

Appendix W: Clarification Memoranda

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Outline

- Role of Clarification Memoranda
- Clarification Memo Process
- Appendix W References to “Clarification” and “Consistency”
- Issued Clarification Memos
- Pending Clarification Memos

Role of Clarification Memos

- Clarification memos address issues that may arise with broad implications, i.e., not related to a specific permit modeling application, which should be addressed through the formal Model Clearinghouse process
- Serve as reminders/clarifications in response to new issues that may arise or concerns that Appendix W is not being adequately or appropriately followed
- Intended to foster national consistency in the application of Appendix W recommendations

Clarification Memo Process

- Issues may arise through ongoing OAQPS assessments, through regular interaction with EPA Regional Office modeling contacts, or in response to new or revised NAAQS
- OAQPS internal review of memos through Air Quality Assessment Division (AQAD) Director and, as needed, through Air Quality Policy Division (AQPD) and Office of General Council (OGC)
- Memos are also reviewed by EPA Regional Office modeling contacts
- Memos issued to EPA Regional Offices through modeling contacts or Air Division Directors (ADDs) as appropriate, with distribution based on scope or focus of memo

Clarification Memo Process

- Finalized memos are distributed to community through SCRAM website, identified under “Recent Additions”
- Clarification memos are also archived on separate SCRAM webpage, with link from “Permit Modeling Guidance” page
- OAQPS is taking action to incorporate clarification memos in MCHISRS to further facilitate public access



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Permit Modeling Guidance

This section provides recommendations on modeling techniques and guidance for estimating pollutant concentrations in order to assess control strategies and determine emission limits. These recommendations were originally published in April 1978 as the "Guideline on Air Quality Models" and were incorporated by reference in the regulations for the Prevention of Significant Deterioration of Air Quality, Title 40, Code of Federal Regulations (CFR) sections 51.166 and 52.21 in June 1978 [Federal Register, 43 (118), 26 382-26 388]. The purpose of these guidelines is to promote consistency in the use of modeling within the air quality management process. These guidelines are periodically revised to ensure that new model developments or expanded regulatory requirements are incorporated. This section provides guidance associated with permit modeling and is divided into three components: [Appendix W Guidance](#), [Screening Guidance](#), and [Other Permit Modeling Guidance](#).

Appendix W Guidance

[Appendix W](#)  (803KB,pdf) - 40 CFR Part 51 Appendix W (November 2005)

[Preferred/Recommended Models listed in Appendix W](#) - a list of preferred and recommended models as provided in Appendix W.

[Use of Alternative Models](#) - A list of dispersion models for use on a case-by-case basis with approval by reviewing authority.

[Example Air Quality Analysis Checklist](#)  - An example checklist as it formerly appeared as Appendix C of the "Guideline on Air Quality Models" as explained in the [Explanatory Note](#).

[Clarification Memos](#) - Provides access to memoranda issued by EPA as clarifications of Appendix W and technical aspects of dispersion modeling in general.



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http://www.epa.gov/ttn/scram/guidance_clarificationmemos.htm
Last updated on Friday, October 07, 2011

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Clarification Memos

Provides access to memoranda issued by EPA as general clarifications for issues related to Appendix W and technical aspects of dispersion models, when necessary.

[Revised Policy to Address Reconsideration of Interpollutant Trading Provisions for Fine Particles \(PM2.5\) \(7-21-2011\)](#)

[Clarification on AERSCREEN as recommended screening model \(4-11-2011\)](#)

[Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS \(PDF\) \(3-1-2011\)](#)

[Applicability of Appendix W Modeling Guidance for the 1-hour SO2 NAAQS \(PDF\) \(8-23-2010\)](#)

[Applicability of Appendix W Modeling Guidance for the 1-hour NO2 NAAQS \(PDF\) \(6-28-2010\)](#)

[Modeling Procedures for Demonstrating Compliance with PM2.5 NAAQS \(PDF\) \(3-23-2010\)](#)

[Clarification on EPA-FLM Recommended Settings for CALMET \(PDF\) \(8-31-2009\)](#)

[Clarification on Regulatory Status of CALPUFF for Nearfield Applications \(PDF\) \(8-14-2008\)](#)

[Clarification on Regulatory Status of Proprietary Versions of AERMOD \(PDF\) \(12-11-2007\)](#)

Questions concerning the memos should be directed to Tyler Fox, Group Leader, Air Quality Modeling Group, at fox.tyler@epa.gov.

3/13/2012

Appendix W on Clarification

- Appendix W includes the following references to the need for consistency and clarification:
 - “Industry and control agencies have long expressed a need for **consistency** in the application of air quality models for regulatory purposes.” [Preface, paragraph (a)]
 - “Historically, three primary activities have provided direct input to revisions of the *Guideline*. The first is a series of annual EPA workshops conducted for the purpose of **ensuring consistency** and **providing clarification** in the application of models.” [Preface, paragraph (b)]
(emphasis added)

Appendix W on Clarification (cont.)

- Appendix W references (cont.):
 - “From time to time situations arise requiring **clarification of the intent of the guidance** on a specific topic. Periodic workshops are held with the headquarters, Regional Office, State, and local agency modeling representatives to **ensure consistency** in modeling guidance and to promote the use of more accurate air quality models and data bases. The workshops serve to provide further explanations of Guideline requirements to the Regional Offices and workshop reports are issued with this **clarifying information.**” [Paragraph 1.0(f)] (emphasis added)
 - “The model that most accurately estimates concentrations in the area of interest is always sought. However, it is clear from the needs expressed by the States and EPA Regional Offices, by many industries and trade associations, and also by the deliberations of Congress, that **consistency in the selection and application of models** and data bases should also be sought, even in case-by-case analyses. **Consistency ensures** that air quality control agencies and the general public have a common basis for estimating pollutant concentrations, assessing control strategies and specifying emission limits.” [Paragraph 1.0(f)] (emphasis added)

Clarification Memos Issued Since 9th Modeling Conference

- Clarification on EPA-FLM Recommended Settings for CALMET (8-31-2009)
- Modeling Procedures for Demonstrating Compliance with PM_{2.5} NAAQS (3-23-2010)
- Applicability of Appendix W Modeling Guidance for the 1-hour NO₂ NAAQS (6-28-2010)
- Applicability of Appendix W Modeling Guidance for the 1-hour SO₂ NAAQS (8-23-2010)
- Additional Clarification Regarding Applicability of Appendix W Modeling Guidance for the 1-hour NO₂ NAAQS (3-1-2011)
- Clarification on AERSCREEN as recommended screening model (4-11-2011)

Modeling Procedures for Demonstrating Compliance with PM2.5 NAAQS

- Issued in response to expected transition away from PM10 Surrogacy Policy
- Addressed basic issues regarding dispersion modeling for demonstrating compliance with PM2.5 NAAQS, including:
 - Use of AERMOD as preferred model for estimating near-field impacts from primary PM2.5 emissions;
 - Appropriate methods and metrics for combining modeled and monitored concentrations given nature of ambient PM2.5 with reliance on monitored background being adequate to account for contribution from secondary PM2.5 in many cases

Applicability of Appendix W Modeling Guidance for 1-hr NO₂ and SO₂ NAAQS

- Addressed the applicability of Appendix W modeling guidance to the new 1-hr NO₂ and SO₂ NAAQS, including:
 - Use of AERMOD as the preferred model for estimating 1-hr NO₂ and SO₂ impacts in near-field applications (out to 50 km)
 - Three-tiered screening approach in Section 5.2.4 is generally applicable for 1-hour NO₂ modeling, with additional/different considerations:
 - Tier 1 assumes full conversion of NO to NO₂;
 - Tier 2 applies ambient ratio to Tier 1 result (annual default ratio = 0.75);
 - Tier 3 “detailed screening methods” on a case-by-case basis, including OLM (ozone limiting method) and PVMRM (plume volume molar ratio method) options implemented in AERMOD

