SMART-CH4: Satellite Monitoring of Atmospheric Methane

bridging gaps through platforms and scales to quantify methane emissions from space

A large consortium

- 12 partners from academic and private sector
- 9 countries from ESA member countries
- international expertise in retrieval algorithms, hotspot detection, inverse modelling from fine to global scales

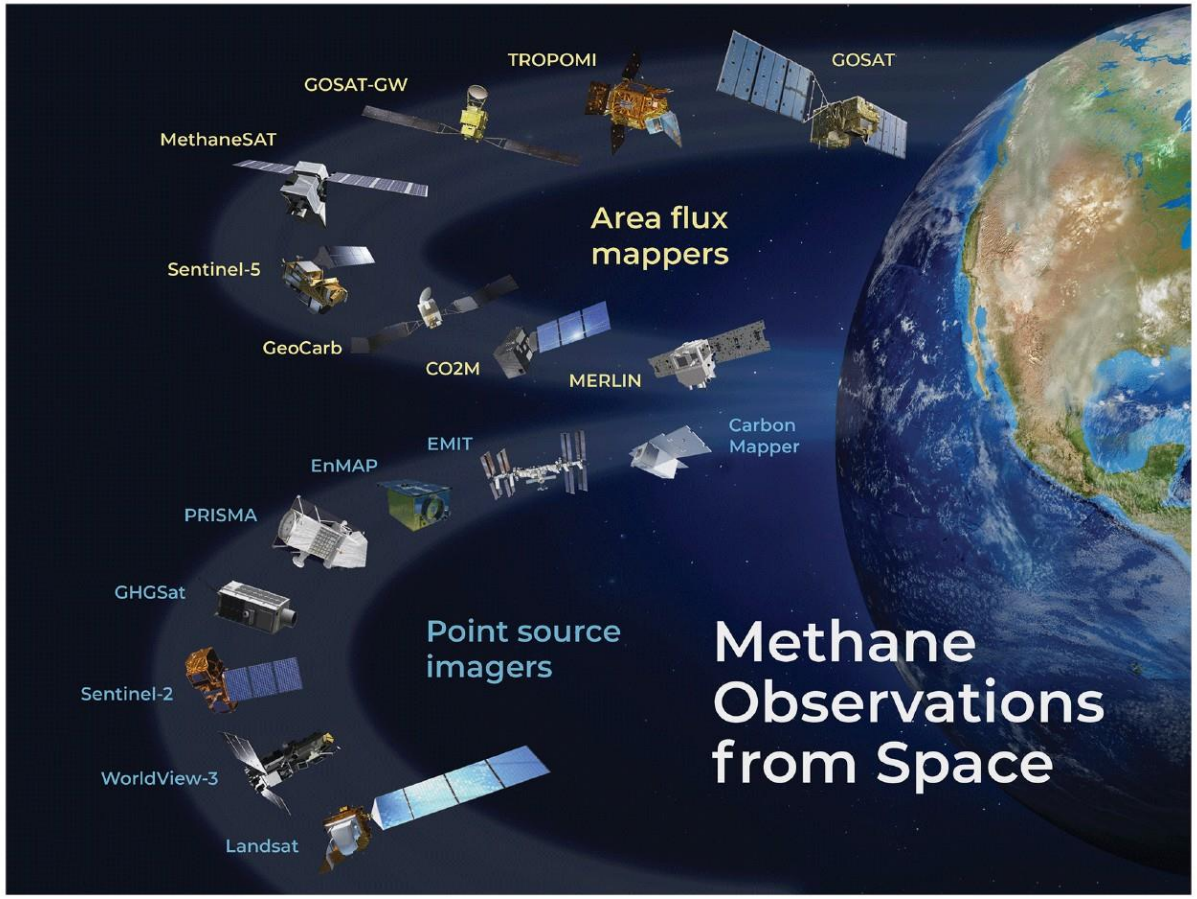
ESA & EU CH_4 call landscape

	...	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	...
Paris Agreement		X														
Global Methane Pledge						X										
Global Stock Take										X					X	
GCP-CH4																
H2020 VERIFY																
H2020 CHE																
HE CoCO2																
HE EYE-CLIMA / PARIS / AVENGERS																
HE IM4CA																
ESA GHG-CCI																
ESA GHG-CCI+																
ESA HiResCH4																
ESA Methane+																
ESA MethEO																
ESA MethaneCAMP																
ESA SMART-CH4																
ESA MEDUSA																

- Large array of projects for CH4 monitoring
- Close collaboration with other ESA, EU and national projects
- Sister project IM4CA selected and to be started by early 2025

