



CEOS AC-VC-22

SRON, Leiden 2026-06-04

Greenhouse Gas Observations

6.1 Welcome & Session Opening

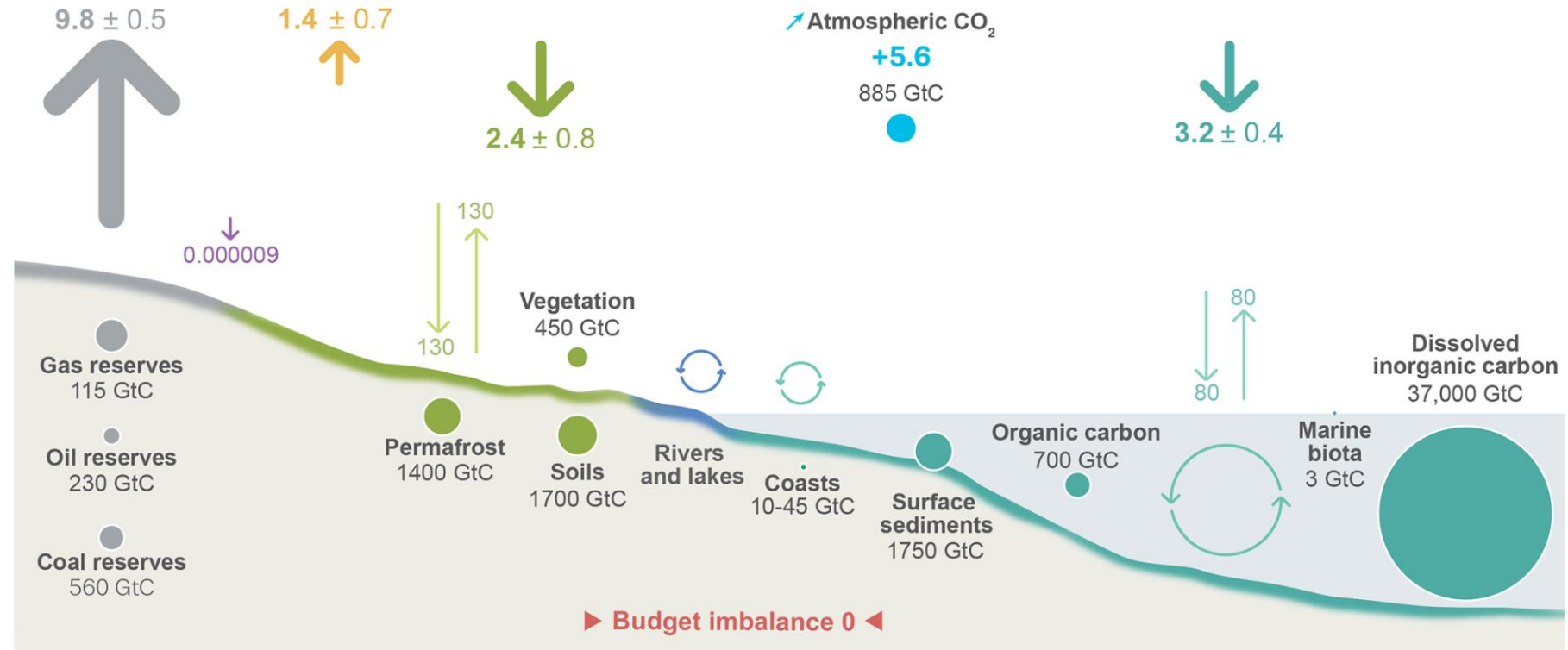
Charles Miller



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California Institute of Technology

For required markings, please visit <https://mh.jpl.nasa.gov>

The global carbon cycle



Friedlingstein et al., ESSD (2026)