Applicability of Appendix W Modeling Guidance for 1-hr NO₂ and SO₂ NAAQS

- Addressed the form of the new 1-hr NO₂ and SO₂ NAAQS based on annual distribution of daily maximum 1-hr values:
 - Analysis procedures to determine modeled design value for cumulative impacts and for comparison of project impacts to interim significant impact level (SIL) described
- Monitoring guidance regarding 3-year average for monitored design value does not preempt or alter Appendix W requirement for use of 5 years of National Weather Service (NWS) meteorological data or at least 1 year of site-specific data
 - Modeled design value is averaged across the number of years modeled

Further Clarifications Regarding Modeling Guidance for 1-hr NO₂ NAAQS

- Clarified the procedures for analyzing results given form of NAAQS, including significant contribution analyses using EPA's interim Significant Impact Level (SIL)
- Recommends default Tier 2 ambient ratio of 0.80 for 1-hour NO₂ NAAQS, and default in-stack NO₂/NO_x ratio for OLM and PVMRM Tier 3 options of 0.50, in the absence of more appropriate information
- Addressed treatment of intermittent emissions (e.g., emergency generators) in PSD modeling demonstrations, a key issue with implementation of the 1-hour NO₂ NAAQS
- Discussion/recommendations regarding identifying nearby background sources to include in modeling and combining modeled + monitored contributions for cumulative analysis

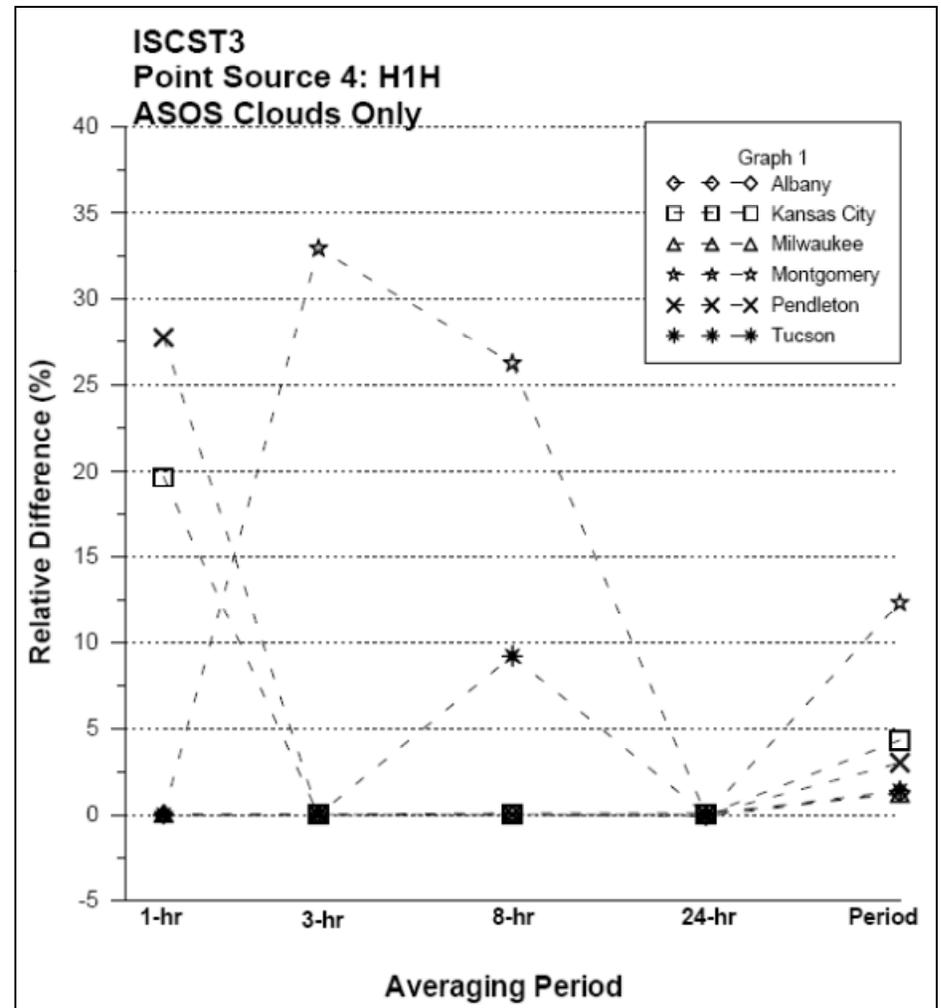
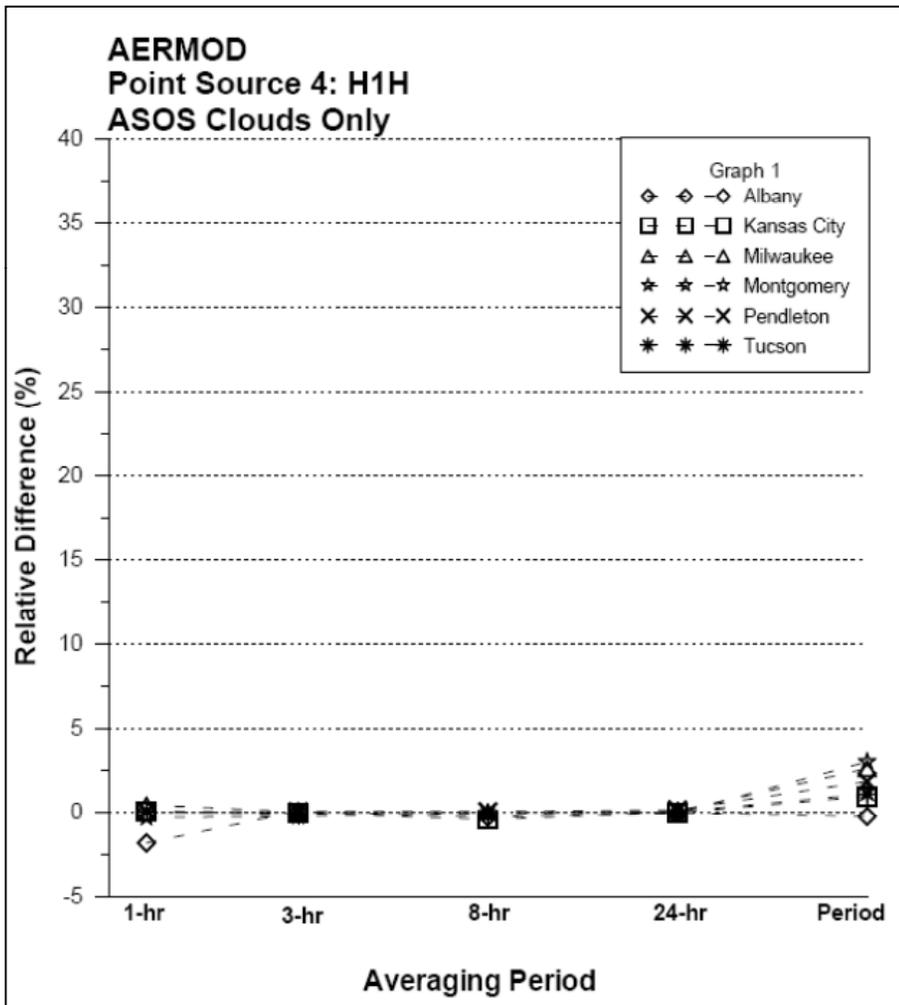
Pending Clarification Memos

- Use of ASOS vs. observer-based National Weather Service (NWS) data and treatment of missing NWS data in AERMOD
- Implementation of EPA formula for Good Engineering Practice (GEP) stack height in AERMOD (with PRIME downwash)
- Note that these pending Clarification Memos are still under development and internal EPA review

