

A central graphic for 'ATMOS 2021' featuring a globe with a satellite in orbit. The globe is surrounded by several circular inset images showing various atmospheric and environmental data visualizations, such as temperature maps and satellite imagery. The background is a dark blue space with stars.

ATMOS 2021

Understanding the Potential and Limitations of Sentinel 2 for Methane Mapping

Javier Gorroño¹, Daniel Varon^{2,3}, Elena Sanchez-García¹, Itziar Irakulis-Loitxate¹, Luis Guanter¹.

¹Research Institute of Water and Environmental Engineering (IIAMA), Universitat Politècnica de València

²School of Engineering and Applied Science, Harvard University, Cambridge, 02138, USA

³GHGSat Inc., Montréal, H2W 1Y5, Canada

Correspondence: Javier Gorroño(jagorvie@upv.es)

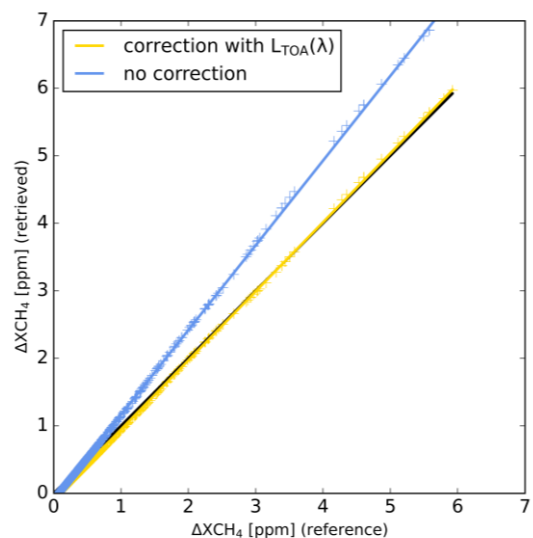
Understanding the Potential and Limitations of Sentinel 2 for Methane Mapping: simulation methodology

Transmittance of a methane plume directly convolved to the TOA radiance

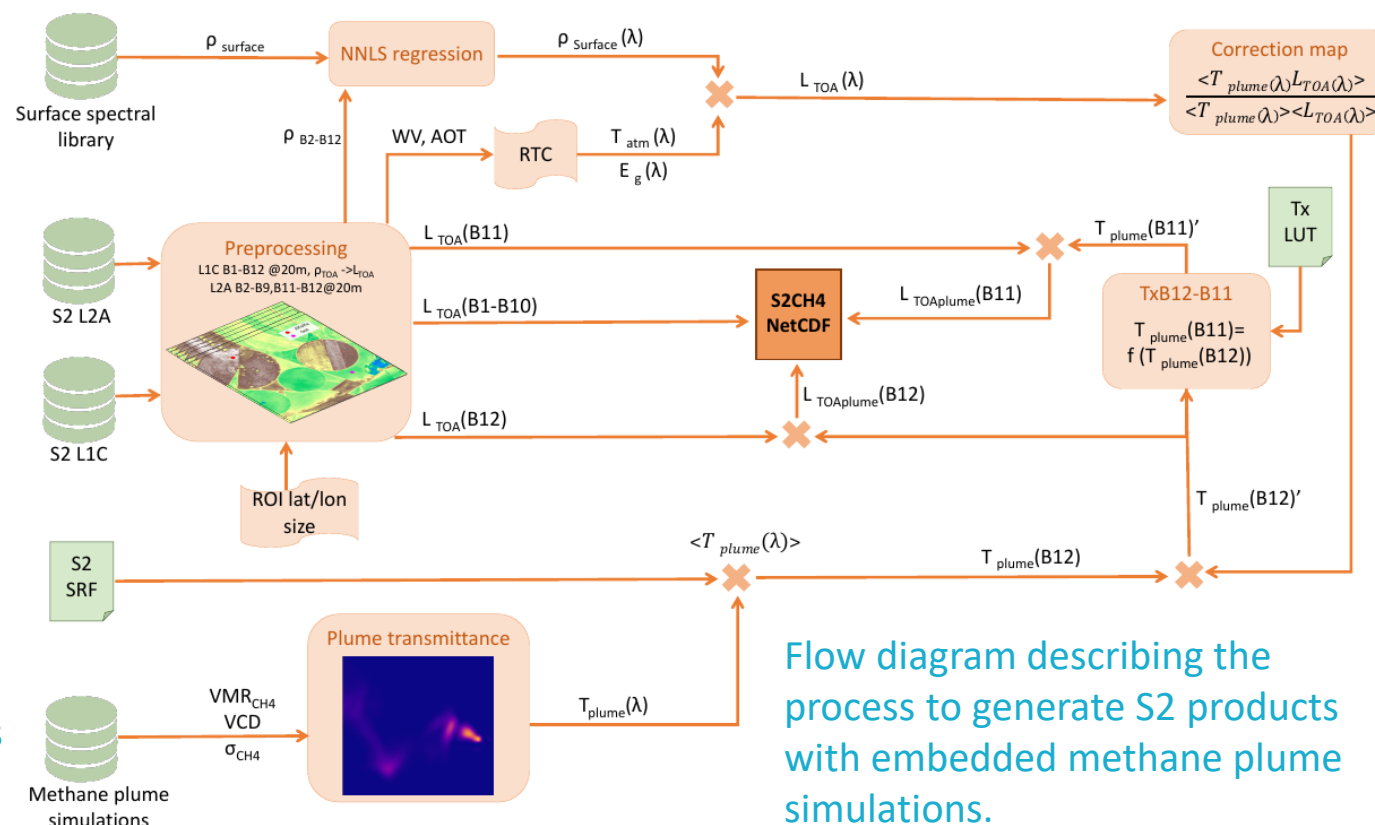
$$L_{S2band}^{plume} = L_{B12} \left(\int_{B12} T_{plume}(\lambda) d\lambda \right) \epsilon_{convolution}$$

