Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2018-456-AC2, 2019

Atmospheric Measurement Techniques Discussions

Interactive comment on "Benefit of ozone observations from Sentinel-5P and future Sentinel-4 missions on tropospheric composition" *by* Samuel Quesada-Ruiz et al.

Samuel Quesada-Ruiz et al.

samuel.quesada@umr-cnrm.fr

Received and published: 10 July 2019

Interactive comment on

"Benefit of ozone observations from Sentinel-5P and future Sentinel-4 missions on tropospheric composition" by Samuel Quesada-Ruiz et al.

Anonymous Referee #2 Received and published: 28 May 2019

In this study, Quesada-Ruiz et al. conducted an Observing Simulated System Experiment (OSSE) in order to assess the benefit of future ozone data from individual or combined use of GEO (Sentinel-4) and LEO (Sentinel-5P) satellite observations on

tropospheric ozone composition. This OSSE, which focused over Europe during the summer 2003 period, consisted in the following two main steps: (1) assimilating S4 and S5P synthetic ozone profile data simulated by the DISAMAR inversion package using LOTOS-EUROS and TM5 3D-CTM fields as input, and (2) comparing the assimilation results to a reference run based on the assimilation of simulated ozone data at a selection of 1132 AirBase stations. Results showed that S4 and S5P satellite data in the UV range clearly bring direct added value to the tropospheric ozone composition in the middle troposphere (200-500 hPa). This study also confirmed the limited use of satellite observations in the UV for deriving the ozone distribution inside the boundary layer. The manuscript is well written and clearly structured and the presented results are scientifically relevant. I recommend the paper for publication in AMT after addressing the following specific comments:

1/Page 4, lines 16-24: one important parameter which has a large impact on the analysis is the background error covariance matrix. The authors should further justify how they built this matrix and why it does not evolve with time. For instance, it would be also interesting to know whether the chosen variance and correlation lengths values come from prior sensitivity tests.

We agree on the importance of the B matrix in the assimilation system. Following the OSSE philosophy, we want to be as less overoptimistic as possible and this is why we decided to freeze our B matrix in time, that is, the same matrix is used for the whole assimilation period. The chosen correlation lengths and variance are commonly used in the MOCAGE-PALM assimilation system.

2/Page 5, line 17: It would help the reader to briefly summarize what were the evaluation results of TM5 ozone data against MOZAIC aircraft measurements in August 2003.

As recommended by the reviewer, a brief paragraph is added to summarize the comparison between TM5 and MOZAIC aircraft measurements.

3/Page 5, lines 27-28: The bias between LOTOS-EUROS and the surface ozone measurements is about 10-20μg.m-3. Does this bias can be considered as a bad, fair or good agreement ? Given the fact that the selection of the nature run component is of great importance for the OSSE, what is the impact of this bias on the results of the study ?

In the OSSE process we cannot use independent real data to evaluate the impact of the assimilation of the retrievals. We use a nature run, which is in fact just one possibility of the actual state of the atmosphere. The validation of the nature run against independent data is done to guarantee that this representation of the actual state of the atmosphere can be considered realistic.

Figure 2 shows that LOTOS-EUROS surface ozone is consistent with the Airbase database ground-based stations measurements, both in the diurnal cycle and in the temporal evolution of the min/max pics. Regarding the bias, and to stay objective as we can, we prefer to avoid to say bad, fair or good but we can say the bias represents about 10 to 18%. This is an information that could be extrapolated in the assimilated results, i.e., the assimilated results could have this bias compared to the reality and explain the low (or high) values from the assimilation.

4/Page 6, lines 26-29: Could you justify the choice of the SNR values for the solar irradiance and Earth radiance measurements ?

The signal-to-noise ratio is very strongly dependent on the wavelength in the region 300 to 320 nm. This dependence is mainly related to the signal, which very rapidly decreases towards the UV. The choice for the SNRs (50, 300, 1000) at 300, 310 and 320 nm is based on experience with existing sensors such as the ozone monitoring instrument (OMI), and on estimates and requirements for TROPOMI before launch (e.g. Veefkind et al., 2012). This is very close to actual post-launch estimates for TROPOMI, which are about (40, 316, 1000) for these wavelengths (N. Rozemeijer, KNMI, private communications). In between these values the SNR is interpolated.

Veefkind, J. P.; Aben, I.; McMullan, K.; Förster, H.; de Vries, J.; Otter, G.; Claas, J.; Eskes, H. J.; de Haan, J. F.; Kleipool, Q.; van Weele, M.; Hasekamp, O.; Hoogeveen, R.; Landgraf, J.; Snel, R.; Tol, P.; Ingmann, P.; Voors, R.; Kruizinga, B.; Vink, R.; Visser, H.; and Levelt, P. F. TROPOMI on the ESA Sentinel-5 Precursor: A GMES mission for global observations of the atmospheric composition for climate, air quality and ozone layer applications. rse, 120: 70–83. 2012.

5/Page 12, lines 18-20: Pixels with cloud fraction greater than 0.05 have been discarded from the analysis. Does it mean that the methodology presented in the manuscript is only valid in clear-sky conditions ? Is a cloud treatment included in the DISAMAR package ? It would be useful to further comment on this cloud issue.

Yes this study is only valid for clear sky conditions. We added this comment in the paper.

Clouds in DISAMAR are treated in an effective way in this study. The cloud is modelled as a Lambertian reflecting surface, specified by the cloud albedo (set to a fixed value of 0.8) and cloud pressure. Mixed scenes are modelled using the independent pixel approach, as weighted mean of a cloudy and cloud free part.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-456, 2019.