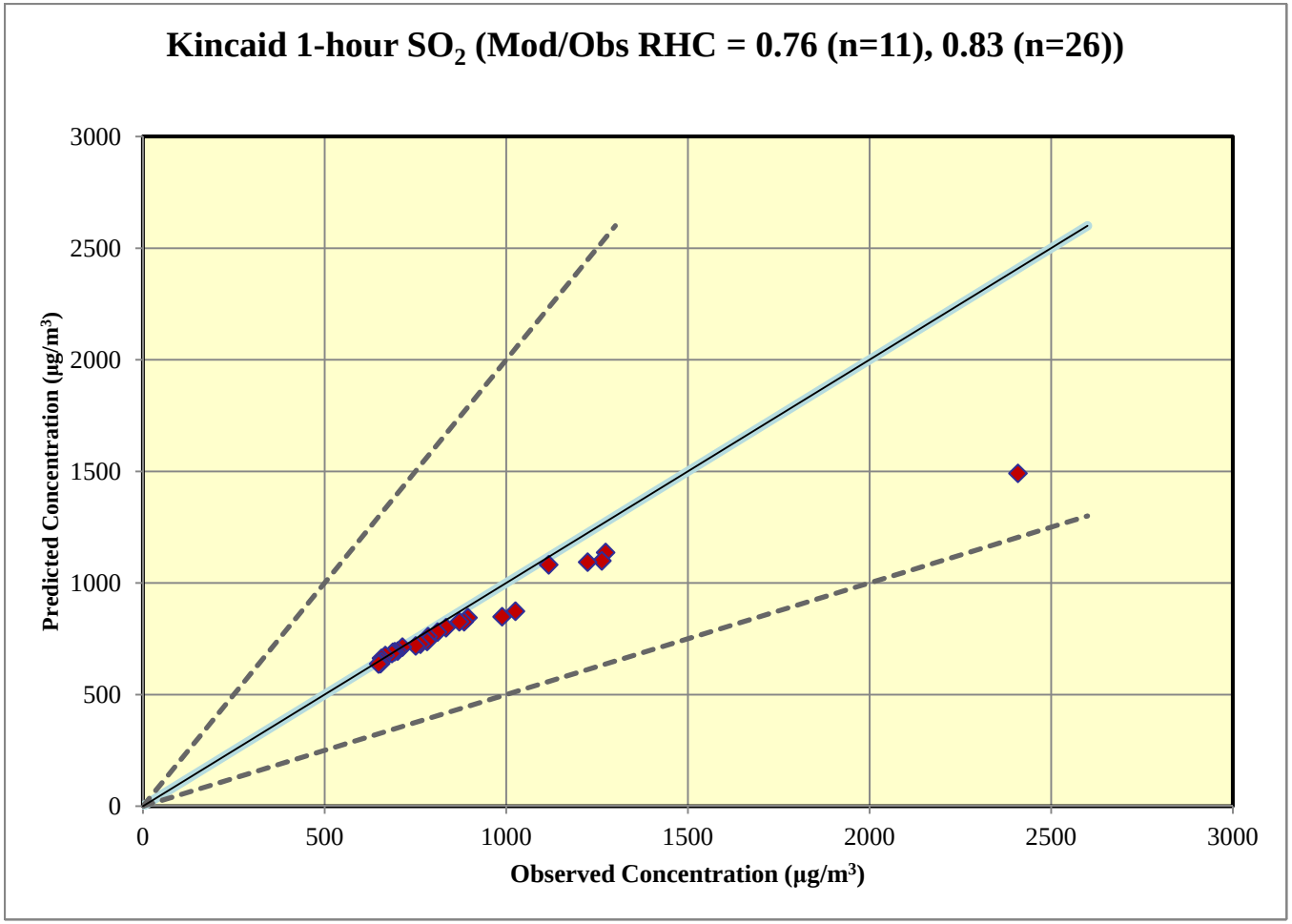
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 12345



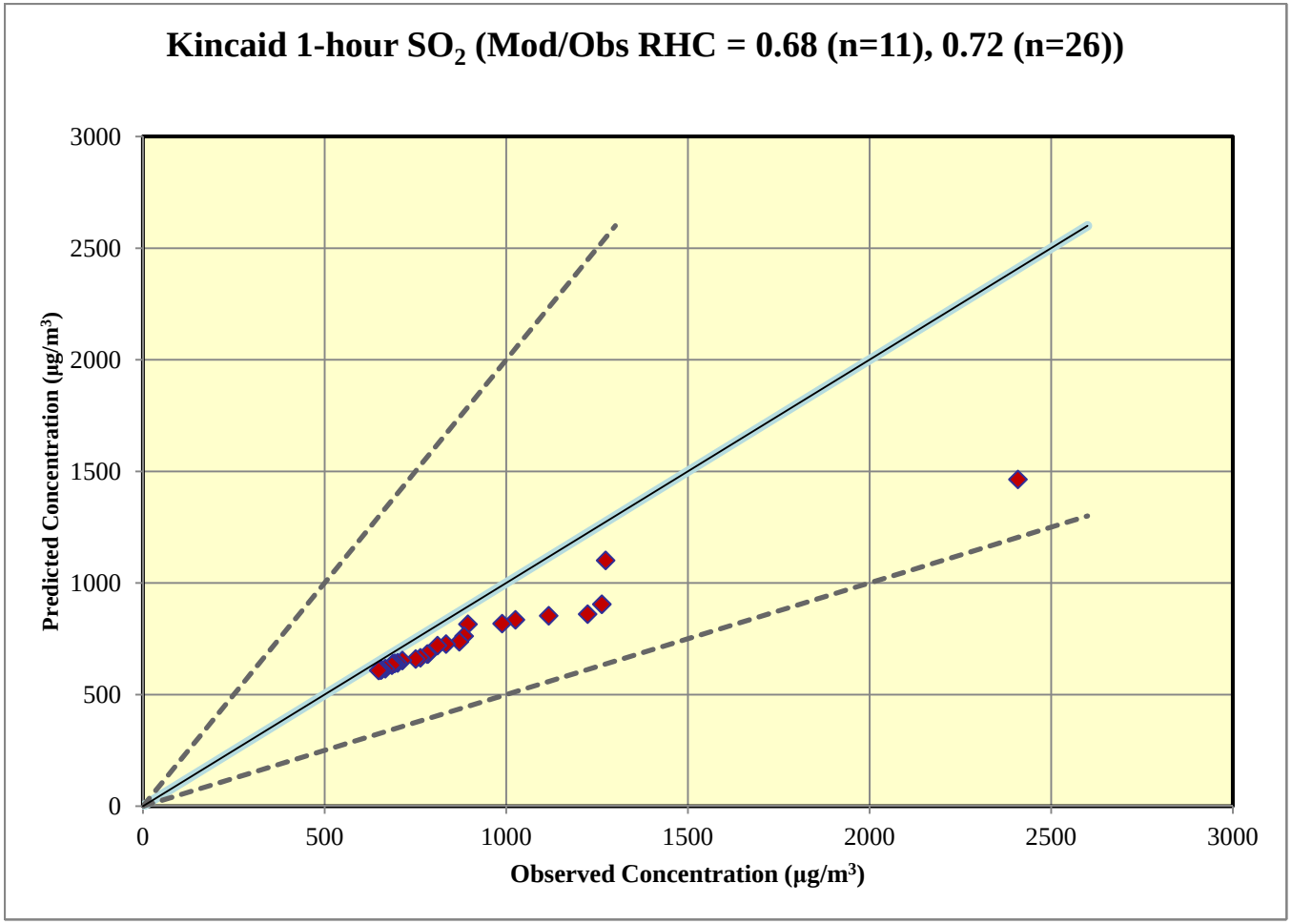
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*



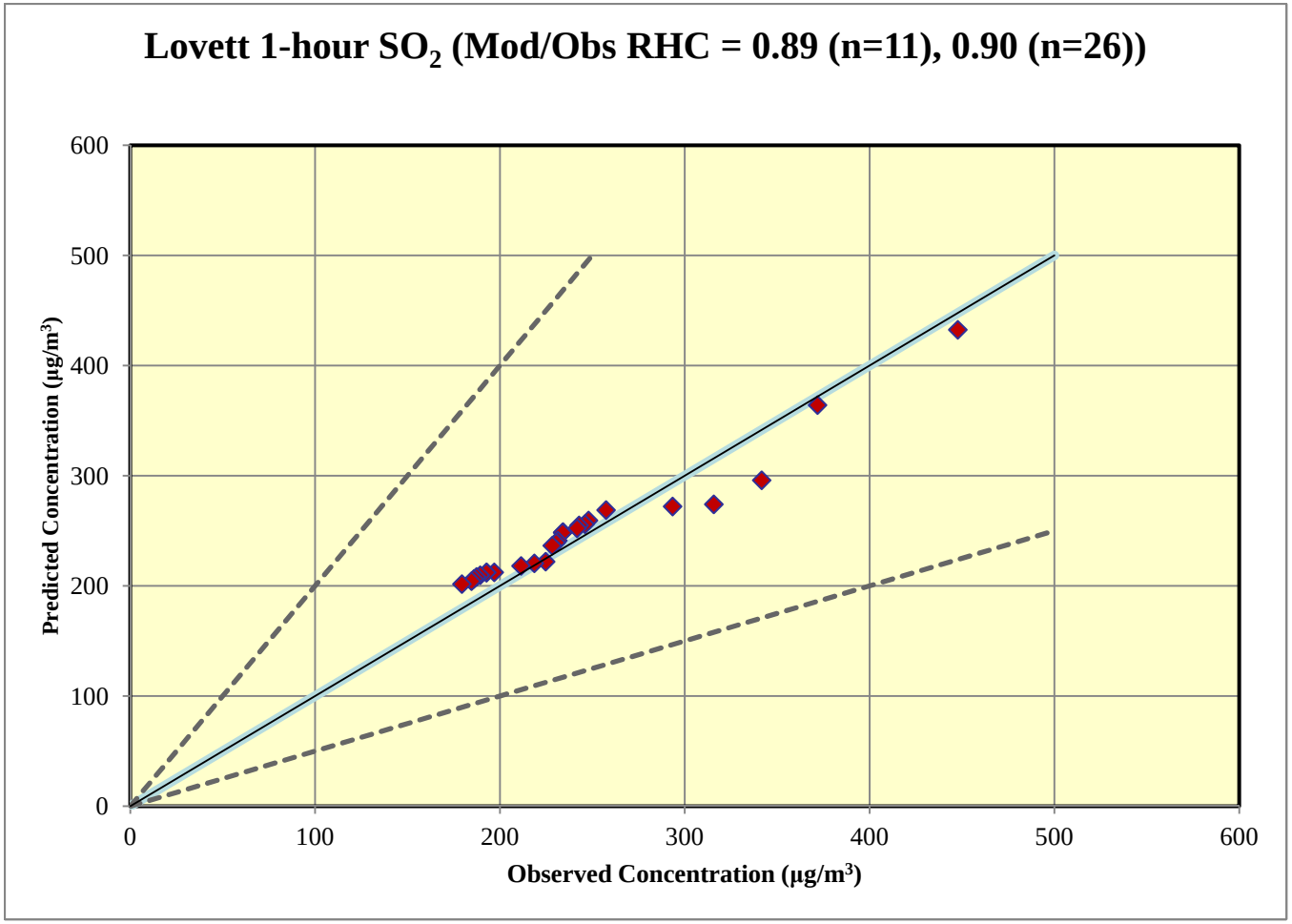
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*, LOWWIND3 (0.3 0.5 0.95)