General objectives

- Support on-going efforts to document CH_4 emissions from space
- Bridge gaps between satellites and scales
- Focus on non-fossil fuel fluxes, including waste lands, agriculture emissions and wetlands
- Improve retrieval and emission quantification algorithms for CH_4 detection towards diffuse emissions



Jacob et al., 2022

Target outcomes

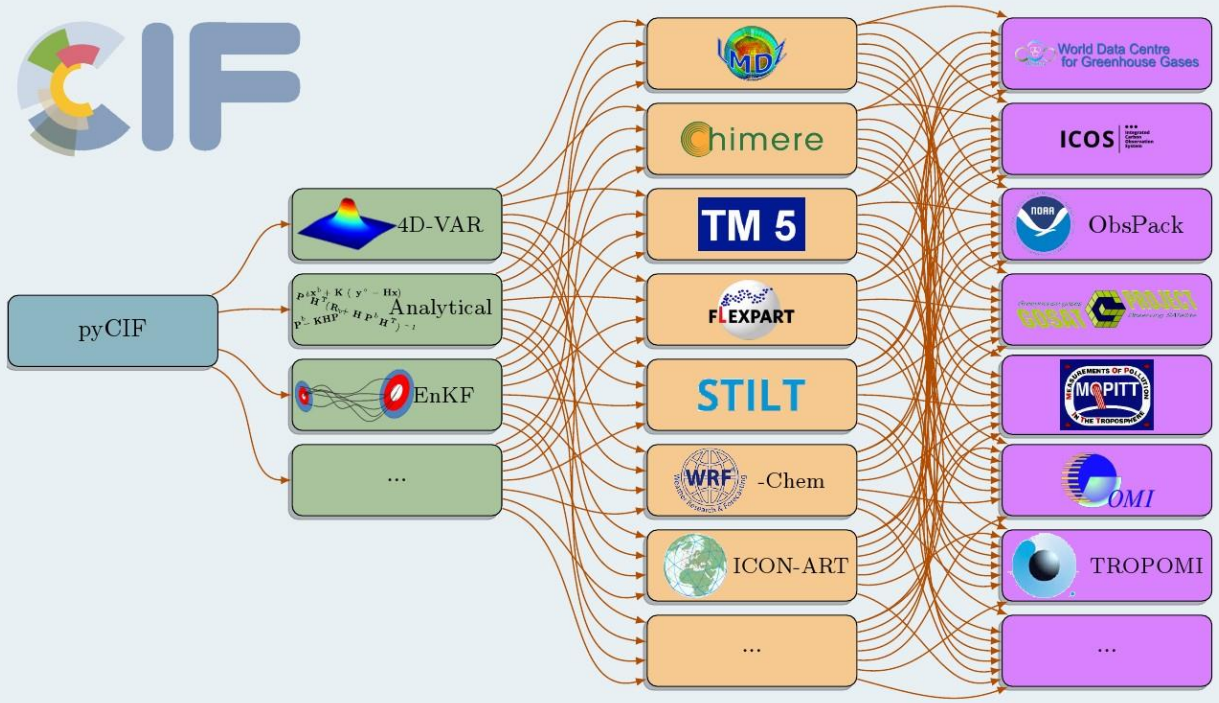
Retrievals and products

- Update TROPOMI CH_4 data from SRON and Uni. Bremen
- Improved SWIR-TIR retrievals for partial column contraints
- Isotopic observations from space for sectoral separation

Fine to global scales flux quantification

- Hotspot detection and estimations of landfills and agricultural big emitters
- Regional pilot studies on target areas with significant non-fossil-fuel emissions:
  - Bucarest: landfills
  - Arctic: peatlands, wetlands
  - South America: agriculture, waste, wetlands
- Separation of sectors at the regional and global scale
- Reconciling global scale estimates using high resolution satellite and transport models
- Promote standardized use of the Community Inversion Framework for inversions to bring together satellite analysis with transport models

