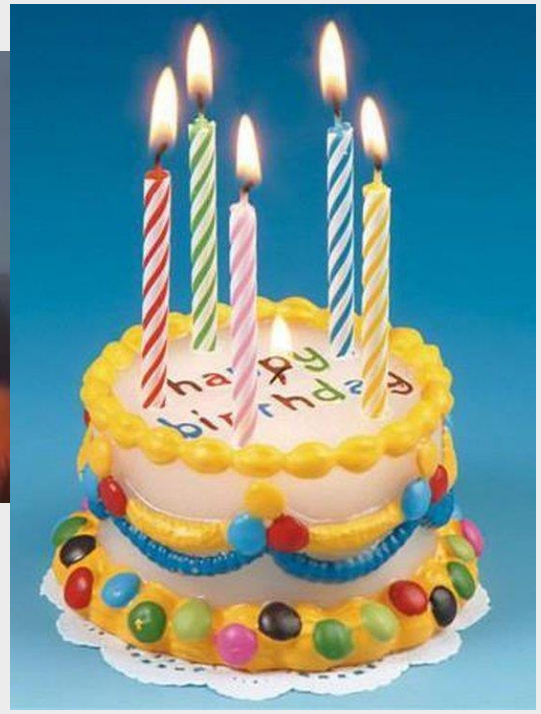
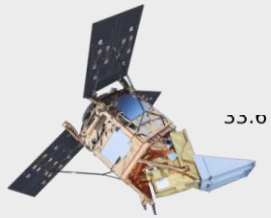
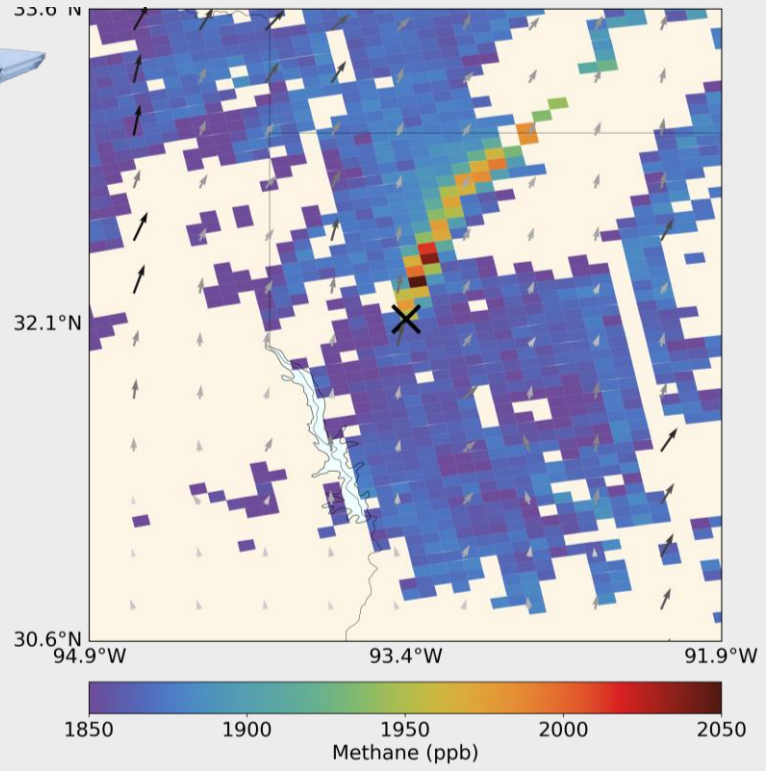
TROPOMI's SWIR channel measuring CH_4 and CO

Ilse Aben

On behalf of the TROPOMI SRON team and collaborators



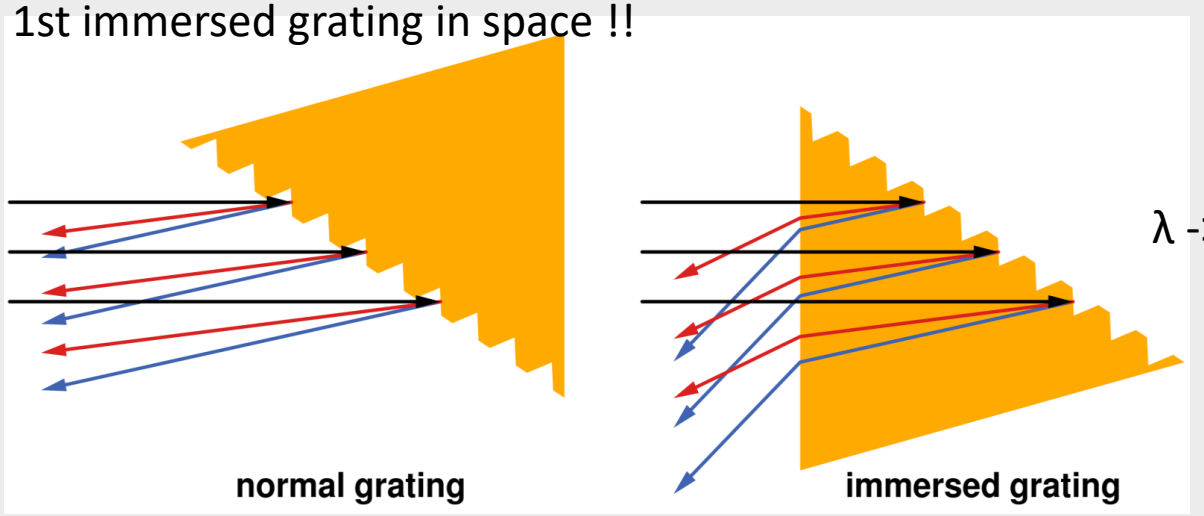




SRON
Netherlands Institute for Space Research

Key technology SWIR channel : immersed grating

1st immersed grating in space !!



