Comment on amt-2022-82
Anonymous Referee #2

Referee comment on "Synergistic retrieval and Complete Data Fusion methods applied to FORUM and IASI-NG simulated measurements" by Marco Ridolfi et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2022-82-RC1, 2022

Review of "Synergistic retrieval and Complete Data Fusion methods applied to FORUM and IASI-NG simulated measurements" by Ridolfi et al.

General comments

In this new study, Ridolfi et al. explore and compare the synergistic retrieval (SR) and complete data fusion (CDF) techniques for the upcoming European FORUM and IASI-NG infrared sounders. The authors discuss retrieval experiments for temperature, humidity, and surface temperature and emissivity for a clear-sky Antarctic atmosphere. Retrieval experiments are conducted for the cases of i) perfectly matching nadir observations of FORUM and IASI-NG and ii) potential mismatch or co-location errors of both instruments. It is demonstrated that the retrieval results of both, the SR and CDF techniques, provide good performance and agree well within the measurement noise errors of the FORUM and IASI instruments for both test cases.

Overall, this is a very carefully designed study with convincing results. The manuscript is well written, clear, and concise. It will be of interest to the retrieval community and I would like to recommend considering it for publication in AMT, subject to a few specific comments and corrections as listed below.

Specific comments

134-38: A number of references on the CDF technique is given below, but it seems this paragraph is lacking references on the SR technique.
I remember seeing a few new papers on FORUM being submitted or published during the last 1-2 years. As FORUM is a new instrument, perhaps it might be good to add a few more references to this paper to provide a bit more background information for the reader? Same for IASI-NG.

The retrieval test cases presented here refer to a perfect situation due to the transparency and sensitivity to surface emissions of the Antarctic winter clear-sky atmosphere. The reader might ask, though, how large are the degradations for non-optimal atmospheric conditions at mid-latitudes or in the tropics? How often are perfect conditions in the atmosphere being found so that the SR and CDF techniques can be applied? To which extent do the findings on the good agreement between SR and CDF still hold for non-optimal conditions?

I would like to suggest to introduce a new subsection directly at the beginning of Sect. 2. For example, "2.1 SR and CDF retrieval theory", or similar.

This might be another place in the paper suitable to discuss and motivate why only a single (perfect) scenario was selected for the retrieval experiments.

Introduce a new subsection 5.1 ("Results for perfectly matching measurements") at the beginning of Sect. 5?

I may have missed it earlier in the paper, but when considering the horizontal mismatch of up to 26 km, did you also consider horizontal smoothing effects related to the IFOV of the FORUM and IASI-NG instruments?

Why are different surface emissivity models for snow applied for FORUM and IASI-NG?

Maybe clarify "For a specific test scenario _with perfect/most suitable atmospheric conditions_ ..."?

Technical corrections

fix sentence ("...is the reference a coarse snow...?")
I399-400: merge dangling sentence with previous or next paragraph

I402: "this latter" -> "the latter"