Biases in XCH_4 retrievals from the 2.3 µm spectral band

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Motivation

- GeoCarb L2 retrieval algorithm development, focused one 1-band CH_4 and CO at 2.3 µm
- Understanding error sources and magnitudes, ensuring we meet mission-level requirements
- Perform pre-launch studies to optimize observation strategy for best data yield

Simulations

- Globally covering scene set with realistic sampling and geometry (derived from OCO-2), surfaces (MODIS), clouds (ISCCP), and background aerosols (CAMS)
- Synthetic measurements (top-of-atmosphere radiances) produced with established RT solvers

Retrievals

- Single-band set-up, profile scaling for gases
- Flexible radiative transfer interface for switching between non-scattering and various multiple-scattering solvers

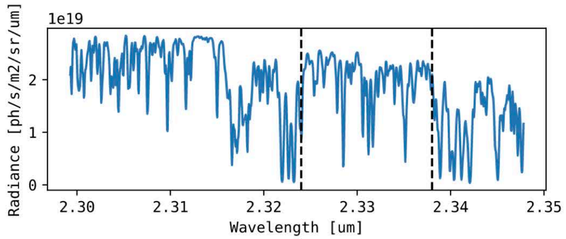

Fig. 1: GeoCarb CH_4/CO band with retrieval window limits

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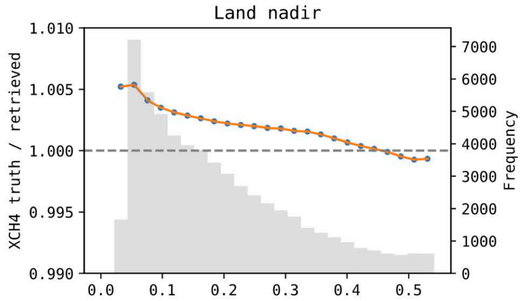
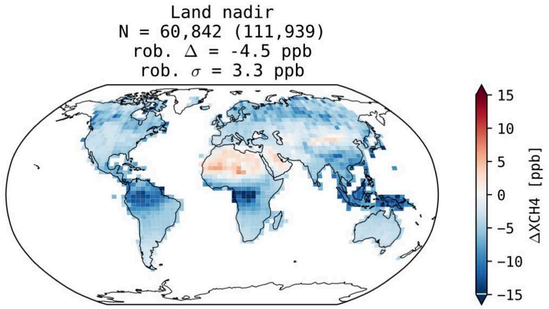
Results #1

- Surface albedo-dependent retrieval bias **appears when aerosols are inserted into the simulations** (not present in clear-sky simulations)



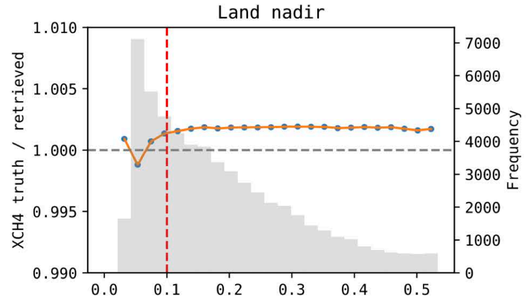


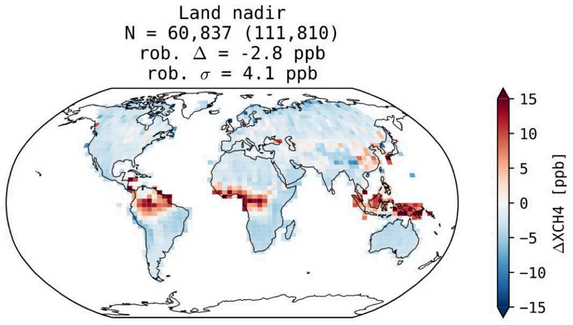
NOTE

- Same **qualitative** behavior of a surface bias seen in real TROPOMI retrievals (see Lorente et al. 2021)

Results #2

- Introducing **aerosol truth information** into the retrieval forward model **removes the effect** for most surfaces with albedo larger than 0.1.





NOTE

- Dark surfaces (albedo < 0.1) show worse biases!
- **Early results show this can be mitigated by adjusting the gas scale factor first guess for dark surfaces.**

Summary

- We can recreate retrieval biases seen in real data using simulation experiments
- Surface-dependent retrieval biases are caused by background aerosol scattering
- Explicitly accounting for aerosols in the retrieval forward model removes the surface dependence
- Further studies underway to understand the required quality and accuracy of the aerosol information.