Atmos. Chem. Phys. Discuss.,
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Revealing the sulfur dioxide emission reductions in China by assimilating surface observations in WRF-Chem" *by* Tie Dai et al.

Anonymous Referee #2

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General Comments:

The "top-down" emission inventories of air pollutants such as sulfur dioxide are crucial to the studies of air quality prediction and emission control policy. The authors develop an emission inversion system based on the WRF-Chem model and 4D-LETKF assimilation method. This system is tested by inverting SO2 emissions with the surface observations. It takes the advantages of considering the nonlinear sulfur chemistry by ensemble forecasts with perturbed emissions, generating the flow-dependent model errors, and localizing the observation impacts. To optimize the assimilation system, the authors also make a lot of efforts to tune the inversion system parameters. The

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Discussion paper

performances of this system are evaluated by comparing to the independently updated "bottom-up" emissions. Results show that the spatial distribution and magnitude of the SO2 reductions over China are both well revealed by this system. This emission inversion system and its application are sound, and the results are convincing. I would like to recommend accepting this study after some minor revisions.

Specific Comments:

1. In ensemble data assimilation, the inflation of background covariance or the analysis covariance is generally required to avoid filter divergence. Do you use any inflation in your assimilation system? Please clarify this.

2. P5L155: As this paper employs the 4D-LETKF method, it would be helpful to clarify the '4D' /temporal features and 'L'/ spatial localization in the formulas of this method.

3. P4L132: Do you also nudge the meteorological fields in the PBL?

4. P5L155: Does the I in formula (4) represent the identity matrix?

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