

## ***Interactive comment on “The CAMS reanalysis of atmospheric composition” by Antje Inness et al.***

### **Anonymous Referee #2**

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The manuscript presents the results from the CAMS reanalysis of atmospheric composition for 2003–2016. The improvements in the reanalysis are evaluated by comparing with the previous reanalysis (MACCRA and CIRA). The CAMS reanalysis provides important information on long-term variations in atmospheric composition. Nevertheless, the evaluation of the reanalysis performance is incomplete and should be improved. More quantitative descriptions are required to summarize the relative performance of the three reanalyses. I would advise the authors to revise the manuscript substantially before considering its publication. My general remarks and specific points are presented below.

1. The descriptions in the text are primarily qualitative. More careful descriptions with summary statistics (e.g., by showing mean bias, RMSE, and temporal correlations for the three reanalyses in tables) are required to make robust conclusions for O<sub>3</sub>, CO, and NO<sub>2</sub>, respectively, throughout the manuscript. I would advise the authors to revise

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the manuscript substantially by adding more quantitative descriptions and conclusions.

2. It is often summarized that CAMS is better than the two older reanalyses. However, many exceptions exist (e.g., CIRA is better, or CAMS and CIRA are similar), and it is unclear if this can be the general conclusions of this study. The conclusions must be supported by summary statistics for each component of the reanalyses, while more careful discussions and conclusions are required to state how much the reanalysis performance has been improved.

3. A bias correction was applied to the OMI NO<sub>2</sub> data using the SCIAMACHY and GOME-2 NO<sub>2</sub> data as anchors. Because we expect similar biases between the three NO<sub>2</sub> data produced using the same retrieval algorithms, the bias correction could introduce spurious biases into the OMI NO<sub>2</sub> data, corresponding to inaccurate diurnal NO<sub>2</sub> variations in the model. This could suppress improvements in the afternoon NO<sub>2</sub> and photochemical productions of ozone. More careful discussions are required.

Specific comments:

- The discontinuity in the assimilated NO<sub>2</sub> products could influence the long-term ozone analysis. This needs to be discussed carefully.
- Section 2.2: It would be useful to show NO<sub>x</sub> emissions in addition to CO emissions
- Section 2.3: How was the background error covariance (inter-species correlations) constructed? How did the observation information propagate among the species?
- In Fig. 16, it is odd that MACCRA is not shown.

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