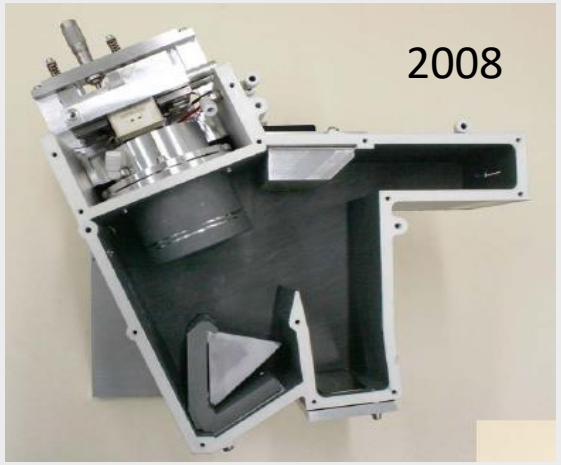
Volume reduction

$R = \lambda / \Delta\lambda = (2.N.a \sin\theta) / \lambda \approx D / \lambda$

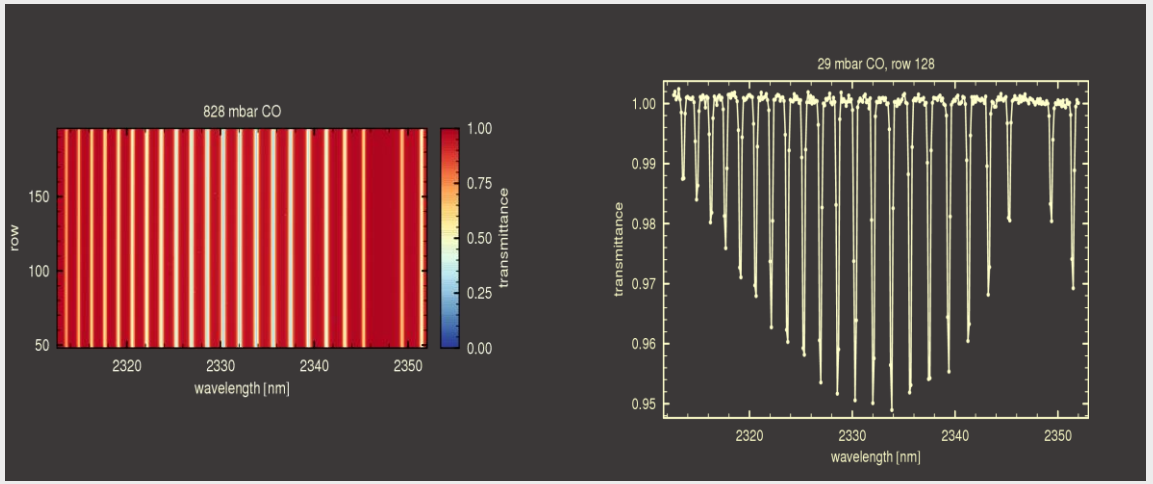
$\lambda \rightarrow \lambda/n$

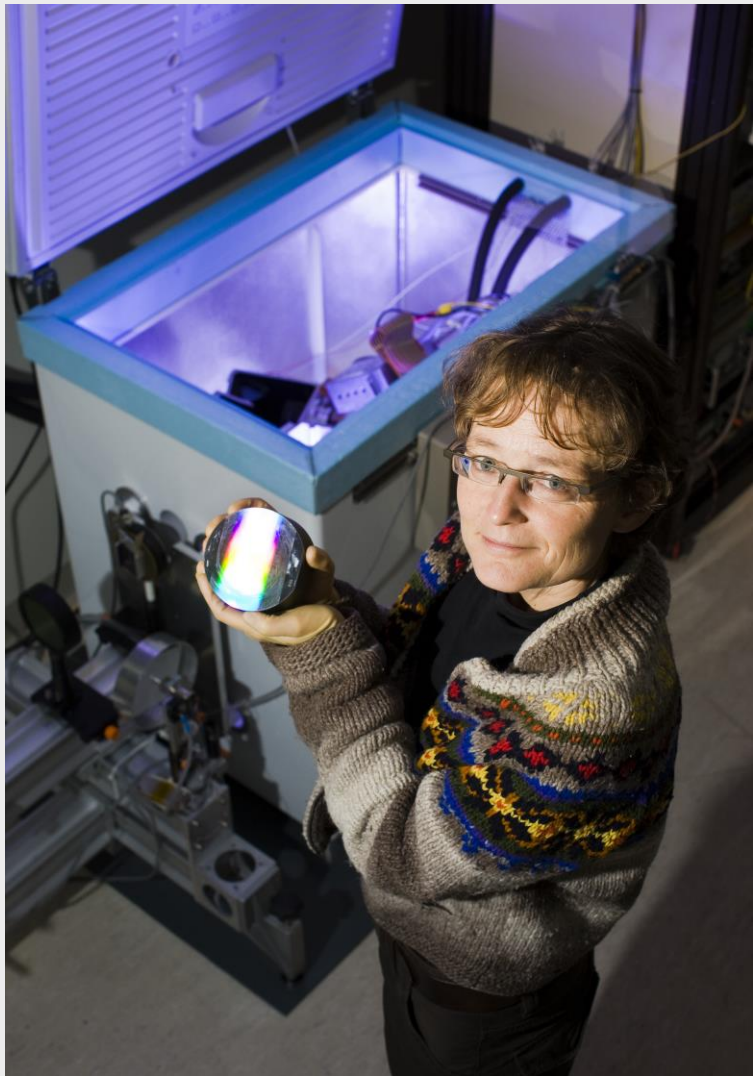
n_vacuum = 1.0
n_silicon = 3.5

30x smaller !! (120 → 3.5 L)



