

Atmos. Chem. Phys. Discuss., referee comment RC1  
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## Comment on acp-2022-744

Anonymous Referee #2

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Referee comment on "Improving Ozone Simulations in Asia via Multisource Data Assimilation: Results from an Observing System Simulation Experiment with GEMS Geostationary Satellite Observations" by Lei Shu et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2022-744-RC1>, 2022

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### General Comments:

The authors provided an OSSE-based analysis to investigate the impacts of satellite and surface O<sub>3</sub> observations on the assimilated O<sub>3</sub> concentrations over Asia. They found that joint assimilation by assimilating both satellite and surface O<sub>3</sub> observations has the best performance. I agree with the authors that joint assimilation is helpful. However, the added value to the assimilated surface O<sub>3</sub> by assimilating satellite observations is expected to be limited over areas with a high density of surface observations because of weaker sensitivity to surface O<sub>3</sub> and larger observation errors in satellite observations. Additional analysis is suggested to demonstrate the difference between areas with and without a high density of surface observations, as it can clarify the advantage of satellite observations with respect to surface O<sub>3</sub> observations. I recommend the paper for publication after consideration of the points below.

### Speical Comments:

Lines 141-147: I understand that the fast ozone profile retrieval simulation (FOR) is necessary for GEMS because GEMS scientific products have not been released. I suggest more analysis to demonstrate the consistency between FOR and OMI such as their averaging kernels and observation errors, as the conclusion of this work is based on that FOR is good enough to simulate satellite observations.

Figure 1 and Figure 2: I assume they are simulated retrievals rather than GEMS and OMI retrievals. In addition, the sensitivity of the 839 hPa level (GEMS, Figure 1f) is uniform from the surface to 600 hPa; the sensitivity of the 842 hPa level (OMI, Figure 2c) is uniform from the surface to 300 hPa. Consequently, the contributions of assimilating GEMS and OMI on surface O<sub>3</sub> concentration are expected to be limited with respect to

surface O3 observations.

Lines 254-256: Can the authors perform a new experiment by only assimilating OMI? I am curious about the improvement which we can obtain by assimilating GEMS instead of OMI.

Figure 5: What is the major added value of assimilating satellite measurements over areas with a high density of surface stations, such as E. China? I noticed that the spatial correlation in China is almost ZERO by assimilating GEMS and is about 0.55 by assimilating surface observations.

Figure 6: Please provide more description for panel d. There are different colors and numbers shown in this panel and I don't understand what they represent. In addition, because only one-month assimilation is performed in this work, it could be helpful to show the time series of daily or hourly O3 concentrations. It can better demonstrate the effect of various assimilations on various temporal scales.