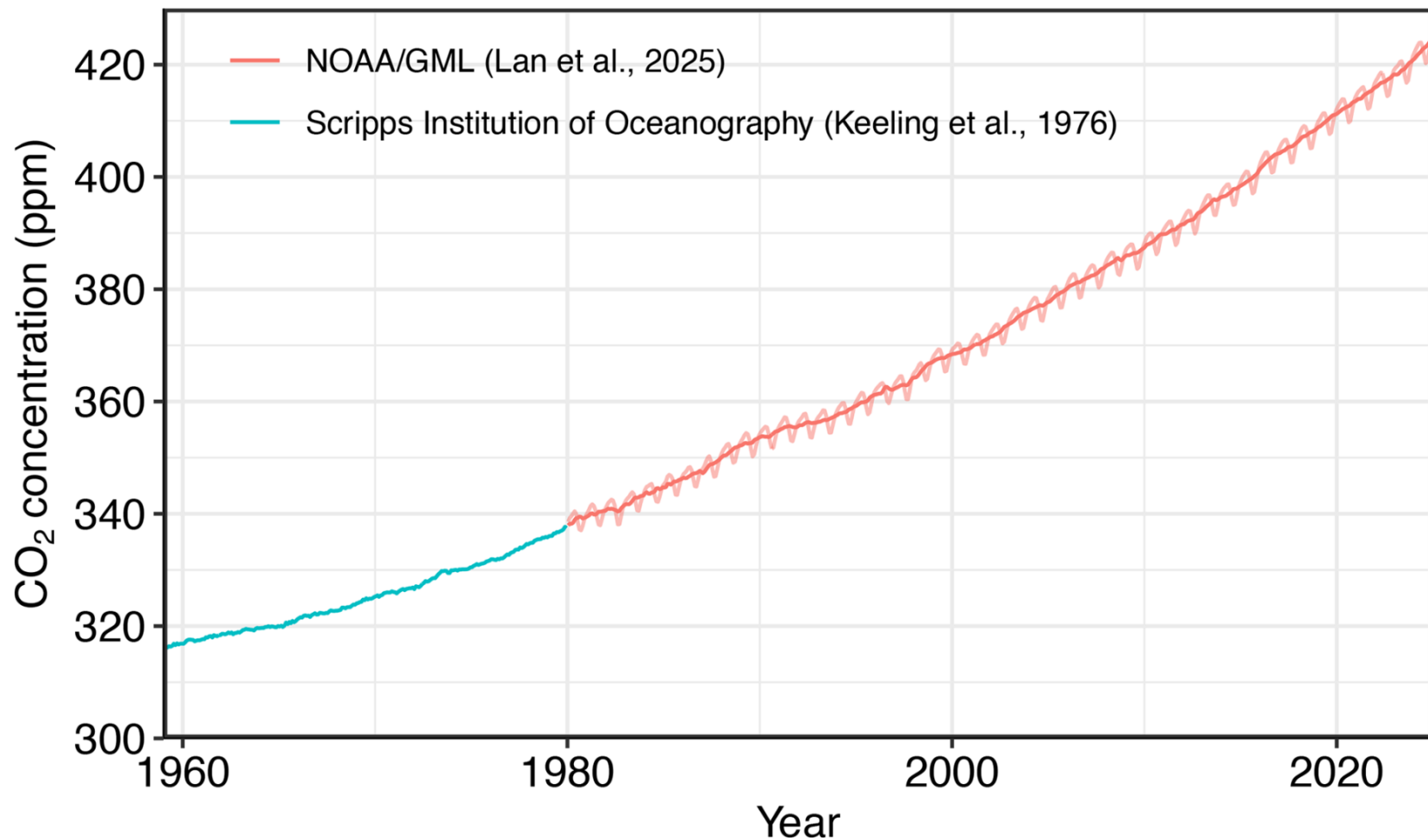
Anthropogenic fluxes
2015-2024 average
GtC per year