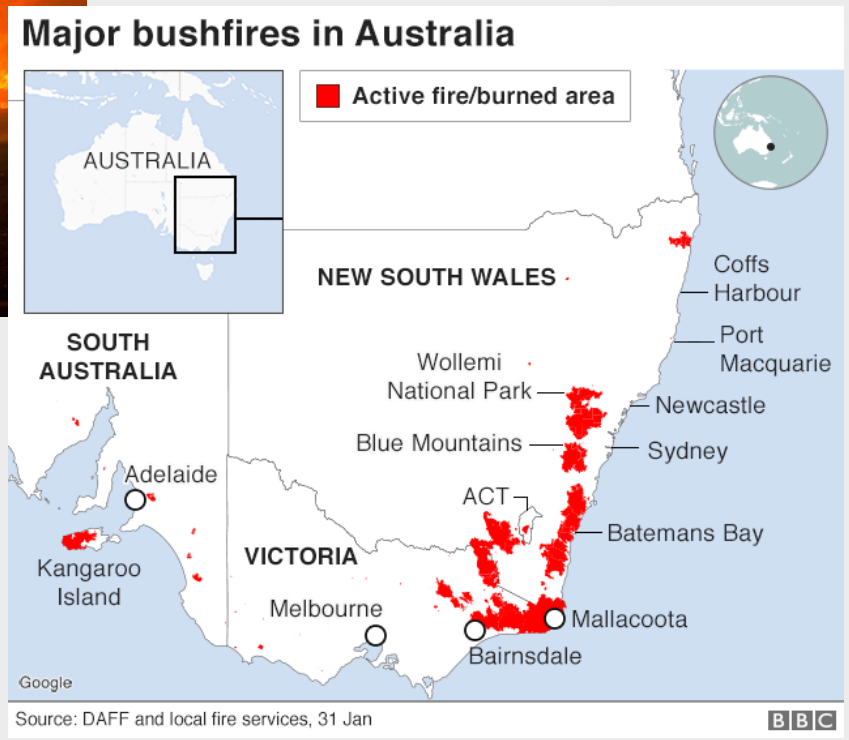
SWIR breadboard at SRON

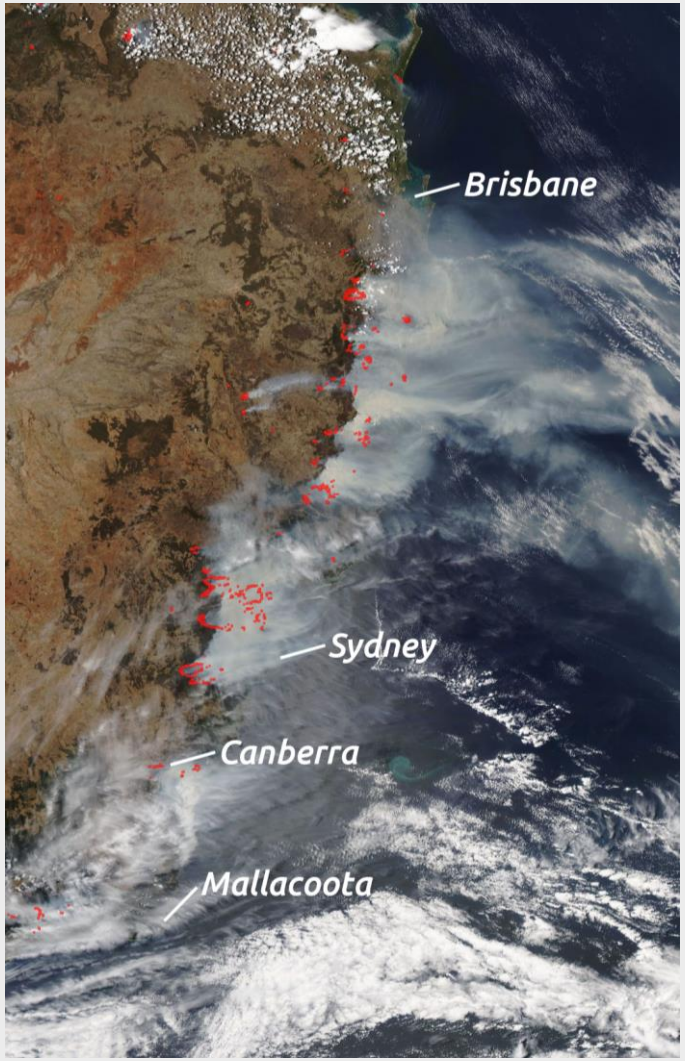




It works !!!!

TROPOMI measuring CO from wildfires → CO_2





Extreme 2019-2020 ‘black summer’ wildfires in Southeast Australia

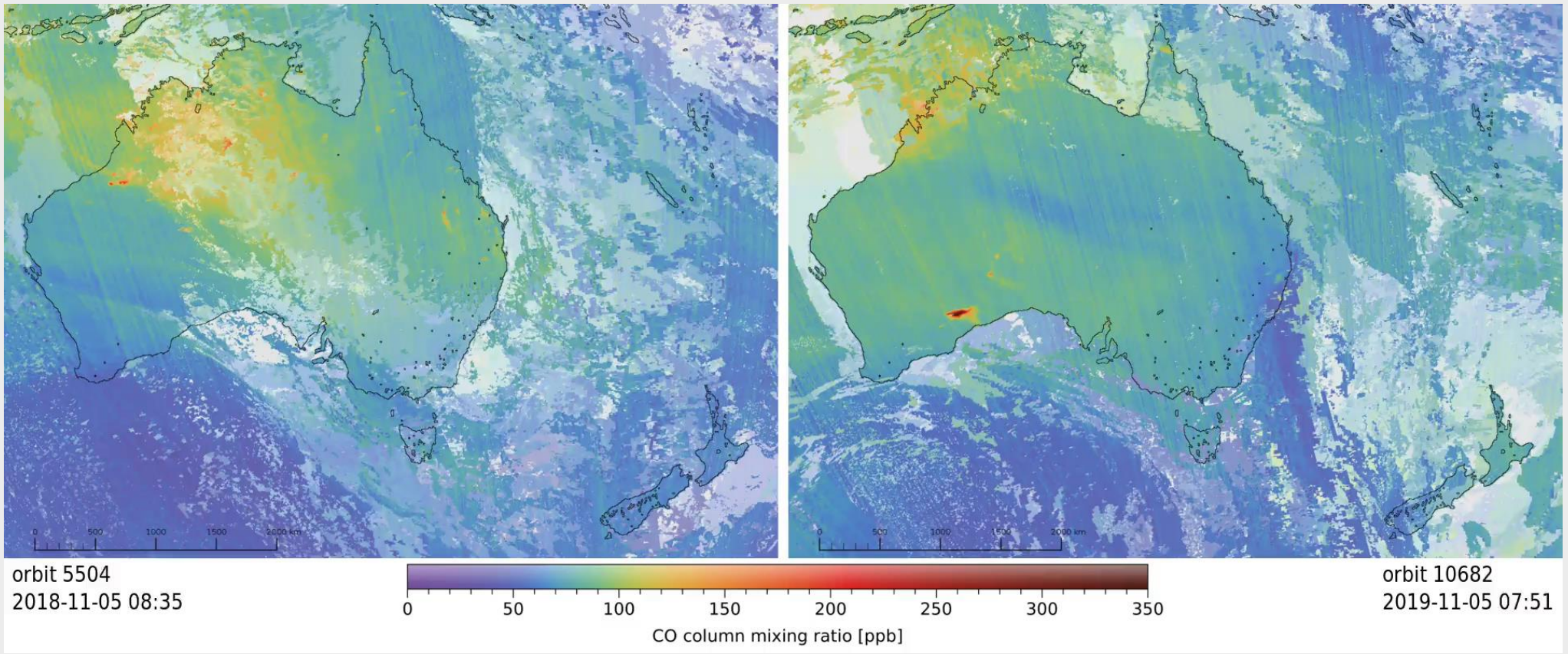
TROPOMI measuring CO from wildfires → CO_2

SRON Netherlands Institute for Space Research

VRIJE UNIVERSITEIT AMSTERDAM

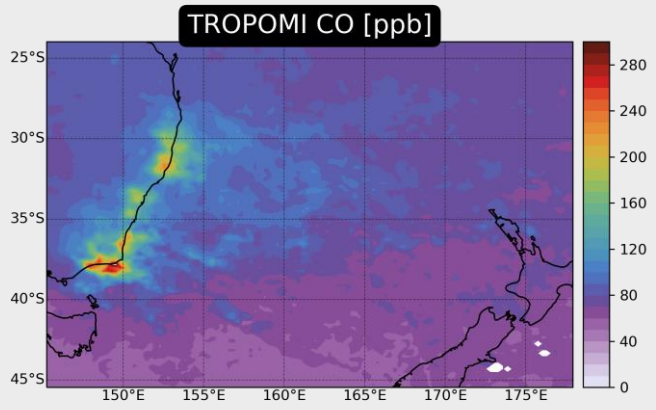
2018/2019

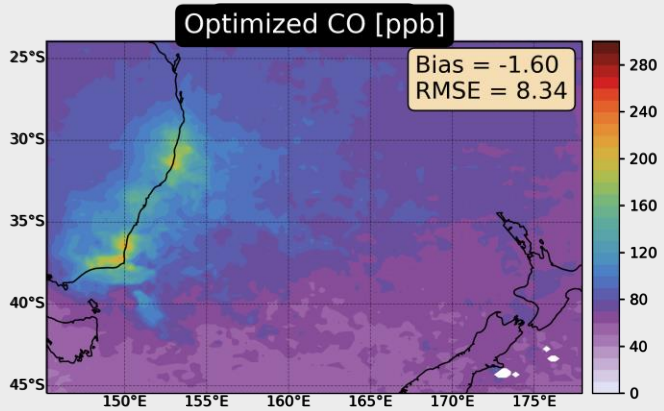
2019/2020

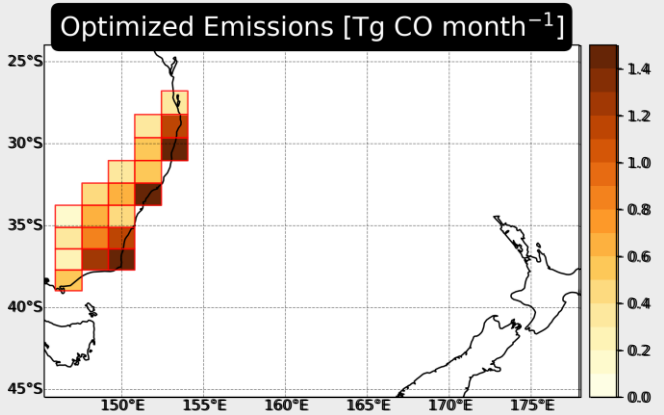


TROPOMI measuring CO from wildfires → CO_2

Transport model + Prior BB_{CO} → (TROPOMI CO; Atmospheric inversion) → Optimized BB_{CO}





