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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An evaluation of the impact of aerosol particles on weather forecasts from a biomass burning aerosol event over the Midwestern US: Observational-based analysis of surface temperature" *by* Jianglong Zhang et al.

Anonymous Referee #1

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General comments:

This manuscript analyzed the relationship of surface temperature with aerosol optical thickness (AOT) during a two-day smoke event. Some interesting results about operational forecast errors of surface temperature during this smoke event are presented. The authors attribute these forecast errors to missing aerosol radiative effects in the forecast models. However, the analysis is not convincing. The presentation needs some improvements.

Major comments:

1. The manuscript has a lot of descriptions of geographical locations, such as upper Midwest, Upper Mississipi, Ohio River Valley, etc. However, they are not identified on the figures. For readers who are not familiar with American geography, it is hard to follow the discussions.

2. L372-375: Could you give some discussion about the meaning of forcing efficiencies and their relationship with surface temperature?

3. L377-380: Figure 1e shows several points of high AOT (>1) between Jun 29 and July 1 at Ames.

4. Section 3.2 and section 3.3: As shown in Figure 3, the interested regions are covered by two different synoptic systems, high pressure system to the southwest of the plume and low pressure system to the northeast of the plume. The sharp gradient of surface temperature in the interested regions are mainly due to the difference of the synoptic systems. For discussing aerosol impacts on surface temperature, differences in dynamical enviroment must be considered.

5. L434-436: How do you get these numbers of $\sim$5°C and -1.5°C/τ_550?

6. L467-469: Will this assumption induce bias in AOT? 7. Section 3.4: Similar to comment 4, will smoke Aerosol Direct Surface Cooling Efficiency be different in different dynamic environment? Also, studies have shown that aerosols can change thermodynamic environment or change cloud formation (as some clouds shown on Figure 6c and 6d), resulting in differences on model forecasts. Will these aerosol effects contribute to biased model forecasts on surface temperature?

Minor comments:

1. L113-115: Any references?

2. L137-151: The WRF-Chem model has been extensively used in weather research and forecasting. Some references, such as Chapman et al. [2009, ACP] and Grell et al. [2011, ACP], can be cited.

3. L162-165: What's the MODIS AOT at Grand Forks?

4. L224-229: A scatter plot between AERONET and MODIS may help.

5. L240-248 is similar to L251-260. It is better to combine these two paragraphs.

6. L267-269: Confused. Please reword.

7. L281: "at 18:00 UTC"?

8. Should L288-293 be inserted to L282?

9. L323: "500 hPa" or "700 hPa"?

10. L326: The color bar of wind speed in Figure 3 has a maximum of 20 m/s.

11. L335: "500 hPa" or "700 hPa"?

12. L367-368: For this smoke event?

13. L376-377: Which time are the outliers are at? Are the outlier retrievals just for surface forcing efficiencies, or also including AOT, SSA etc.?

14. L571: Isn't C_τ the same under similar conditions? Why should we expect different C_τ for lower aerosol loading?

References:

Chapman EG, WI Gustafson Jr, JC Barnard, SJ Ghan, MS Pekour, and JD Fast. 2009. Coupling aerosol-cloud-radiative processes in the WRF-Chem model: Investigating the radiative impact of large point sources. Atmos. Chem. Phys., 9:945-964.

Grell, G.A., S.R. Freitas, M. Stuefer, and J.D. Fast, 2011: Inclusion of biomass burning in WRF-Chem: Impact on wildfires on weather forecasts. Atmos. Chem. Phys., 11, 5289-5303.

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