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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Development and evaluation of an operational SDS forecasting system for East Asia: CUACE/DUST" *by* C. H. Zhou et al.

C. H. Zhou et al.

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General comments

We appreciate the comments of the reviewer.

Specific Comments

Q: This paper describes an ambitious new assimilation scheme for the Asia dust problem. It is a nice new system, which seems to do ok compared to observations. A forecasting system is important to have in place. However the text needs substantial editing before it can be published. I recommend that this paper be folded in with other submitted papers before publishing.

A: This paper focus on the development of the Chinese dust operational forecasting system - CUACE/Dust and its application in the spring 2006 dust storm forecasts. Data assimilation is one of its components. Since this is a very large system, detailed evaluation of each component is needed to ensure a robust performance of the system.

Q: The biggest problem with this paper is with the editing of the text. It is difficult to understand what is going on, and where we are going, what data is being used, etc. More clear explanations are required for the paper. A lot of details are completely left out, while unimportant information is furnished. I try to identify the main ones here, but I did not do this carefully for the entire text.

A: Thanks for the suggestions on the editing. We will revise the paper as carefully as we can to make it more readable.

Q: I would like to note that the authors submitted 3 papers simultaneously to ACPD, and all of them are not well edited, and it is not clear that the material deserves so many papers. Please consider reducing the number of papers greatly. Part of the evaluation of the assimilation system would be the present study-so they should probably be folded together. I accidentally started to review Niu et al., and noted that that paper needs substantial expansions and edits. Please submit fewer, but better papers, including many more comparisons and a methodology section for each paper.

A: As mentioned above, CUACE/Dust is a rather complicated system with many new developments built in it. We think each of the components deserves a thorough evaluation, especially for the dust data assimilation system (DAS). It is impossible to combine all of them into a single paper.

Q: Please emphasize what we learned that was useful in the paper-not just that there exists such a system, but what elements were required to get the system to work?

A: Through the analysis of the operational forecasting results for spring 2006, we have found that there are two important factors to get the system to work: one is a rea-

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sonable forecasting system that can accurately describe the dust emission transport and microphysics and the other is the emission database and meteorological inputs. Due to the uncertainties in both of these factors, forecasting results are also subject to uncertainties when compared with observations. The data assimilation system has played an important role in achieving a good forecasting result for 0-24h forecast.

Q: Does the assimilation add to your ability to make predictions? How does it do compared to persistence?

A: The data assimilation system has been applied to the operational SDS forecast and enhanced our ability to make the predictions. Spring mean TS score for 24h forecast has been improved from 0.22 to 0.31 while the mean TS score difference is slim for 48h and 72h forecast. All these have been described in the paper by Niu T. in this special issue.

Q: Figures 1-4: we see very little of interest in these plots-tell us what we are learning? What does the description on page 5 tell us about these processes?

A: Figures 1-4 are to demonstrate the performance of the modeling results with surface observations from different starting times to check the forecast consistency, which is very important for the operational forecast. For CUACE/Dust, the most obvious and direct way is to compare the routine SDS records in 3 hours interval from weather station with the model outputs. From each figure, we can see the difference of the coverage and strength between the forecast concentration and the observation. From different plots of same lead time, we can see different of the development and movement of the severe SDS event between the forecast concentration and the observation. The model consistence performance can also be compared in different plots for different lead time.

Q: These are a sequence of events, discussing the observations-this is not telling us anything new about these processes or about how the model does well or fails. Most of the text on page 5 can be eliminated (or tell me why I should care about it, please).

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A: This section is to introduce the observation used to compare with the modeling results. We have reduced the length of this paper leaving the details in other papers in this special issue.

Q: For figure 5: please compare more quantatively. Identify failures in the model. The model does not appear to capture most of the features in the LIDAR-is that good? If I am misunderstanding your points, maybe you should include better graphs, or descriptions (including maybe arrows pointing out what you want us to notice). Why was this particular time period shown, and not another time period? "For Beijing, both model predictions and lidar observations showed that the dust storm was transported to it through the upper air and settled down to the surface at about 19:00 (BST) in the evening. The dust concentration center located at 2000-3000m in altitude." I can't see this at all in the observations-it looks to me like the model is getting the observations wrong. Same with the analysis of Tsukuba.

A: Thank you for pointing this. There is a mismatch of the time axis between observations and the model results. We have adjusted the scale of the modeling results to match the observations for each location. As can been seen from the revised figures, the comparisons are much better now.

Q: There is too much discussion of individual events, and not enough about statistics. What is the correlation coefficient in Figure 6? How should we evaluate such a forecasting scheme?

A: Good suggestion. We have computed the correlation in Figure 6 and added into the manuscript. Again, the comparison of each individual event is to evaluate the model performance under various dust storm conditions from large scale SDS to small scale and scattered SDS. Figure 7 is a good summary of the entire spring forecasting results. We have analyzed more cases to answer the questions raised by the reviewer and added the results to the paper. Reasons for the mis-forecasts of some SDS processes were explored.

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Q: Normally in weather forecasting, one compares model predictions to persistence and sees whether the model adds any information. Could you also do this for Figure 7? Summarize whether the model is adding information.

A: We are not sure about what persistence means here? How can we compare model forecasting ability to persistence? In order to improve the forecast skill, a 3D data assimilation scheme which merges the previous day's model outputs with the surface SDS observation and satellite retrieval information has been applied to improve the initial SDS conditions. CUACE/Dust will restart for a 3-days lead time run everyday.

Q: SDS: please do not make new, rather obscure acronyms. It makes the paper much harder to read than necessary. Please right out sand/dust storms every time. Same for TS. In the first paragraphs the citations are very irregular- Please cite one paper for each point that is not obvious, make sure it is the best citation, and try to be consistent, generally.

A: SDS (Sand and Dust Storms) has been adapted in a WMO/WWRP dust storm research project. TS skill is the short form for Thread Scoring, a very popular evaluation skill for numerical forecasting model. Please see the reference paper: Wilks, D. S.: Statistical Methods in the Atmospheric Sciences, Academic Press, San Diego,1995.

Q：Page 2: lines 1-4: this is nicely set up, but then you don't tell us what you do. Please do so and finish the thought here.

A: We don't know exactly what page 2 lines 1-4 is. We guess it is for the abstract part which has been revised in the following way: "CUACE/Dust, an operational mesoscale sand and dust storm (SDS) forecasting system for East Asia, has been developed by online coupling dust aerosol emission scheme and dust aerosol microphysics onto a meteorological model with a positive advection scheme and a k-diffusion scheme introduced. The inputs contain a detailed northeast Asia soil erosion database and meteorology from an operational medium range model. It also includes a 3DVar data assimilation system that uses visibility and dust storm records from weather stations,

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PM10 data from dust observation network and dust intensity data IDDI retrieved from the Chinese Geostationary Satellite FY-2C”

Q: you go into too much detail in some places (what sigma surfaces the model uses), but do not tell us how you do the wet or dry deposition, or what bin sizes or size distributions you are assuming, which is much more important.

A: We modified a number of locations to short the description of technical details. The size bin configuration has been given in the manuscript while the detailed descriptions of dry and wet deposition have been given else where in the references.

Q: Section 2.4: Please tell us more about this assimilation system. It needs to be described and evaluated.

A: Please refer to another paper of this special issue “Data Assimilation of Dust aerosol observations for CUACE/Dust forecasting system” by Niu et al which describes and evaluated the assimilation system.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 7987, 2007.