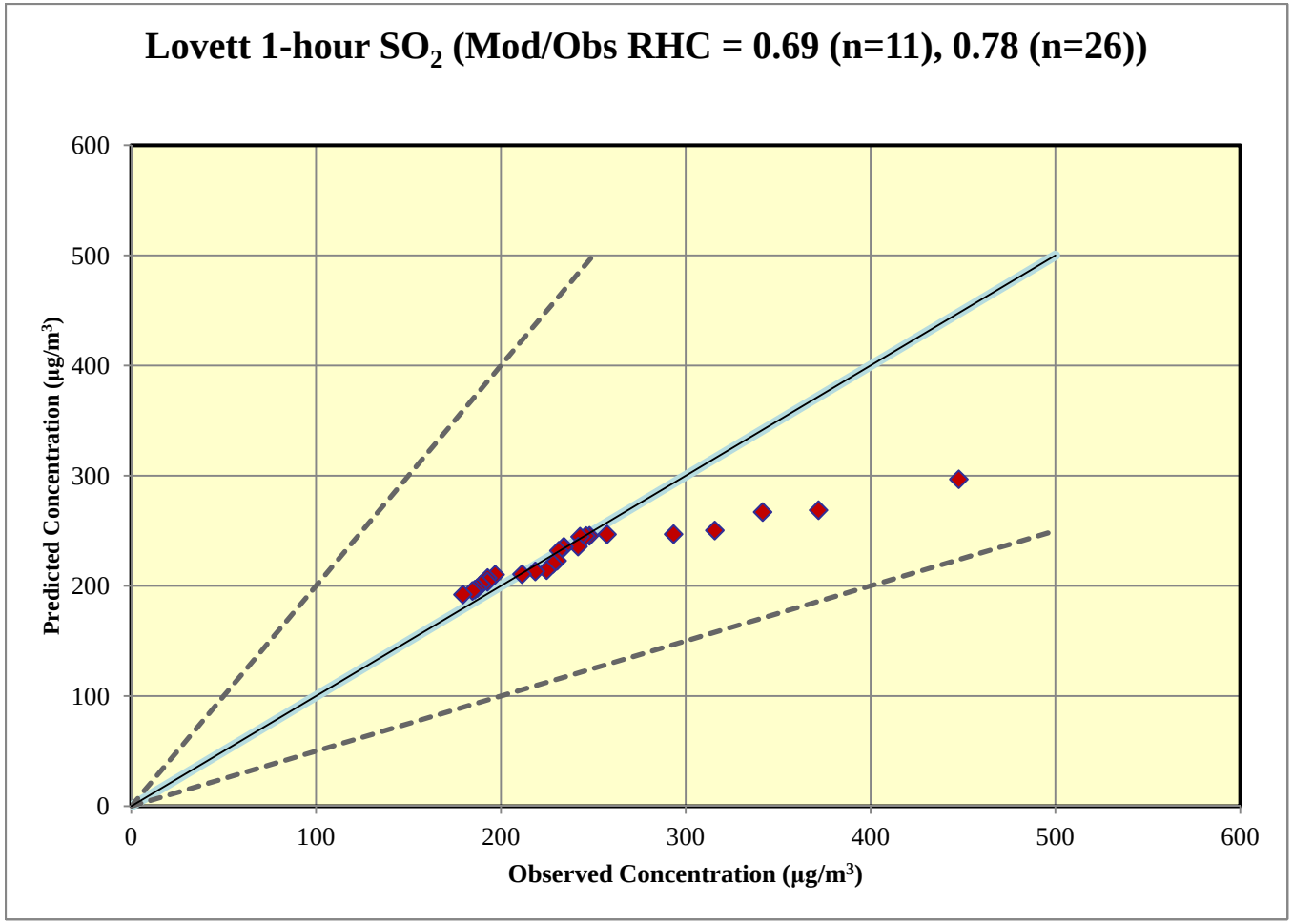
Attachment 3:

Quantile-Quantile Plots for Lovett EGU Evaluation

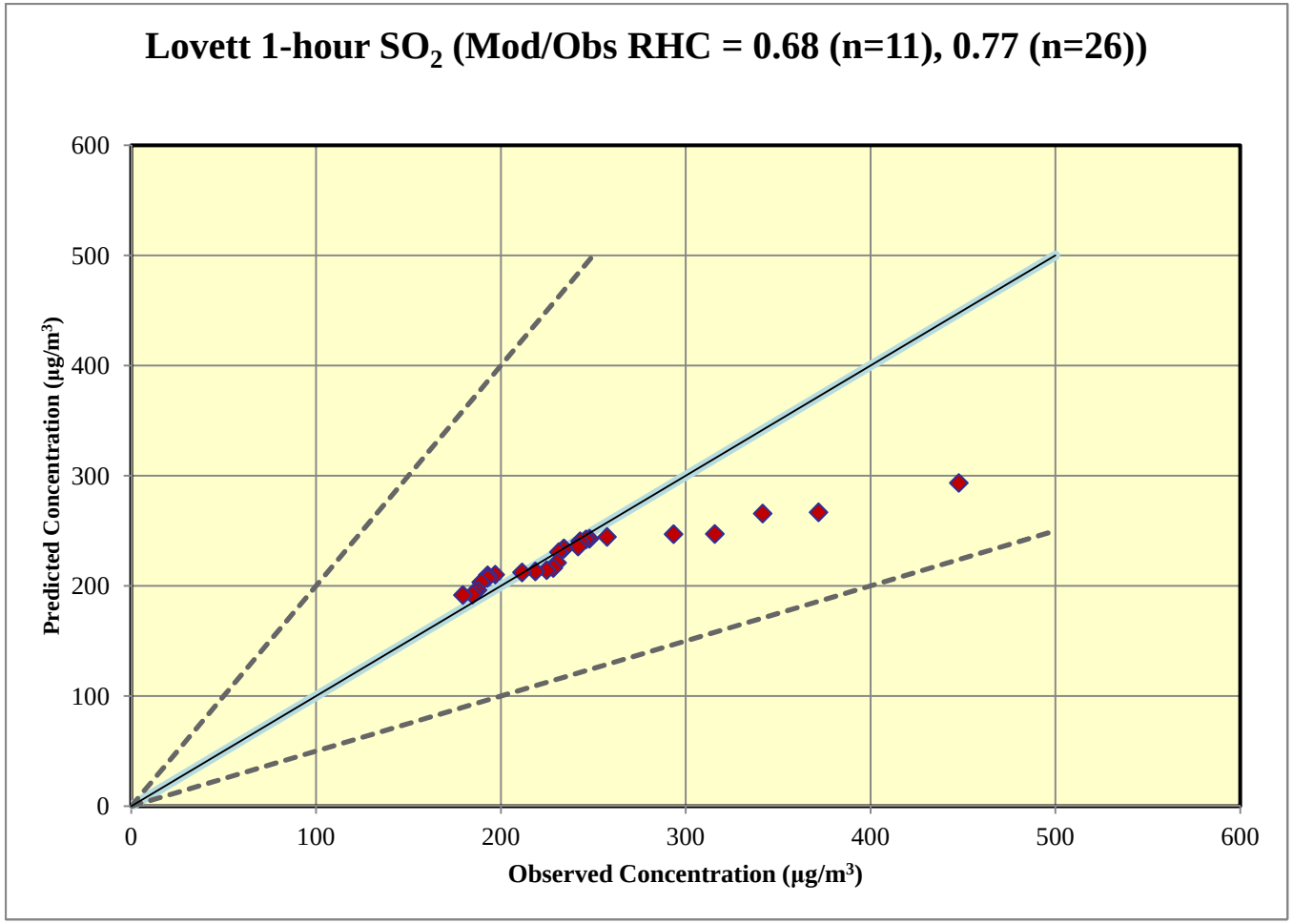
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 02222



