Atmos. Chem. Phys. Discuss., 15, C844–C847, 2015
www.atmos-chem-phys-discuss.net/15/C844/2015/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Data assimilation of satellite retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS" *by* A. Inness et al.

Anonymous Referee #1

Received and published: 16 March 2015

The paper presents an evaluation of the updated ECMWF's chemical composition data assimilation system C-IFS. Multiple chemical species are assimilated (O3, CO and NO2) and results are systematically evaluated in the observation space and in the model space against independents measurements. I think the study is sound and suitable for publication in the Atmospheric Chemistry and Physics journal. However there is a substantial lack of methodological and scientific explanations in some places in the article. Please see below for detailed comments about this point.

Also, it is unfortunate that the authors do not emphasize the model response of one assimilated component to another. For example what would be the model response on

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model O3 of assimilated NO2 and/or CO. I think this might be off topic in the present paper but certainly is a point to discuss in the conclusions and discussions. That would be a first step before assessing the impact of cross correlation in the assimilation of multiple chemical species in your future work.

Comments and suggestions:

P4268, L12-15: All those species are forecasted but not all are assimilated. Please be more specific.

P4270, L10-12: Please provide a reference here.

P4271, L4: Rephrase, please. It sounds like you improve the model by using assimilation. The model analyzed fields show an improved representation of atmospheric composition.

P4272, L24: Suggestion: Please say that the error covariance matrix between chemical species is diagonal

P4272, L25: What about the feedback of meteorological variables on chemistry?

P4273, L4-9: Please explain why CO background error is estimated using and ensemble and but not for O3 and NO2?

P4273, L10-12: Please be more specific here. A correlation length of 5 levels corresponds to what physically (km, hPa)? I guess, the correlation length would be larger over UTLS than toward the surface, where vertical model resolution increases. Please provide physical estimates for LT, MT and UT. What about NO2 vertical correlation length though?

P4273, L19: Typo: Profiles of profiles of . . .

P4273, L20: Is it possible to add errors in relative values in the plot?

P4273, L25-26: Please clarify and explain why 5%.

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P4274, L18: Please discuss why you use a 12h assimilation window. Is it short enough in time? Provide references.

P4274, L19: Explain why you use two minimizations at different resolution. At least provide a reference.

P4275, L1-3: Provide the retrieval equation or a reference

P4275, L3-6: I understand you want to avoid averaging the observation within a grid box in order to avoid estimating the correlation of observational errors. However by randomly selecting an observation this might lead to assimilate noisy or unrepresentative observations. Over low polluted areas the random error or retrieval noise could be higher than the signal itself for certain instruments. Over polluted areas, because of the very heterogeneous nature of the true state and hence of the observations, assimilating randomly selected observation might cause representativeness issues. For those two reasons this method could significantly degrade the analysis compared to averaged assimilated data even with a poor estimation of the error correlation. Could the author discuss on this? Justify why they use this method over the super-observation approach? And add sentence about possible limitations?

P4275, L15-16: Why did you choose those instruments as anchors?

P4275, L22: The authors should use the word evaluation instead validation in some places. You validate a method and you evaluate results, this is not exactly the same.

P4277, L16 – P4278, L2: Could you scientifically explain why increase and decrease of CO occur? Why the UTLS CO mostly decreases while the extra tropical CO in the free troposphere increases?

P4278, L14-16: How CO column data assimilation can change the CO profile. The authors need to provide explanation about transport processes here.

P4284, L8-10: Please provide a reference for this statement.

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P4284, L19-20: Do you have an explanation of why this is happening. Is this due to long-range transport, stratosphere-troposphere exchanges or bias in the assimilated data? The authors should add a couple sentences about this or refer to the latter explanation about NO2 in the text.

P4284, L28: are

P4285, L3: What is MRT? I guess this is a typo and it should be MT.

P4285, L15: "so badly" . . . use more formal English please.

P4286, L3: Give the definition of MNMB or a reference.

P4288, L27-28: Please rephrase. The experiments do not give estimates of satellite values.

P4289, L8: Be more specific about "uncertainties in the chemistry".

Figures:

Please add a title on each subplot of each figure.

Figure 1: What is the altitude range of TRC and PC calculations.

Figure 3: Please provide the unit next to the colorbar.

Figure 6: Provide latitude and longitude of each location

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 4265, 2015.