↑ Fossil CO₂ E_{FOS}
 ↑ Land-use change E_{LUC}
 ↓ CDR not included in E_{LUC}

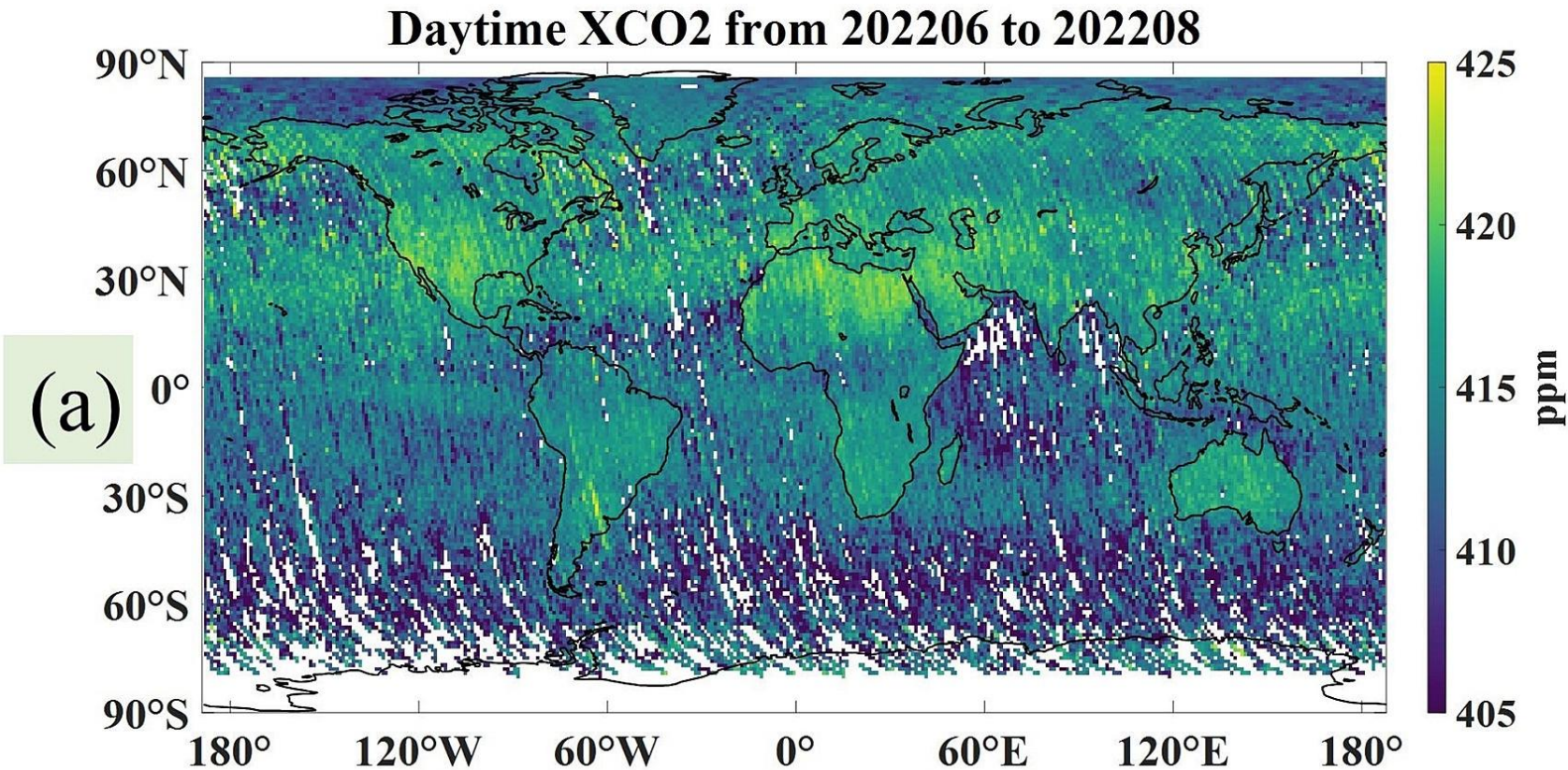
↓ Land uptake S_{LAND}
 ↓ Ocean uptake S_{OCEAN}
 + Atmospheric increase G_{ATM}