A unified system: the Community Inversion Framework



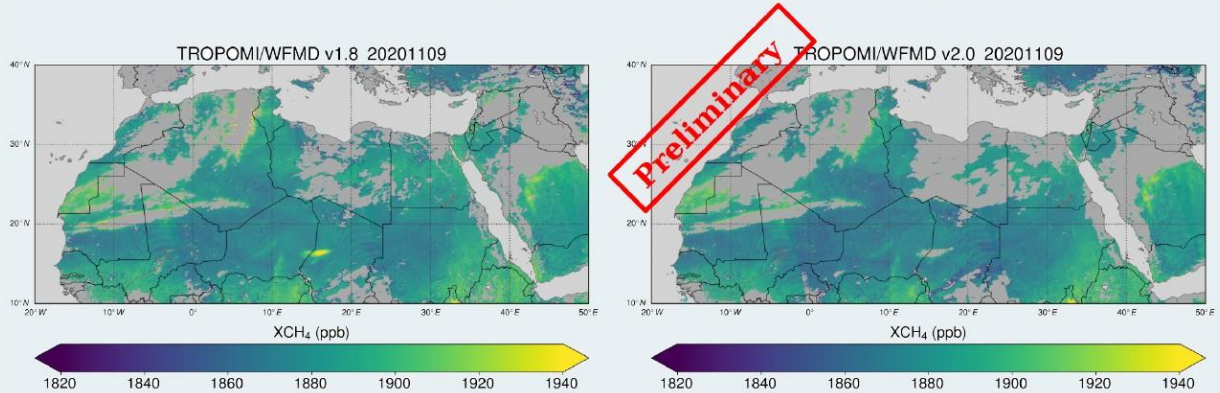
- ✓ designed as research community precursors toward operational systems for GHG and AQ applications
- ✓ new python package to drive multiple models using various inversion methods and data-streams
- ✓ comprehensive observation operator:
  satellites, regridding, isotopes, sectoral separation, model coupling and nesting

Please visit `community-inversion.eu`

Preliminary results: continuation of improved products

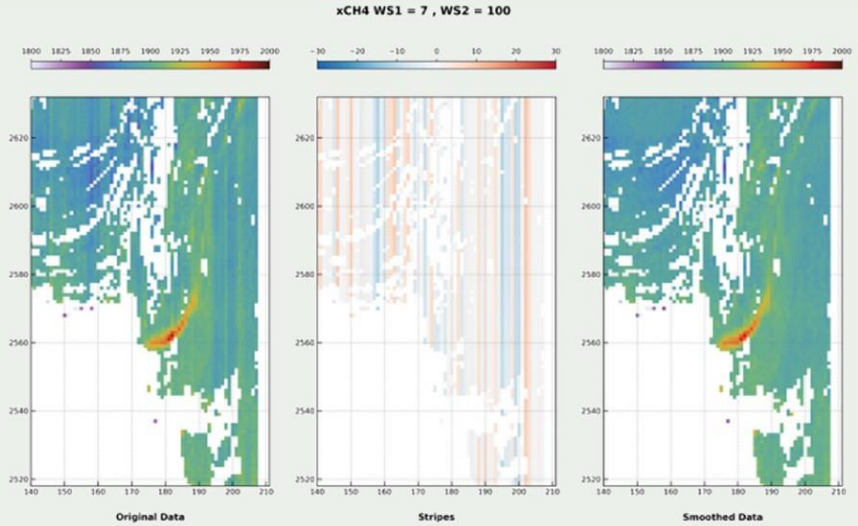
Towards WFMD v2.0 (Uni. Bremen)

- Better precision, destriping & aerosol correction
- Resource saving machine learning



Schneising et al., Uni. Bremen

Continued SRON improvement

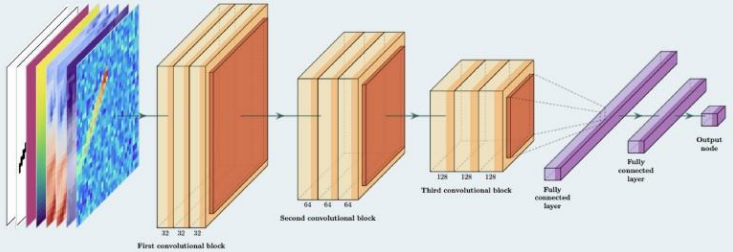


Borsdorff, Martinez, Barr, Mandal, Landgraf, SRON

- Continuous improvement of destriping
- New approach for data filtering and quality

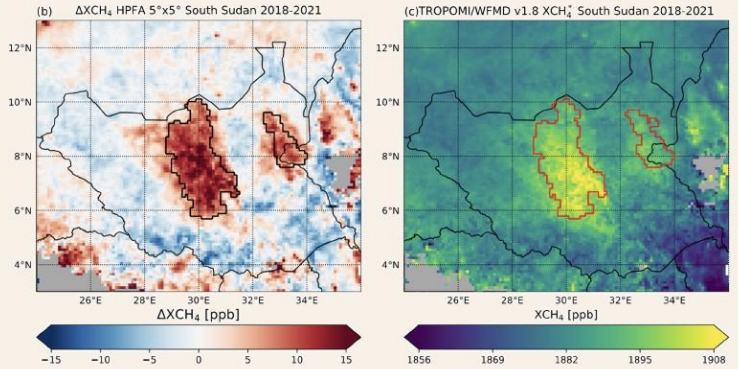
Preliminary results: towards non-FF hotspot detection

