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Towards retrieval of CO from MTG-IRS in the Fourier space with IASI as a demonstrator

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5. Prospects

• Classification applied to CO

• Near-to-real-time maps of column density from IASI

• Apply the same principle to the MTG-IRS data

• New mission design on PSI retrieval approach

○ On-board High Altitude Platforms System

○ Increased persistence of observation

1. Background

• Spectral domain VS a partial interferogram retrieval approach

Periodic signatures of CO in spectra

Sharp signatures in interferograms

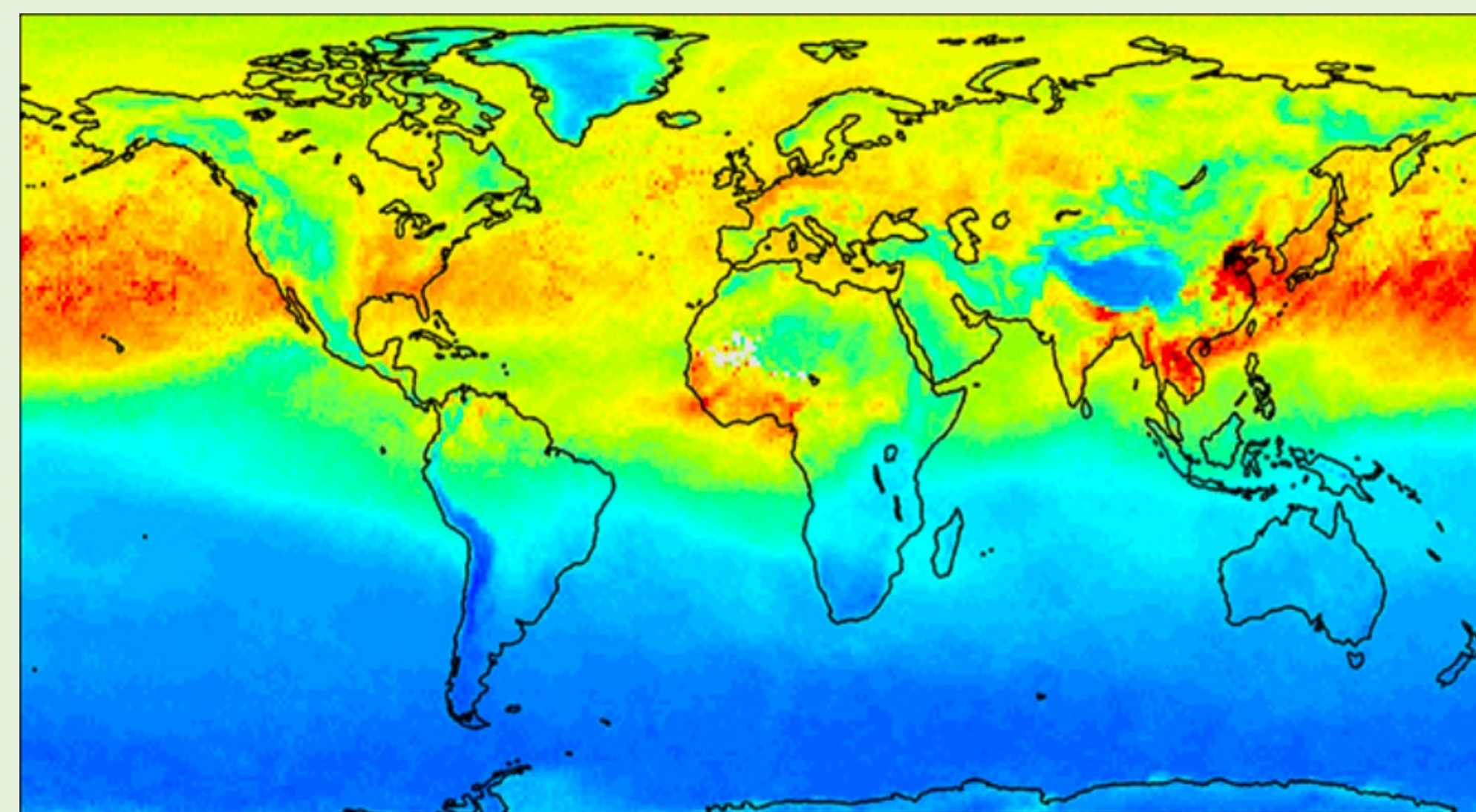


Fig. 1 : Map of column density of CO¹

1. [George et al., 2015, doi: 10.5194/amt-8-4313-2015]