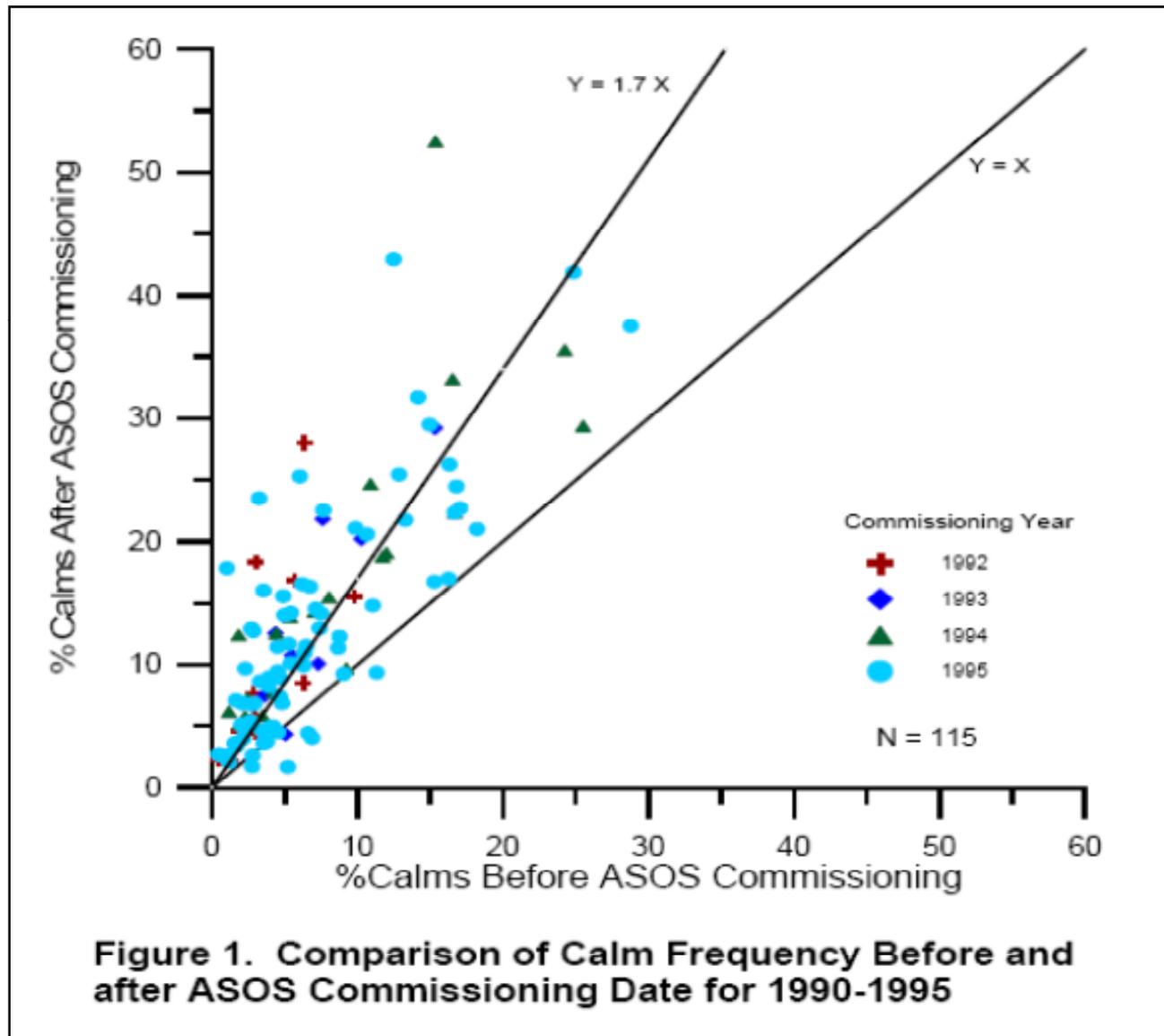
Pending Clarification Memo – NWS Met Data Issues in AERMOD

- AERMOD requirements for data completeness differ from ISCST3, which required 100% data completeness under regulatory default option
- AERMOD sensitivity to ASOS¹ vs. observer-based data has been assessed; generally less of an issue with AERMOD than ISCST3
- However, missing NWS data is more extensive with the advent of ASOS (increased # of calms) and METAR² (variable winds, i.e., missing wind direction with speeds up to 6 knots)

AERMOD ASOS Sensitivity – Clouds Only: 55m Stack With Downwash



ASOS vs. Observer-based Calms



Pending Clarification Memo – NWS Met Data Issues in AERMOD

- These data gaps associated with calm and variable winds are biased toward low wind speeds, increasing concerns regarding the representativeness of the standard NWS/ASOS data for some applications
 - For example, the Birmingham, AL airport (BHM) ISHD data includes 32% calm and 4% variable winds for 2010
- Appendix W does not explicitly address data completeness requirements for NWS (or other airport) data; however, missing NWS data was relatively rare prior to ASOS and METAR

Pending Clarification Memo – NWS Met Data Issues in AERMOD

- Section 8.3.3.2(c) of Appendix W refers to EPA’s “*Meteorological Monitoring Guidance for Regulatory Modeling Applications*” regarding data completeness requirements for site-specific data:
 - “Data bases for use in regulatory dispersion modeling applications should be 90 percent complete (before substitution). The 90 percent requirement applies to each meteorological variable separately and to the joint recovery of wind direction, wind speed, and stability. Compliance with the 90 percent requirement should be assessed on a quarterly basis.” (Section 5.4, EPA-454/R-99-005)
- Section 8.3.3.2(c) of Appendix W also recommends that:
 - “After valid data retrieval requirements have been met, hours in the record having missing data should be treated according to an established data substitution protocol provided that data from an adequately representative alternative site are available.” (emphasis added)

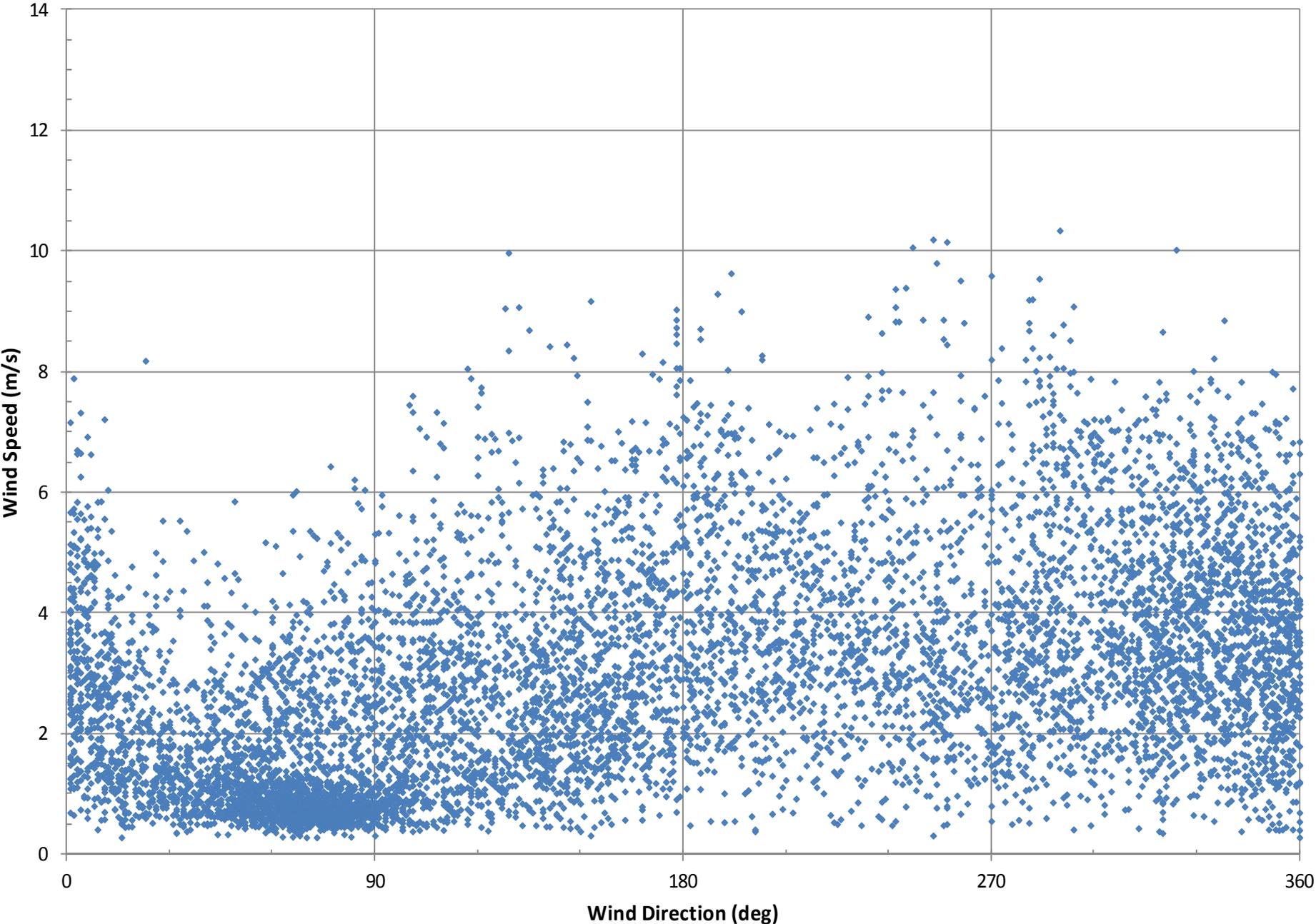
Pending Clarification Memo – NWS Met Data Issues in AERMOD