WRF-Chem informed plume detection (SRON)



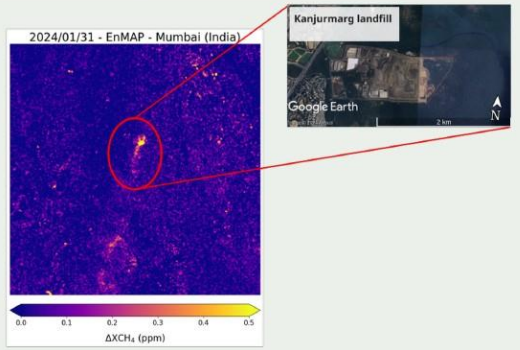
- Synthetic training
- Machine learning based fitting

Long-term detection of persistent sources (Uni. Bremen)



- Statistical long-term analyzis
- application to wetlands and landfills

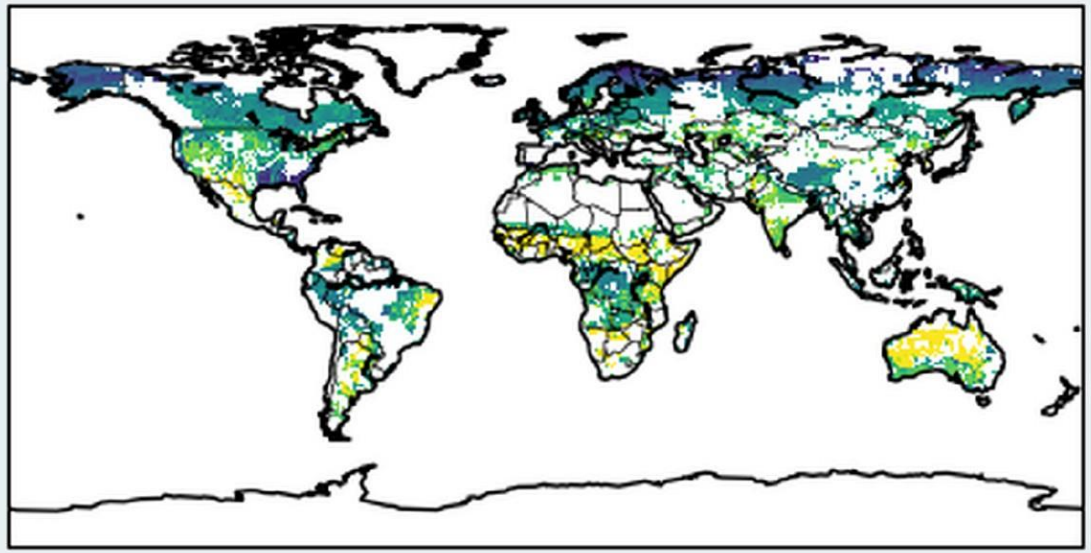
EnMAP/EMIT fine scale detection (UPV)



- Detection using fine scale satellites
- Application to landfills

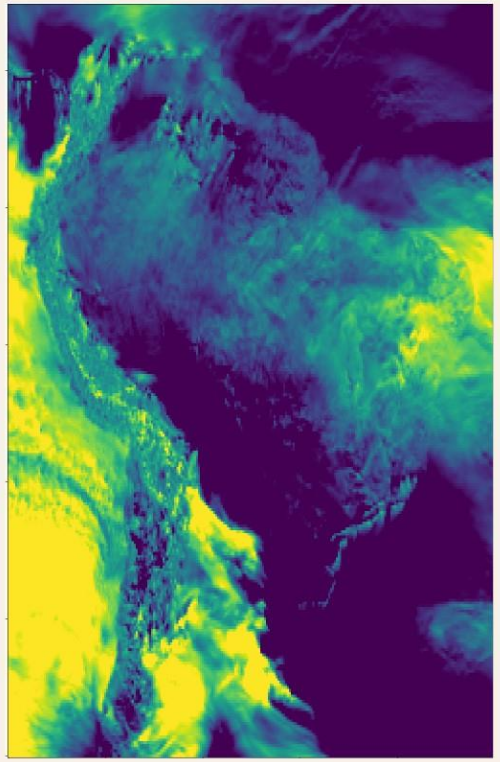
Preliminary results: regional and global inversions

Global inversions



- TM5-MP and LMDZ based inversions
- Use of TROPOMI / GOSAT / IASI, and isotopes
- Sector-based long-term inversions

Regional inversions



- Scandinavia and South America (+ preliminary on Europe)
- CHIMERE, FLEXPART and TM5-MP (zoom)
- use of TROPOMI data