Carbon monoxide – incomplete combustion of carbon-containing substances

3. Classification

• Explore potential of deep learning with interferogram instead of spectra

• Investigate and remove the dependency on surface temperature and the H₂O content

• Point A sensitive to surface temperature

• Point B sensitive to slight column density of H₂O

Simulations:
• 2311 TIGR profiles
• 8 CO profiles
• 7 surface temperatures
= **129360 simulated interferograms**

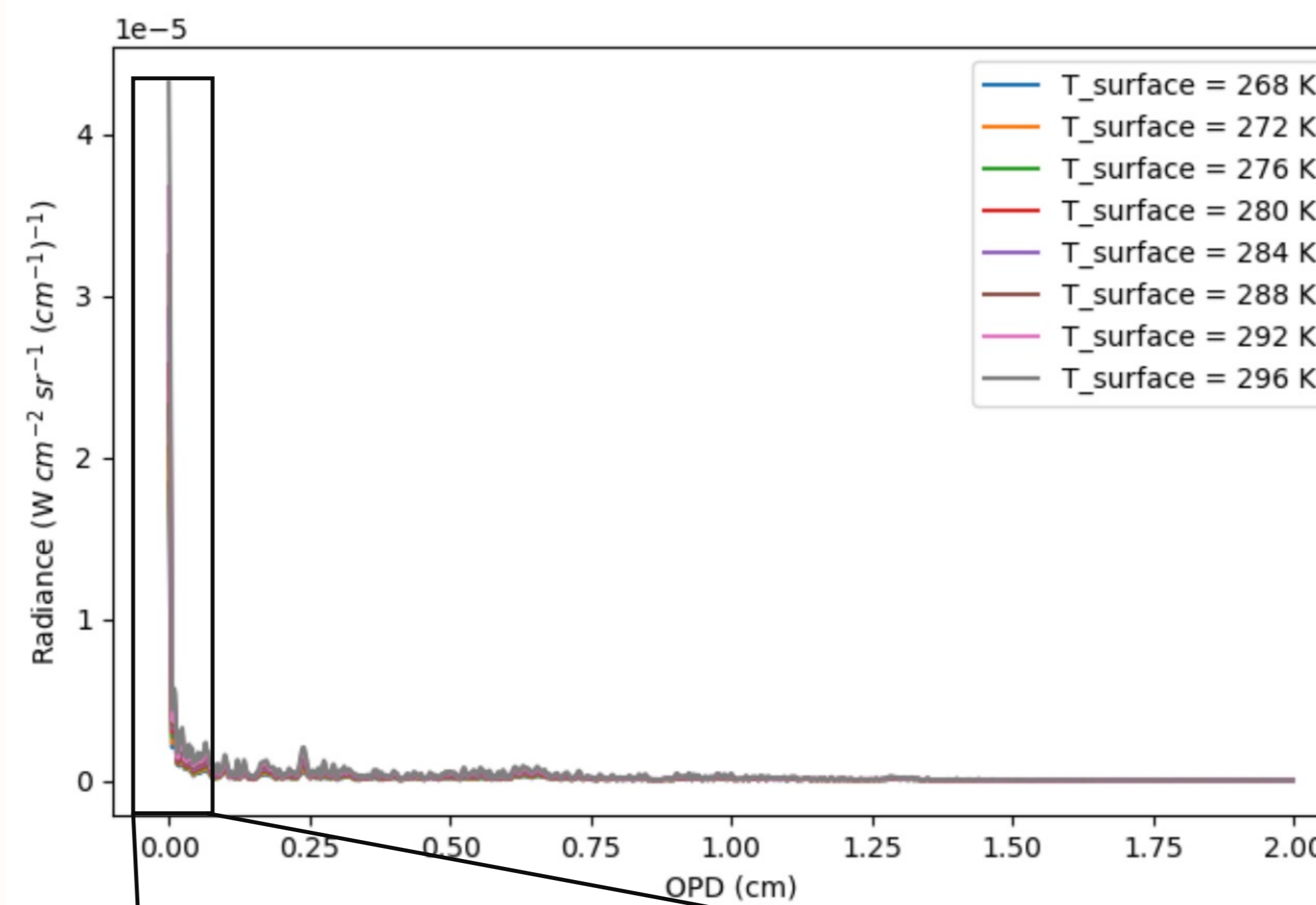
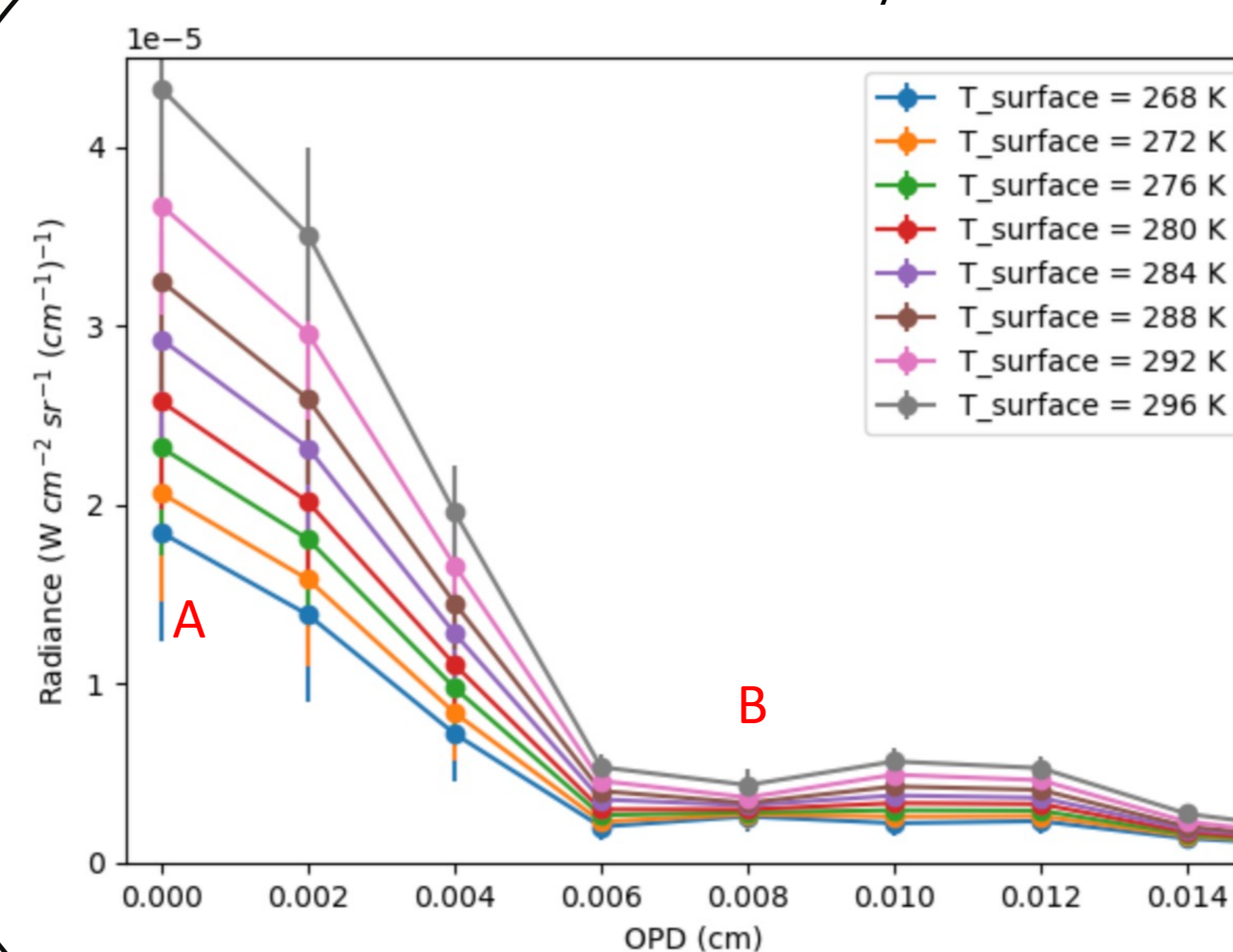


Fig. 3: Interferograms for SCD H₂O = 3.43 × 10²⁸ ± 1.29 molecule/cm²



2. Strategy

• Used case : Infrared Atmospheric Sounding Interferometer data (IASI / FTIR)