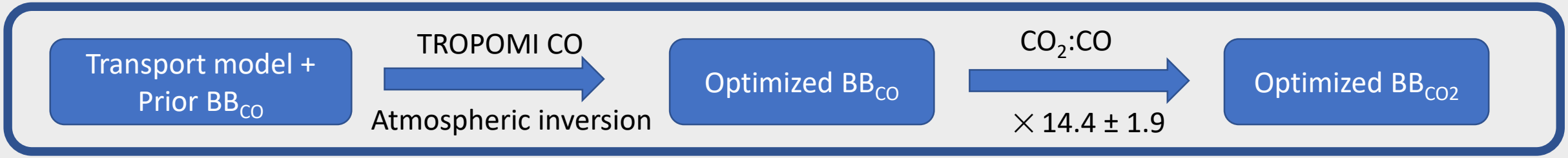


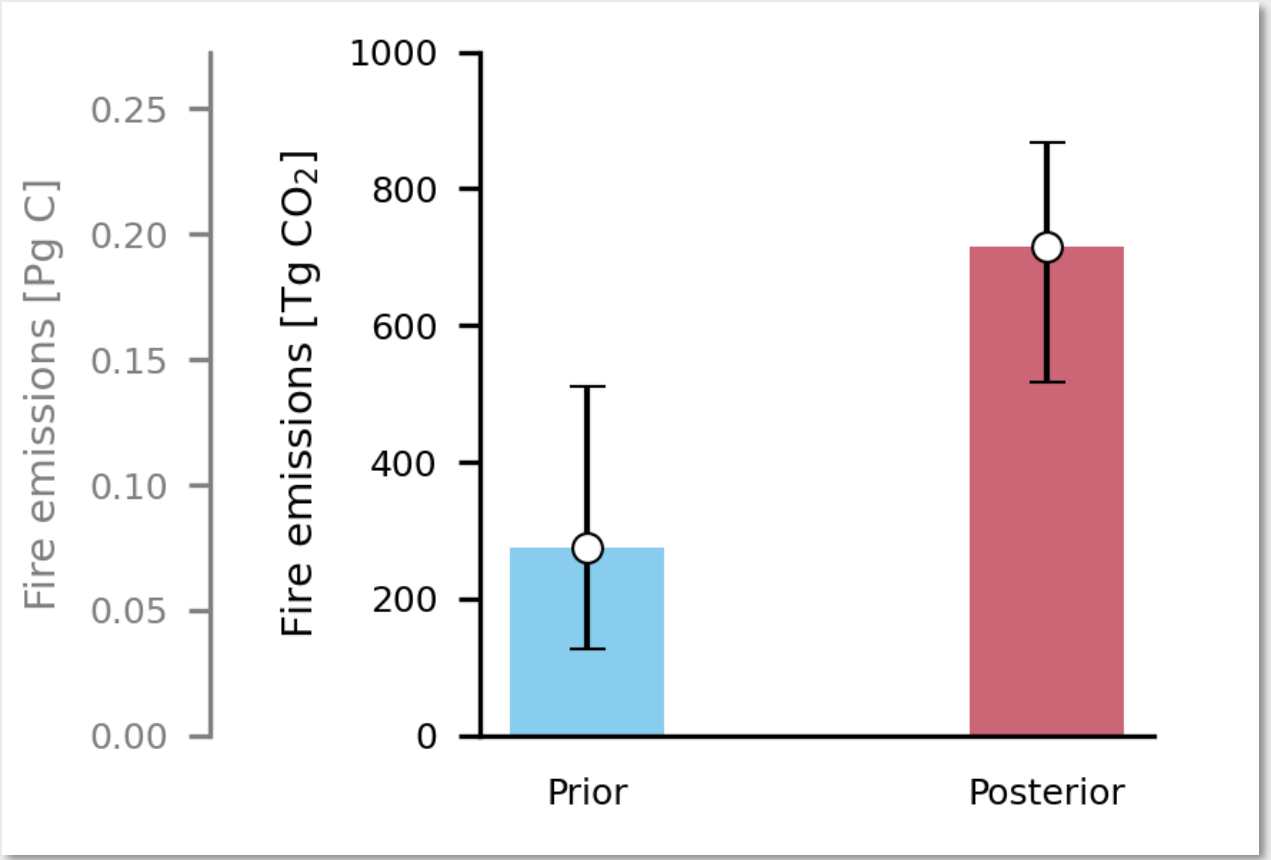
1. Performed flux inversions for 20 180x180km regions over Australia between Nov 2019 – Jan 2020.
2. After optimization, a number of hotspots appear with much larger fires emissions

nature

Vd Velde et al. 2021

TROPOMI measuring CO from wildfires → CO_2



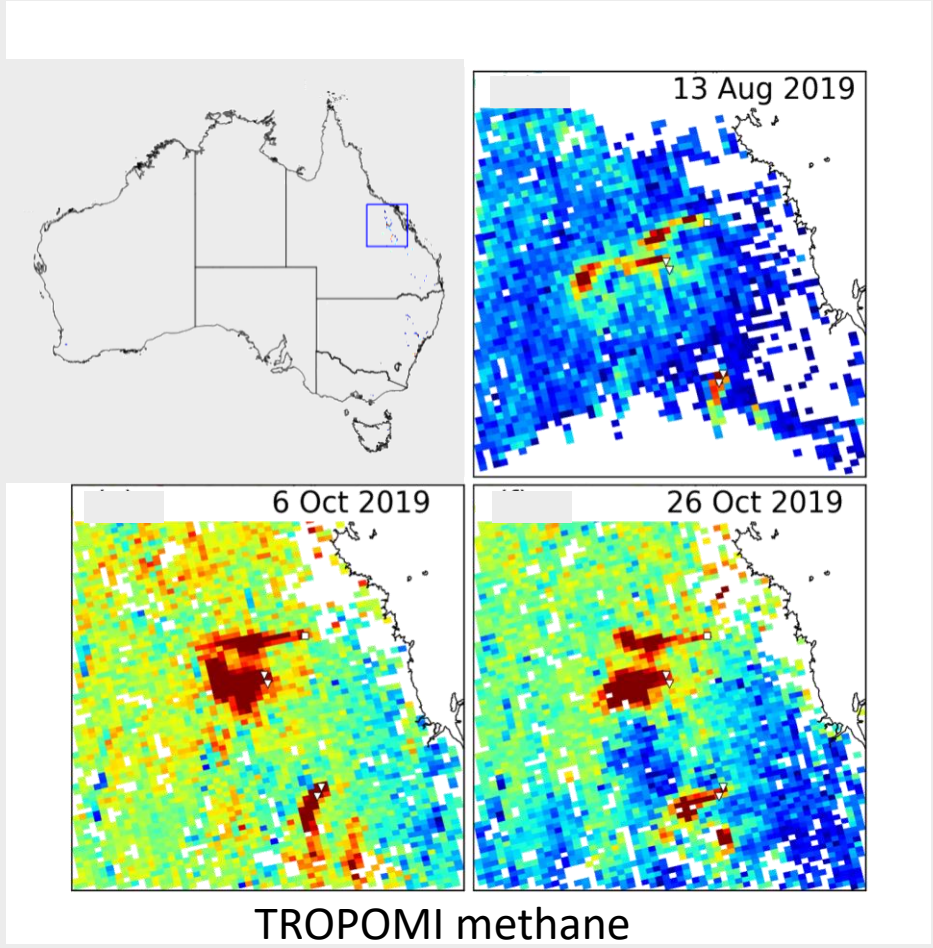


- 715 Tg CO_2 released to atmosphere for the 3-month period
- ~10% of global BB emissions per year
- ~2 times larger than Australia's total greenhouse gas emissions per year

