

General Comments:

The manuscript by Rusli et al. with the title *“Anthropogenic CO₂ monitoring satellite mission: the need for multi-angle polarimetric observations”* investigates the added value of multi-angle polarimeter (MAP) measurements in the context of the Copernicus candidate mission for anthropogenic CO₂ monitoring (CO₂M).

Scattering by aerosols and cirrus are the main sources of uncertainties in retrieving XCO₂ from solar backscattered radiation. Additional MAP observations are expected to provide information about aerosols that are useful for improving XCO₂ accuracy. Two different MAP instrument concepts are considered in this analysis: MAP-mod and MAP-band. The authors determine the instrument specifications for both concepts that are required to achieve XCO₂ accuracy and precision that align with the requirements of the mission.

Adopting the derived MAP instrument specifications, a retrieval exercise using a spectrometer only and spectrometer + MAP joint retrieval is performed. The study shows that the MAP auxiliary information help to reduce XCO₂ errors below mission requirements.

The manuscript is well written and structured in a clear and sensible fashion. It is suitable for publication in AMT after some minor corrections listed below.

Specific Comments:

P2 L36: *“The CO₂M mission is designed as a constellation of up to 3 satellites with imaging capabilities and a revisit time of 2-3 days for latitudes (poleward of) 40 degrees.”*

- What is the revisit time between 40S and 40N?

P2 L39: *“As opposed to currently operational CO₂ missions that are designed to observe natural CO₂ fluxes, with the exception of OCO-3 (Basilio et al., 2019), the CO₂M mission is intended to measure anthropogenic emissions (Pinty et al., 2017).”*

- Earlier in the manuscript you mention that the primary sounders are nadir-looking, very similar to currently operational CO₂ missions. What makes the CO₂M mission *better* suited to measure anthropogenic emissions compared to other missions?

P5 L142: *“Atmospheric vertical profiles of temperature, H₂O, CO₂, and CH₄ are provided as input.”*

- Please specify the source/origin of the vertical profiles.

P6 L168: *“We take the input vertical profiles of the trace gases as a given and retrieve the total columns via scaling factors.”*

- See above (please specify the source/origin of the vertical profiles).

P14 L357: *“With a PSD above 2 ppm, XCO₂ retrievals based on only spectrometer measurements do not meet the mission requirements by a very wide margin (note that we do not apply post-retrieval filtering here).”*

- How does PSD change after a post-retrieval filtering is applied? Does it help to fulfill mission requirements?

P22 L473: *“We adopt the baseline MAP-mod setup to simulate MAP observations and we consider the ensemble of 500 simulated scenes (as outlined in section 4) for this joint retrieval exercise.”*

- Why only for the MAP-mod setup and not also for the MAP-band setup? It would be interesting to see a similar figure to Fig. 7 showing MAP-band results.

Technical Comments:

P5 L135: *“spetrometer”* -> spectrometer

P5 L138: *“The measured radiances are simulated by convolving...”*

- The word *“measured”* might cause confusion here.

P12 L312: *“simulated measurements”*

- It's either simulated or measured, not both.

P16 L406: “ $\langle \Delta XCO_2 \rangle$ can be as high as ~ 2.4 ppm for the highest $\Delta I/I$ and ΔDLP considered here.”

- Looks more like ~ 2.6 ppm to me.