



Interactive  
Comment

# ***Interactive comment on “Development of a numerical system to improve particulate matter forecasts in South Korea using geostationary satellite-retrieved aerosol optical data over Northeast Asia” by S. Lee et al.***

## **Anonymous Referee #2**

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The authors represents results from the application of data derived the geostationary satellite into aerosol model to improve short-term particulate matter (PM) forecast in South Korea. To enhance satellite-measured data, a kringing technique is used to fill missing data. The study is interesting and valuable contribution to the topic. The manuscript is well written and well structured. I recommend publication after addressing the following concerns.

### General comment

It is obvious that the model has the strict negative bias. The statistics analysis (Table C1630

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4 and 5) shows large negative bias (MFB=-98.7—113.2% and NMB=-62.6—70.0%) in the noSTK case for AOD and PM10. Figure 7 shows that the model forecast PM10 concentrations less than half those of observations. The bias in the noSTK case is constant and so (negatively) large that this is not difficult that the STK cases obtain better scores (especially in short time forecast). In fact, negative biases are still found in the STK cases. I wonder if the application of the STK could show any modification in horizontal distribution (e.g., shape of PM10 plume) or timing of peak of PM10 and AOD. Other concern is the necessity of sophistication of model. The model bias rapidly negates the beneficial effect from modification of initial condition (i.e. the application of the STK), indicating that refinements of the model (e.g., emissions and parameterizations) might be much more effective to improve the PM10 forecast than the replacement of initial condition.

#### Minor comments

1. (P5317, L13) The STK can use observed data more than what? Please specify.
2. (P5318, L21) What was low (< 60%)? Which score? Please specify.
3. (P5322, L10) The system is planned to be used as operational system. Is 12-hour forecasting enough long for early warning of PM10?
4. (P5323, L20) Did you use SSA and FMF in this study?
5. (P5325, L11) Please describe the mathematical linkage. In this study, the kriging is used for temporal and spatial interpolation (compensation). Data assimilation techniques are based on statical estimation and used for integrate model and observation.
6. (P5325, L25) Did you use the STK to smooth existing data points? Did you apply the STK only to fill missing points?
7. (P5326, L4) The STK method can use an AOD field at 12:00 derived from AOD fields observed at 9:30, 10:30, 11:30, 12:30 and 13:30. On the other hand, 3D-Var and OI are sequential technique. They can assimilate the AOD fields at observed times,

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sequentially. From this aspect, 3D-Var and OI can use more observation data points more than the STK method.

8. (P5326, L1) 13:30 is better than 01:30.

9. (P5326, L10) “Uncertainties” is inadequate. “Biases” is proper.

10. (P5326, L15) The system is going to be used operationally. The light computational cost of the STK is one of advantages for operational forecasting. However, to calculate AOD field at 12:00 through the STK, we must wait for GOCI AOD data at 13:30. Is this OK for the schedule?

11. (P5328, L20) How did you modify vertical profiles of concentrations from the GOCI AOD?

12. (Section 3.1) Can you show AOD fields before and after the application of the STK? Exhibiting how the STK compensates missing regions due to clouds and high reflectance will reinforce readers’ understanding. Other concern is if there enough GOCI data to fill missing points. Sometimes, we found large missing fields in satellite-measured AOT maps due to clouds. Can the STK method with five GOCI AOT fields fill the missing field completely? If not, how do you replace the initial condition of the forecasting.

13. (P5330, L19-21) Do these sentences mean that when the model has a considerable negative bias, the STK is favorable comparing with other DA methods?

14. (P5333, L11-16) This result means that excepting sea salt and BC from CVs led to better results? In the other words, including sea salt and BC in CVs degraded results?

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