► Budget Imbalance B_{IM}
 ● Stocks GtC
 ↓↑ Natural carbon fluxes in GtC

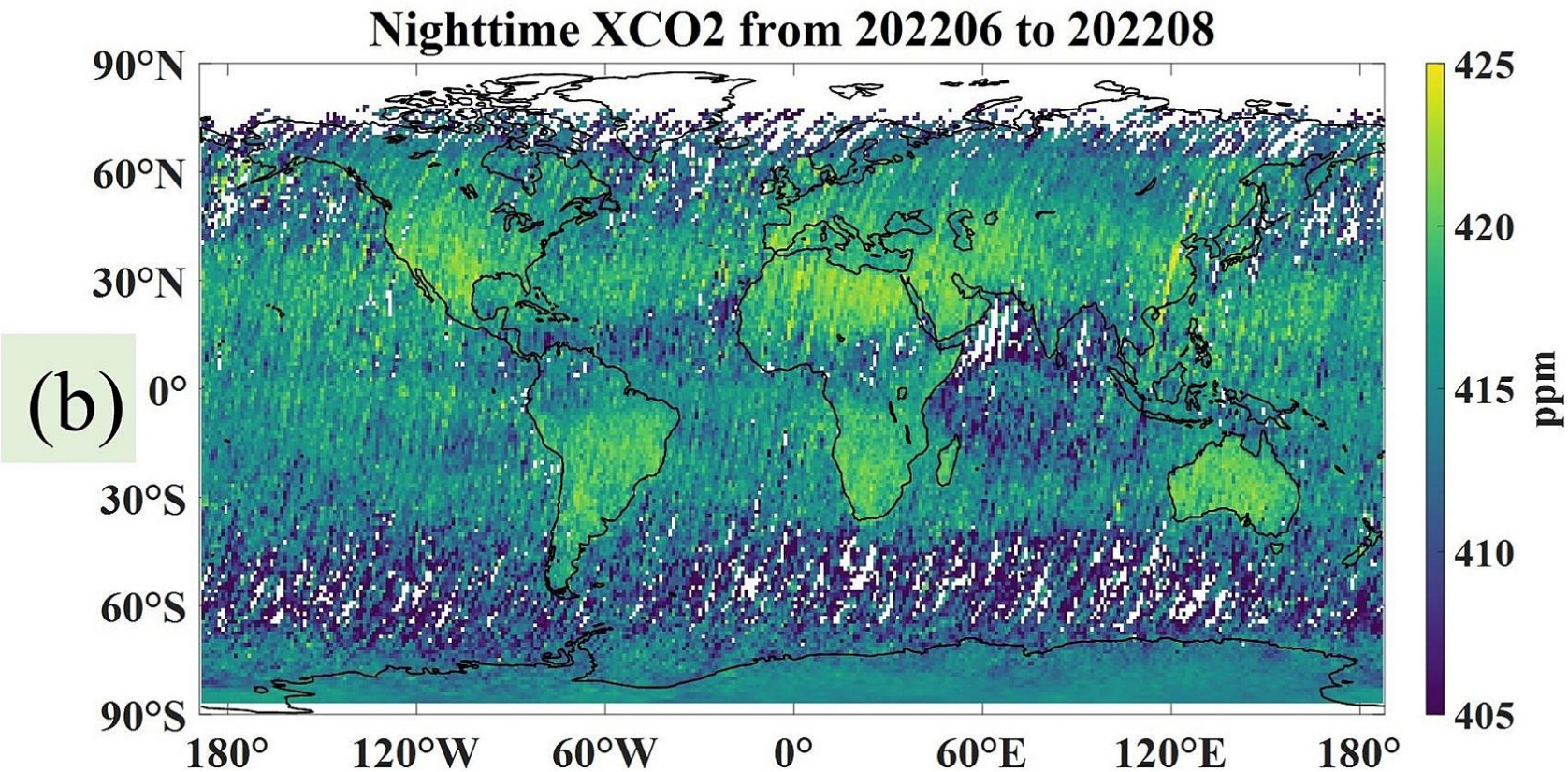
