

Interactive comment on “Data assimilation of dust aerosol observations for CUACE/Dust forecasting system” by T. Niu et al.

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General Comments:

The manuscript is interesting from the point of view that it provides an successful data assimilation system (DAS) that was developed for the Chinese Unified Atmosphere Chemical Environment - Dust (CUACE/Dust) forecast system and applied in the operational forecasts of sand and dust storm (SDS) in spring 2006. This data assimilation system can help to better forecast Asian dust phenomena, which are not very frequent in the literature. Furthermore, the using of real-time surface visibility data and Chinese satellite retrieval SDS data is another interesting point in this assimilation system, which improved forecasting capability especially in operational dust forecasting system.

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Sand and Dust Storm (SDS) operational forecasting is a important and pretty new issue. Due to model's uncertainties and observation errors, the uncertainties is somewhat existed in forecasting output. This data assimilation system can estimate these errors and balance them to some degrees. Meanwhile, the presented data assimilation approach can extrapolate information to some areas where on observation existed. In general, I think this assimilation system is new and reasonable one and has an important role in improving forecasting capability. I recommend publishing this paper in ACP, after taking into account the following concerns:

Specific Comments:

- (1). There are many different sizes bin that composing the DM40, so how do you treat this in this system, and how do you get the value from each size bin?
- (2). More descriptions in details should be provided about data assimilation methods, indicating how to improve the forecasting capability of dust model system.
- (3). Page 8313 Section 2.1.1, about $IDD1 = T_s - T_{bb}$. More detailed descriptions should be given, telling what $IDD1$ stands for? What can we get from $IDD1$?
- (4). Page 8314 Section 2.1.2: The system used the surface visibility data. In most cases, the surface visibility includes contributions from anthropogenic air pollution. How do you discriminate between dust-related and air-pollution-related visibility?
- (5). Page 8316 Section 2.2.1: Why does the data assimilation in some places produce a negative concentration?
- (6). LBFGS should be the limited memory BFGS.
- (7). Page 8316-8317 Section 2.2.2: The authors described a method to estimate the background error matrix B from eqs. (2) and (3). But it is difficult to understand how to establish the B matrix. More detailed descriptions must be given here.
- (8). Page 8319 Section 3.2: What are O-B and O-A? How do you define each and what

are their units?

(9). Page 8321 Section 4.2: Which period dose the TS stand for and how do you define the dust forecast as YES or NO?

(10). About Figure 4(b): More details should be given; otherwise it's difficult to understand.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8309, 2007.

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