

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2020-441

Anonymous Referee #1

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Referee comment on "WRF-GC (v2.0): online two-way coupling of WRF (v3.9.1.1) and GEOS-Chem (v12.7.2) for modeling regional atmospheric chemistry–meteorology interactions" by Xu Feng et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-441-RC1>, 2021

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Review of GMD-2020-441

"WRF-GC (v2.0): online two-way coupling of WRF (v3.9.1.1) and GEOS-Chem (v12.7.2) for modeling regional atmospheric chemistry-meteorology interactions" By Feng et al. (2021)

General Comments:

The authors developed and presented the WRF-GC model v2.0, an online two-way coupling of the Weather Research and Forecasting (WRF) meteorological model (v3.9.1.1) and the GEOS-Chem chemical model (v12.7.2). The main feature of the WRF-GC v2.0 includes aerosol-radiation Interactions (ARI) and aerosol-cloud interactions (ACI). The authors evaluated the sensitivity simulations with different combinations of ARI and ACI over East Asia during January 2015 and July 2016 using the WRF-GC v2.0. The manuscript is well structured. The objective and methodology described in the manuscript are clear. However, some revisions on the results (chapter 4 and 5) are required prior to the recommendation. Please refer to the major comments below.

Major comments:

- Table 1. Why did the authors conduct the sensitivity experiments with ARI and ACI only on Case Summer? If possible, please add the additional sensitivity experiments on Case Winter or one-year test.

- Chapter 4.3, 4.4, 4.5, 4.6 (Validation of the simulated AOD, LCO<sub>D</sub>, surface downward shortwave radiation, and air temperature). Among the sensitivity simulations with different combinations of ARI and ACI, the Case ACR (ARI and ACI are both turned on) had the best consistency with the observed values? Author should show the model performance evaluation (MPE) in depth prior to the sensitivity experiments. I believe model sensitivity itself does not tell many things.
  
- Overall, this manuscript is missing interpretations of key physical/chemical processes related to ARI and ACI in the WRF-GC model v2.0. In chapter 5, there is no explanation on the impacts of ARI and ACI on the meteorological factors and air pollutants.
  
- Considerations of ARI and ACI in the WRF-GC v2.0 can alter a variety of meteorological factors in addition to the surface temperature and shortwave radiation as mentioned in the manuscript. Authors should add the analysis for the impacts of ARI and ACI on other meteorological factors, such as planetary boundary layer, relative humidity, and so on.
  
- The results and discussion are too general. What would be benefits of the on-line model applications? If the purpose of the model update or development is to simulate the regional-scale interaction between meteorology and air pollutants, the modeling capability should be thoroughly validated as if other regional photochemical models conventionally do. Model performance evaluations against the surface measurements of the criteria air pollutants including PM<sub>2.5</sub> and O<sub>3</sub> are recommended. After that, model sensitivities with or without the ARI and ACI can show the results of the interactions.

Specific comments and typos:

Line 407 : Add a comma before the "2015" à during January 8 to 28, 2015.

Line 414 : at 550 nm in July

Line 474 : Please revise the subscripts. (for example,  $PM^{2.5}$  à  $PM_{2.5}$ )