- A key phrase in Section 8.3.3.2(c) of Appendix W is “*provided that data from an adequately representative alternative site are available*”
- The use of hourly-averaged wind speed and direction from AERMINUTE based on 1-minute ASOS wind data fits perfectly within the guidance established in Section 8.3.3.2(c) since the 1-minute ASOS data are from the same site and instrument:
 - The 1-minute ASOS wind data are clearly as representative as the standard ASOS data archives, which are based on a single 2-minute wind speed and direction, usually reported within about 10 minutes before the hour, with wind speeds reported in whole knots and wind directions to the nearest 10 degrees
 - Hourly-averaged winds based on 1-minute data are actually more appropriate inputs since AERMOD uses a 1-hour “time step” and use of hourly averages eliminates the need to “randomize” wind directions

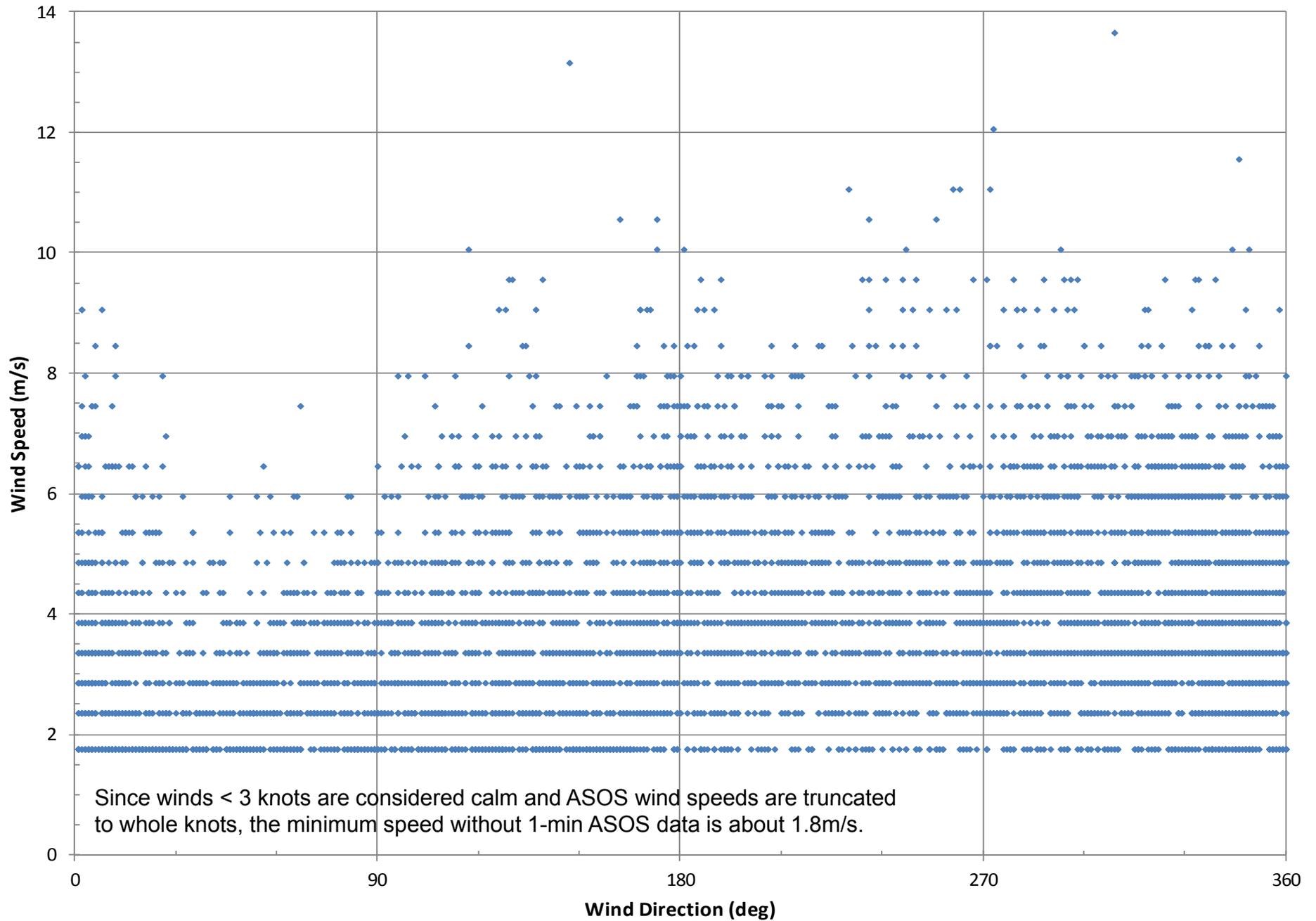
Pending Clarification Memo – NWS Met Data Issues in AERMOD

- EPA recommends that AERMINUTE should routinely be used to supplement the standard NWS data with hourly-averaged winds based on the 1-minute ASOS wind data (when available).
 - For the Birmingham, AL (BHM) 2010 example, use of 1-min ASOS data reduced calms from 32% to 1.2% and variable winds from 4% to 0.01%.
- Although Appendix W does not establish a minimum requirement on data completeness for NWS data, the 90% joint capture by quarter recommended for site-specific data serves as a useful benchmark:
 - If NWS data completeness is less than 90% by quarter with the use of AERMINUTE, then the representativeness of the data may be suspect and alternative sources of met data should be considered;
 - Additional substitutions to achieve 100% completeness (required under the regulatory default option in ISCST3) are not required for AERMOD.
- Next slides compare wind distributions for BHM with and w/o 1-min data