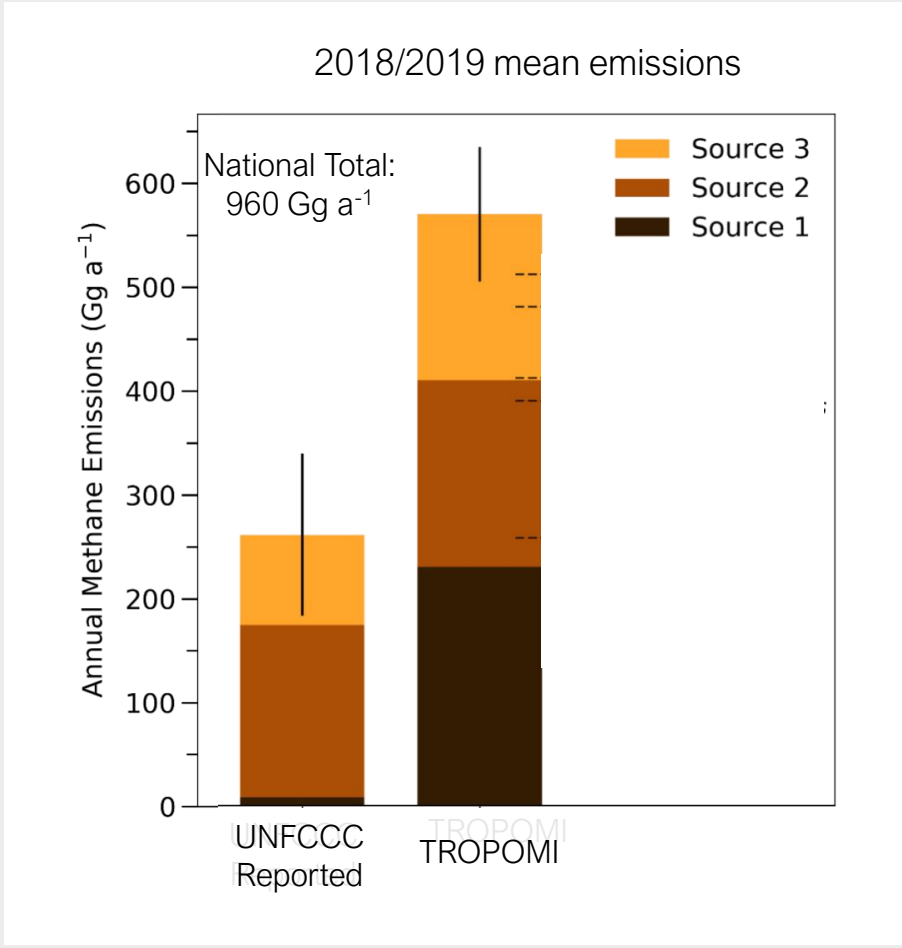
nature

Vd Velde et al. 2021

Australian methane super emitter coal mines



TROPOMI methane



6 mines : 7% AUS coal production, 55% reported CH_4 coal emissions

1 mine (surface mine) : 1% AUS coal production, 24 % reported CH_4 coal emissions

