

## Reviewer 2 - Timothy Schmit

We would like to sincerely thank the Reviewer for taking the time to read and review the manuscript.

### general comments

Much work went into this simulation study to develop a basis for the potential impact on ozone from EUMETSAT's high spectral IR sounder. Overall, the manuscript is a great first step in showing the benefits of geostationary advanced sounders regarding Ozone, and a pathway for investigating other species. Seems like the manuscript script could have been much shorter if the authors had used different models for the simulations and assimilation steps. For example, maybe <http://raqms-ops.ssec.wisc.edu/>, but this was not the path taken, so much on the calibration of the OSSE had to be included.

We thank the Reviewer for this remark. This has been a very preliminary and pioneering study about assimilation of L1 simulated radiances from a new infrared instrument into a Chemistry Transport Model, and the resources available have been exploited. Indeed, this implied that the approach chosen was to use the same model for both Nature Run and Control Run, acting on the sources of differences between them. A more traditional approach could be taken in possible future studies.

### specific comments

- For more on the instrument, this reference on the IRS could be added: Sylvain Abdon, Hubert Gardette, Cyril Degrelle, Jean-Michel Gaucel, Patrick Astruc, Patrice Guiard, Antonio Accettura, Daniel Lamarre, Donny M. Aminou, Didier Miras, "Meteosat third generation infrared sounder (MTG-IRS), interferometer and spectrometer test outcomes, demonstration of the new 3D metrology system efficiency," Proc. SPIE 11852, International Conference on Space Optics — ICSSO 2020, 118521F (11 June 2021); <https://doi.org/10.1117/12.2599240>  
Reference suggested has been cited.
- Line 8. Since the IRS uses the IR part of the EM, the various gases can be monitored at night as well as during the day. This fact should be noted somewhere before the summary. Stated another way, advanced IR sounders in geo can complement UV/visible sensors. Maybe add this reference: <https://journals.ametsoc.org/view/journals/bams/104/3/BAMS-D-22-0266.1.xml>  
Thanks for this complement, the following paragraph has been added in the Introduction:  
"Since covering a part of the infrared portion of the electromagnetic spectrum, IRS will be able to provide both day and nighttime data. This could potentially complement the information issued from UV/VIS sensors currently used for monitoring from GEO platforms [Kopacz et al. (2023)]".
- Line 15. Define that NR is the Natural Run. Currently defined on line 208.  
Comment taken into account.
- Line 20. This statement would be equally true in operations, not just in research.  
Text has been modified.
- Line 57. Could include this overview article on the MTG: Holmlund, K., and Coauthors, 2021: Meteosat Third Generation (MTG): Continuation and Innovation of

Observations from Geostationary Orbit. *Bull. Amer. Meteor. Soc.*, **102**, E990–E1015, <https://doi.org/10.1175/BAMS-D-19-0304.1>.  
Reference suggested has been cited.

- Line 318. What local zenith angle cut-off was used?  
We used a cut-off for satellite zenith angles at 63 degrees.
- Line 350. The reader could be reminded that the IRS will be providing data over Europe every 30 min, while only hourly data were included in this study.  
Indeed, it has not been mentioned in the manuscript that the observations were simulated on an hourly basis. We have added the following paragraph in Subsection 5.3:  
“Although the IRS instrument will be capable of providing an acquisition every 30 minutes over LAC4 (as introduced in Section 2), in this work only one set of observations per hour has been simulated. This choice has the additional aim of further optimising the subsequent assimilation and reducing the computational cost.”
- Line 335. As a start, only clear sky values were used, but for low clouds, won't the sensor still observe most of the ozone?  
Indeed, most of the ozone signal can be seen by IRS. However, if we want to use this information, we first have to identify the channels contaminated by the low cloud. This would need a cloud detection scheme (like the McNally and Watts algorithm). Unfortunately, we have not implemented yet this algorithm in MOCAGE. So we may underestimate the benefit of IRS in our study because we only use clear scenes.

#### technical corrections

- Line 27. Replace trough with through.  
Text has been modified as suggested.
- Line 37. Consider changing to “wide spectral range”.  
Text has been modified as suggested
- Line 203. This kind of experiments comply a series of steps should be These kind of experiments comply a series of steps  
Modified to “Such experiments”
- Line 247. Remove ‘it’ ... At the same time, it the same surface emissions as ....  
Comment taken into account.
- Line 219. The text states “observations are more dense over land and in the South-East portion of the instrument disk”, yet the figure (8) is mostly just covering Europe.  
Text has been changed to: “South-East quadrant of the domain”.