

## ***Interactive comment on “Impact of Spaceborne Carbon Monoxide Observations from the S-5P platform on Tropospheric Composition Analyses and Forecasts” by R. Abida et al.***

**Anonymous Referee #1**

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This manuscript describes an Observing System Simulation Experiment that quantifies the impact of the TROPOMI CO total column from a future Sentinel-5 Precursor platform on tropospheric analyses and forecast of the MOCAGE model. The authors use a set of different models (the LOTOS-EUROS and the TM5) to develop their Nature Run to avoid over-optimization in the OSSE system. They also carried out a specific study on the assimilation of fires using MOCAGE by modifying the model regular setup. This is a very good study from a team of experts in the field of data assimilation and OSSE, so I recommend publishing after addressing the minor issues below. The writing for sessions “2.4 The Control Run” and “2.5 The Assimilation Run” need care, more than what I suggest below. Also, make sure all acronyms are properly defined.

C1

L30: “. . .with the largest benefit occurring over land in remote regions”, explain remote from what? Sources?

L60-68: several sensors are listed but all references are from the MOPITT team. Please add references for the relevant sensors.

L81-103 paragraph: In the discussion of S-5, S-4, and S-5P, etc, please list the time frame of these missions. Since OMI and SCIAMACHY are discussed, as well as S-5P, this should be a good place to introduce TROPOMI. Among the sensors/missions discussed in this paragraph, which ones have CO, since it's the topic of study here?

L99-101: “The S-5P LEO platform will address the challenge of limited revisit time from LEOs by providing unprecedented high spatial resolution of 7x7 km, and improved sensitivity in the Planetary Boundary Layer (PBL), allowing resolution of, e.g., derived CO emission sources at finer scales than hitherto.” How?

L223: “. . .the NR has a realistic representation of the CO diurnal cycle.” Does CO have diurnal cycle? Also, describe the ground measurement methods. Is it in situ or radiometric?

L232-233: “. . .the behaviour of the CO time-series from the CR compared to the NR, is similar to the behaviour of the NR CO time-series compared to the Airbase data.” Not clear, are the differences similar? You might want to add the difference  $100 \times (\text{NR} - \text{CR}) / \text{NR}$ .

L237-242: TROPOMI should have been introduced in the Introduction.

L308: “Over sea, . . .” should probably be “Over the ocean, . . .”

L387: “. . .different to . . .” to “. . .different from . . .”

L391: “. . . the OSSE will more realistically simulate. . .” to “. . . the OSSE will simulate more realistically . . .”

L392: “This follows our guiding principle to . . .” to “This allows us to . . .”

C2

L394-395: “As mentioned in Sect. 2.3, we use the MOCAGE model to generate the CR. In this OSSE study, the CR is a 395 free model run.” to “In this OSSE study, the CR is a free model run using MOCAGE.”

L409: “... and about 800 m in the neighbourhood of the tropopause ...” to “... and approximately 800 m near the tropopause ...”

L417: ... as they are a priori not known.” To “... as their a priori is not known.”

L420: “..., helping to differentiate the CR from the NR.” To “..., which helps to differentiate the CR from the NR.”

L420: “As for the NR, ...” to “Similar to the NR, ...”

L435-436: add “the”

L453-454: “... for the B-matrix: Lx and Ly are ...; Lz is constant and ...” to “...for the B-matrix, where Lx and Ly are ...; and Lz is constant and ...”

L459: “... (see Fig. 3 in Sect. 3.1).” should be Fig. 5

L504: Should be Figure 5, not Figure 3

L564-570: The reasons the AR are not performing well over fire emissions are not explained correctly in this paragraph, as suggested by L670-676. Should move part of L670-676 to this part of the paper to properly explain why AR did not work well over fires.

L642: “Figure 11 shows that the AR ...” would be better to “The AR ...”

L651: “... (iii) an area in the Easter part of the study domain, ...” should name the location/country/regions.

L662-665: same issue explaining MOCAGE assimilation over fires.

Fig. 5. Legends and labels are not legible when overlap with dashed lines. Should redo with care and use larger fonts.

C3

Fig. 7 and alike: when use multiple panels, try to arrange them to maximize the space and show larger figures. Please use larger fonts for titles.

Fig. 13, the top right panel title should be S-5P, not S5-P

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C4