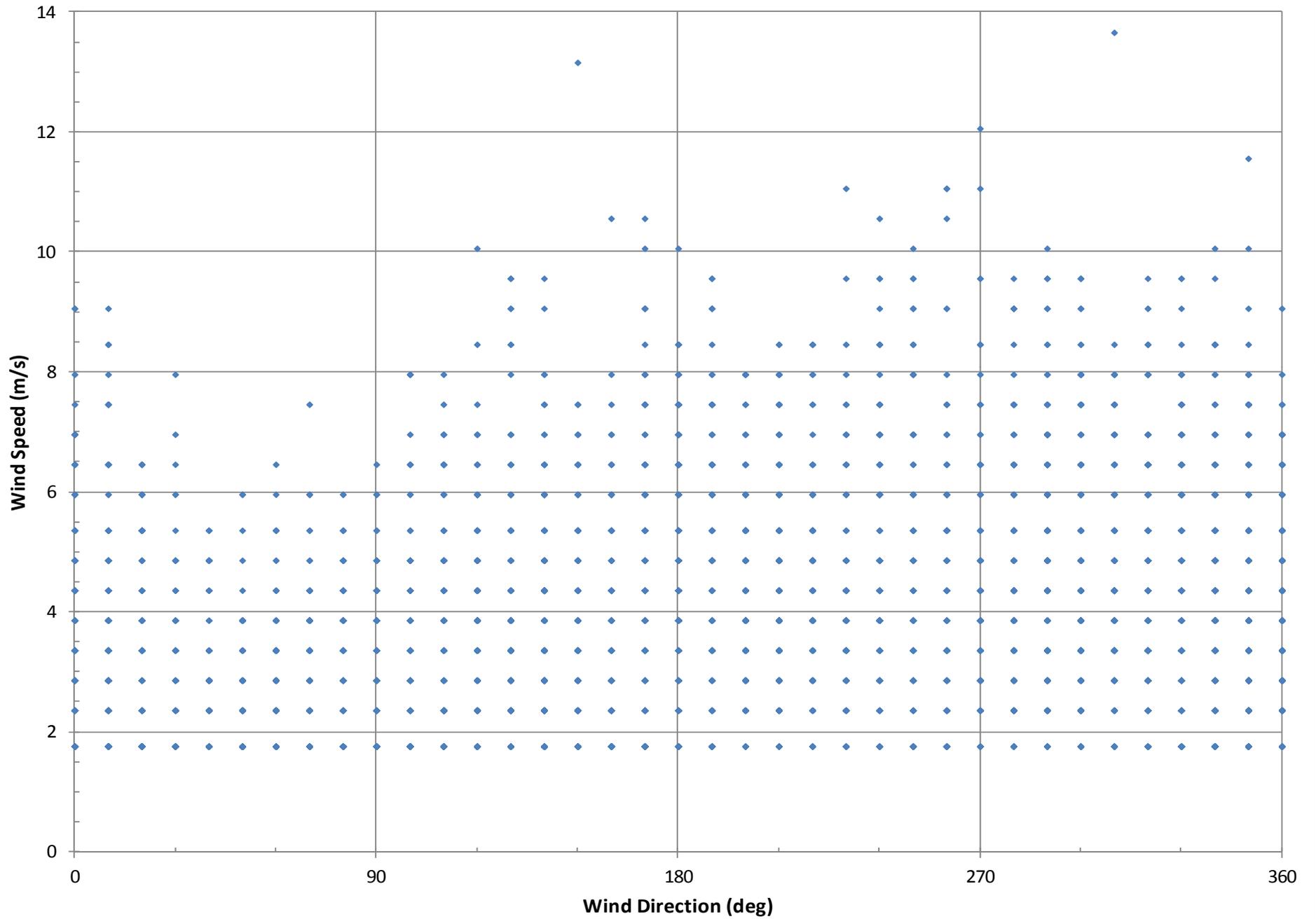
Plot of WS vs. WD for BHM 2010 with 1-min ASOS Winds

