

**Three-State Air Quality Study
Response to Comments by 3SAQS Cooperators**

**Document: [Three-State Air Quality Modeling Study Draft Modeling Protocol 2008 Emissions Modeling Platform - 3SAQS_2008_Modeling_Protocol_Draft.docx](#)
Response-to-Comments Dated April 4, 2014**

#	From	Date	Draft Protocol Comment	Response for Final Protocol
1	UT DAQ – Lance Avey	3/14/14	The 2008 Base Case Modeling will only be done using the 36 and 12 km WestJump modeling domains for the 3SAQS. This is fine for 2008, but will a 4km domain be used for 2011 WRF and photochemical Base Case modeling? 12 km resolution seems a little coarse for the terrain of the Western U.S.	Yes, we will have a 4km modeling domain for the 2011-based simulations that covers the entirety of CO, UT, and WY.
2			The 3SAQS will use CAMx for photochemical modeling. With wintertime ozone being a concern to the Uintah Basin of Utah, both CAMx and CMAQ should be applied. Little is known on the performance of CAMx and CMAQ for wintertime ozone, and applying both models may lend to a better evaluation of the particular models strength and weaknesses for wintertime simulations.	There is currently no plan to run CMAQ for the 2008-based 3SAQS modeling. The 2008 simulations are considered to have a short shelf life to bridge stakeholder needs until we have a 2011 modeling platform so we will not address winter ozone events using the 2008 modeling platform. Wintertime ozone is being considered as a special case study in the 3SAQS. It will require focused research on the best model configuration and input data to simulate the physical and chemical dynamics that contribute to winter ozone formation. The initial efforts of the CAMx modeling using the 2011 modeling platform will be on annual simulations. Our plans are then to use the 2011 modeling platform to address wintertime ozone modeling that will require focused WRF modeling, emission inventory updates, and PGM modeling. We can see benefits of running both CMAQ and CAMx for these winter ozone events.
3			WRF snow cover and depth have an important	Snow cover, snow depth, and mixing will all be

			<p>impact on meteorological variables; such as surface temperature and the planetary boundary layer height and stability structure. UDAQ feels an evaluation of snow cover and depth should be included, especially in regions and that are susceptible to wintertime pollution episodes.</p>	<p>included in the 3SAQS 2011 WRF modeling evaluation. There are no plans to evaluate these parameters in the 2008 modeling.</p>
4			<p>WRF's ability to replicate the vertical profile near the surface (PBL) is important in order to contain and properly replicate pollutant precursors and pollutants. An evaluation of WRF PBL structure during high pollution events may be beneficial. Observed vertical profiles are limited in within the modeling domain (e.g., Uintah Basin), but examining the WRF profile by itself may still be useful to see if WRF produces the strong temperature stability that is known during high wintertime pollution events. Likewise, the modeled vertical profiles of ozone, CO, NOx, CH4, etc. from the photochemical model output would be useful.</p>	<p>This is a good suggestion that we will consider including in the 2011 WRF and CAMx evaluation.</p>
5	US EPA – Gail Tonnesen	2/28/14	<p>(Page 20) Results from the CMAQ model and comparisons between the CMAQ and CAMx models have been presented in past workshops and meetings. We recommend that the results from both models be presented in the MPE for documentation purposes. It will benefit the study and future evaluations to have all of the model work documented. If this is not feasible, we recommend that this issue be discussed with Technical and Steering Committees to determine whether CMAQ simulations should be analyzed, summarized, and presented in the model documents.</p>	<p>We do not have a CMAQ run for the 3SAQS 2008 simulation. Currently we have no plans to run CMAQ for the 2008 or 2011 3SAQS modeling platforms. We have a 2008 CMAQ simulation from the WestJumpAQMS project, but the emissions data used for the 3SAQS 2008 modeling are different from the WestJumpAQMS project making direct comparison between 3SAQS and WestJumpAQMS projects difficult. We will compare the WestJumpAQMS and 3SAQS 2008 CAMx results to highlight the impacts of the emissions changes. If CMAQ modeling should be included in the 3SAQS 2011 platform, this issue</p>