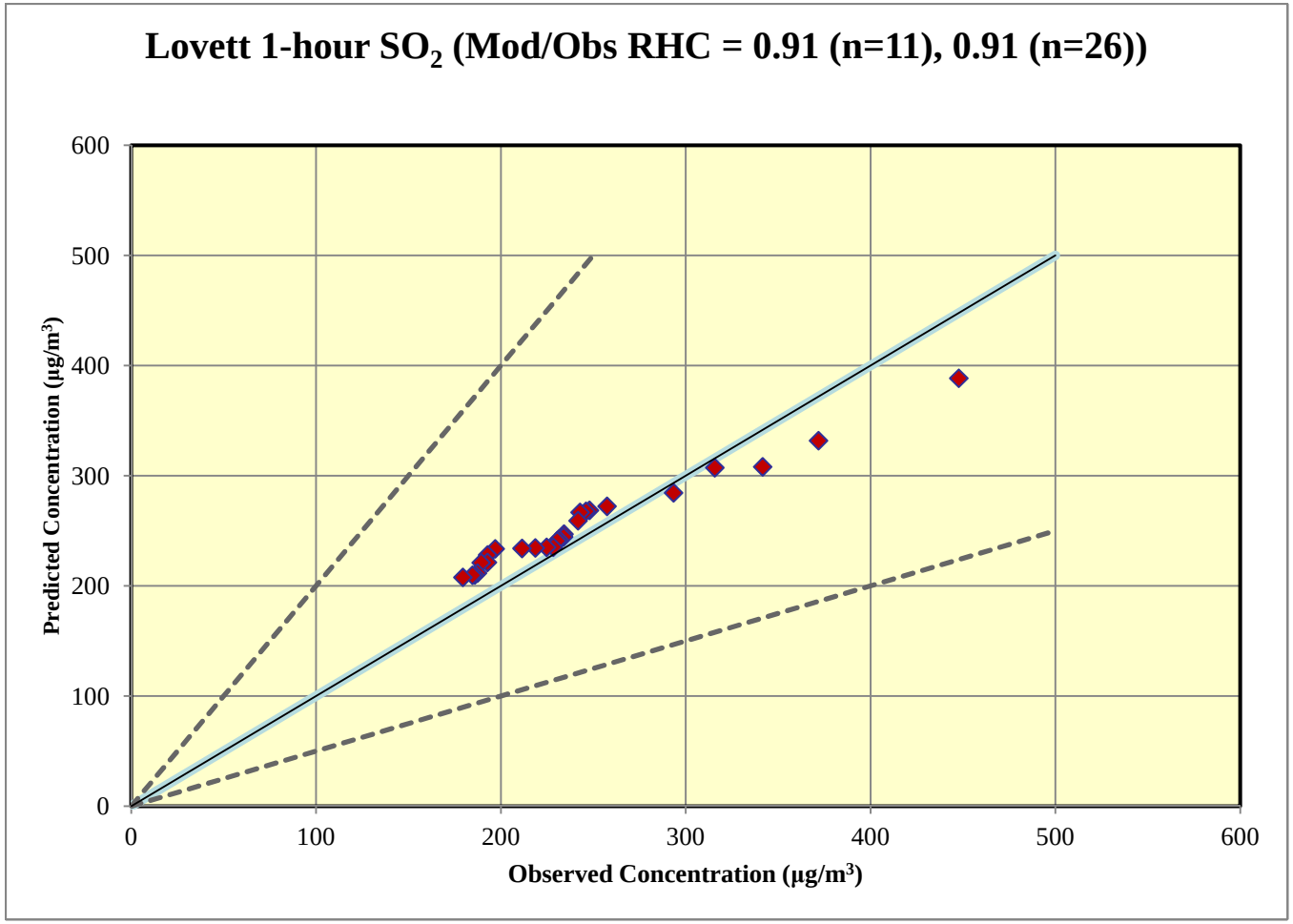
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 12345



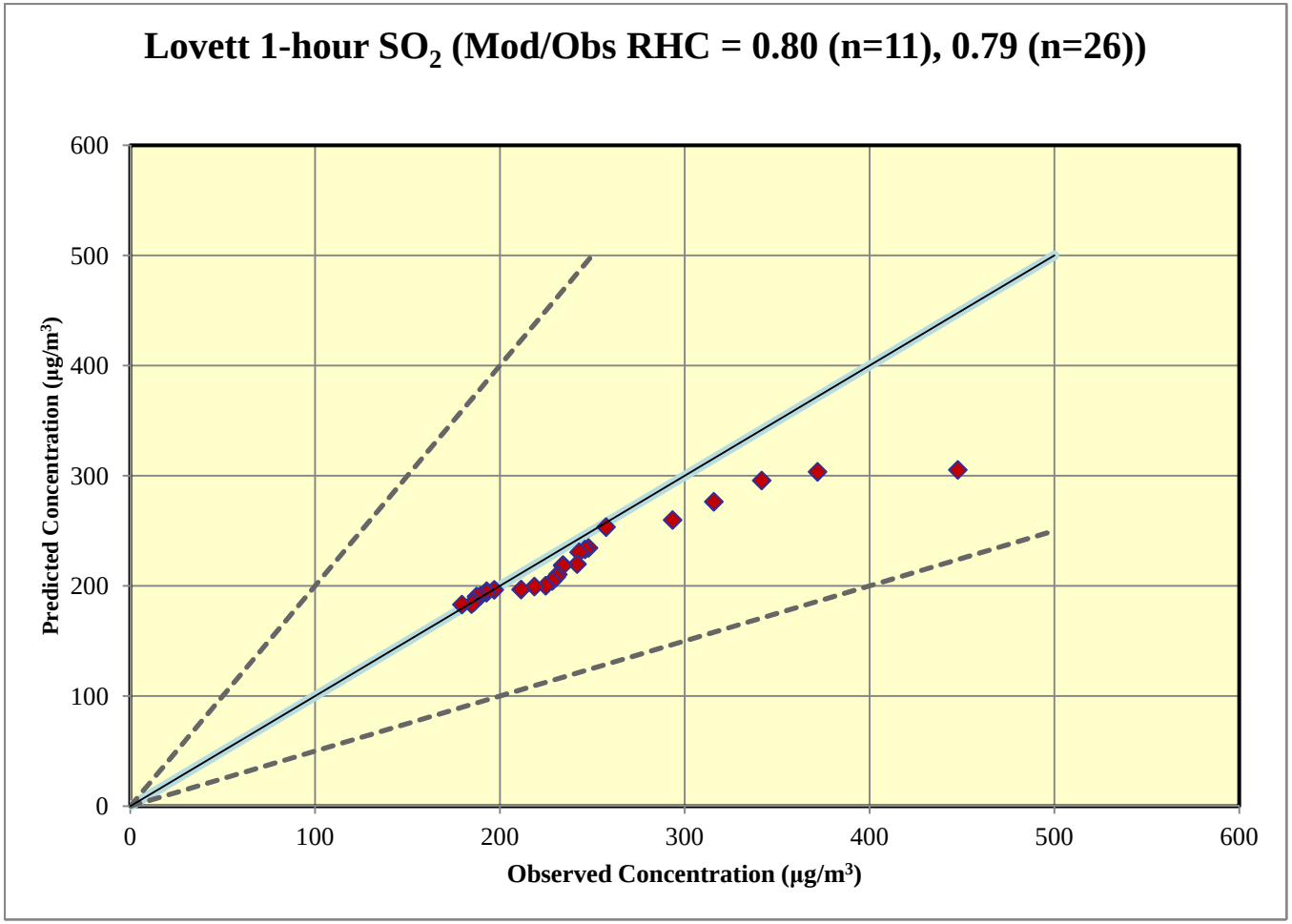
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*



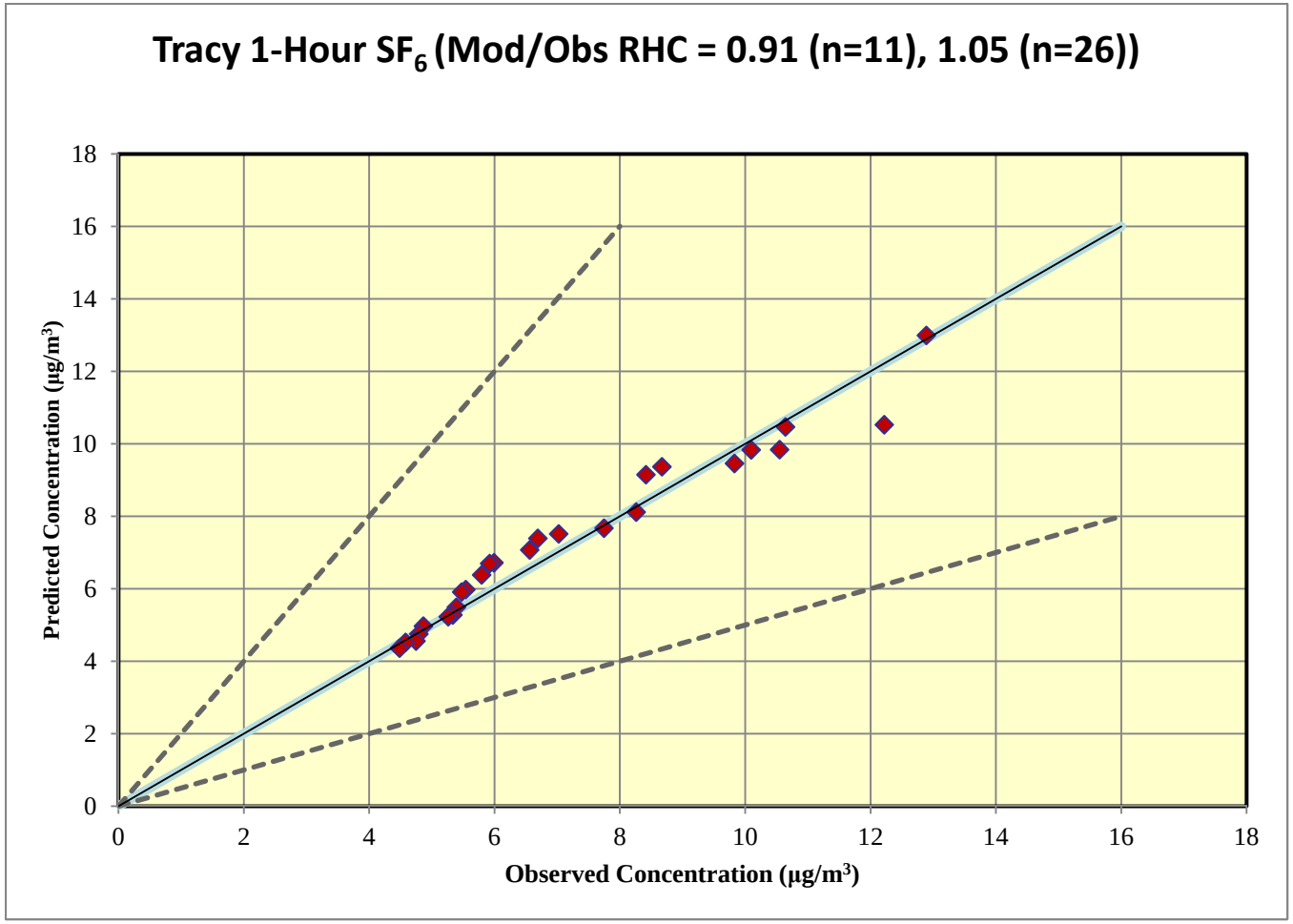
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*, LOWWIND3 (0.3 0.5 0.95)