Atmospheric CO₂ Concentration



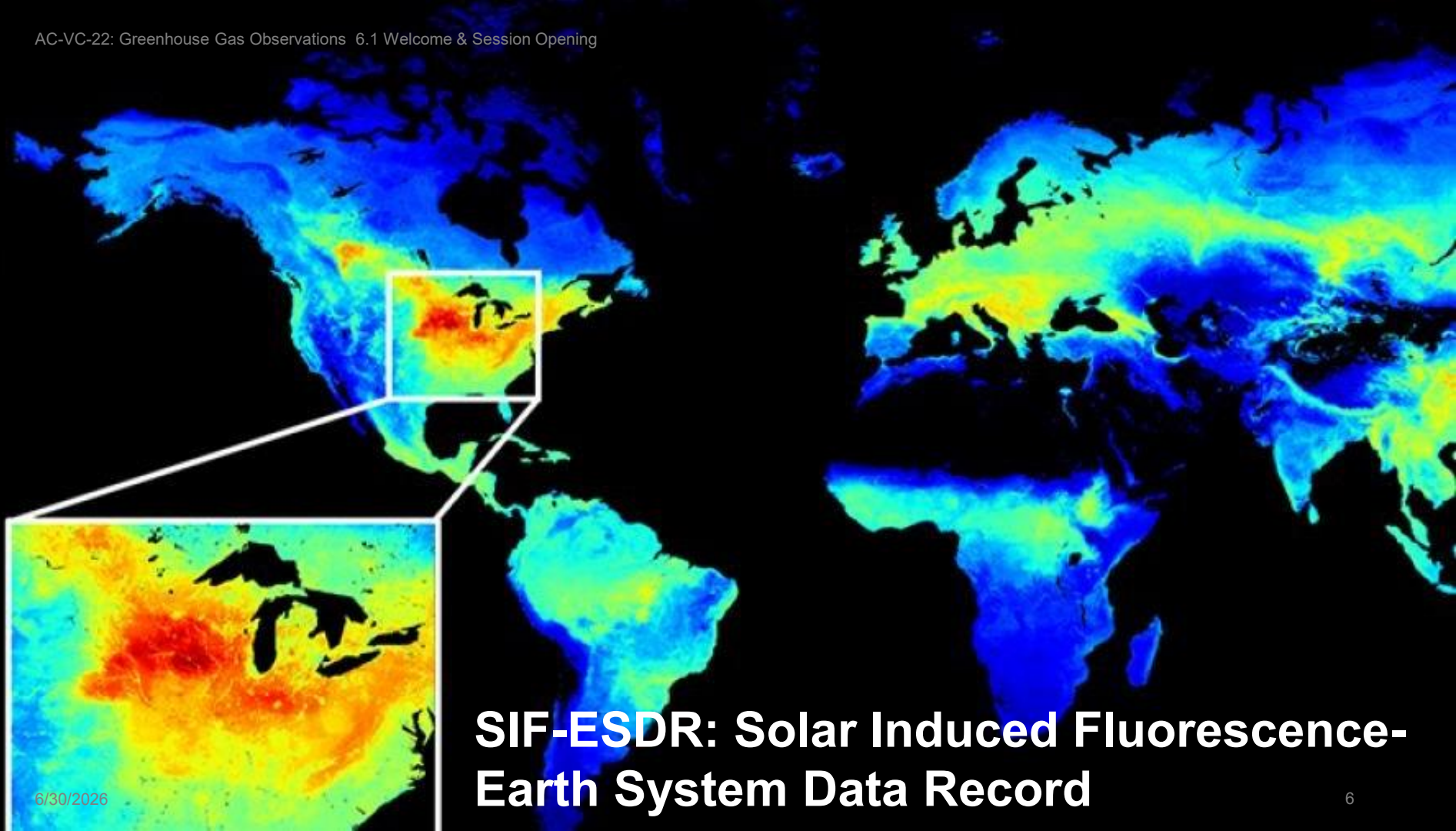
Friedlingstein et al., ESSD (2026)