...plus estimated error as follows:

$$\epsilon_{convolution} = \frac{\int_{B12} L_{TOA}(\lambda) T_{plume}(\lambda) d\lambda}{\left(\int_{B12} L_{TOA}(\lambda) d\lambda \right) \left(\int_{B12} T_{plume}(\lambda) d\lambda \right)}$$



Scatter plot of retrieved versus reference methane enhancement for the Kopeje site and Q of 10000kg/h. The reference product is the same as the target one with no excess methane to simulate an ideal scenario.



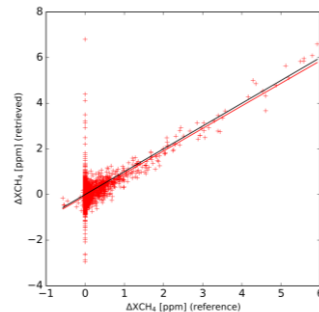
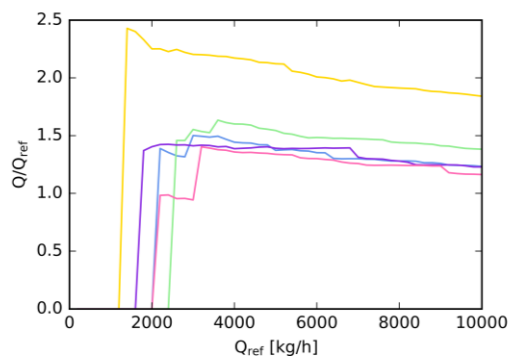
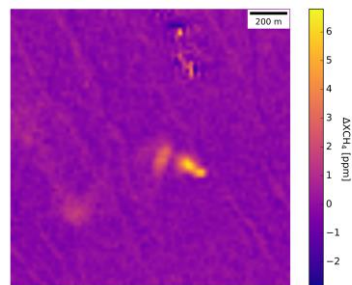
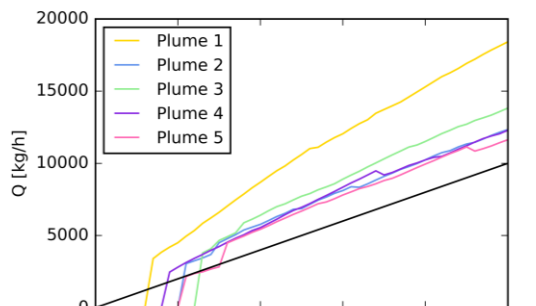
Flow diagram describing the process to generate S2 products with embedded methane plume simulations.

Understanding the Potential and Limitations of Sentinel 2 for Methane Mapping: results



KOPEJE SITE

Q is overestimated at 20-40% at $Q=10000\text{kg/h}$ with a large overestimation of plume 1 (largely due to its high methane concentration). Detection limit ranges from 1500-2500 kg/h .

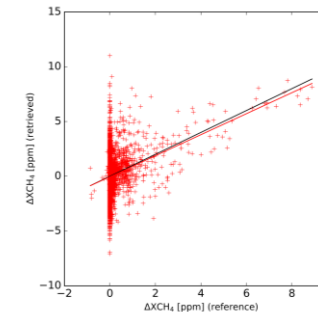
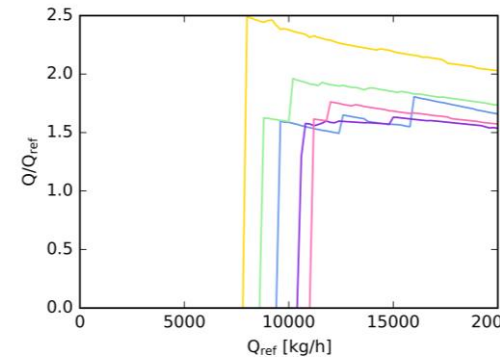
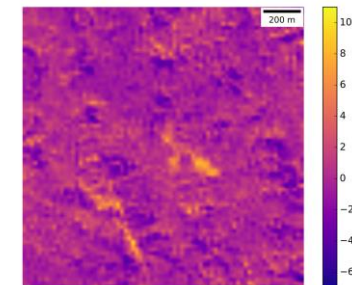
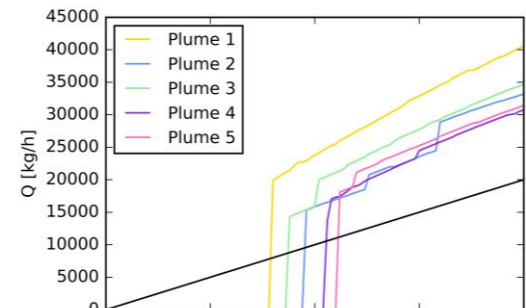


Q regression against reference values

Enhancement map and scatter plot for methane plume 2 with flux rate $Q=10000\text{kg/h}$

PERMIAN SITE

Q is overestimated at 50-70% at $Q=20000\text{kg/h}$ with a large overestimation of plume 1 again. Detection limit ranges from 8000-12000 kg/h showing the limited capacity of detection over heterogeneous scenes.



Q regression against reference values

Enhancement map and scatter plot for methane plume 2 with flux rate $Q=15000\text{kg/h}$