General comments:

The manuscript entitled, "Anthropogenic CO_2 monitoring satellite mission: the need for multi-angle polarimetric observations" presents an analysis of the value of adding a multi-angle polarimeter (MAP) to the Copernicus anthropogenic CO_2 monitoring (CO2M) mission. Using synthetic observations, they assessed the precision and accuracy of the CO2M XCO2 estimates from a 3-band spectrometer with and without the addition of auxiliary MAP information and found that MAP reduced the errors to below the mission requirements. They also assess the specific technical properties of the desired MAP instrument via linear error analysis. The manuscript is thorough, clear, and very well-written and I recommend publication in AMT after the authors address minor comments below.

Specific comments:

- In Section 5, did you compare ΔXCO2 to the retrieved state vector elements (e.g. retrieved AOD)? This can be informative.

- Regarding the errors of the standard retrieval approach, I think it is worth noting that you could certainly reduce those errors to within the mission requirements, but only by heavily post-filtering (and maybe bias correcting) the data. This new joint retrieval means you can keep significantly more data!

- P2 L36: So the revisit time is daily for 40S to 40N?

- P4 L111 "*in this work we are interested primarily in XCO2 and do not discuss the retrieved aerosol properties.*"

It would be interesting to at least look at how well MAP+CO2M does at retrieving the aerosol properties, compared to either MAP or CO2M alone. Does the aerosol information in the O2 and SCO2 bands add anything useful to the MAP aerosol results?

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

Where do you get the prior profiles from?

- P6 L170 "*there are only 4 aerosol parameters that are not retrieved, i.e. f_{sphere}, z_{aer} of the fine-mode aerosol, and w_{aer} for both modes.*"

I understand that the radiances aren't very sensitive to w_{aer}, but why aren't f_{sphere} and z_{aer} of the fine-mode aerosol solved for? Fixing these parameters to the truth obviously becomes problematic if real measurements end up being sensitive to them.

- P8 L212 "*the error analysis follows a two-step approach*"

Could you briefly explain the reasoning for splitting it into two steps?

- Figure 1 and corresponding text: make it clear when you are talking about the true scene properties vs. the retrieved properties.

- P14 L357 "*With a P_{SD} above 2 ppm, XCO_2 retrievals based on only spectrometer measurements do not meet the mission requirements by a very wide margin (note that we do not apply postretrieval filtering here)*."

Can you comment on how much you might expect P_{SD} to be reduced with post-filtering in these simulations?

- P17 L415 "*Given that the improvement in ΔI=I from 3% to 2% is a major technical challenge*…"

Would reducing ΔDLP to 0.002 be easier?

- Figure 5: why does case 1 benefit so much from the SWIR bands?

- P21 L465 "*The details of our proposed baseline setup for the MAP-band concept is provided in Table 8.*"

Maybe put this line earlier in Section 6.3.

- P25 L537 "*The baseline setups of MAP-mod and MAP-band have generally similar performance.*"

But do the few scenarios where the MAP-band instrument does really poorly mean that MAP-mod is the better choice? Briefly discuss if you recommend one MAP instrument over the other, or if either would be acceptable.

Technical comments:

P2 L50: change to "shorten or lengthen"

P3 L68: change to "It clearly shows the benefit…"

P5 L135 change to "spectrometer"

P16 L406 looks like the highest value in Fig. 2 is actually just above 2.5, not ~2.4.

P24 L511 change to “custom”

P26 L549 remove “to a large extent”