Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
https://doi.org/10.5194/gmd-2021-429-RC1, 2022

Comment on gmd-2021-429

Anonymous Referee #1

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-RC1, 2022

This manuscript describes the use of an air quality model (WRF-CHEM) with nested domain configuration and a high spatial resolution emission data set for the predictions of air quality on the island of Cyprus. The use of the high spatial resolution emission data set, compared to a global emission data set, improves the forecasting for primary emitted pollutants (e.g. NOx) in urban areas on Cyprus. This is not a particularly novel result in that other studies have shown that a high resolution emission data set combined with a high resolution model will yield better results than a global scale model for an urban area.

The use of the high spatial emissions data set is the most significant aspect of this work and I would encourage the authors to supplement the manuscript with any novel aspects of how the emissions were prepared (e.g. development of spatial surrogate fields from GIS data, population maps, road network maps). The adaptive time stepping is also highlighted as a improvement significantly speeding up the model. Can the authors provide details of the tests performed to optimize the model accuracy with minimal computational cost? This would be of direct interest to readers of GMD.

It appears the goal of the work is to develop an operational forecast model for Cyprus. It is possible that a hybrid model approach could yield with best results with the CAMS model output providing the chemical lateral boundary conditions for the highest resolution WRF-CHEM domain. There may be differences in chemical speciation between models but it is possible to map lumped species from one mechanism to another. This would by valuable, at least for the longer lived species, as you might get the best of both methods in the CAMS system capturing global emissions and transport and WRF-CHEM capturing the more local emissions and chemistry. For example, ozone correlation is quite poor within the WRF-CHEM domain compared to the CAMS system (summer R=0.62 vs R=0.26 for background site).

The evaluation considers temperature and wind but does not consider precipitation. Precipitation is an important removal method for soluble gases and particulate matter.

Insights can be gained from assessing precipitation and also wet deposition fluxes for pollutants, such as sulfate wet deposition, if observations are available. The wind speed over-prediction seems like a large error in the transport term for local pollutants. A sensitivity test with increased roughness length for mountainous and urban building areas could be performed to assess impact on wind and pollutant concentrations.

In comparing CAMS with WRF-CHEM, it might also be informative to compare the WRF-CHEM 10km domain results with the CAMS results as the spatial resolution would be quite similar and the authors could isolate differences from long range transport without the effect of grid spacing. I am not suggesting using the 10-km WRF-CHEM results for the operational forecasting but rather as a way to evaluate the outer domain WRF-CHEM model results which are impacted by global emissions and transport.

Specific Comments

Figure 1. Red labels are not clear.

Page 4, Line 20. Duplicate of line 19.

Page 4. Did the authors consider a spin-up time from the met analysis to develop more higher resolution met fields ?

Page 5, Line 5. Remove extra period.

Figure 5. Please label sites as urban, rural, industrial, etc.