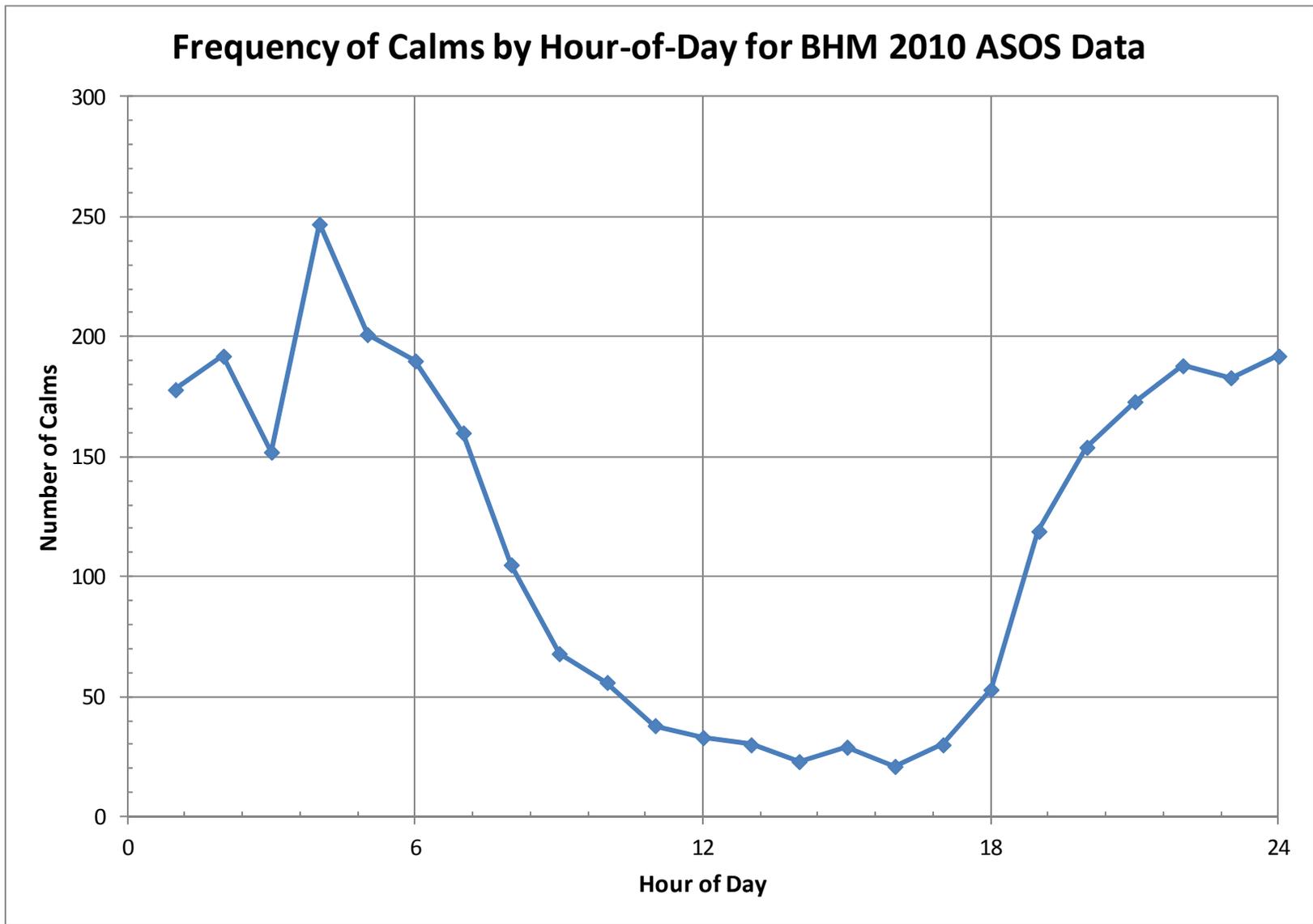


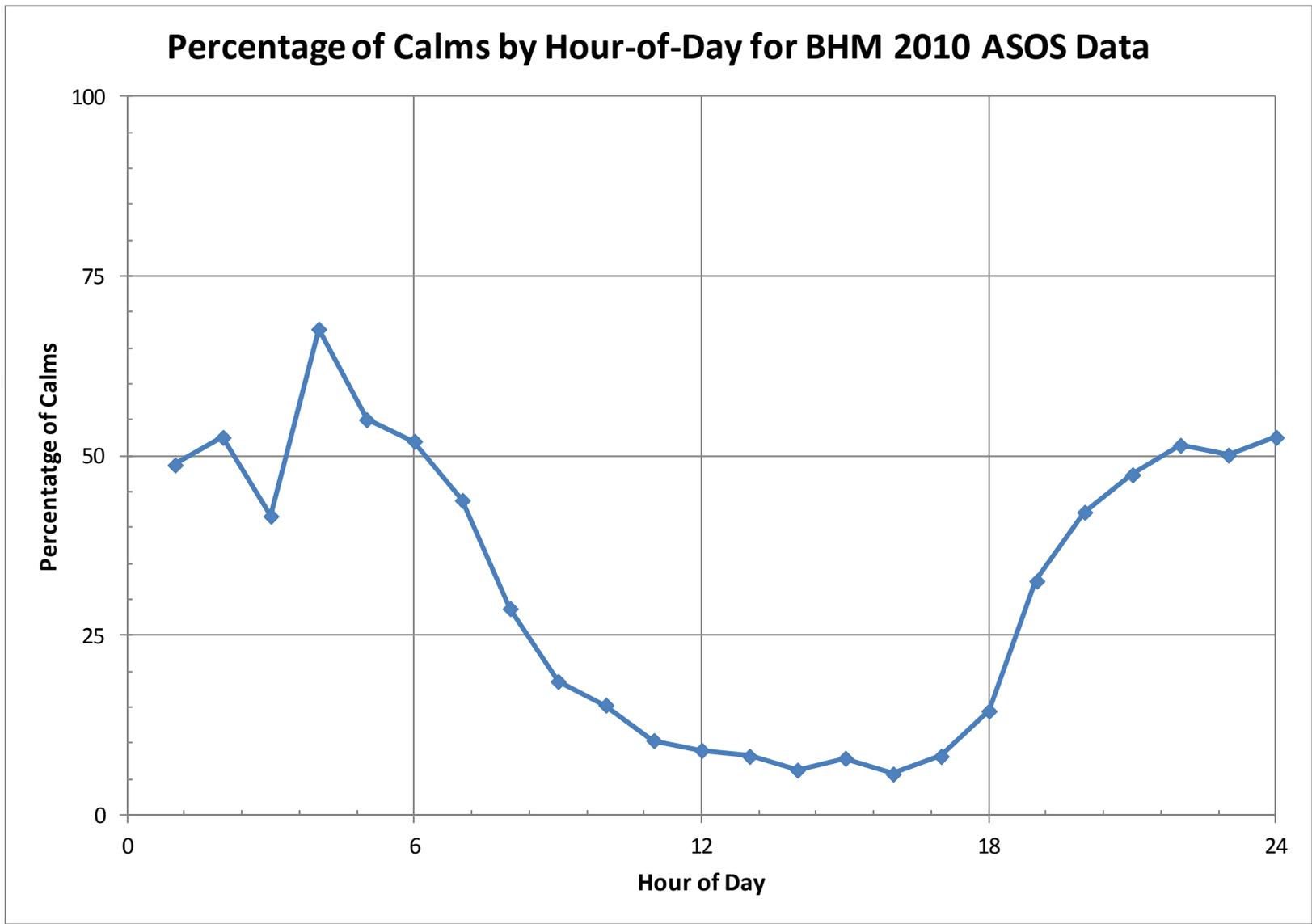
Plot of WS vs. WD for BHM 2010 Without 1-min ASOS Winds



