Response to Topical Editor Initial Decision

Dear Fiona,

many thanks for your Topical Editor Initial Decision. Please find below our response to the points you raise.

1. Reviewer #1 (Nicholas H. Savage) asked the following question about Section 2.2: How large an impact does the correction of negative MMRs have on the budget of transported species? Although this was adequately addressed in your response, a corresponding change to your manuscript was not carried out. I suggest that you address this question within the manuscript itself because other readers may have a similar question and may not necessarily read the details in your online response.

We will add to the manuscript the following (l 196):

"For the majority of the species the contribution of the negative fixer was below 0.1% of the dominating source or sink term. The contribution was of the order of 1% for nitrogen species such as NO, N_2O_5 as well as up to 3% for highly soluble species such HNO_3, HO_2, NO_3_A. Large gradients of NO_x at the terminator in the stratosphere as well as intensive wet deposition were the reasons for the increased occurrence of projected negative concentrations.

2. In Section 2.3 you clarify that MEGAN emissions calculated offline are used. Can you confirm in the manuscript whether these are added to the model with a diurnal cycle or not?

We will add at l 209:

"… without accounting for the diurnal cycle"

3. In Section 2.4.3, lines 362-363, I suggest that you replace "The C-IFS lightning emissions were 4.9 TgN/yr at T159 resolution and 5.7 Tg N/yr at T255 resolution" is replaced with "The C-IFS lightning emissions, using the parameterisation of Meijer et al. 2001 based on convective precipitation, were 363 4.9 TgN/yr at T159 resolution and 5.7 Tg N/yr at T255 resolution. " Although it is mentioned earlier, given your discussion of both possible parameterisations, this addition will help emphasise to the reader which parameterisation is being used in the evaluation runs.

We changed the text accordingly.

4. In section 2.5.1, line 494: I suggest that you replace "factor" with either "ratio" or "fraction"
5. In section 2.6, line 483: Make "inter-comparison" plural
6. In section 2.6, line 486: Replace "multi model ensemble" with "two multi model ensembles"
7. In section 2.6, line 510: Replace "modeling" with "modelling"

All corrected

8. In section 2.6, add Banda et al. (2014) as mentioned in your response to the query regarding prescribed surface ch4 concentrations

reference included at l 518

9. In section 3.2.1, line 613, please add that no consideration is given to the horizontal movement of the aircraft when sampling the model.

We add the following (l 619):

" … and no consideration was given to the horizontal movement of the aircraft."

10. I refer to Reviewer #1's query on Section 3.3: Does the lower bias in C-IFS imply that the Cariolle scheme is performing better in the lower stratosphere than the MOZAIC chemistry? If so, please comment on this and implications for future choices of upper boundary conditions for ozone - if the Cariolle scheme is cheaper and better, why are you planning to add a detailed stratospheric chemistry scheme to CB05? In response, you mention that "Please note that the stratospheric ozone was nudged to the MACC re-analysis above the tropopause". However, this isn't entirely clear from the revised manuscript. In particular, in Section 2.5.4, it says "Additionally, stratospheric O3 in C-IFS can be nudged to O3 analyses of either the MACC re-analysis (Inness et al., 2013) or ERA interim (Dee et al., 2011)." I suggest that you make it more explicit that stratospheric ozone is nudged towards MACC reanalysis.

As we don't investigate stratospheric ozone in the paper we don't want to include a statement comparing the Cariolle scheme with the MOZART chemistry. Flemming et al. 2011a cover the subject for the ozone hole 2008. That stratospheric ozone of the C-IFS runs was nudged to the MACC re-analysis is mentioned in section 3.1. (Summary of model runs setup). We will repeat this information in the discussion of the tropospheric biases as follows (l 711):

"Note that stratospheric ozone in C-IFS was nudged to the MACC re-analysis (see 3.1) but good agreement of C-IFS with observation in UT in all three regions is also present in a run without nudging to stratospheric O_3."

11. I refer to Reviewer #2's comment "p. 7761: It would be much easier to follow the arguments about the size of biases if the actual bias were plotted for each model. For example, the argument that "the bias of MOZ seems stronger over land" is hard to verify from these plots." May I suggest that you include both absolute columns as well as biases in Figures 6 and 7?

We believe that having both the absolute fields and the biases in the paper is a bit redundant. For this reason we would like to include the bias plots only in the supplement. We will however include the following reference (l 770):

"Figures showing the corresponding biases can be found in the supplement."

12. Finally, the Executive Editors request that model description and evaluation papers such as yours should include a section on "Code availability". See http://www.geosci-model-dev.net/6/1233/2013/gmd-6-1233-2013.html for further details. Could I please ask that you include such a section in your revised manuscript?

We add the following section (l 987):

Code availability

The C-IFS source code is integrated in ECWMF's IFS code, which is only available subject to a licence agreement with ECMWF. ECMWF member-state weather services and their approved partners will get access granted. The IFS code without modules for assimilation and chemistry can be obtained for educational and academic purposes as part of the openIFS release (https://software.ecmwf.int/wiki/display/OIFS/OpenIFS+Home). A detailed documentation of the IFS code is available from https://software.ecmwf.int/wiki/display/IFS/CY40R1+Official+IFS+Documentation. The CB05 chemistry module of C-IFS was originally developed in the TM5 chemistry-transport model. Readers

interested in the TM5 code can contact the TM5 developers (http://tm5.sourceforge.net) or can go directly to the TM5 wiki page, http://tm.knmi.nl/index.php/Main_Page.