Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC3
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Comment on gmd-2021-429

Anonymous Referee #3

Referee comment on "Evaluation of WRF-Chem model (v3.9.1.1) real-time air quality forecasts over the Eastern Mediterranean" by George K. Georgiou et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-429-RC3, 2022

General remarks:

The paper evaluated a high-resolution real-time air quality forecast system over the Eastern Mediterranean using WRF-Chem. The predicted atmospheric pollutants are evaluated using measurements from a network of nine ground stations in Cyprus and compared with the forecast skill of the EU Copernicus Atmosphere Monitoring Service. It used 3 nested domains and the third domain is 2 km focused over the inland of Cyprus.

The manuscript is not organized well for the model evaluation. The authors only chose NO2, O3 and PM2.5 for evaluation, there is not motivation to explain it. Also, the analysis is jumping here to there without connections. The relationships between NO2 and O3 in the chemical mechanism are not investigated to explain the biases. The PM2.5 evaluation is too simply and need further analysis. What are the major aerosols contributing the PM2.5 consternations? This has not been described. In a lot of places, the conclusions do not have solid evidence without showing the Meteorological Fields analysis, somehow like guess or assumption.

The paper compared the model results with ground-based measurements and the CAMS, but most of these comparisons are only described the biases or differences, there is no solid analysis or investigation to explain what factors attributing to these biases or differences. However, these factors are important to improve the model performance. If the authors would like include other forecast or model data sets (CAMS), more details about the CAMS need to be described, in such a way that the identified differences in the evaluation against observations can be explained.

Specific comments:

- P2, L20: What is the motivation to mentioned other RT-AQF models? Other than these RT-AQF models, why do you need to use WRF-Chem for reginal forecast? Any benefits or priorities to use WRF-Chem compared to these existing RT-AQF models. Better to reorganize the introduction to highlight the motivation of this study
- P4, L1: Please describe the details about how did you run the model for prediction? What is the forecast length, what is the temporal interval to cycle the chemical Fields, every 6 hours? Is there any chemical initial condition from other model has been included, if not, what it the spin-up time?
- P4, L19: Please cite the correct reference of HTAP v2.
- Table 3: please add the significance level for the correlation coefficient.
- P7 L5: Why the model can not predict the high NO2 concentration at the site of LIMTRA in both winter and summer? Any emission sources are missing? At the site of LARTRA, the modeled NO2 concentration is underpredicted, any factors would help to improve it?
- P5 L15 and Table 4: better to explain why the CAMS model results are quite different to the WRF-Chem, what factors may contribute to that, resolution, chemical scheme, or emission?
- P7, L4-25: There shows significant differences in Figure 4 for NO2 forecast between the WRF-Chem and CAMS model for both summer and winter over these sites except Background. Though you have described these differences from the statistic way, but did not explain the reasons. What are the major factors contributing to the differences? Are these using the same emission? Or the resolution differences? These need to be investigated.
- P8, L2: why CAMS can not capture the diurnal profile of the wintertime NO2 mixing ratios at the locations with intense anthropogenic activity?
- Figure 6: How to explain the big underprediction of CAMS results?
- P8, L11, any evidence to the PBL may be related to this issue in WRF-Chem?
- P13, again, the differences for O3 between WRF-Chem and CAMS need to be explained in Fig. 6, especially, the NO2 in CAMS is not good, but the O3 is not too bad, why?
- Figure 3: why the O3 is overpredicted in winter, but underpredicted in summer? Just the emission issue? Did you investigate the model performance of Meteorological Fields, which may be related to the O3 production, such as the OH, PBL, etc.
- P13, L29: why you said that the O3 background concentrations is underestimated? But in Figure 3, the O3 concentration is obviously overestimated over the whole domain.
- Figure 7: any reasons that may cause the differences between WRF-Chem and CAMS results in the AYMBGR? Which factor cause the overprediction in PARTRA?
- P16, L2-L4: please show the precipitation from the model in summer and winter.
- Figure 3: why the PM2.5 is overpredicted in winter, while underpredicted in summer? Why there is increasing PM2.5 concentration during the 3-day period in December 12-14? Is model issue or emission issue?
- Figure 6: Both two models can not capture the PM2.5 diurnal cycle, can you explain the reason?
- Figure 8: the model results can not capture most of the peaks at the sites of LARTRA, NICTRA, PARTRA, can you explain why?