Plot of WS vs. WD for BHM 2010 w/o 1-min ASOS & w/o Randomized WD



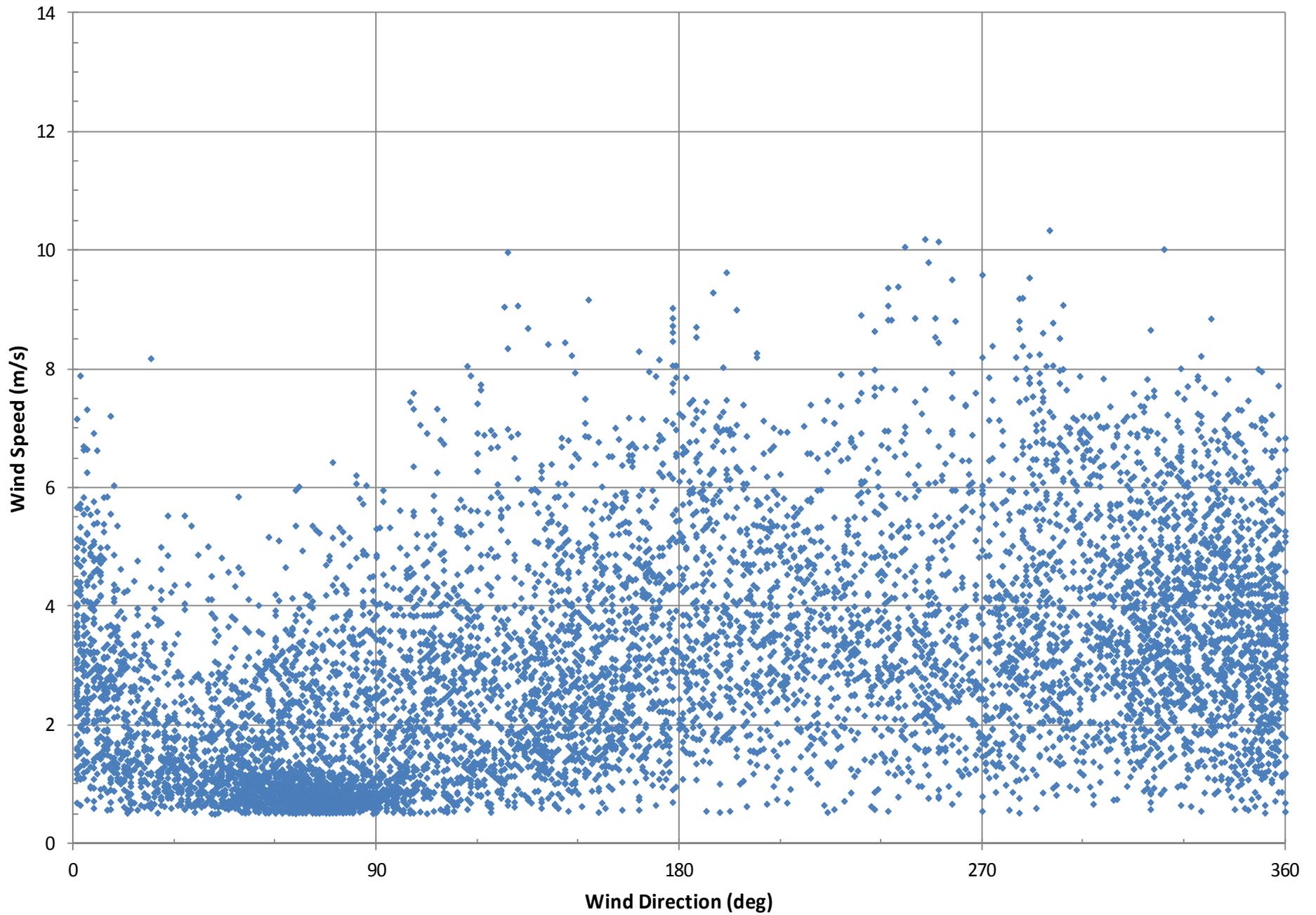




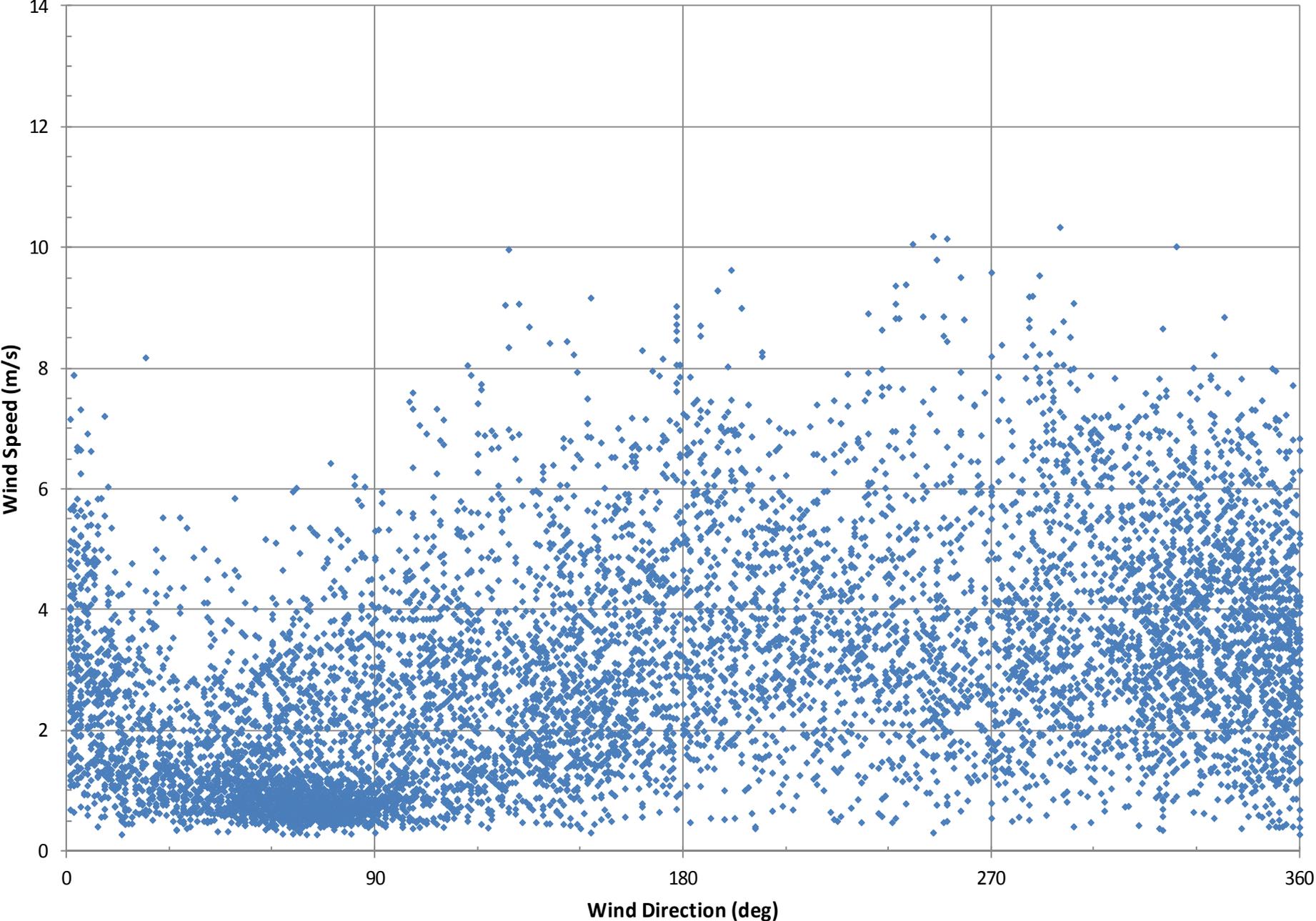
Pending Clarification Memo – NWS Met Data Issues in AERMOD

- Potential technical issues and concerns regarding the use of “low wind speeds” in AERMOD derived from 1-minute ASOS data will be addressed in separate presentations. We also note that:
 - Although Section 8.3.4.2(c) of Appendix W recommends that “*measured site specific wind speeds of less than 1 m/s but higher than the response threshold of the instrument should be input as 1 m/s*” for steady-state Gaussian plume models;
 - Section 8.3.4.2(c) goes on to recommend that “[f]or input to AERMOD, no adjustment should be made to the site specific wind data.”
- However, since the alternative to the use of NWS meteorological data under Appendix W is to collect site-specific data, and since the current guidance regarding site-specific meteorological data does not require a wind speed threshold less than 0.5 m/s, we believe that it is reasonable and appropriate to allow users to apply a threshold of 0.5 m/s to hourly-averaged winds derived from 1-min ASOS data;
 - A pending update to AERMET includes an option to specify a wind speed threshold for 1-min ASOS data in Stage 3, such that hours with average wind speeds less than the threshold would be treated as calms. Next slide shows application of threshold for BHM.

Plot of WS vs. WD for BHM 2010 with 1-min ASOS Winds and 0.5 m/s Threshold



Plot of WS vs. WD for BHM 2010 with 1-min ASOS Winds



Pending Clarification Memo – EPA Formula Height in AERMOD

- Prior to version 11059, the AERMOD model ignored building downwash effects if the stack height was greater than or equal to the EPA formula for GEP stack height, H_{gep} :

$$H_{\text{gep}} = H_b + 1.5L, \text{ where}^1$$

H_b = building height above stack base

L = lesser of building height and projected building width

- This AERMOD implementation was consistent with all previous versions of AERMOD, ISC, and ISC-PRIME
- Significant discontinuities in AERMOD impacts have been noted for stacks that straddle the EPA formula height, orders of magnitude in some cases
 - Significant discontinuities did not occur prior to inclusion of the PRIME downwash algorithm in AERMOD

Pending Clarification Memo – EPA Formula Height in AERMOD

- Comments for the 7th Modeling Conference in 2000 recommended that EPA consider modifying ISC-PRIME to eliminate the discontinuities for stacks straddling the EPA formula height.
- EPA's response at the time was that the current implementation was a requirement imposed by GEP Stack Height Regulations promulgated under Section 123 of the Clean Air Act (CAA).
- The magnitude of discontinuities associated with stacks straddling the EPA formula height prompted a reassessment of that position.
- EPA's reassessment concluded that AERMOD should be modified to remove this criterion for ignoring downwash influences, and this change was implemented in version 11059.

Pending Clarification Memo – EPA Formula Height in AERMOD

- GEP stack height regulations define GEP stack height as the greater of:
 - 65 meters (de minimis GEP height);
 - EPA formula height ($H_b + 1.5L$); or
 - height determined by fluid modeling or field study demonstration
- Based on this definition, EPA formula height does not apply for stack heights below 65 meters
- Criterion for determining GEP height through fluid modeling or field study is the height needed to avoid “excessive concentrations” due to downwash based on an increase of at least 40% due to downwash vs. no downwash

Pending Clarification Memo – EPA Formula Height in AERMOD

- Given the definition of GEP and the criteria for establishing the creditable GEP height for a particular source through fluid modeling or field study, it is very clear that GEP height does not represent the height at which downwash effects become negligible
- In fact, the definition implies at least a 40% increase in concentrations due to downwash influences for a stack at GEP height
- The GEP stack height regulations provide no basis or justification for ignoring that 40% increase when estimating a source's ambient impacts through dispersion modeling

