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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Data assimilation of CALIPSO aerosol observations" *by* T. T. Sekiyama et al.

T. T. Sekiyama et al.

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Dear anonymous referee#3:

Thank you very much for your fruitful comments on our manuscript. The responses to these comments are as follows. We hope these are satisfactory ones for you.

> (1) In the introduction the authors mention the essential role of data assimilation in numerical weather predictions. Some references would be useful.

We add "Kalnay, E: Atmospheric Modeling, Data Assimilation and Predictability, Cambridge University Press, Cambridge, United Kingdom, 341 pp., 2003." as a reference about the history of data assimilation in NWP.

> (2) Aside from NWP 4-dimensional data assimilation is used within several chemistry transport models to estimate the state of the gas-phase air pollutants. This should be

mentioned.

We add previous studies of data assimilation analyses of other atmospheric chemical species, e.g. Arellano et al. (2007 in Atmos. Chem. Phys.) describing EnKF for Carbon Monoxide, when the manuscript is revised.

> (3) Page 5787, lines 1-11: Aside from MODIS observations which cannot discriminate the type of aerosols, there is at least one additional type of satellite based aerosol measurement which allow a type discrimination, namely SYNAER observations.

Thank you for the information of SYNAER. Holzer-Popp et al. (2002) in JGR and Holzer-Popp et al. (2008) in ACP indicate that SYNAER integrates multiple satellite measurements. It seems a multiple retrieval method rather than a single satellite observation. And so, we think it will be interesting to install the SYNAER retrieval algorism into an observational operator of EnKF or 4D-Var.

> (4) The authors state that the type and size of aerosols have been assimilated without retrieval errors because the 4D-LETKF deals directly with CALIPSO level 1B data. The cloud-aerosol discrimination (CAD) is used to distinguish aerosol particles and cloud droplets. How is the CAD obtained ? Does it contain retrieval errors which contaminate the direct assimilation ?

The CAD is just an "indicator". The CAD is calculated secondarily from level 1B data, but CAD scores themselves are not assimilated. In addition, not only "cloud" signals but also many dubious "aerosol" signals are screened out by setting a strict threshold in order to eliminate CAD errors. Therefore, the data assimilation results are produced directly from CALIPSO level 1B data, and won't be contaminated by retrieval errors.

> (5) Page 5792, lines 10-18: The observational operator should be described more detailed.

Please refer to the reply to Referee #2's comment #2b. We are going to revise these sentences.

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> (6) Page 5793, line 18: It is not described how the model variables are updated due to the assimilation. How is the increment distributed throughout the size bins ?

The 4D-LETKF recognizes that 10-sized particles are completely different aerosol species. Each size particle has individual characteristics optically. In other words, the optical characteristics of aerosol particles have a strong dependency on the particle size. Therefore, the 4D-LETKF can update each size-bin concentration correctly in conformity with two-wavelength measurements (532 and 1064 nm) and first estimate values (= model forecasts).

> (7) In Figure 1 the authors do not explain why the data assimilation don't reproduce the aerosol layer observed between 20 and 27N at an altitude of about 1-3 km.

When the manuscript is revised we add "The thin aerosol layer observed near 25N at an altitude of 1-3 km is not reproduced both in Fig. 1b and 1c. This indicates the limitations of model simulation and data assimilation." after line 20 page 5795.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 5785, 2009.