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Atmospheric Measurement Techniques Discussions

Interactive comment on "Quantifying lower tropospheric methane concentrations using near-IR and thermal IR satellite measurements: comparison to the GEOS-Chem model" *by* J. R. Worden et al.

Anonymous Referee #1

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Summary: This paper presents a method to combine satellite measurements of methane using a thermal IR instrument (TES) and a near-IR reflected sunlight instrument (GOSAT). Because these instruments are sensitive to methane at different altitudes, they can be used to calculate lower tropospheric methane concentrations. The authors compare their lower tropospheric methane concentrations to the GEOS-CHEM model. The concept is useful and the paper is within the scope of AMT, but the results seem incomplete.

Major comments:

1. The authors do not compare their results to any in situ measurements or reanalysis products (e.g. CarbonTracker Methane). The paper would be much stronger if the authors compared their satellite results to measurements, rather than simply using GEOS-Chem model results. The authors recognize this omission and state that it is beyond the scope of the paper. Since the purpose of the paper is to present a method to determine lower tropospheric methane concentrations, the comparison to in situ measurements is an important thing that should be within the scope of the paper.

2. There are no details about the GEOS-Chem model or the methane fluxes that were included in GEOS-Chem. This model is the major validation and comparison target for the satellite-derived lower tropospheric methane concentrations, so this is an important thing to include. The only description is this sentence: "Figure 3 shows methane fluxes used in Version 9.0.2 of the GEOS-Chem global chemical transport model (Bey et al., 2001; Kaplan et al., 2002; Pickett-Heaps et al., 2011; Wecht et al., 2012, 2014; Turner et al., 2015)." The authors should add a section with information about the source of the GEOS-Chem methane fluxes in v 9.0.2, the flux accuracy, and results from prior model-measurement comparisons.

Comparing the retrieval to a model is problematic, for example on p. 3859, where the authors describe "...regions where the modeled fluxes are likely in significant disagreement with the true fluxes."

3. Section 3.3 describes CO2 bias error. The GOSAT CH4/CO2 "proxy" retrieval and its potential errors are not explained clearly.

Minor comments:

- Paper lacks a "road map" of its organization in the introduction to orient the reader.

- Change "free-troposphere" to "free troposphere". Similarly for "lower-troposphere".

- Acronyms not defined: HBL, SWIR, TIR

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