Sadavarte et al., ES&T, 2021

Detecting TROPOMI CH_4 plumes using ML & tip-and-cue high spatial resol. sats

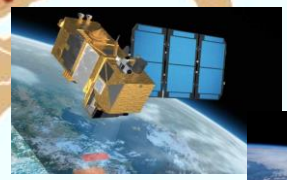
SRON Netherlands Institute for Space

2021 TROPOMI-detected Super-emitters

~3000 plumes detected in 2021

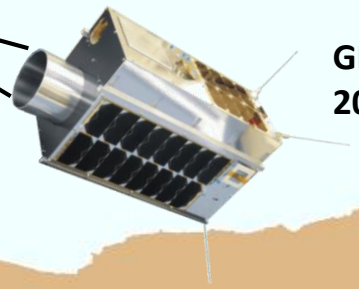
10 tons hr^{-1}

100 tons hr^{-1}



SENTINEL-2

PRISMA

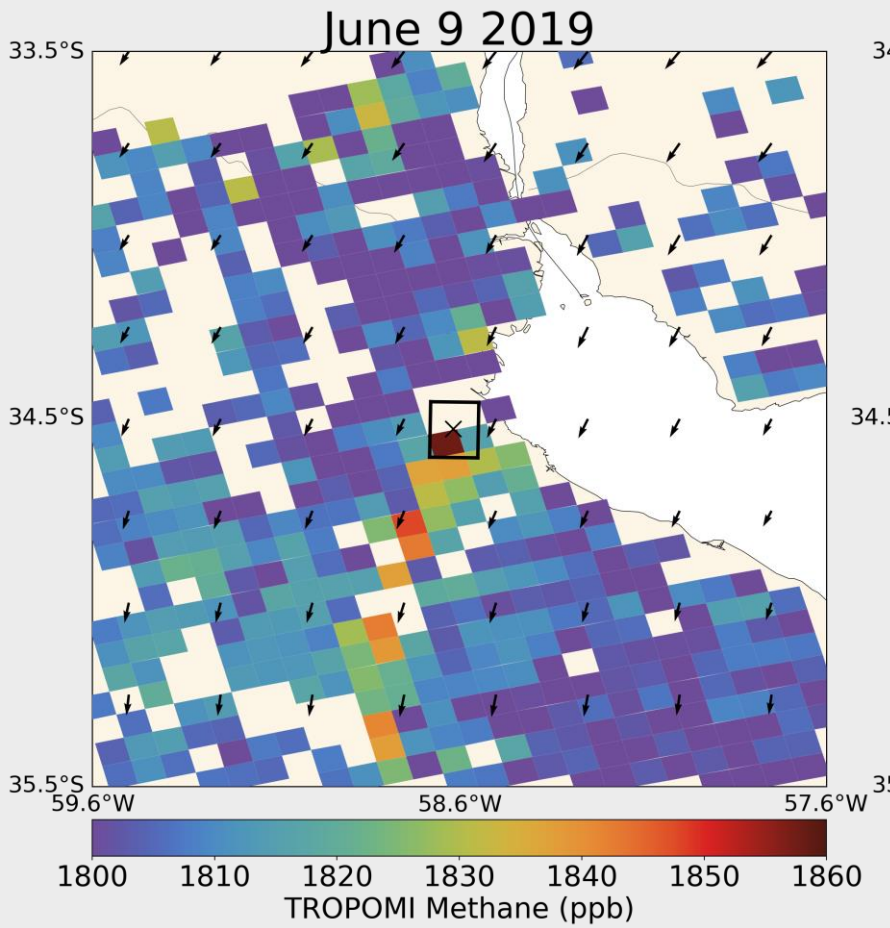


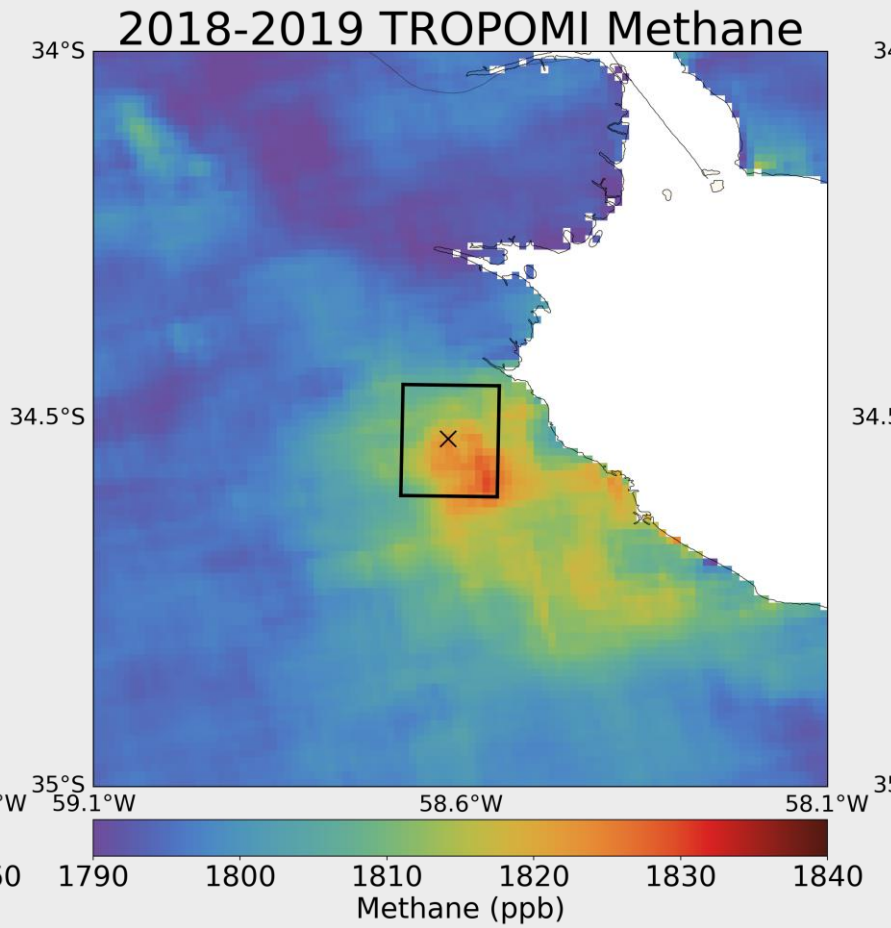
GHGSat C-x
20 m resolution

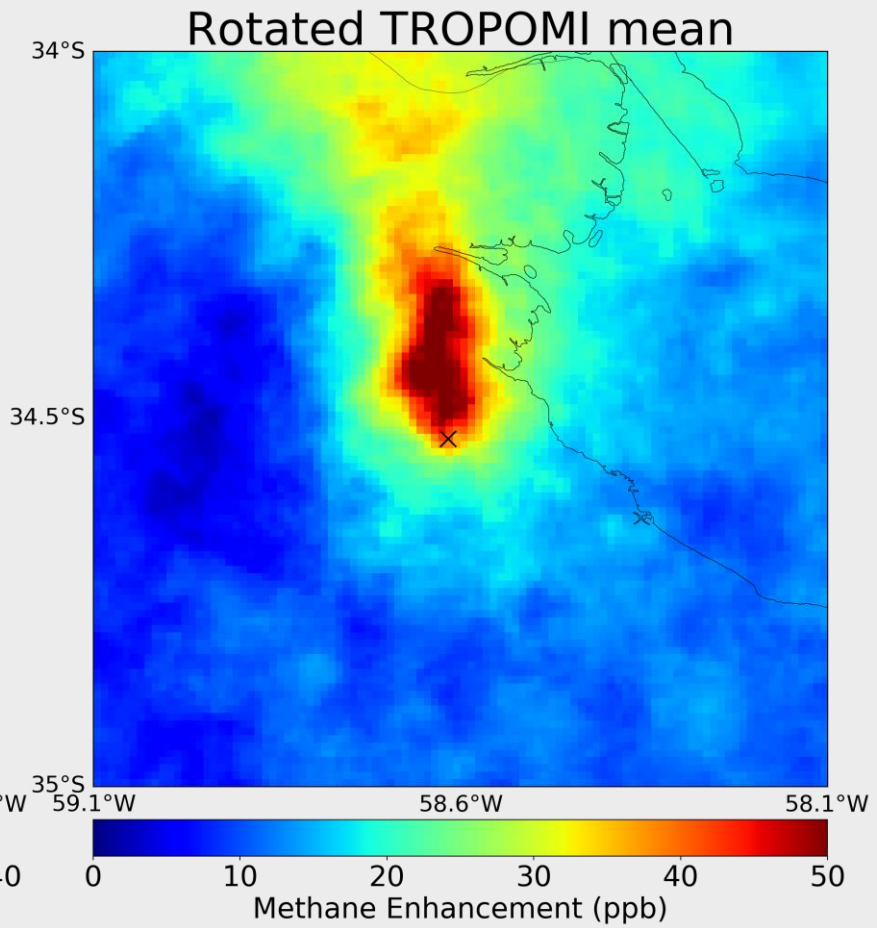
Schuit et al. (in prep)

TROPOMI ‘tip-and-cue’ GHGSat : persistent emissions Buenos Aires (Argentina)