				should be discussed with the 3AQS Technical and Steering Committee.
6			<p>(Page 46) Based on the work completed in other projects on snow cover and snow albedo, it is not clear that average values for snow cover is/was an appropriate approach. Snow cover in winter has a significant effect on the surface albedo which is a critical input for simulating winter oxidant formation, including ozone, NO₂, and nitric acid. Without accurate representation of snow cover, the models cannot accurately simulate air quality in the winter. Because the 2008 modeling is completed, we recommend that more representative albedo values be considered for future modeling activities. For instance, albedo measurements from the Wyoming and Uinta Basin winter ozone studies should be considered to determine more accurate snow albedos.</p> <p>EPA has also identified a problem in the treatment of surface albedo and photolysis in the current version of CMAQ 5.0. EPA will provide a patch for the source code to correct the model calculation of the albedo of snow. Please coordinate with EPA prior to performing any CMAQ simulations.</p>	<p>As described in the comments above to Lance Avey, wintertime ozone is being considered as a special case study in the 3SAQS. We plan to first run a 2011 CAMx simulation using the base model configuration, evaluating the model performance throughout the year and then revisiting areas of particular weakness. For these annual runs it is not appropriate to assume that all snow cover has the maximum albedo value representative of clean white snow as occurs during winter ozone events, so an average snow cover value will be used. We are including targeted analysis of snow cover and mixing in the 2011 WRF analysis that we will refer to when evaluating the 2011 CAMx wintertime performance. At that point, we will be seeking participation in a working group to conduct targeted analysis on wintertime ozone performance and what additional data are available for evaluation and improving the model inputs and performance. At this time use of local-specific snow cover albedo values would be appropriate. There is currently no plan to run CMAQ for the 2011 3SAQS modeling platform</p>
7			<p>(Page 49) Because the model products from this study will be utilized for ozone, AQRVs, and cumulative impacts, we recommend that the MPE commits to including ozone/PM_{2.5} precursors; visibility; sulfur and nitrogen deposition; and comparisons with data from the 2008 Upper Green Winter Ozone Study data. We also recommend that the MPE includes analyses of CO, NH₃ and NH₄. It is</p>	<p>We have generated MPE products for many of the species that you recommend and will include these in the 2008 modeling report. Please see http://www.ie.unc.edu/cemspd/projects/data_viewer/single.cfm?project=3SAQS and navigate to AQ > CAMx_3SAQS12_B08a to see a list of the monthly performance metrics that are available for this simulation. We do not currently have the 2008</p>

		important to assess the model's performance for CO because CO is often evaluated as a tracer for vehicle emissions or other combustion sources and can help in the interpretation of model performance for other pollutants originating from these sources. Further, because this model will be used to evaluate impacts on visibility and AQRVs, extra effort is required to ensure adequate model performance.	Upper Green Study integrated into the MPE but we will explore adding these to the evaluation results. However, since the 2008 modeling platform was not configured to simulate winter ozone events, the usefulness of this evaluation is questionable.
8		(Page 49) It appears that the model results from the 4 km grid domain will not be presented. We recommend that the results from the 4 km domain be included in the MPE. If this is not feasible, we recommend that this issue be discussed with Technical and Steering Committees.	We did not conduct 4-km modeling for the 2008 3SAQS platform.
9		(Page 55) It is not clear whether 8-hour ozone averages will be presented in the MPE. Based on the NAAQS standard for ozone, we recommend that daily 8-hour ozone averages be presented in the MPE.	MDA 8-hour ozone performance will be presented as part of the 2008 and 2011 MPE reports
10		(Page 56) We recommend including the results of an analysis using a threshold of 60 ppb in the MPE for ozone. Current EPA modeling guidance (see reference below) recommends that NMB, NMGE, and average peak bias and error be calculated two ways for ozone evaluations: 1) for days on which the 1-hour or 8-hour observed concentrations are greater than 60 ppb; and 2) for all observed data (no threshold). This will help to focus the evaluation on the model's ability to predict ozone concentrations on high ozone days that are relevant to the NAAQS. Therefore, EPA's modeling guidance recommends a 60 ppb cutoff threshold for ozone. A publication written by EPA recommends calculating performance statistics: (a) without a threshold and (b), with a 60	Thanks for the suggestion, we will include a 60 ppb threshold in our ozone evaluation for both the 2008 and 2011 MPE reports

		<p>ppb threshold (see Simon et al. reference below).</p> <p>EPA 2007 Guidance: http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf</p> <p>Journal Article: Simon et al., Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012, Atmospheric Environment, 61, 124-139, 2012.</p>	
11		(pp. 57 and 59) These two statements include references to WestJumpAQMS model performance evaluation. Should these statements reference the 3SAQS instead of WestJumpAQMS?	Yes, these are typos.
12		(Page 66) This statement references WGA. Should this statement reference WESTAR instead of WGA?	Yes, on January 2011 WESTAR took over management of the 3SAQS and it should be referenced moving forward.
13		(Page 66) This section includes a 2011 WRF Meteorological Modeling Application/Evaluation report and a 2011 Base Case and Model Performance Evaluation Report. We recommend deleting these items or clarifying that independent modeling protocols will be developed for the 2011 modeling products/components, and that the 2008 modeling protocol does not apply to the 2011 modeling process.	These should refer to the 2008 WRF and base modeling performance MPE documents.
14		In preparation for the 2011 MPE, we recommend that the MPE for 2011 include the analyses outlined below, in addition to the analyses included in the 2008 modeling protocol. We believe these additional analyses or parameters are useful for evaluating the results of air quality model simulations. Errors associated with these parameters can result in either over- or under-predictions of ambient pollutant	Thank you for these recommendations. We will include these in the 2011 MPE to the extent possible.