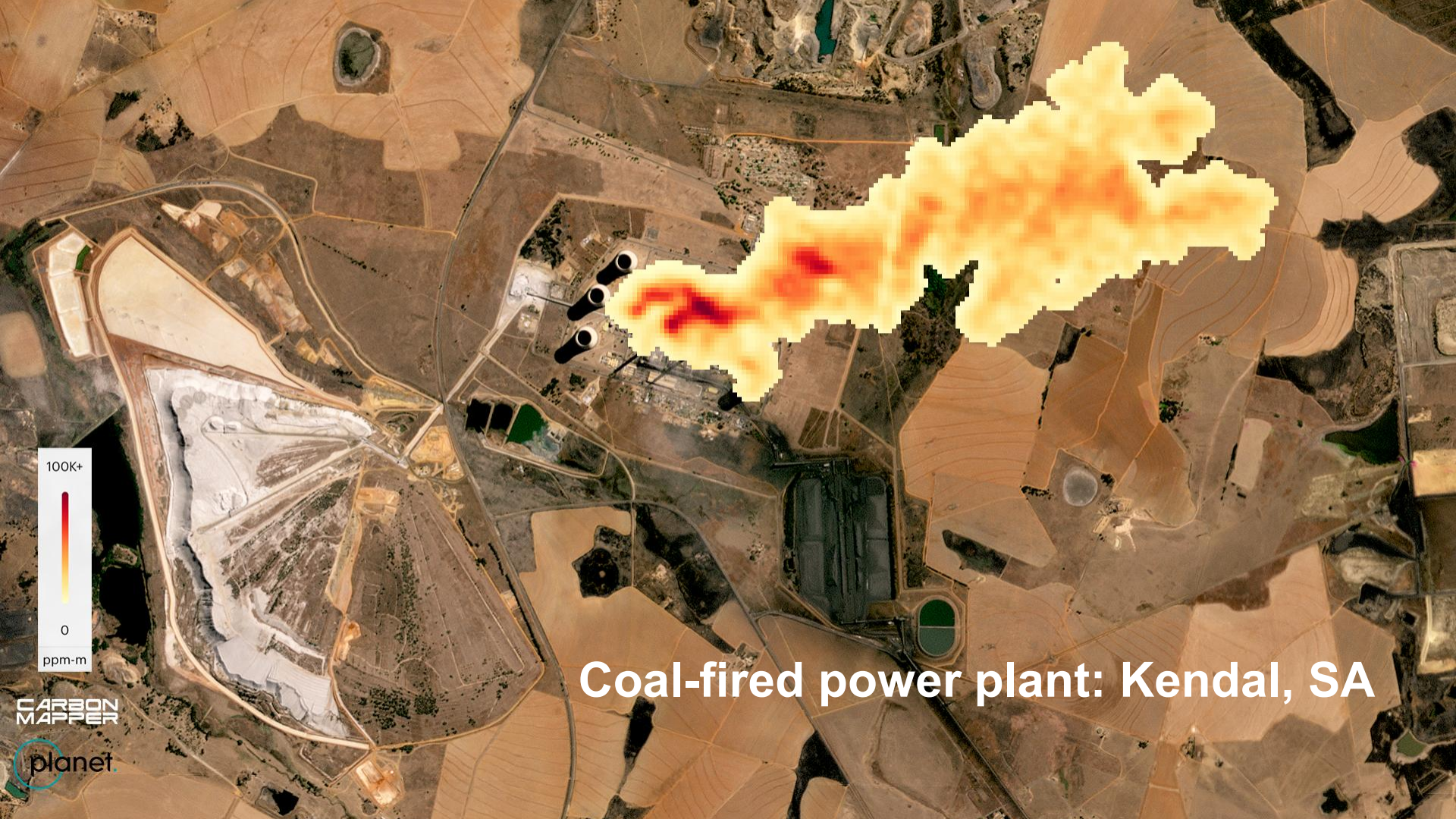
*First global XCO₂ observations from
spaceborne lidar
Ge et al., RSE (2025)*



