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Discussions

Interactive comment on "Implementation of warm-cloud processes in a source-oriented WRF/Chem model to study the effect of aerosol mixing state on fog formation in the Central Valley of California" *by* H.-H. Lee et al.

Anonymous Referee #2

Received and published: 12 January 2016

This paper well describes the impacts of source-oriented aerosols and aerosol-cloud interaction on fog formation by implementing the modified cloud microphysics and radiation schemes into the source-oriented Weather Research and Forecasting chemistry model (SOWC). Here are some major and specific comments, which need to be considered before the publication.

1. The authors noted in section3 that the computational cost of the SOWC model simulation is 25 times higher than that of the standard WRF/Chem simulation. Known that the SOWC model is computationally very expensive, how can authors conclude

that the SOWC model should be a useful public model to predict effects of climate change on the hydrological cycle and energy budget?

2. Substantial efforts, modification of radiation schemes to interact with cloud droplets (section 2-3), has been put in this paper to study aerosol-cloud interactions during fog simulations. Why did the authors select the fog event that occurred under calm and stable meteorological condition, which is responsible for similar model results between 'S_ARon_CRmod' and 'S_ARon_CRorig' (see last paragraph in section 4-2)? How will simulation results be affected by the modified calculation method of cloud optical property if we choose different fog cases?

3. Cloud-droplet number concentration between 'S_ARon_CRmod' and 'S_ARon_CRorig' shows significant differences (the difference is greater than the one between 'S_ARon_CRmod' and 'S_ARoff_CRmod'), even though other fields such as Qc, SKT, NSF, LH, and SH are similar between two simulations. Please check the sentences in section 4.2.

4. Figure 6 shows that Nitrate concentration in the model is much lower than the observation at all CAAQD stations used in the analysis. How can high Nitrate concentrates in the SJV? What causes high Nitrate concentration in the SJV?

5. Please check specific comments shown below.

1) It would be better to show available observations for aerosol concentration to compare with the simulated aerosol concentration. Model produces abundant smaller cloud droplets and high CCN concentration, which causes bias in surface temperature.

2) What is the reason of early dissipation of fog in the model simulations?

3) Which fields are nudged by using FDDA? Temperature and water vapor mixing ratio?

4) Did you see the same simulation results without KF cumulus scheme in a 4-km inner domain?

5) Please check the following sentence. "aerosol radiative forcing the shortwave energy flux reaching the ground reduces by âĹij 3.7 W m−2 in this case study."

6) "S_ARon_CRmod also captured the diurnal pattern of T2 and Q2 during the fog event, but under-predicted the absolute magnitude of T2 and Q2 by 1.76 (2.22)âŮęC and 0.56 (0.88)gkg−1 in the daytime (nighttime),.." → Even though the authors showed the bias variation (difference) in Figure 9, it would be better to show the diurnal variation of observation and simulation, respectively.

7) Please check the following sentences. ", but S_ARon_CRorig had slightly cloud droplet number concentrations (Table 5)."

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