Use data from different days with different winds to find rough location

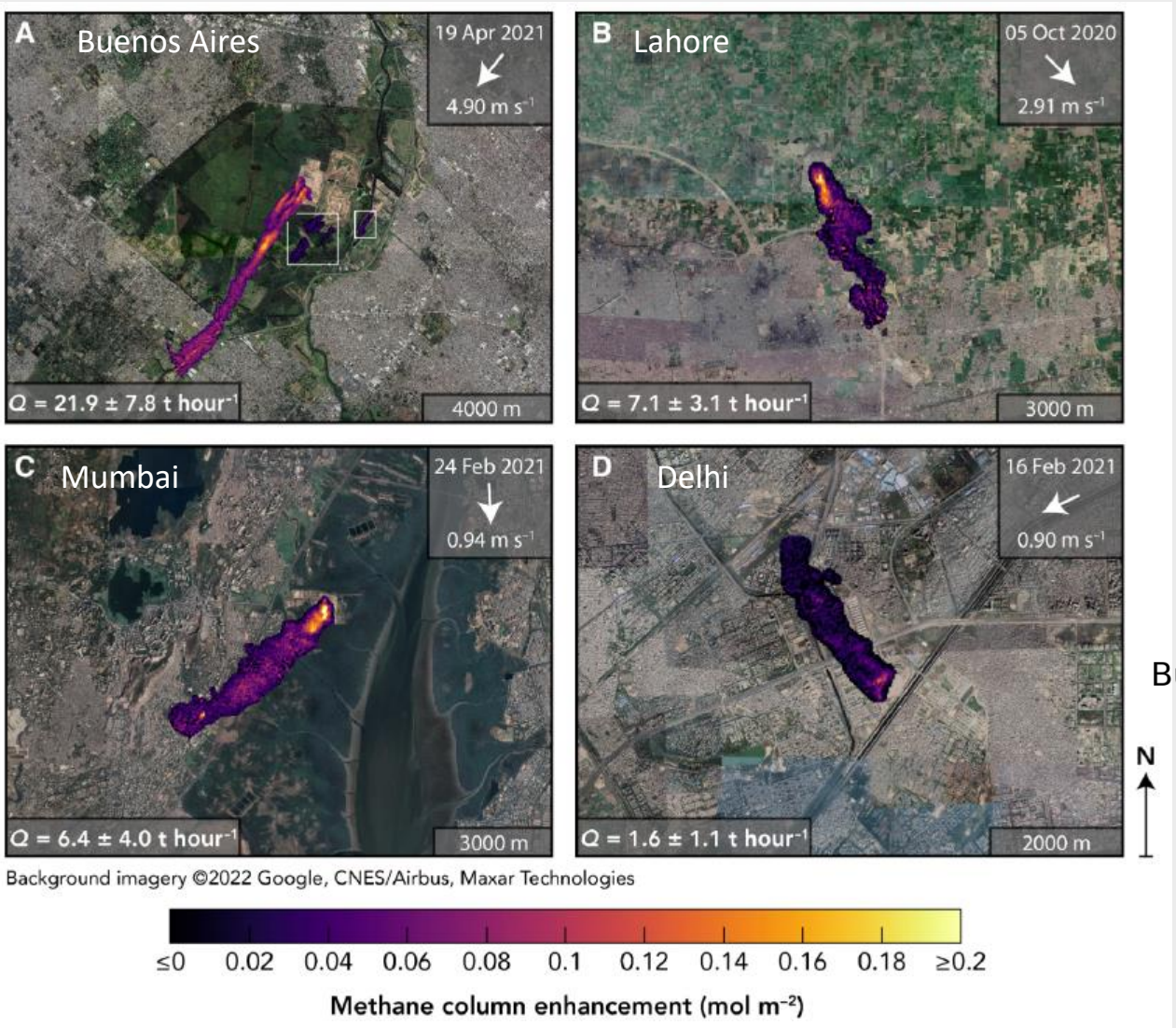


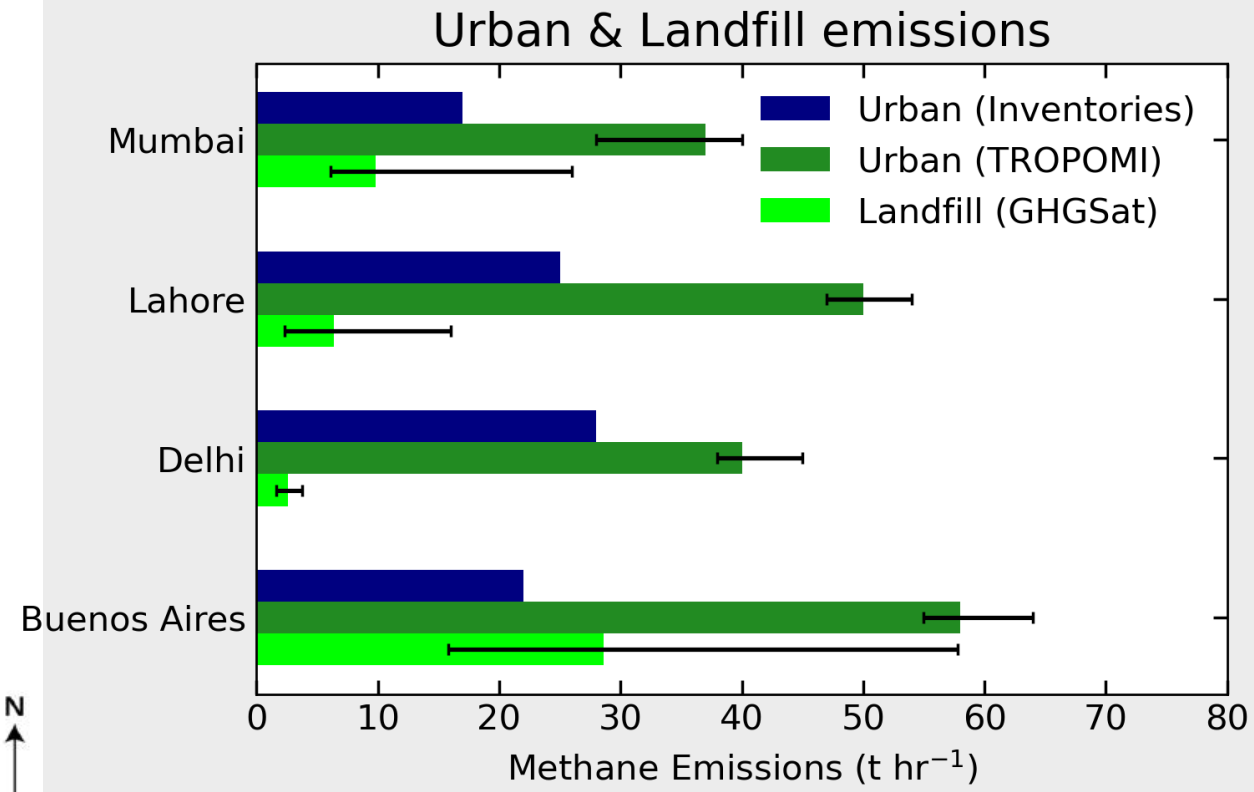




Maasakkers et al. (Science Adv.2022)

