

Response to Topical Editor:

Comments to the author:

Dear Dr. Campbell and co-authors,

thank you very much for your revisions and the replies to the referees remarks.
And again my apologies for the delay with the editorial process of your manuscript!

Before final publication, I have one last recommendation: It think the fact that, as you reply, "At this time, the Advanced NAQFC (NACC-CMAQ) does not use dynamic boundary conditions for trace gases, but only has dynmically ingested smoke and ..." is an important information, and I kindly ask you to add this information somewhere to the text where you think it would be appropriate.

Thank you very much for chosing GMD(D)!

Yours,

Patrick Jöckel

Authors Response: Thank you for your comments. Yes, we agree this needs to be added, and we have updated the production files (along with other small editorial changes) to include the following statement in the final paragraph of Section 5 (see Lines 921-926):

"At this time, NACC-CMAQ also does not use dynamic lateral boundary conditions for trace gases, but only has dynamically ingested smoke and dust aerosols at its lateral boundaries dynamically from the NOAA operational GEFS-Aerosols model. Current work is underway to use next-generation UFS-based global model systems as updated lateral boundary conditions for trace gases in the future of the NAQFC."

Author's Response to Reviewers:

We thank both anonymous reviewers for their insightful comments to improve our manuscript. Please find our detailed responses to each comment below (in **bold**).

Authors response to RC1:

This paper presents a newly developed GFS-CMAQ model that is being used for operational air quality forecasts over the United States. The new developments and the statistical performance of the system are described in detail. Current deficiencies and plans to address those deficiencies are also discussed. The paper is well written and easy to follow. I just have a few minor concerns listed below. After these concerns are addressed, I recommend the paper for publication in GMD.

Figure 2: It will be helpful to show a box for chemical initial conditions and the source of those initial conditions.

Response: Thank you for this comment. We will work to improve this figure's understand; however, please note that the chemical initial conditions in an NRT forecast system simply are taken from the previous day's (CMAQ) forecast output (i.e., the CGRID file), and is not unique to the advanced NAQFC in the paper. With this in mind, we will add this detail on chemical initial conditions in the revised text in Section 2.1.2.

Line 528: I think NAQFC should be replaced with NMMB or prior NAQFC here.

Response: Thank you for this correction. We have revised the manuscript.

Lines 722-723: can you summarize the findings of Tang et al. (2021b) on the wildfire impacts in a couple of sentences here?

Response: First we note that Tang et al. (2021b) has now become Tang et al. (2022), and has changed in scope slightly. However, it does provide an in-depth comparison of this Advanced NAQFC (NACC/GFSv16-CMAQ) system against a downscaled WRF-CMAQ system for wildfire events. Thus, we add a few sentences summarizing their results, as requested by the referee.

Conclusions and path forward: I did not find a discussion on the dynamic lateral boundary conditions for trace gases in the path forward section. Could you please add that in the paper?

Response: At this time, the Advanced NAQFC (NACC-CMAQ) does not use dynamic boundary conditions for *trace gases*, but only has dynamically ingested smoke and dust *aerosols* at its lateral boundaries dynamically from the NOAA operational GEFS-Aerosols model. We also do not mention this in the conclusions and path forward, as there is not currently a direct plan to implement dynamic boundary conditions for *trace gases*.

Authors Response to RC2:

The paper describes the development and evaluation of a forecasting system, describing in details how this is implemented to cover meteorology, emissions and air quality.

The paper is really interesting, comprehensive, and well written.

I only have a suggestion for improvement. For me it was not easy in the beginning to find 'validation metrics' for the system, even if validation is performed and properly presented. I would suggest the authors to put the validations part in separated sections, so that is more visible to the reader.

Authors Response: Thank you for this comment. We have now added two additional sections with new headers: "Section 4.2 Meteorological Evaluation and Metrics" and

"Section 4.5 Air Quality Evaluations and Metrics". We hope this elucidates these sections for the reader.