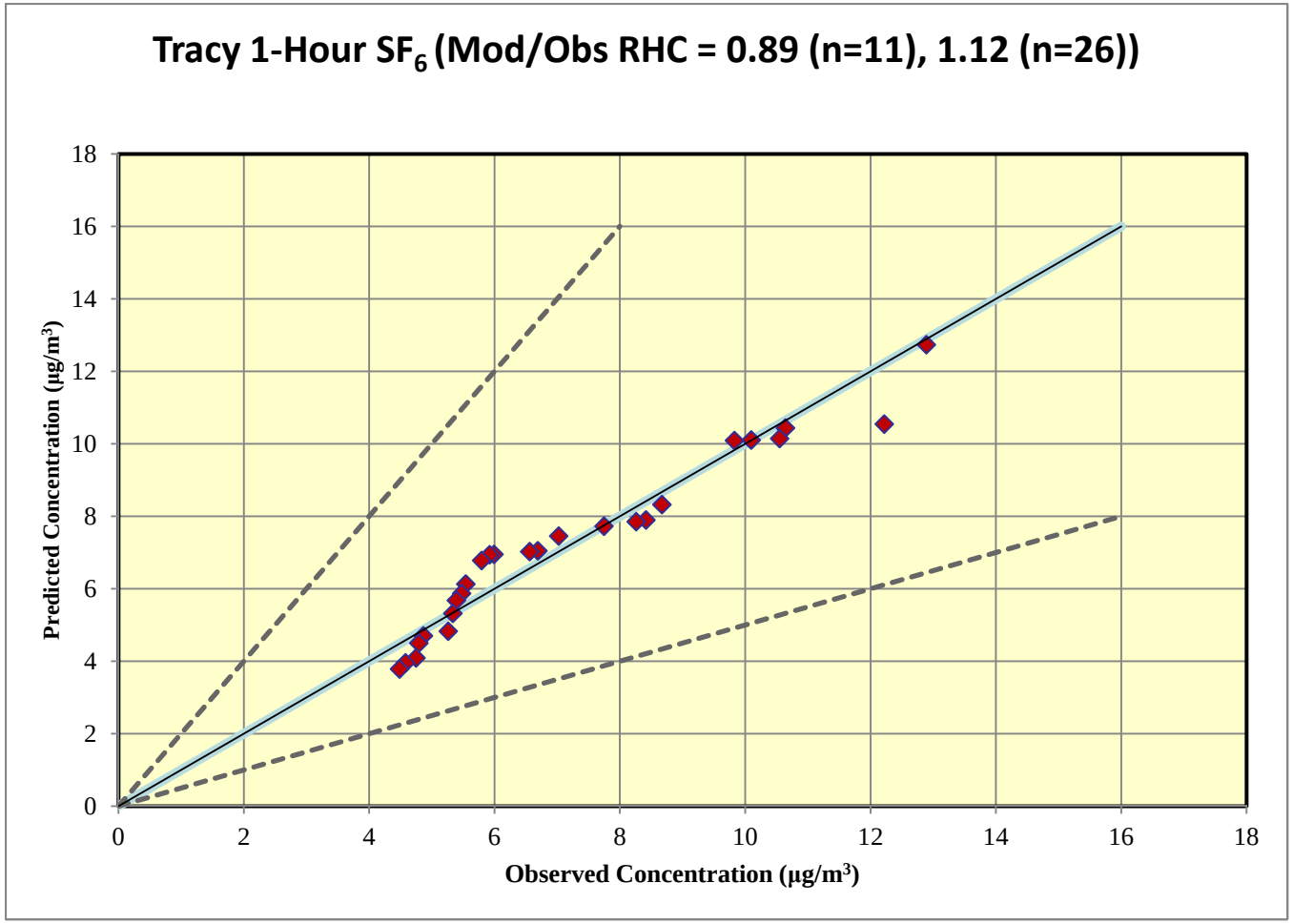
Attachment 4:

Quantile-Quantile Plots for Tracy EGU Evaluation

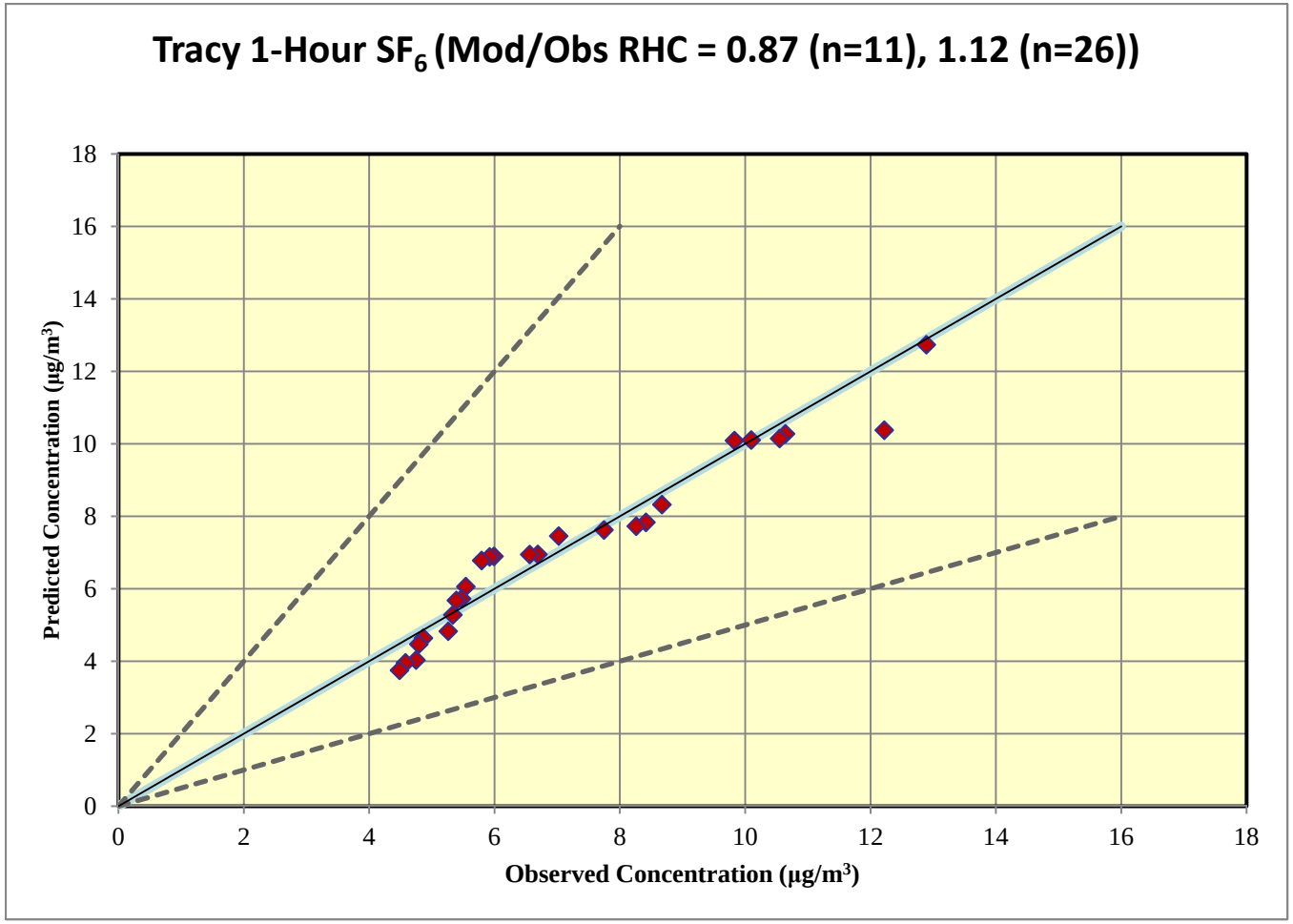
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 02222



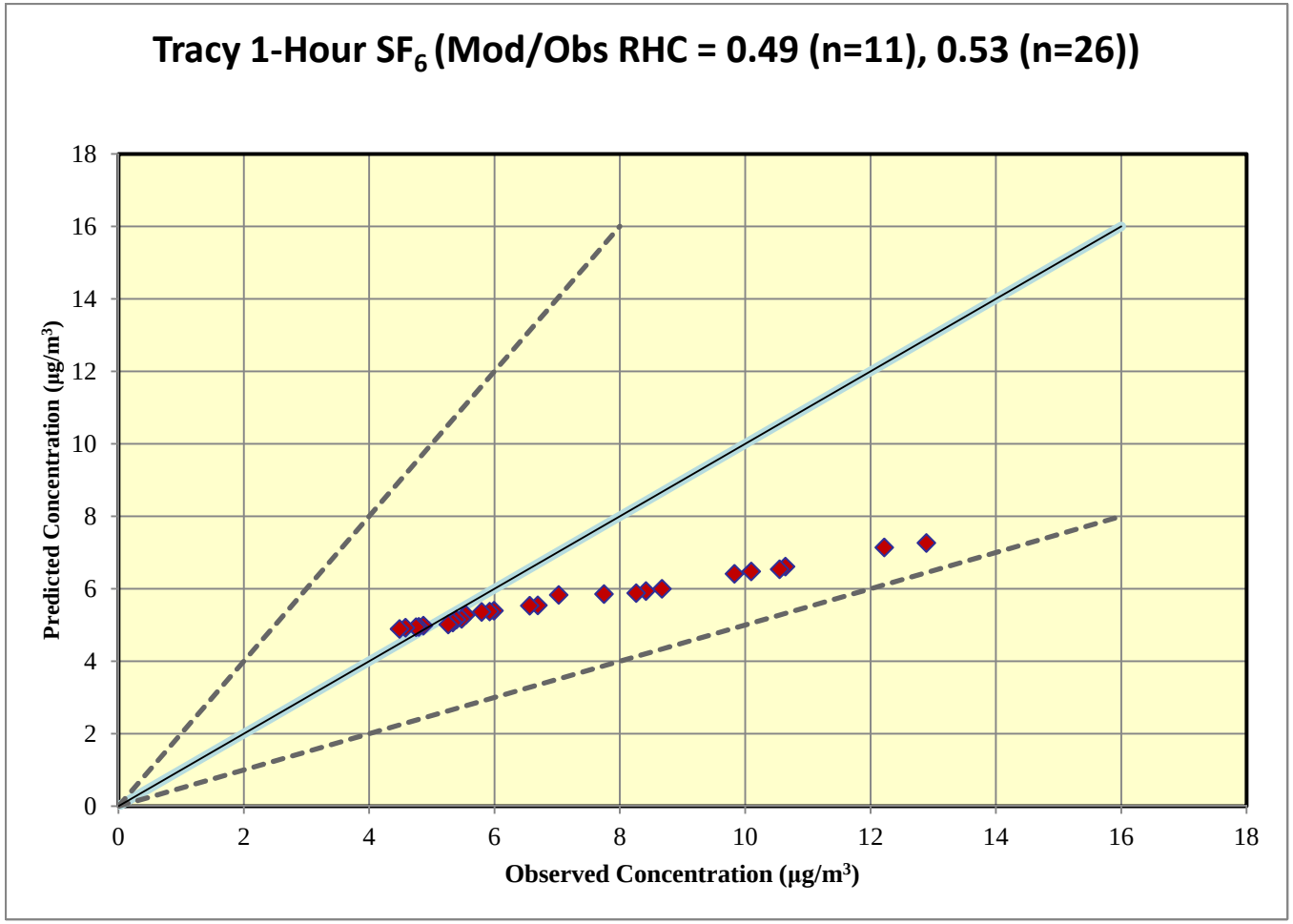
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 12345