TROPOMI - GHGSat : methane emissions landfills





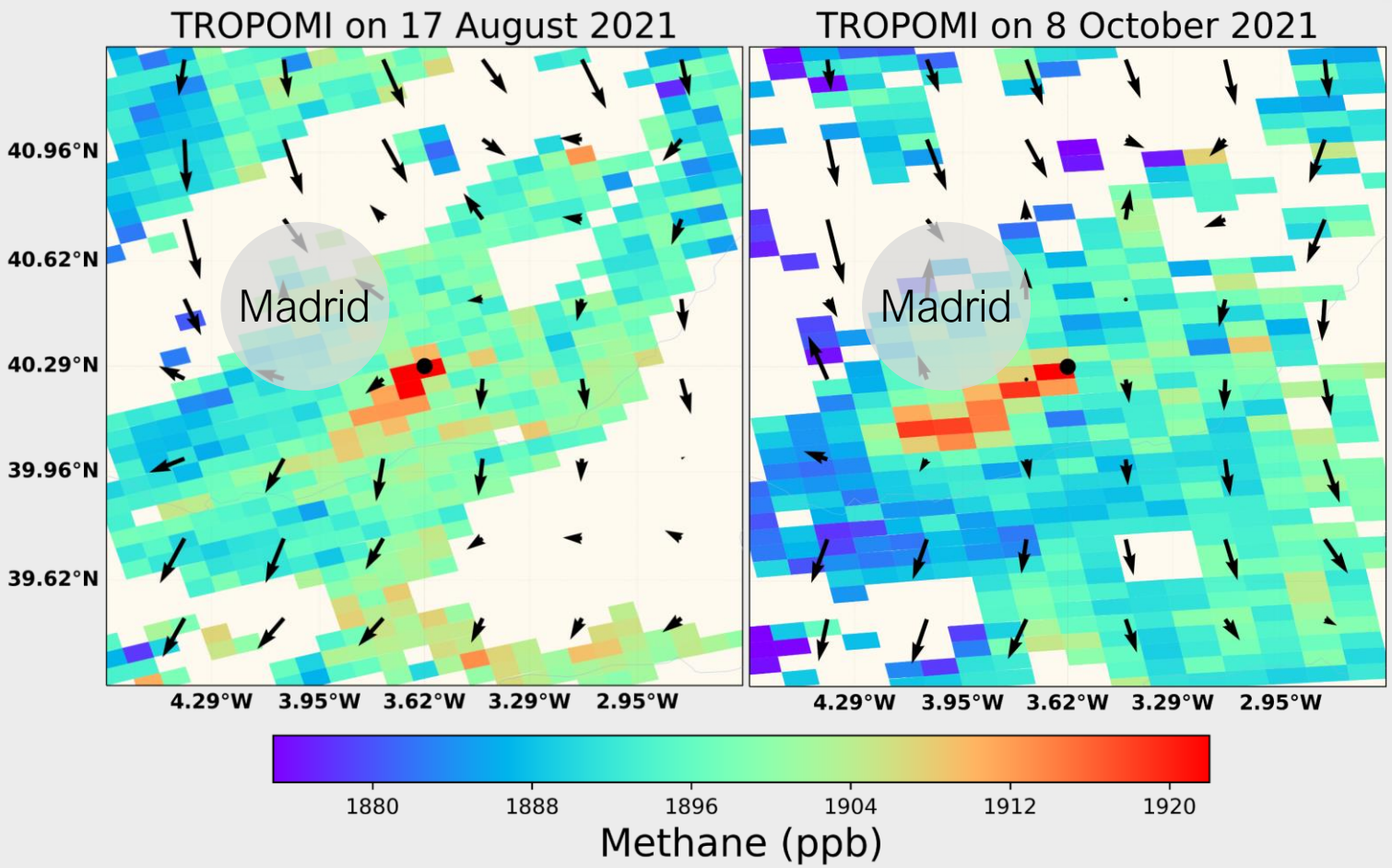
First space-based detections of methane emissions from landfills !

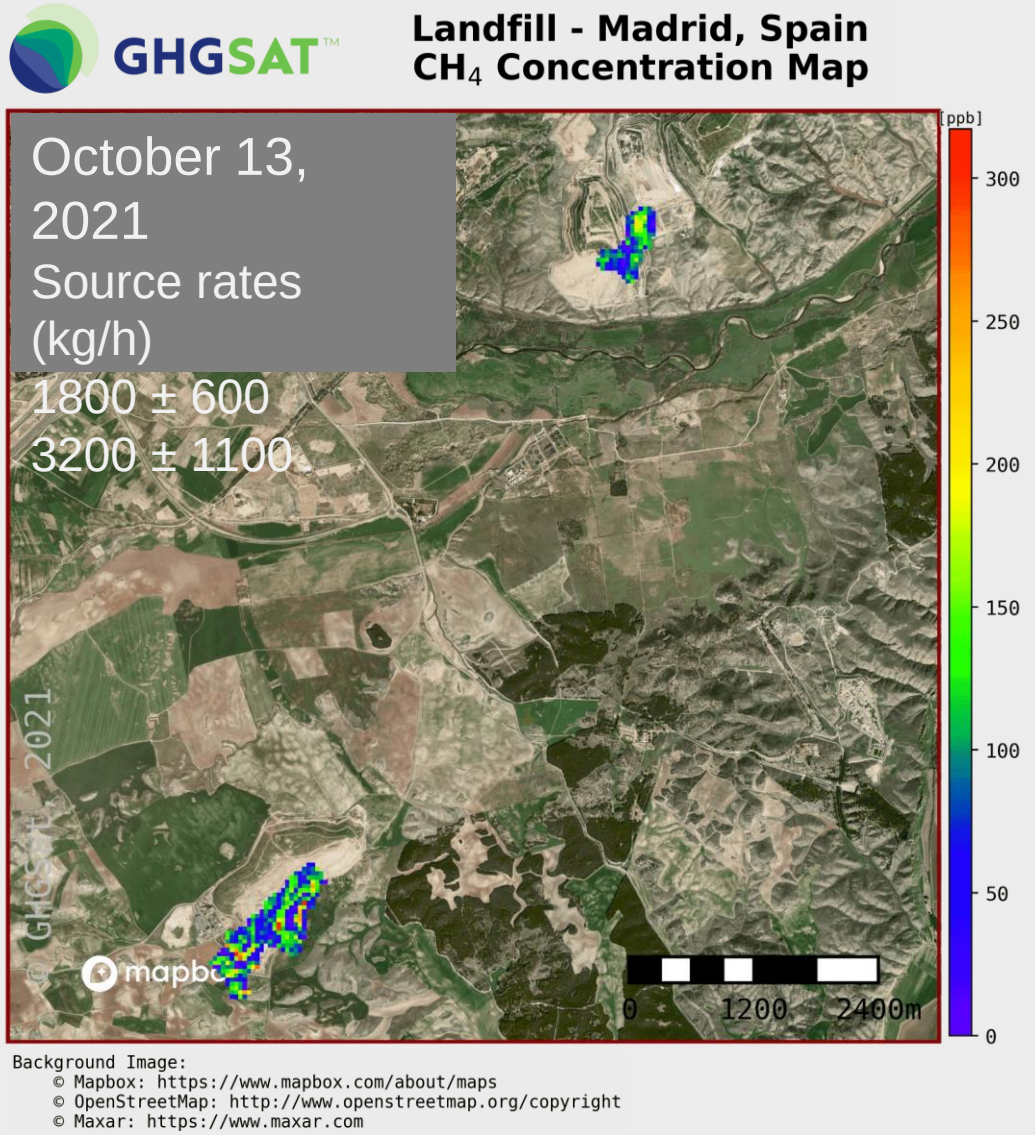
By now detected methane emissions from **many more landfills**

Maasakkers et al., Science Adv., 2022

Landfill emissions are also detected in Europe

Guided by long-term TROPOMI data, GHGSat detected large emissions from landfills near Madrid on multiple days in 2021.





ESA coordinated a ground-based, aircraft, satellite campaign summer 2022 (EDAP)

Figure Credit: Gourav Mahapatra. ESA web story from November 11.

International Methane Emissions Observatory (IMEO)
Methane **A**lert and **R**esponse **S**ystem (**MARS**)

IMEO will support governments and companies to reduce their emissions as agreed in the Methane Pledge at COP26

MARS :
1. detection, 2. notification and 3. mitigation

1st element of the MARS detection system is the Super Emitter detection system using TROPOMI and other satellites to pin-point exact facilities leaking/emitting.

(IMEO/UNEP, Kayrros, EDF, Univ. Valenc., SRON)

‘TROPOMI is a real game changer

producing exciting research

with direct societal impact’

THANK YOU

TROPOMI-team