Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2020-656-RC2, 2020

Atmospheric Chemistry and Physics Discussions

Interactive comment on "The potential for geostationary remote sensing of NO_2 to improve weather prediction" *by* Xueling Liu et al.

Anonymous Referee #3

Received and published: 23 December 2020

Title: The potential for geostationary remote sensing of NO2 to improve weather prediction Xueing Liu et al., 2020

Review: Summary: This manuscript examines the impact of the assimilation of hourly observations of tropospheric NO2 columns on near surface winds. Using a series of assimilation experiments over the Denver, CO region, and synthetic TEMPO observations, they quantify the impact of the NO2 assimilation with respect to the assimilation of different meteorological parameters. They find that while the assimilation of NO2 improves the representation of boundary layer winds, that improvement is of the same magnitude as when the meteorology alone is assimilated. When the meteorology and NO2 are both assimilated, the improvement from including the NO2 observations is marginal.

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Discussion paper

I recommend this manuscript for publication with minor revisions as described below.

Major comments: The series of experiments described are over very small temporal and spatial scales. The applicability of these results to other regions and seasons is not discussed. Understanding that repeating the analysis for multiple regions and seasons is beyond the scope of the manuscript, the conclusions should be refined to acknowledge this.

Make sure references are cited correctly and in a consistent style throughout the manuscript.

Throughout the manuscript the authors refer to 'TEMPO NO2'. This should be changed to more accurately indicate that synthetic data is being used.

Minor comments:

P2L12: "With the exception of water vapor and ozone (e.g. Inness et al., 2019), observations of atmospheric constituents are generally not used in current NWP." There are a host of operational global models that assimilate observations of aerosol optical depth. See: Xian, et al. Current state of the global operational aerosol multiâĂŘmodel ensemble: An update from the International Cooperative for Aerosol Prediction (ICAP). Q J R Meteorol Soc 2019 doi:10.1002/qj.3497

P3L3: "Examples in simpler models include studies by Allen et al., 2014, 2015; and Haussaire and Bocquet, 2015." This sentence likely needs to be fleshed out.

P4L7: Specify reanalysis data used for initial and boundary conditions

Figure 1: The figure caption doesn't mention what the red square inside the inner domain represents. State boundaries would also help, given that the inner domain location is referenced with respect to Denver.

P6L4: Fix Romine reference

Section 2.3: I suggest explaining this more accessibly and less in terms of namelist

options and code. E.g. explain what T170 resolution is, and any specific code or namelist options can be put in a table in supplemental material.

Section 2.4: Consider changing the title of this section to 'Synthetic Observations' or something like that. What is the reasoning for using the author's own TEMPO simulator, rather than the synthetic data provided by the TEMPO science team?

P6-P7: "The meteorological initial and boundary conditions are taken from the North American Mesoscale Forecast System (NAM), and the chemistry simulation is constrained by MOZART output." What does this mean? That MOZART was used as initial/boundary conditions for this simulation?

P7L4: Spell out NARR, and potentially mention the differences between the two reanalyses (e.g. at least that NAM has output at 12km spatial resolution, and NARR has 32km).

P8L1/Figure2: Is this an average of the lowest 5 levels? It would be useful to know what average altitude range this translates too. E.g. is it possible that power plant towers, which are important emission sources for NO2, could be above this level? Also, the colorbar legend for Figure 2d is too small to read.

Figure 3: Y axes are too small to read, and X axes should specify time zone. These sets of figures could probably go on one page, rather than three.

Figure 4: There is a white box in the upper right corner of each panel. Given that these panels are described with respect to each other, consider putting them all on the same scale to allow for easier comparison.

P15L16: Should be 'The experiment MET has the. . .' I think this sentence might missing a word. It reads like a fragment.

Figure 6: Bigger labels, label the hours, and larger color bar labels with units.

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2020.