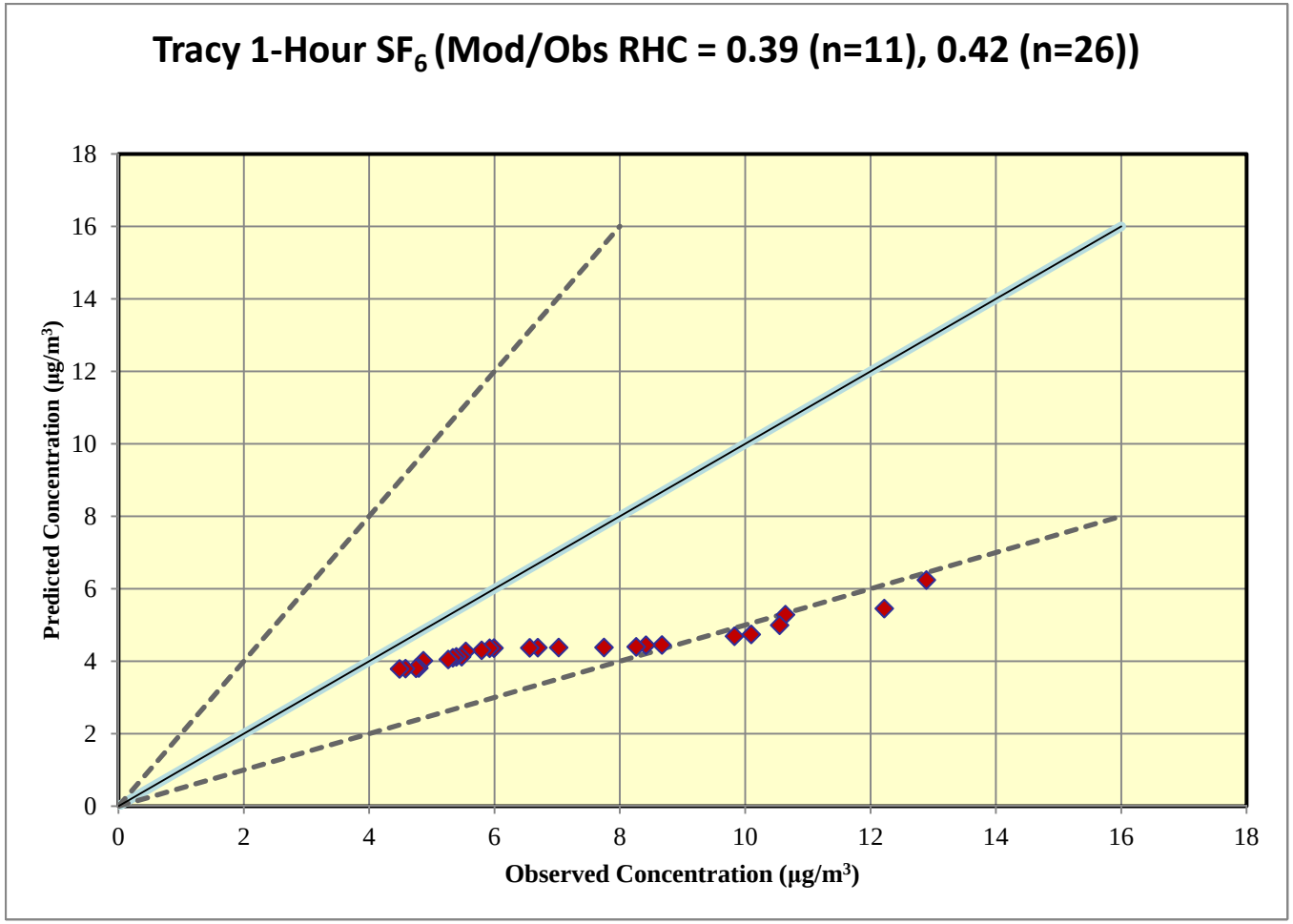
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*



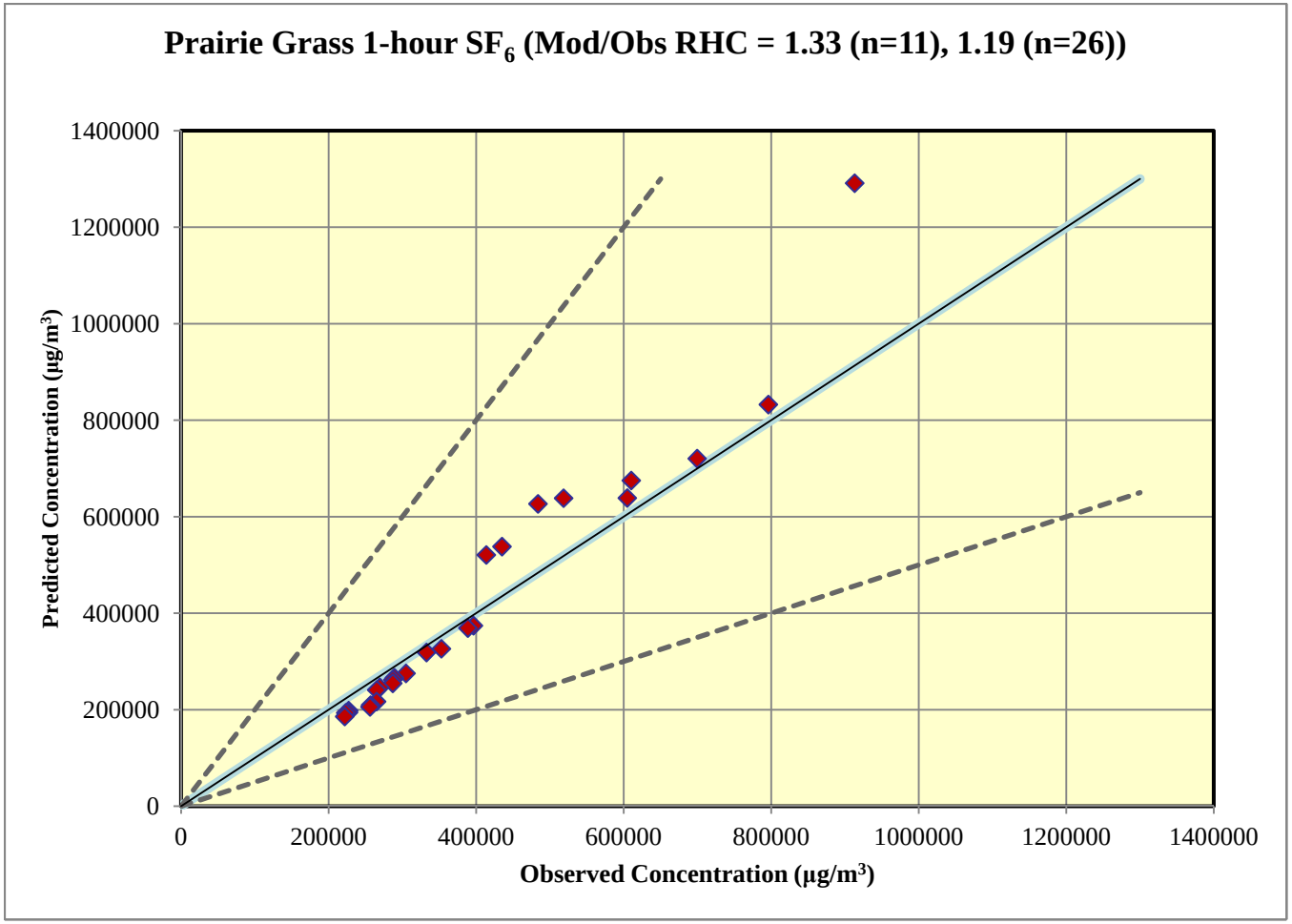
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*, LOWWIND3 (0.3 0.5 0.95)



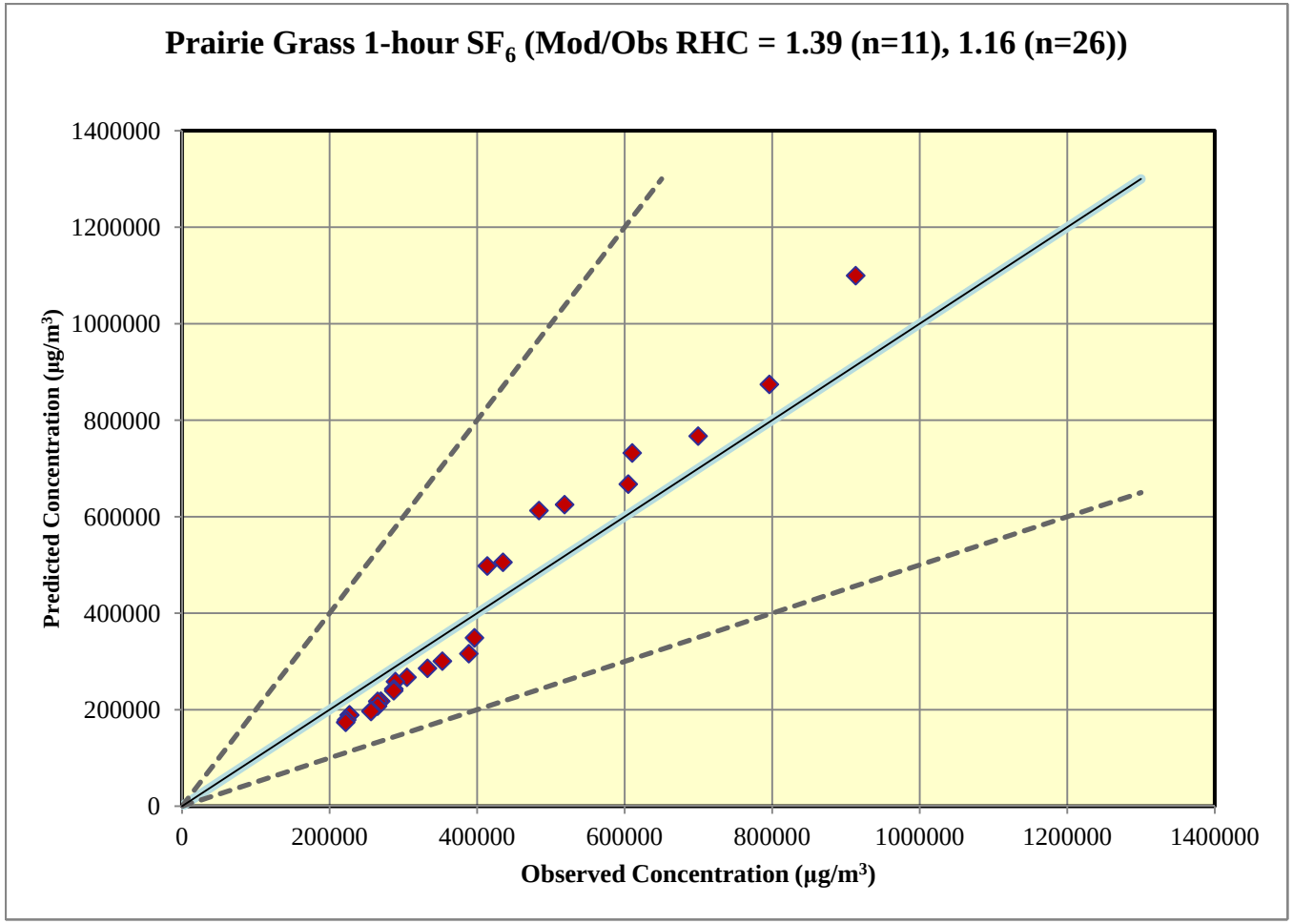
Attachment 5:

Quantile-Quantile Plots for Prairie Grass Tracer Evaluation

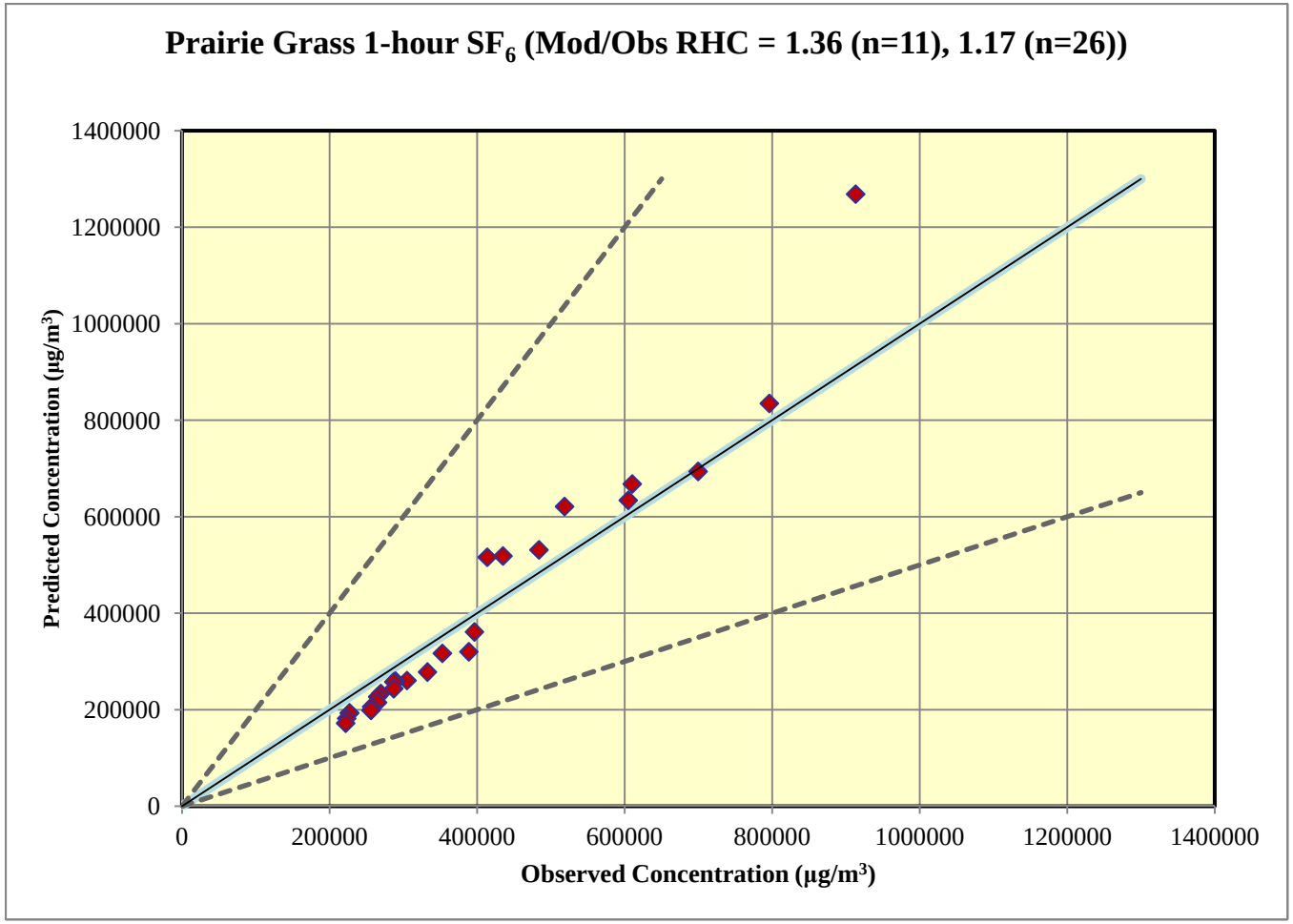
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 02222



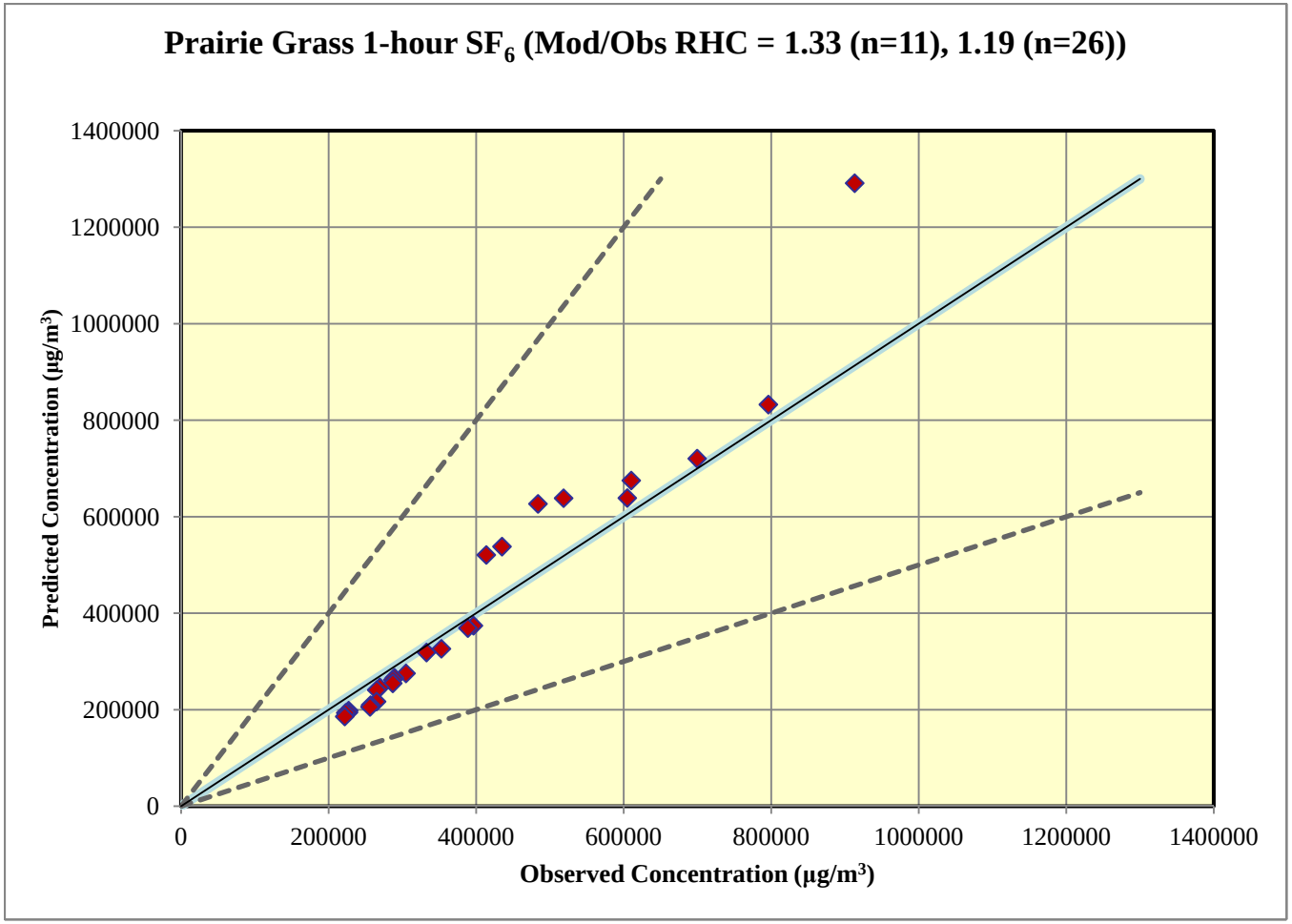
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 12345