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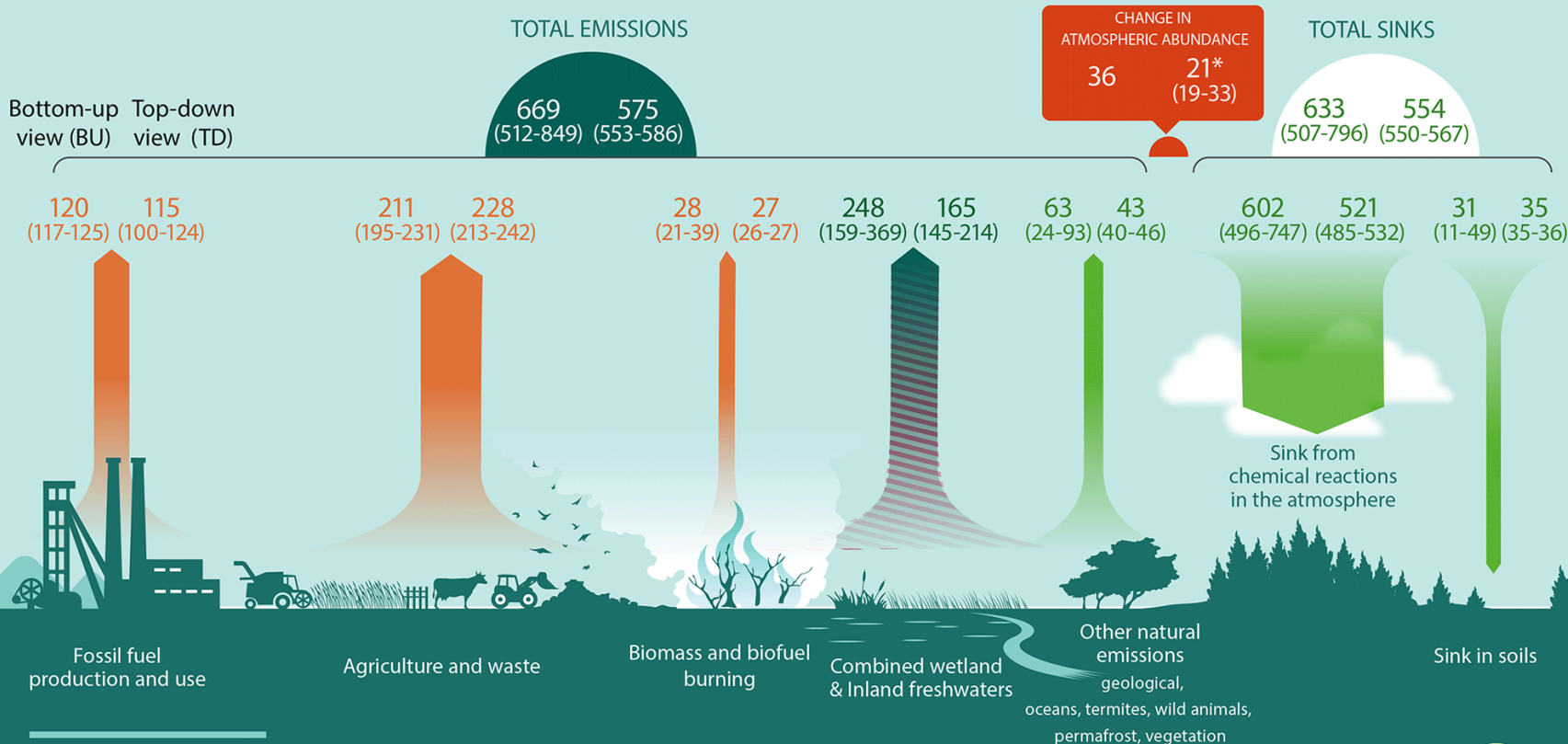
SIF-ESDR: Solar Induced Fluorescence- Earth System Data Record