		<p>concentrations and air quality impacts. We also believe the additional analyses are an important quality assurance step that will be useful for interpreting and diagnosing any performance problems and could avoid potential problems or delays in subsequent air quality modeling efforts. The parameters outlined below could be evaluated qualitatively and/or quantitatively for a few episodes with high observed concentrations of ozone, PM_{2.5} and visibility impairment. For example, days with haze, ozone exceedances, or stagnant, sunny weather conditions.</p> <p>Vertical Ozone Comparisons: Model comparisons to any vertical profile data that is available, including ozonesondes or aircraft data. This evaluation is useful to determine how well the model represents ozone above the boundary layer and ozone transport. It also can be useful in assessing how reliably the global model represents BCs and ozone background levels and informs whether predictions of ozone intrusions are accurate or artificial.</p> <p>Snow Cover and Surface Albedo: Snow cover in winter has a significant effect on the surface albedo which is a critical input for simulating winter oxidant formation, including ozone, NO₂, and nitric acid. Without accurate representation of snow cover, the models cannot accurately simulate air quality in the winter.</p> <p>Precipitation and Cloud Cover: Precipitation impacts both visibility and deposition, while cloud cover can affect the photolysis rates. Errors in</p>	
--	--	--	--

		<p>precipitation and cloud cover can cause either over- or under- predictions in pollutant concentrations and deposition.</p> <p>Diagnostic Model Outputs: There are a number of diagnostic model outputs that are useful for identifying problems in model performance. We recommend that the base case simulation include a limited set of process analysis outputs (e.g., rates of ozone and odd oxygen production) and photolysis rate data. We also recommend that 3-d outputs be included for a limited number of species, including ozone, CO, NOx and CH4. performance evaluation. This output information, along with other parameters (i.e., snow cover, albedo, etc), will be beneficial in identifying problems related to the modeled photochemistry, emissions and transport.</p> <p>Boundary Conditions: An evaluation of ozone boundary conditions (BC) should be performed to quantify its contribution and to verify that there is not excessive transport of ozone from the boundaries. This can be evaluated by a model simulation using BC inputs without simulating emissions or chemistry. This evaluation will help to ensure that there are no artificial model over-predictions of ozone.</p> <p>Ammonia: Evaluation of the model ammonia (NH₃) performance is especially important to improve the accuracy of predicted impacts to visibility. If the model is biased low for NH₃ it could also perform poorly for visibility and AQRVs.</p>	
15		<p>In preparation for the model results, we recommend that the 3SAQS technical committee begin to discuss</p>	<p>We've discussed the concept of forming working groups composed of the 3SAQS committee</p>

			as soon as possible an approach to address potential problems with model performance. For example, if the model performs poorly for AQRV in winter, the technical team could develop recommendations to improve model performance. Additionally, the modeling protocols should allocate time and resources to evaluate and improve model performance at each stage of the modeling. For example, we recommend that the technical committee review WRF performance before work begins to process emissions data, and that the technical committee review the emissions data before starting CAMx or CMAQ simulations.	members and stakeholders. While we welcome the formation of these groups and agree with your suggestion that we should have a logical sequence of evaluating met/emissions/BC's before running the air quality model, we do have to consider the requirement to populate the 3SDW with base modeling results by the summer of 2014. We need to find a balance between evaluating/improving model inputs and generating results for the project stakeholders. Our current plan is to create an version A of the 2011 modeling platform that we will then scrutinize to identify improvements to be implemented in a version B of the 2011 platform.
16	CDPHE – Kevin Briggs	3/5/14	The protocol is mostly standard and has been developed for many projects over the years and so we don't have a lot of comments. The 2008 base case is well documented as part of WestJump.	
17			We would like the opportunity to review and comment on the 2020 projection inventory prior to the projections year being modeled.	We will prepare an inventory summary/comparison memo that includes the 2008, 2011, and 2020 inventory data used for the 3SAQS. This memo will provide a platform to use for evaluating and commenting on these inventory data. If you have a particular concern with the 2020 inventory data, please let us know to help us target our analysis/comparisons.
18			In the reports section, Section 10.2, there is no mention of a 2020 report. Will there be a 2020 report/presentation?	The 2020 modeling results will be included as part of the 2008 modeling platform MPE report.
19			As described in Section 8.4 Subregional Evaluation of Model Performance, we would like to see some type of subregional evaluation done for WRF in addition to the PGM, or at least, the tools be developed to do a	The 2008 WRF MPE report includes performance metrics by state. The 2008 and 2011 PGM MPE reports will include state-level performance for the 12km domain and 3-state (CO, UT, WY)