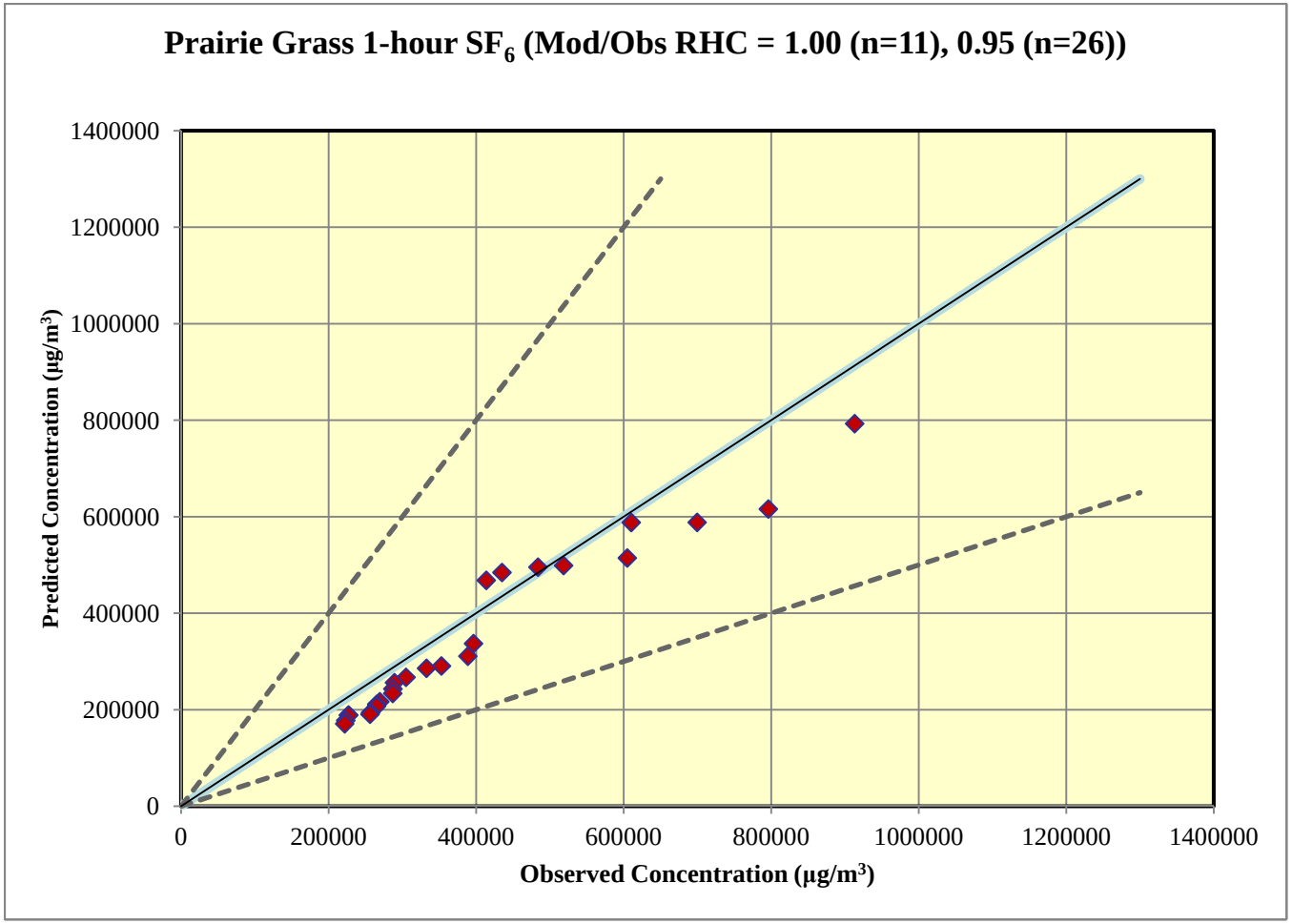
Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*



Evaluation of 26 highest Modeled and Monitored Concentrations: AERMOD v. 15181, Beta ADJ_U*, LOWWIND3 (0.3 0.5 0.95)



Attachment 6:

Declaration of Roger W. Brode

ORAL ARGUMENT NOT YET SCHEDULED

UNITED STATES COURT OF APPEALS

FOR THE DISTRICT OF COLUMBIA CIRCUIT

NATIONAL ENVIRONMENTAL DEVELOPMENT ASSOCIATION'S CLEAN AIR PROJECT,	)	
Petitioner,	)	
v.	)	Docket No. 10-1252
	)	(and consolidated cases)
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY,	)	
Respondent.	)	

DECLARATION OF ROGER W. BRODE

1. My name is Roger W. Brode. I hold B.S. and M.S. degrees in Atmospheric Sciences and I am currently assigned as a physical scientist in the Air Quality Modeling Group within the Air Quality Assessment Division of the Office of Air and Radiation's Office of Air Quality Planning and Standards at the U.S. Environmental Protection Agency ("EPA"), where my

responsibilities include the development, evaluation and application of air quality dispersion models and the development of guidance associated with application of such models in support of EPA regulations governing the Prevention of Significant Deterioration ("PSD")_permitting program. I have been involved in the development, evaluation, testing, and documentation of the American Meteorological Society EPA Regulatory Model ("AERMOD") throughout its history. I currently serve as co-chair of the AMS/EPA Regulatory Model Improvement Committee (AERMIC) consisting of atmospheric scientists and dispersion model experts overseeing the further technical development of the model, and as co-chair of the AERMOD Implementation Workgroup consisting of EPA Regional Office and State dispersion modelers whose charge has been to indentify and assess potential issues with implementation of the AERMOD model as EPA's preferred model under Appendix W of Part 51 of the Code of Federal Regulations.

2. The revised primary national ambient air quality standard for oxides of sulfur ("SO2 NAAQS") requires that the three year average of the annual 99th percentile of the daily maximum 1-hour average concentrations of SO2 be less than or equal to 75 parts per billion. In addition, owners and operators of a new major stationary source or a major source undergoing a major modification located in areas not designated "nonattainment" for the SO2 NAAQS must obtain a PSD permit, and to do so must demonstrate (among other things) that the emissions increases from the new or modified source will not cause or contribute to a violation of the revised SO2 NAAQS. Existing air quality models, including AERMOD, are readily capable of accurately predicting whether the revised primary SO2 NAAQS is attained and whether individual sources cause or contribute to a violation of the SO2 NAAQS. Specifically, dispersion models that are used to demonstrate compliance with the SO2 (and

other) NAAQS, including under PSD permitting programs, use sequential hourly meteorological data as the basis for estimating ambient concentration levels. These data are combined with other inputs (chiefly source emission information, background emissions, and receptor information) to predict transport and dispersion of emitted pollutant plumes. Since the key varying inputs to these models are input on an hourly basis, all applications of these models under the guidance in Appendix W (40 CFR Part 51) are predicated upon the models' ability to predict hourly ambient concentrations. These models thus generate one-hour air quality distributions from which the three year average of the annual 99th percentile of daily maximum 1-hour average concentration of SO2 can be readily calculated or otherwise reasonably approximated.

3. As part of the basis for EPA adopting the AERMOD model as the preferred model for near-field applications in the *Guideline on Air Quality Models*, Appendix W to 40 CFR Part 51, the performance of the AERMOD model was extensively evaluated based on a total of 17 field study data bases (AERMOD: Latest Features and Evaluation Results. EPA-454/R-03-003. U.S. Environmental Protection Agency, Research Triangle Park (2003), portions of which are attached to this affidavit) ("EPA 2003"). The scope of the model evaluations conducted for AERMOD far exceeds the scope of evaluations conducted on any other model that has been adopted in Appendix W to Part 51. These evaluations demonstrate the overall good performance of the AERMOD model based on technically sound model evaluation procedures, and also illustrate the significant advancement in the science of dispersion modeling represented by the AERMOD model as compared to other models that have been used in the past. In particular, adoption of the AERMOD model has significantly reduced the

potential for overestimation of ambient impacts from elevated sources in complex terrain compared to other models.

4. Some of the field studies used to evaluate AERMOD model performance involved ambient sampling of SO2 for a period of one year or more at several (typically about 10) monitors sited around operating power plants. Other field studies involved sampling of controlled releases of non-reactive tracers, typically SF6, generally over a shorter duration than the operational studies, but with more robust sampling to facilitate more detailed diagnosis of model performance. Although the long-term field studies associated with operating power plants included assessments of 3-hour, 24-hour and even annual average impacts from the model, evaluation results for 1-hour averages were routinely included for all of the field studies. As shown in Tables 2 and 3 of EPA 2003, modeling and monitored results for 1-hour averages are in excellent correlation in these studies, with the ratio of predicted to observed performance approaching 1:1 in most instances. Thus, in my opinion, the performance of the AERMOD model for estimating 1-hour ambient concentrations is well-documented and the form of the new 1-hour SO2 standard raises no questions or concerns regarding the appropriateness of AERMOD.

5. The SO2 NAAQS Coalition states that the revised SO2 NAAQS is a "probabilistic" standard and asserts that this makes modeling more problematic, especially as compared to the previous "deterministic" standard. (Coalition p. 5.) The terms "probabilistic" and "determinstic" do not have an ordinarily understood meaning in this context, but it appears that the assertion is that predictive models like AERMOD are not suitable for a standard which includes a percentile-based form (where the relevant comparison is to a percentile of air quality from an air quality distribution), as opposed to an expected exceedance form

(whereby a standard may exceeded on a given number of days and compliance is assessed based on air quality on the designated day once the allowed exceedance days are removed from the distribution). I know of no reason that AERMOD and other similar types of models is suitable for one type of form and not the other. As just stated in paragraph 2, the models readily generate air quality distributions from which either percentiles (for the revised SO2 NAAQS, the 99th percentile) or exceeding days can be determined. In fact, the percentile form of the 1-hour SO2 NAAQS is a more "stable" metric than a standard based on the 1st-highest or 2nd-highest concentrations, since the potential impact of "outliers" in the distribution is mitigated, especially when the multi-year average aspect of the SO2 NAAQS is accounted for.

6. Both the SO2 NAAQS Coalition and their affiant Mr. Paine raise a number of points regarding the issue of whether allowable or actual source emissions should be modeled, stating that use of allowable emissions overstates sources' impacts. See, e.g. Paine Decl. at ¶ ¶ 11-14. This issue is independent of the predictive accuracy of AERMOD or other models.
7. EPA's rules and guidance provide significant flexibility in the choice of which models to use in determining if sources cause of contribute to NAAQS violations for purposes of PSD permitting. EPA's rules specify that "where an air quality model specified in Appendix W of this part ... is inappropriate, the model may be modified or another model substituted" with written approval from EPA. 40 C.F.R. §51. 166 (l)(2). The rules therefore allow flexibility, subject to appropriate requirements, for alternative modeling techniques to be applied on a case-by-case basis subject to approval by appropriate reviewing authority.
8. The declaration of Michael E. Long voices concerns regarding the use of the AERMOD dispersion model to support implementation of the 1-hour SO2 standard, and asserts that

"AERMOD significantly over predicts the actual one-hour ambient concentrations in our area when the available information is used in the model as directed by EPA." Long Decl. at ¶ 8. This assertion is based on a comparison of model-predicted ambient concentrations to ambient SO2 concentrations reported for 2008 at local EPA monitoring stations in the vicinity of the ArcelorMittal facilities being modeled. Mr. Long reports that the "AERMOD model predicted one-hour concentrations that were higher than the monitored values 90% of the time and the predicted values were as much as 373,131 times higher than the actual monitored values." Id. Lacking any additional details regarding the model-to-monitor comparisons cited by Mr. Long, the response here is necessarily limited to a general discussion of issues involved in such comparisons. A number of factors can affect the comparison of a modeled concentration with a monitored concentration, including the accuracy of the emission rate and other source characteristics input to the model, the representativeness of the meteorological data input to the model, and the influence of local geographical features and land use characteristics on the transport and dispersion of the plume. Another key factor that affects comparisons of modeled vs. monitored concentrations, paired in time and space, is the potential error or uncertainty in the wind direction input to the model for that hour since the wind direction will determine the transport direction of the plume. Slight errors in the transport wind direction may account for significant differences in modeled vs. monitored concentrations for a specific hour, especially for elevated plumes under stable atmospheric conditions where the lateral spread of the plume can be very limited for relatively long transport distances, and errors of a few degrees in wind direction can be the difference in the plume directly impacting the monitor for a particular hour or the plume missing the monitor completely. In such cases, a factor of

373,131 difference between modeled and monitored concentrations could easily be attributable to error or uncertainty in the wind direction. Note that wind directions reported from routine meteorological monitoring stations located at airports, the most common source of meteorological data used in air quality modeling applications, are reported to the nearest 10 degrees. In addition, the comparison may reflect issues related to use of allowable versus actual emissions, which is irrelevant for purposes of determining whether the AERMOD model itself is biased.

