

Review comment on: **Evaluation of total ozone measurements from Geostationary Environmental Monitoring Satellite (GEMS)** by

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The authors present the first total ozone column retrieval from a geostationary satellite. The presented comparisons with PANDORA as well as with TROPOMI and OMPS indicate a good correlation and a mean bias below 2.5%

### **General comments**

1) The description of the algorithm was not quite clear to me. Is the presented profile retrieval part of the total column column algorithm or does it belong to the ozone profile product?

2) The comparison to PANDORA, TROPOMI, and OMPS include the period from August 2020 to December 2020. A full yearly cycle would give better picture of the indicated seasonal variability. With the half year period shown in the paper a seasonal cycle can not be separated from a general degradation effect.

Figure 2 shows example distributions from March 2021 - so the data might be available

3) In section 3.3 validation of GEMS total ozone with other satellites I suggest to add a figure of the difference between GEMS and TROPOMI or OMPS.

4) The cloud data are mentioned to have large impact on the total ozone columns. However only the OMPS cloud data are discussed briefly. A full satellite - satellite comparison of the cloud data is certainly worth an extra paper but brief discussion of the GEMS and the TROPOMI cloud data and why the influence on total ozone is not as strong as for OMPS can be included.

### **detailed comments**

Check that the date / time format is in agreement with the Copernicus guidelines (also in the figures)

page 5 line 123: "treats surfaces, clouds,... at surface pressure" does this mean you assume clouds to be at 1013 hPa?

p 5 l 133: "The models proceeds in three steps." i suggest to add something like. "Details of the individual steps are presented below." Like that it is obvious that an overview is given first.

p 6 eq 1.  $\lambda_{340}$  instead of  $\lambda_{317}$  ? The description above indicates the wavelength is 340 nm.

p 6 l 161: capital S for "step 2" as for Step 1 and 3

p 6 l 174 "0.99 hPa to infinity" although it is clear what is meant here it might be misunderstood as the pressure range from 0.99 to infinity, this includes 1013 hPa and all levels in between. I suggest "all altitudes above the 0.99 pressure level".

p 6 l 175: the ozone climatology is different from the one in the forward model does this cause any inconsistencies?

p 7 l 180 "... SNR corresponding to 320nm is 720." What is meant with 720? consider to skip the last two "words".

p 7 eq 4: this means the cloud fraction is not taken from the GEMS Cloud Product, why is that?

p 8 | 219: The resolution has been updated in August 2019 to 3.5 x 5.5 km. In the context of the GEMS validation I would use 3.5 x 5.5 km.

p 8 | 221: Lerot et al 2021 is not listed in the references. Please also include the TROPOMI total ozone ATBD (<https://sentinel.esa.int/web/sentinel/technical-guides/sentinel-5p/products-algorithms>, June 2023)

p 8 | 223: There has been a major update in TROPOMI level 1 data in August 2022. All the data presented here have been processed with the old level data.

p 9 | 249: one GEMS scan from the east to the west takes 30 minutes and is performed every 60 minutes, what happens in the 30 minutes between one scan and the next one?

p 9 | 255: "It can also predict future development in the ozone states" I doubt that the GEMS total ozone algorithm can retrieve data from the future. Modify to: "It also gives essential information to models, that help us predicting the future development in the ozone state"

p 10 | 261 and figure 3: According to the text and the caption also OMPS and TROPOMI data are include in figure 3 but they are not listed in the legend nor can I see them.

p 11 table 1 is it worth including some validation results (slope, bias, R<sup>2</sup>) in the table?

p 12 | 306: There seems to be an issue with the Pandora measurements at Ulsan - you state this somewhere later in the text, perhaps it might be worth including it here.

p 13 | 333: The bias to the PANDORA measurements in Busan differs from the one in Seoul. When looking at figure 5 it seems that the time range is different. Especially the higher values in August are missing in Seoul, does this have an impact on the mean bias?

p 14 fig. 7 a) use GMT or KST for all plots, for a better comparison. 7b) and 7c) three orbits from TROPOMI or OMPS are shown. so there is certainly a significant time difference between the presented data.

Add the respective overpass times in the caption.

Add a delta O<sub>3</sub> picture here

p 15 | 358-360 "The UV measurements ... the cloudy scene." these two sentences contain the same information, one sentence might be skipped.

p 15 fig 8: include similar cloud data for TROPOMI and GEMS as well, and add the respective references.

p 17 table 2: the time collocation criteria for TROPOMI and OMPS differ from each other, Is this correct and if so, why?

p 17 figure 10.: when discussing figure 5, a seasonality in the bias was mentioned, in how far is figure 10 affected. Maybe you could generate similar plots for each season and mention the results briefly in the text. Is it useful to show the plots?

p 18 | 413: perhaps replace by: "Moreover, the dependency increases from August to December"

p18 | 415: "-1% in August"