

## ***Interactive comment on “3D-Var versus Optimal Interpolation for Aerosol Assimilation: a Case Study over the Contiguous United States” by Youhua Tang et al.***

### **Anonymous Referee #1**

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This paper is really about the Implementation of aerosol assimilation with GSI using the CMAQv5.1 model. As a way of comparison it compares the results with a previous aerosol assimilation system developed by Tang et al. (2015) which provides material for an interesting discussion, but it is in no way a formal or even valid comparison between a 3DVar and OI as the title suggest. The two assimilation systems differ: 1- by their analysis method, 2- by the method to obtain analysis increments (error statistics for GSI, versus prescribed influence functions for Tang et al. (2015)), and 3 - for matching model representation with radiative transfer model and observables. They are thus too many aspects at stakes to be able to draw any informed conclusion about the merits of 3D Var against OI or any other analysis scheme. Furthermore, the system used

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in Tang et al. (2015) is not an OI but is rather a (data) nudging method. OI is based on covariance functions. The influence functions used by Tang et al. (2015) are boxes of 11x11 grid points horizontally and with PBL height in the vertical (for PM2.5 observation assimilation), and cannot be derived from any covariance functions, as they are not positive definite. I thus do not recommend the publication of this manuscript as a comparison between two analysis systems and would strictly avoid presenting conclusions in that sense, but rather would focus the paper about the implementation of aerosols assimilation with GSI using CMAQ. However, instead of assessing an assimilation system by comparing with observations, as it is normally done or by examining its impact on forecast, in the case of aerosols, the aerosols observations gives in fact too little information to draw upon. The interesting concept used in this paper is to compare instead with a simple assimilation system in order to draw conclusions. I realize that this change of focus amounts to a significant rewriting of the manuscript, but it is in my opinion the only fair option that would avoid misleading conclusions. The introduction should also adopt a terminology that is more in line with current practice to avoid expressions like “Another method is indirect guessing” (line 14, p2).

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