9. The declaration of Robert J. Paine addresses practical issues in applying the AERMOD model that allegedly arise due to the form of the 1-hour SO2 standard, as well as concerns regarding the conservatism of the assumptions on source emissions based on Appendix W guidance in relation to the 1-hour SO2 standard. Responses to these issues are summarized below, numbered according to Mr. Paine's declaration, with some responses applying to multiple comments:

    (a)

Paine Decl. ¶ 9. : The AERMOD model "does not yet provide results that allow permit applicants to follow EPA's guidance for determining whether they comply with the 1-hour SO2 NAAQS because of the unique statistical form of that NAAQS."

Paine Decl. ¶ 10. : "The form of the 1-hour SO2 NAAQS requires the applicable guideline dispersion model to compute the highest 1-hour concentration for each day at each modeled receptor point, and to keep track of this daily 1-hour maximum concentration statistic for each of the 365 days for each year modeled independently at each location modeled.

Paine Decl. ¶ 11. : "In the case for which a cumulative modeling analysis is required, this same procedure must be applied to the combined contributions of the individual source being permitted, nearby sources and regional background."

Response: As stated in paragraph 2 above, all of these metrics are readily obtainable from model outputs. Although the existing version of AERMOD does not contain an algorithm from which these metrics emerge automatically as model outputs, this does not change the result that all of these metrics are obtainable. In fact, we are aware that Mr. Paine, along with other private sector parties, developed post-processing tools to compute the 1-hour SO2 design value based on the form of the revised SO2 NAAQS utilizing model output options available at the time.

(b)

Paine Decl. ¶ 11. : "Furthermore, EPA in most cases requires a conservatively high regional background concentration to be added for all hours modeled, rather than the actual values measured during each hour of the modeling simulation."

Response: EPA issued guidance on a range of issues related to the new 1-hour SO2 standard on August 23, 2010, including a recommendation that the overall highest 1-hour monitored SO2 concentration from a representative monitor could be used to account for the monitored background component in a cumulative impact assessment "without further justification." We recognize that use of the overall highest 1-hour monitored value may entail a degree of conservatism that could prevent a source from demonstrating compliance with NAAQS; however, that conservatism forms the basis for allowing the approach to be used without further justification. The August 23 memorandum further stated that "Additional refinements to this 'first tier' approach based on some level of temporal pairing of modeled and monitored values

may be considered on a case-by-case basis, subject to approval by the reviewing authority, with adequate justification and documentation." However, we also note that Appendix W explicitly makes "no attempt" to "comprehensively define" the criteria involved in determining which nearby sources to include in an analysis "owing to both the uniqueness of each modeling situation and the large number of variables involved in identifying nearby sources." See Appendix W section 8.2.3.b.

(c)

Paine Decl. ¶ 12. : "Following EPA's regulatory requirements for PSD modeling, the modeled predictions of hourly concentrations of a probabilistic standard such as the 99th percentile daily maximum hourly SO2 concentrations produced by a single source for which a permit is sought can be much higher than concentrations that actually occur in the ambient air."

Response: As noted in paragraph 6 above, the issue of allowable versus actual emissions is independent to the question of the accuracy of AERMOD or other models. Also, as stated in paragraph 5 above, there is no reason that AERMOD (or other similar models) is not equally accurate in predicting percentile air quality distributions or expected exceedances on a given day. The underlying data which are input to the model generate air quality distributions which are equally suitable for either type of form.

(d)

Paine Decl. ¶ 12. : "Modeling of peak SO2 emissions as if they occur continuously is a distortion of reality and will overestimate the ambient air concentrations. This is especially true for 1-hour averages, since the variation of emissions for such a short averaging period is

potentially much higher than that for the other SO2 NAAQS averaging periods. This makes the assumption of constant peak emissions a critical issue for this new standard."

Response: The purpose of dispersion modeling in the context of the PSD permitting program is to demonstrate that the proposed new or modified emissions will not cause or contribute to violations of the standard if the permit is granted. This is inherently a predictive exercise since it entails an assessment of proposed future emissions. EPA's guidance for conducting such analyses is dictated by and consistent with that purpose. Mr. Paine's statement that 1-hour averages are more variable than longer averaging periods again does not relate to potential model bias and in any case makes a sweeping generalization for situations that differ case-by-case. The statement that peak SO2 emissions should not be modeled is a restatement of the dispute as to use of allowable or actual emissions, and does not relate to the issue of model bias.

(e)

Paine Decl. ¶ 13. : "The model overprediction tendency is even more likely to be a problem in a cumulative impact analysis because numerous sources (i.e., the source being permitted and potentially thousands of other nearby sources) are all modeled at peak emissions at all times and added to a regional background level of SO2. . . leading to unrealistic predictions that the 1-hour SO2 NAAQS will be exceeded."

Response: As noted, the issue of allowable versus actual emissions is independent of the issue of models' predictive accuracy. However, EPA's August 23, 2010 clarification memo regarding the applicability of Appendix W guidance for the 1-hour SO2 NAAQS cautioned "against the literal and uncritical application of very prescriptive procedures for identifying which background sources should be included in the modeled emission inventory for NAAQS

compliance demonstrations, including those described in Chapter C, Section IV.C.1 of the draft New Source Review Workshop Manual (EPA, 1990), noting [again] that Appendix W emphasizes the importance of professional judgment in this process." One motivation for that caution was a concern that application of such procedures could lead to an overly conservative result by including too many background sources in the cumulative impact assessment. As noted elsewhere, Section 8.2.3.b of Appendix W suggests that "the number of such sources is expected to be small except in unusual situations."

(f)

Paine Decl. ¶ 13. : "Moreover, since the nearby sources will be modeled individually (but their emissions are already accounted for in the regional monitoring), there will inevitably be double-counting of the background impacts between the components of the "nearby sources" and the "regional background", especially for the common situation of the state requiring a single peak regional background value to be used for all modeled hours."

Response: As noted in several responses above, there are many application-specific factors that need to be considered in determining how to conduct an adequate assessment of cumulative impacts, accounting for contributions from nearby background sources explicitly in the model as well as a monitored contribution, while avoiding or minimizing the potential for double-counting of modeled and monitored impacts.

(g)

Paine Decl. ¶ 14. : "The distribution of total peak daily emissions over the three-year period of 2000-2002 [from major SO2 sources in central North Dakota] was found to overpredict the second-highest monitored 24-hour concentrations by roughly a factor of 2 because the emissions

on average are lower than peak values assumed in the modeling. For the probabilistic 1-hour standard . . . and for closer receptors, the overprediction ratio would likely be even higher than for a 24-hour average, causing extensive areas of fictitious modeled NAAQS violations."

Response: The first statement in this comment merely confirms what was indicated in an earlier response, namely that modeled impacts based on maximum allowable emissions should not be expected to accurately predict ambient monitored concentrations in most cases, since monitored concentrations can only reflect impacts from actual emissions. Overprediction by a factor of 2 does not suggest a significant degree of conservatism given that modeled emissions reflected peak emissions. No rationale is offered to support the assertion that the overprediction ratio would likely be even higher for the 1-hour standard, and we see no reason to expect that necessarily to be the case.

(h)

Paine Decl. ¶ 14. : "Based on my experience with modeling the 1-hour NAAQS for nitrogen dioxide – a NAAQS that is similar in form to the 1-hour SO2 NAAQS – this overprediction ratio could approach a factor of 10 in areas with numerous sources modeled together."

Response: Although the form of the 1-hour NO2 standard is very similar to the form of the 1-hour SO2 standard, the role of NOx chemistry in modeling ambient NO2 impacts associated with NOx emissions makes it difficult to draw comparisons between the two standards in terms of the potential for the model to overestimate ambient impacts as compared to monitored concentrations. The comment does not indicate what assumptions were made in the NO2 modeling analyses regarding the conversion of NO emissions to ambient NO2. An overly conservative assumption in relation to that conversion could introduce a significant bias in the

modeled concentrations relative to monitored concentrations of NO2 that would have no relevance to modeling 1-hour SO2 impacts.

(i)

Paine Decl. ¶ 15.: "If a cumulative modeling assessment shows violations of the NAAQS, then the PSD permit applicant can still obtain a permit for its source by showing that the proposed source does not contribute significantly to the modeled violation. EPA, however, has not yet defined a procedure for determining whether a proposed source that conducts a cumulative modeling analysis and finds modeled violations due to other sources is by itself causing or contributing to these predicted (and possibly false) 1-hour SO2 NAAQS violations. This "safety valve" thus does not yet exist for applicants trying to demonstrate that their proposed SO2-emitting sources will not cause or contribute to any modeled violations of the 1-hour SO2 NAAQS."

Response: Recognizing the importance of the significant contribution test within the PSD permitting program, EPA recommended an interim Significant Impact Level (SIL) in its August 23 guidance memorandum regarding the 1-hour SO2 NAAQS. This interim SIL provides the "safety valve" that may allow a permit applicant to obtain a permit in cases where the cumulative impact assessment shows modeled violations of the 1-hour SO2 NAAQS, if it can be demonstrated that the proposed emission increases do not contribute significantly to those modeled violations, paired in time and space. Although the form of the 1-hour SO2 standard may complicate the "bookkeeping" needed to make such a demonstration, the principle of the significant contribution test based on the SIL has not changed under the 1-hour SO2 NAAQS.

Pursuant to 28 U.S.C. § 1746, and under penalty of perjury, I declare the foregoing is true and correct to the best of my knowledge.

01/18/2011

Date

Roger W. Brode