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Impact of nonlinearity on changing the a priori of trace gas profile estimates from the Tropospheric Emission Spectrometer (TES)

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Abstract. Non-linear maximum a posteriori (MAP) estimates of atmospheric profiles from the Tropospheric Emission Spectrometer (TES) contains a priori information that may vary geographically, which is a confounding factor in the analysis and physical interpretation of an ensemble of profiles. One mitigation strategy is to transform profile estimates to a common prior using a linear operation thereby facilitating the interpretation of profile variability. However, this operation is dependent on the assumption of not worse than moderate non-linearity near the solution of the non-linear estimate. The robustness of this assumption is tested by comparing atmospheric retrievals from the Tropospheric Emission Spectrometer processed with a uniform prior with those processed with a variable prior and converted to a uniform prior following the non-linear retrieval. Linearly converting the prior following a non-linear retrieval is shown to have a minor effect on the results as compared to a non-linear retrieval using a uniform prior when compared to the expected total error, with less than 10% of the change in the prior ending up as unbiased fluctuations in the profile estimate results.

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