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Atmospheric Measurement Techniques Discussions

Interactive comment on "Comparison between the assimilation of IASI Level 2 retrievals and Level 1 radiances for ozone reanalyses" *by* E. Emili et al.

Anonymous Referee #1

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This article aims at comparing the assimilation of IASI ozone radiances and IASI ozone retrievals in the CTM MOCAGE. I appreciate the authors want to have as few differences between the two settings as possible, as details matter. The subject of the article is interesting and useful for the community. I recommend this paper is published after some (possibly major) modifications. Hereafter are my detailed comment.

General comments: - although both SOFRID retrievals and assimilation of L1 use the RTTOV model, differences may be significant. Indeed the version of the RTTOV coefficients used in both cases is not given. I suspect that SOFRID uses coefficients on 43 levels which are the levels of the retrieval and that the L1 assimilation uses newer coefficients, on 54 or 101 levels (the authors state 104 vertical levels on P7 L20 which does not exist), which may have been build from a different line-by-line model (or dif-

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ferent version of that model; or even from a different spectroscopic database). Such differences can have visible impacts on the radiance simulation by RTTOV. Could the authors give mode details about the coefficients? Is it possible to produce SOFRID L2 retrievals using the same version of RTTOV model and RTTOV coefficients as those used in CTM assimilation? And then run the L2 assimilation trials in CTM? That would be a significant improvement to the comparison proposed in this paper!

- ECMWF NWP forecasts are used in both SOFRID and CTM assimilation. In the CTM runs, forecasts are taken from the latest available analysis (00 or 12 UTC) as said in sec. 3.1, supposedly every hour, and scaled on the CTM grid. In the SOFRID retrieval process, are the forecasts from IFS used the same way? Before being fed to RTTOV, the meteorological forecasts have to be interpolated to the location of IASI pixels. I would appreciate that the authors describe how this interpolation is done in SOFRID and in the CTM. ECMWF 4DVAR analyses have ozone in the control variable and assimilate ozone-sensitive information (such as some IASI channels). I would not be surprised that the subsequent ECMWF forecasts are more consistent with the L1 assimilation than with the L2 products. Can the authors elaborate on that point?

- No description of the L1 and L2 innovation statistics is given. Figures on biases and standard deviations of L1 and L2 innovations would be of interest in this paper. How the value chosen for the observation error standard deviation (0.7 mWm-2sr-1) compare to those statistics? Cloud masks are not really described. Cloud fraction from AVHRR is mentioned but no threshold value is given. How clear cases are selected? A data thinning is applied. Which is the minimum distance between two pixels? No description of the spatial coverage of L1 and L2 is given. Would it be possible to have a typical daily coverage or an average density over the month?

- Background covariance error matrix: the values used in this study (2% / 10%) are barely supported by Figure 1. The authors state that the bias may be an important component of the RMSE in Figure 1, is it possible to provide profiles of bias and standard deviation in addition to RMSE? P10 L5, the vertical structure of the B matrix is

described as "correlation length of 1 model grid point". Do you mean 1 model level? Please clarify.

- Results L1 vs L2 Figure 2 shows the relative differences between L1 analyses and L2 analyses. As the values of background error variances are rather small, I would find interesting to show analysis increments difference statistics (average and/or standard deviation). All figures are given in relative difference and no ozone fields are plotted. Except from the value given P11 L6, the reader have no idea how these relative differences compare to the actual ozone concentration. I would appreciate the authors find a way to illustrate the 3D field they want to analyse in their study. Figure 3 (and similar figures) would be more useful if error bars were added. They would help understand whether the differences are statistically significant or not. The statistics are given over the whole month. How stable are they on a day to day basis? Would it be interesting to split the statistics between day and night? The paragraph about the computational cost and convergence issues is interesting but may be placed separately from the scientific results.

- Results when MLS is assimilated As in a real system, several sources of observation may be assimilated simultaneously, this section has a real added value. I regret that the results are not shown in a consistent way with the previous section. Figure 2 shows L1a - L2a; Figure 5 should show MLS+L1a - MLS+L2a because we want to compare these two settings.

Minor: - P2 L26: please detail what Averaging Kernels are for non-expert readers. - P2 L27: the innovation has not been described so far, please define innovation. - P4 L8: the IASI acronym is already detailed P3 L18 - P4 L11: please add Hilton et al (BAMS 2012) reference to Clerbaux et al (2009) - P4 L13: the authors state "A total of 3 IASI ... providing nearly global coverage 3 times per day". Each IASI has a nearly global coverage twice a day (morning and evening overpasses) thus the global coverage will be achieved 6 times a day. - P4 L16: IASI exactly has 8461 channels per spectrum - throughout the paper: MetOP should be written Metop according to Eumetsat

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