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Atmospheric Measurement Techniques Discussions

Interactive comment on "Characterization of blackbody inhomogeneity and its effect on the retrieval results of the GLORIA instrument" *by* Anne Kleinert et al.

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The manuscript presents a study that investigates the required uncertainty of the onboard radiometric reference standards to properly resolve decadal trends of retrieved water vapor, temperature profiles, and trace species for the Gimballed Limb Observer for Radiance Imaging of the Atmosphere (GLORIA). As noted in the manuscript, traceability to the SI is necessary for rigorous comparison of measurements between multiple instruments and is extremely important for decadal climate trending. The paper is well-written and represents a substantial scientific contribution within the scope of the journal.

I recommend that the paper be accepted subject to small revisions. My comments are included below.

General Comments:

The study focuses on the impact of temperature and emissivity uncertainties of the onboard radiometric reference standards and does not address other sources of uncertainty in the calibration or retrieval algorithms, which may or may not be more significant contributors to the overall uncertainty. While a comprehensive uncertainty analysis of all contributors is not the focus of this study, it would be helpful to briefly indicate if the onboard reference standard temperature and emissivity uncertainties are expected to be the primary source of uncertainty for the retrieved quantities and to note their relative significance with respect to the other identified sources of uncertainty (calibration and retrieval).

The uncertainty coverage factor (k) is only specified in one instance in the manuscript (page 10, line 11), and it is not clear if this is for the total uncertainty in the GLORIA blackbody temperature when using VIRST as a transfer standard and the VLTBB as a radiometric standard, or if it is the uncertainty of the of only the VIRST measurement, or the VLTBB as a source. "The typical uncertainty at -40C at a wavelength of 10 μm is 100 mK (k=2)." Given the identified importance of traceability to the SI, it would be useful to utilize expanded uncertainty notation throughout, with the coverage factor (k) explicitly noted when an uncertainty is specified. Alternatively, a brief note that all uncertainties are of a specified coverage factor or confidence unless otherwise noted would be sufficient.

Specific Comment: Section 4.1

Equation 18 and figure 6 assume that the effective emissivity is constant with wavenumber. Providing a statement regarding the expected spectral variability of Nextel 811-21 and/or uncertainty within the spectral range of the GLORIA measurement would be a useful clarification.

Specific Comment: Section 5

The conclusion would be further strengthened by explicitly noting what level of climate trends can be detected and over what time period, given the uncertainties in the GLORIA retrieved products discussed in the manuscript. Additionally, please consider including a summary statement in the conclusion that clearly states whether the total uncertainty in the retrieved products is expected to be driven by the temperature and emissivity uncertainties in the onboard radiometric references (the subject of this manuscript), or if other uncertainty contributors in the radiometric and spectral calibration or retrieval algorithms are expected to be the dominant uncertainties.

Editorial comment: Section 1, line 10

I believe that 'earth' should be capitalized in this context.

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