

Evaluation of CO₂ and CH₄ retrievals from MethaneSAT: A Simulation-based study

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Poster

On March 4, 2024, the Environmental Defense Fund in partnership with the Harvard Center for Astrophysics launched MethaneSAT, the next U.S.-based greenhouse gas sensor. MethaneSAT is a wide-swath near-infrared sensor with an O₂ band at 1.27 μm and a CO₂+CH₄ band at 1.59-1.65 μm . It will fly in a polar sun-synchronous orbit and observe an average of thirty 200 km x 200 km land areas per day. Compared to OCO-2, it has about 3 times lower spectral resolution and higher per-pixel noise, but much greater native spatial resolution at roughly 130 m x 400 m. The operational CH₄ retrieval will be a proxy retrieval using only the CO₂+CH₄ band. This retrieval is largely insensitive to atmospheric scattering, but relies on the assumption that CO₂ can be used as a reference gas and that the CO₂ and CH₄ anomalies are uncorrelated over the scene of interest.

In this work, we present a full-physics retrieval that utilizes both the 1.27 μm and CO₂+CH₄ bands which allows simultaneous retrieval of CH₄ and CO₂ columns. In both current and future greenhouse gas missions O₂ information is usually obtained from the 0.76 μm O₂ A-band while use of the 1.27 μm O₂ band has largely been avoided due to the difficulty in modeling the intense airglow in the upper atmosphere at 1.27 μm . In this study we will simulate radiances accounting for airglow emission which will then be used to drive retrieval simulations. We will compare our full physics results to the proxy CH₄ approach as well as full physics results from a theoretical instrument that uses O₂ information at 0.76 μm instead. The latter allows us to compare the use of these two different O₂ bands, which is relevant for many current (e.g., OCO-2 and GOSAT) and future sensors (e.g. CO2M and MicroCarb). We will also determine whether, when averaged to 2 x 2 km², the MethaneSAT CO₂ retrieval will have comparable error statistics to OCO-2, opening up a host of potential CO₂ studies from this exciting new instrument.

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