			subregional performance evaluation.	performance for the 4-km domain. Are state level performance metrics what you refer to when you say "subregional evaluation"?
20	BLM CO – Chad Meister	3/5/14	The BLM would also be interested in reviewing portions of the emissions inventory relevant to our work (i.e. oil and gas projections, coal mining (especially if methane is going to be treated differently in the model than it has been traditionally), etc...).	We are developing an emissions review tool as part of the 3SDW that will allow stakeholders to view and plot the different inventory components by state, county, SCC and inventory sectors (e.g. oil and gas, onroad mobile, nonpoint). For the 2011 modeling excess methane emissions (ECH4) will be modeled using CB6r2 chemistry and used in the chemistry in addition to the global background methane (1.75 ppm).
21	NPS – Mike Barna	3/14/14	(Page 13) Will the 4 km domain (or subset thereof, e.g., the WestJump DSAD) be applied for study, or only the 36 and 12 km domains?	We did not conduct 4-km modeling for the 2008 3SAQS platform
22			(Page 14) For consistency with WestJump, CAMx v.5.41 should be used. Presumably, future work (e.g., 2011) should employ CAMx v.6.	We are using version 5.41 for the 2008 modeling and will be using CMAQ v6.1 for the 2011 modeling.
23			(Page 31) From Table 6-1, it appears that the only source sector that will modified from WestJump is 'on-road mobile'. Is there a problem with the existing version of these emissions?	The WestJump onroad emissions were estimated from inventory-mode MOVES results for two representative days per month (weekday and weekend day). We used the NEI2008v2 MOVES emission factor mode lookup tables for the 3SAQS 2008 modeling to support the application of day specific temporal and meteorology adjustments. We made this change to ensure consistency with the 2020 onroad emissions, which will be based off of the NEI2008v2 MOVES data. We also feel that using the emissions rate look up tables is an improvement over the inventory mode emissions used for the WestJump. Note that there were other non-inventory changes implemented in the 3SAQS 2008 emissions that are not reflected in Table 6-1

				but are discussed later in the protocol.
24			(Page 34) Change units from 'ug/m3' to 'micrometers'	Noted
25			(Page 35) Is CB05 speciation preferred over CB6?	At the time of the 3SAQS 2008 emissions processing there were issues with CB6 that were leading to overestimation of ozone formation. These issues were corrected in CB6r2 and we will transition to this mechanism for the 3SAQS 2011 modeling.
26			(Page 36) The addition of CAFO locations in Wyoming should significantly improve treatment of ammonia emissions in this area, and appears to be similar to the ammonia emissions processing that was done for Colorado as part of the RoMANS2 study. Are CAFO locations available for Utah?	Yes and we're implementing these for the 2011 modeling.
27			(Page 40) Will emissions for the Williston Basin also be developed for the 2020 case?	O&G emissions for the Williston Basin are under development under a separate study by WRAP and ENVIRON for the BLM Montana/Dakotas Office. The first version of the 2020 inventory will not include 2020 O&G emissions for the Williston Basin as they will not be ready in time.
28			(Page 49) This indicates that the 4 km domain will be employed after all. Will it be the WestJump DSAD domain?	This is not correct for the 2008 modeling platform. We only ran for the 36 and 12km domains. We will correct this typo in the protocol.
29	USFS – Debbie Miller	3/5/14	I have read the protocol and EPA and state's comments and can't think of too many things to add. I am curious about the decision not to include the 4km results. Was this something we discussed already? I think it would be helpful to explain that decision in the protocol.	Noted. As described above in addressing the comments on 2008 CMAQ modeling and wintertime ozone performance, the 2008 simulations are considered to have a short shelf life to bridge stakeholder needs until we have a 2011 modeling platform. The short shelf life of these results was the major consideration in why we didn't also simulate a 4km domain for 2008.
30	BLM – Craig	3/3/14	Why are we not doing an analysis at 4 km grid resolution?	See comment above

	Nicholls			
			It seemed in a few places that there might have been some cut and paste artifacts going from a WestJump document to the 3SAQS protocol.	Noted and you're correct. We will try to remove these references in the final version of the protocol.