• Radiative transfer code LARA used to simulate the IASI spectra²

• Spectra transformed back to the interferogram domain

• First approach : Classification to infer quick estimation of CO column density

• Second approach : full physics retrieval using optimal estimation method

Signature peak of CO at ~0.24 cm OPD as expected due to line spacing of ~2 cm⁻¹ in the spectral domain

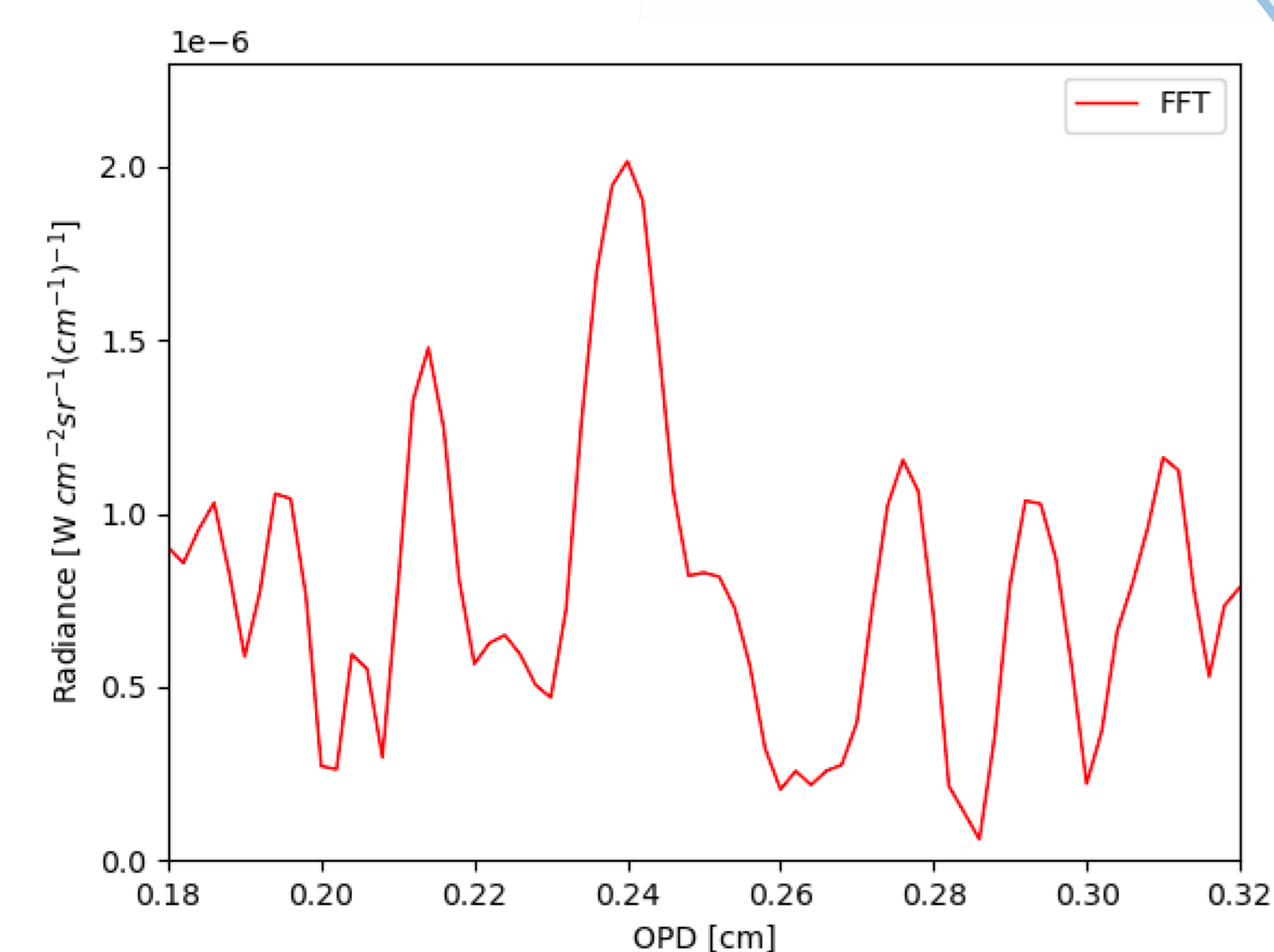
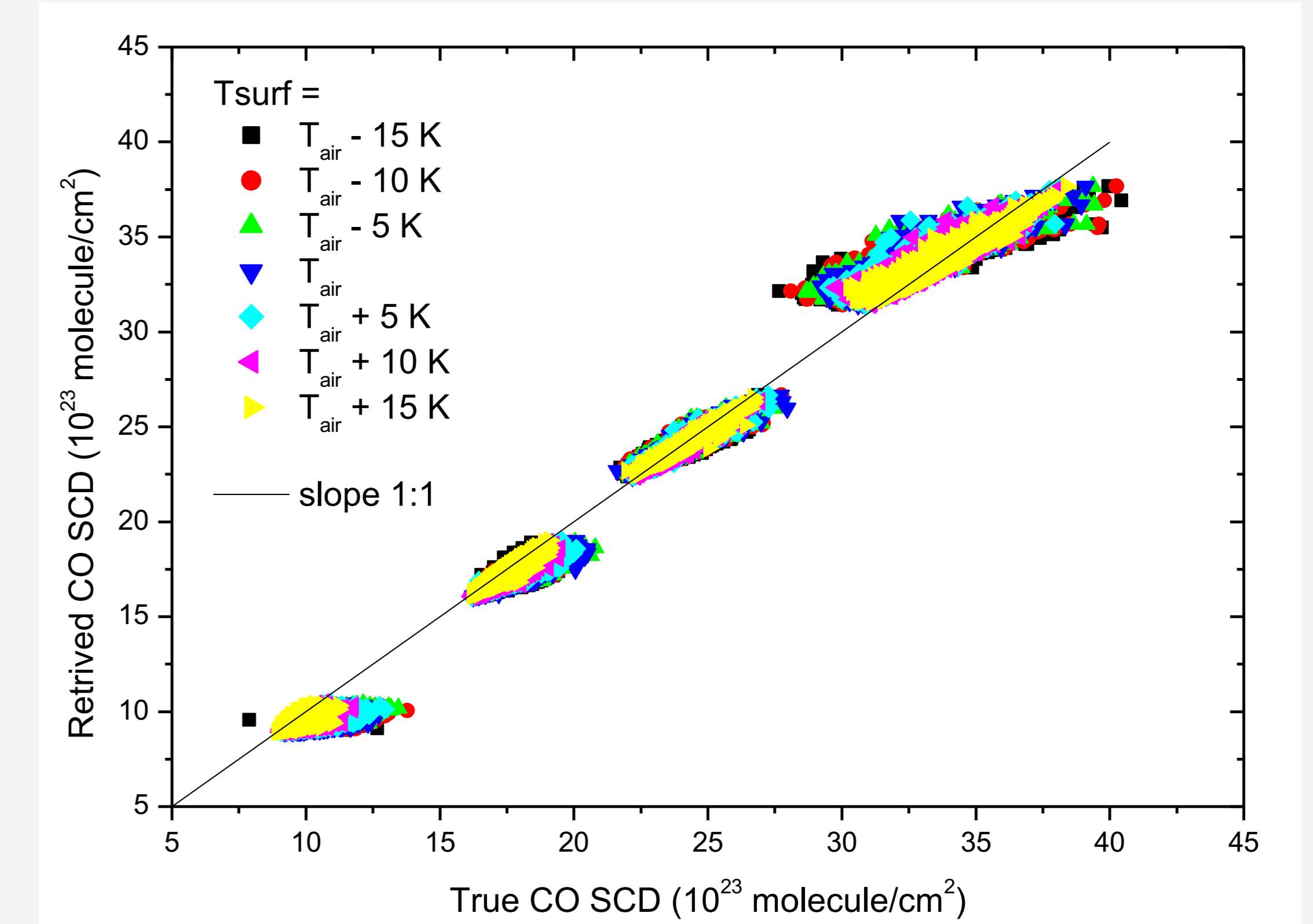


Fig. 2: A partial interferogram obtained from a simulation

2. [Segonne et al., 2020, doi: 10.3390/rs12244107]

4. Retrieval

Fig. 4: Retrieved VS true CO SCD



• Successful retrieval of surface temperature, H₂O and CO column densities

• Slope of linear regression is 1.0168 with standard deviation 4. × 10⁻⁴ (with R = 0.99)

• CO retrieval is less efficient for high and low values of SCD

• Effect of the thermal contrast is not negligible

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