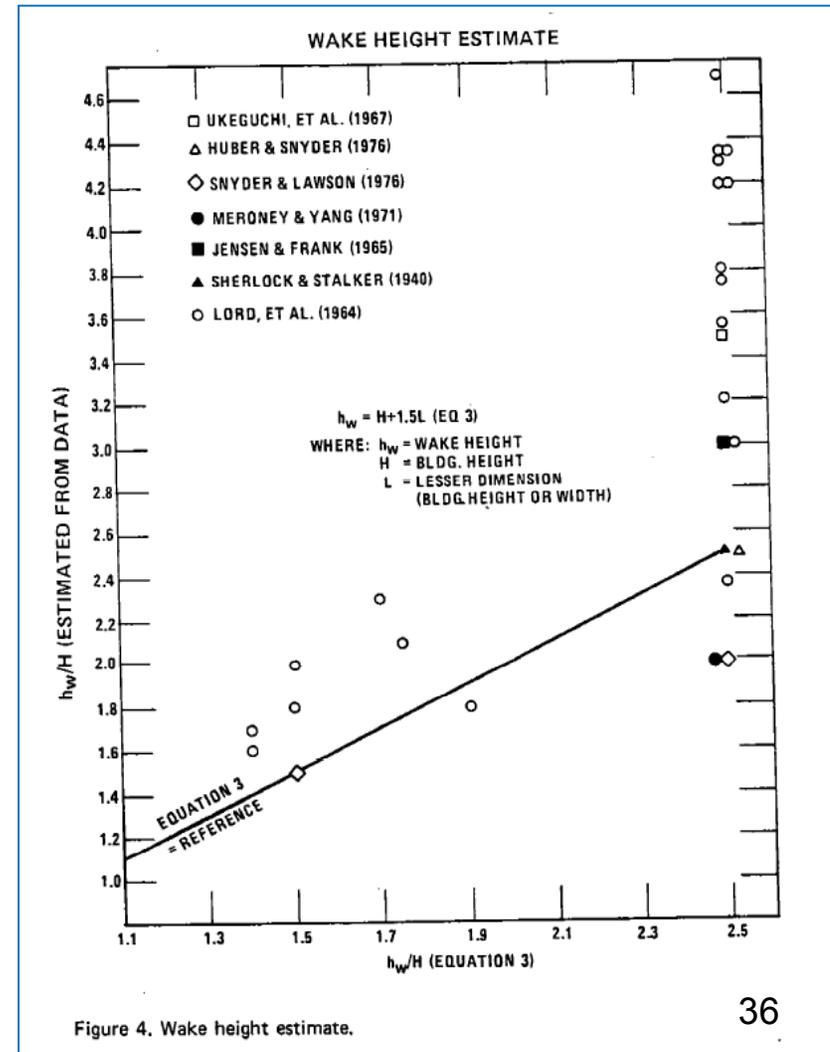
Pending Clarification Memo – EPA Formula Height in AERMOD

- Pre-PRIME downwash algorithms defined vertical extent of wake influences consistent with EPA formula height, resulting in little, if any, discontinuity for stack heights straddling EPA formula height
- However, the vertical extent of wake influences in PRIME formulation can extend well above the EPA formula height
- Wind tunnel studies clearly indicate that wake influences extend above EPA formula height for some stack/building geometries
 - Thompson study (*AE*, 1993) examining buildings up to 4 times wider than the building height reported that “excessive ground-level concentrations [based on GEP criterion of 40% increase with vs. without building] were found for the wider buildings for stacks taller than the two-and-one-half-times rule [same as EPA formula height for squat buildings]”

Pending Clarification Memo – EPA Formula Height in AERMOD

- Figure 4 in EPA's 1985 Technical Support Document for the GEP stack height regulations shows many data points where wake height exceeds the EPA formula height.
- The 1984 NPRM for the 1985 GEP stack height regulations states that:
 - “EPA has found that the formula represents, not an average, but a lower limit, of the height needed to avoid the 40-percent increase in pollutant concentrations that the engineering community has traditionally regarded as excessive. Rather than being statistically distributed uniformly around the formula, the height needed to limit the impact of downwash to a 40-percent increase in concentration tends to be skewed toward greater than formula height.” (emphasis added)

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Pending Clarification Memo – EPA Formula Height in AERMOD

- In other words, the increase due to downwash for stacks at the EPA formula height is usually greater than the 40% criterion defined in the stack height regulations as “excessive”.
- For purposes of the GEP stack height regulations the intent is to not overestimate the stack height needed to avoid excessive concentrations, since that could result in giving too much credit for some sources, allowing the source to take higher emission limits.
- This does not mean that GEP height can never be higher than the EPA formula, only that sources have to demonstrate that a higher height is really necessary to avoid excessive concentrations due to downwash.
- The EPA formula height is essentially the “default” value that can be used in most cases without further justification and therefore should appropriately reflect some degree of conservatism.

Pending Clarification Memo – EPA Formula Height in AERMOD

- EPA believes the technical evidence is clear and non-controversial that building downwash effects can significantly increase ground-level concentrations for stacks that exceed the EPA formula height.
- Therefore, ignoring potential downwash influences for stack heights that exceed the EPA formula height could effectively allow a source to take a higher emission limit than would otherwise be the case if such influences were taken into account.
- This would run counter to the purpose of the GEP stack height regulations under the CAA to ensure that “*the degree of emission limitation required for control of any air pollutant under an applicable implementation plan*” not be affected by that part of the stack height that exceeds GEP.
- EPA’s Office of General Council has concurred with this reassessment regarding ignoring downwash effects for stacks \geq EPA formula height.

Pending Clarification Memo – EPA Formula Height in AERMOD

- EPA has also reassessed the appropriateness of the 5L distance limit on the structure influence zone (SIZ) for a building incorporated in the BPIPPRM building processing program (used to generate building dimensions for input to the AERMOD model):
 - GEP stack height regulations define “nearby” in relation to which structures can be considered in determining GEP as “that distance up to five times the lesser of the height or the width dimension of a structure [5L], but not greater than 0.8 km”.
 - The 5L limit has been incorporated within the BPIPPRM program to define the lateral extent of a structure’s influence, and effectively ignores the potential influence of any structure beyond the 5L limit.
- Technical evidence, including the Thompson (1993) study referenced above, clearly indicates that building downwash influences can significantly increase concentrations for structures that are beyond a distance of 5L from a stack.

Pending Clarification Memo – EPA Formula Height in AERMOD

- The “5L issue” is similar to the issue described above in relation to the EPA formula height, but in a lateral rather than vertical dimension:
 - The definition of “nearby” in the GEP stack height regulations is not intended to imply that significant downwash influences do not extend beyond a distance of 5L from a structure, but rather to put a reasonable, but conservative, limit on the lateral scope of structures that can be considered in justifying a higher creditable GEP stack height.
 - Ignoring downwash effects for buildings beyond 5L could effectively allow a source to take a higher emission limit than would otherwise be the case if such influences were taken into account, which is counter to the purpose of the GEP stack height regulations.
- It should also be noted that the PRIME downwash algorithm in AERMOD explicitly accounts for the location of the stack relative to the building, unlike the earlier ISCST3 model which effectively assumed that the stack was located at the center of the downwind edge of the building.
- Further details regarding this reassessment of the 5L issue in BPIPprm will be provided later as part of broader plans to revise BPIPprm.

Pending Clarification Memo – EPA Formula Height in AERMOD

- Summary of key points:
 - The EPA formula height is not intended to represent the height at which building downwash effects become negligible, and evidence clearly indicates that downwash can significantly increase concentrations for stacks that exceed the formula height;
 - EPA formula height “*represents, not an average, but a lower limit, of the height needed to avoid the 40-percent increase*” in concentrations due to downwash, and therefore serves as an appropriately conservative “default” value for GEP height in most cases;
 - GEP stack height regulations allow for sources to take credit for stacks higher than the EPA formula height if the need for such height can be demonstrated through an appropriate fluid modeling or field study;
 - Ignoring potential downwash effects for stack heights greater than or equal to the EPA formula height could allow a source to take a higher emission limit than would otherwise be the case if such influences were taken into account, which would run counter to the purpose of the GEP stack height regulations.
- Caveat/Disclaimer:
 - GEP stack height regulations are very complex and this presentation is not intended to fully address issues that may arise in applying those regulations to specific cases.