

# ***Interactive comment on “Impact of Atmospheric and Aerosol Optical Depth Observations on Aerosol Initial Conditions in a strongly-coupled data assimilation system” by Milija Zupanski et al.***

## **Anonymous Referee #1**

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The paper presents a demonstration of a strongly coupled assimilation system for the atmosphere with aerosols. It uses two established systems, for the atmospheric modeling using WRF-Chem, and for assimilation the hybrid-ensemble MLEF system. The main weaknesses of the paper are brought up by the authors themselves, in general independent data is used for verification, and though the DFS is informative and can show general indications of system performance a broader case study and exercise is needed with traditional verification using either an independent model or observations. The interesting case presented for the dust plume on the 4th of August should be included; however, this should be just one of many or part of a much longer examination of the system performance. In the conclusions, the authors state that additional

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assessment is required, and there is little presented on the meteorological variables which may or may not have been impacted by the AOD assimilation. Again thorough examination of these meteorological variables against either another modeling system or independent data is needed to complete the analysis of the system performance. Further, there are 14 species in GOCART, and only DUST-1 has been presented, it would be enlightening to know the impacts on these different species as well. Regrettably there is much needed yet in this manuscript to bring it up to a full examination of the system and its performance. At this time I recommend rejection of the current manuscript and encourage a resubmission when the WRF-Chem/MLEF system has been explored and exercised in more depth.

Small typographical corrections: page 2, line 8. “In this research” page 12, line 19 “. . . experiment results additionally reduced” page 7, line 33 and page 12 line 18 “referent” experiment was used while other times “reference” you may consider the use of “reference” consistently. Comment on 5.3.3 Aerosol Uncertainty and associated Figure 8: regarding the lowering of the forecast error standard deviation for DUST-1, couldn't this just be due to the inclusion of the atmospheric observation making the ensemble members more consistent with one another with the wind forcing and placement of the dust. It seems obvious that this may occur, but again the exploration of any unexpected correlations is what needs to be explored.

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