100K+
0
ppm-m

Coal-fired power plant: Kendal, SA

GLOBAL METHANE BUDGET 2010-2019

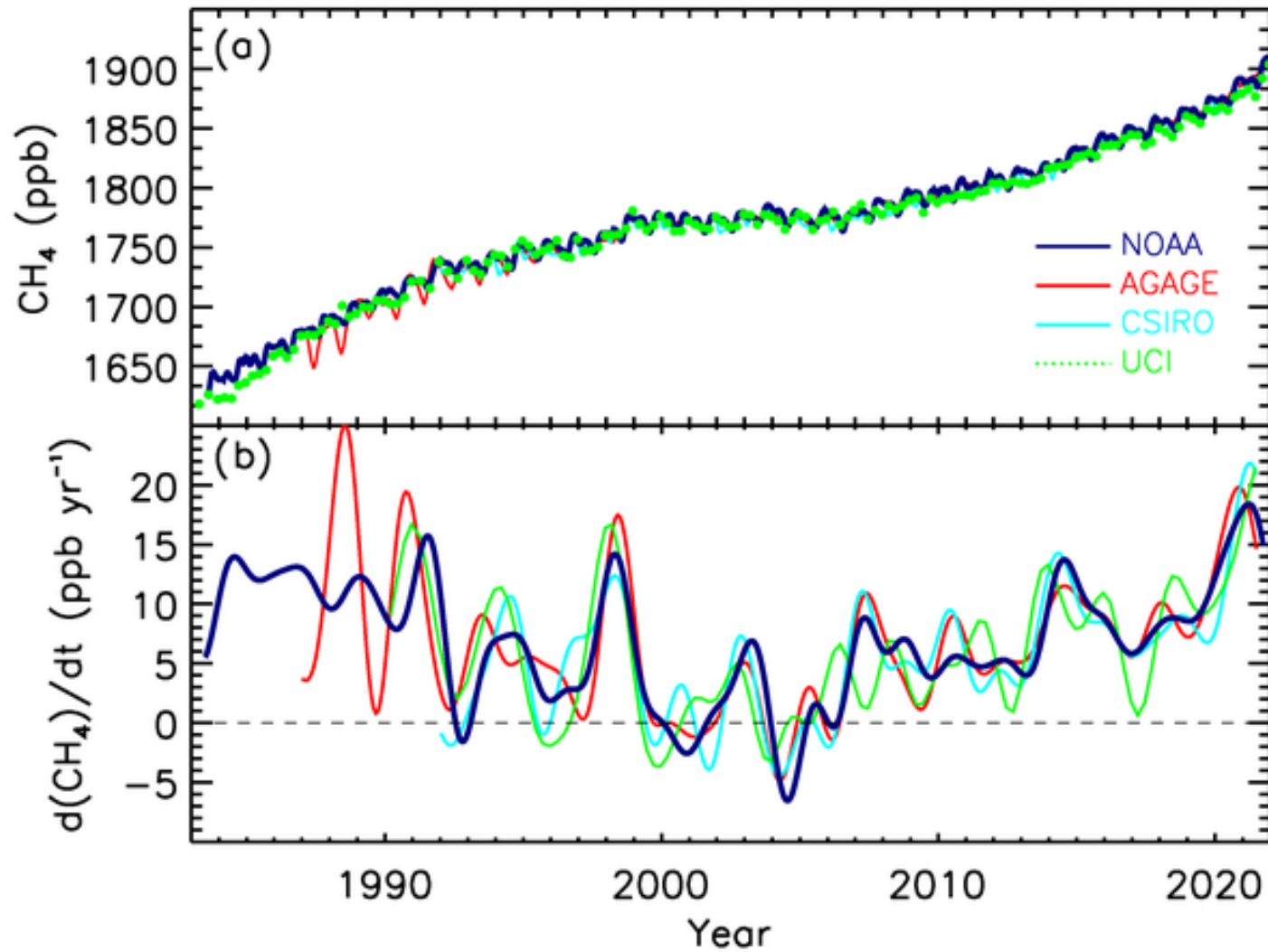


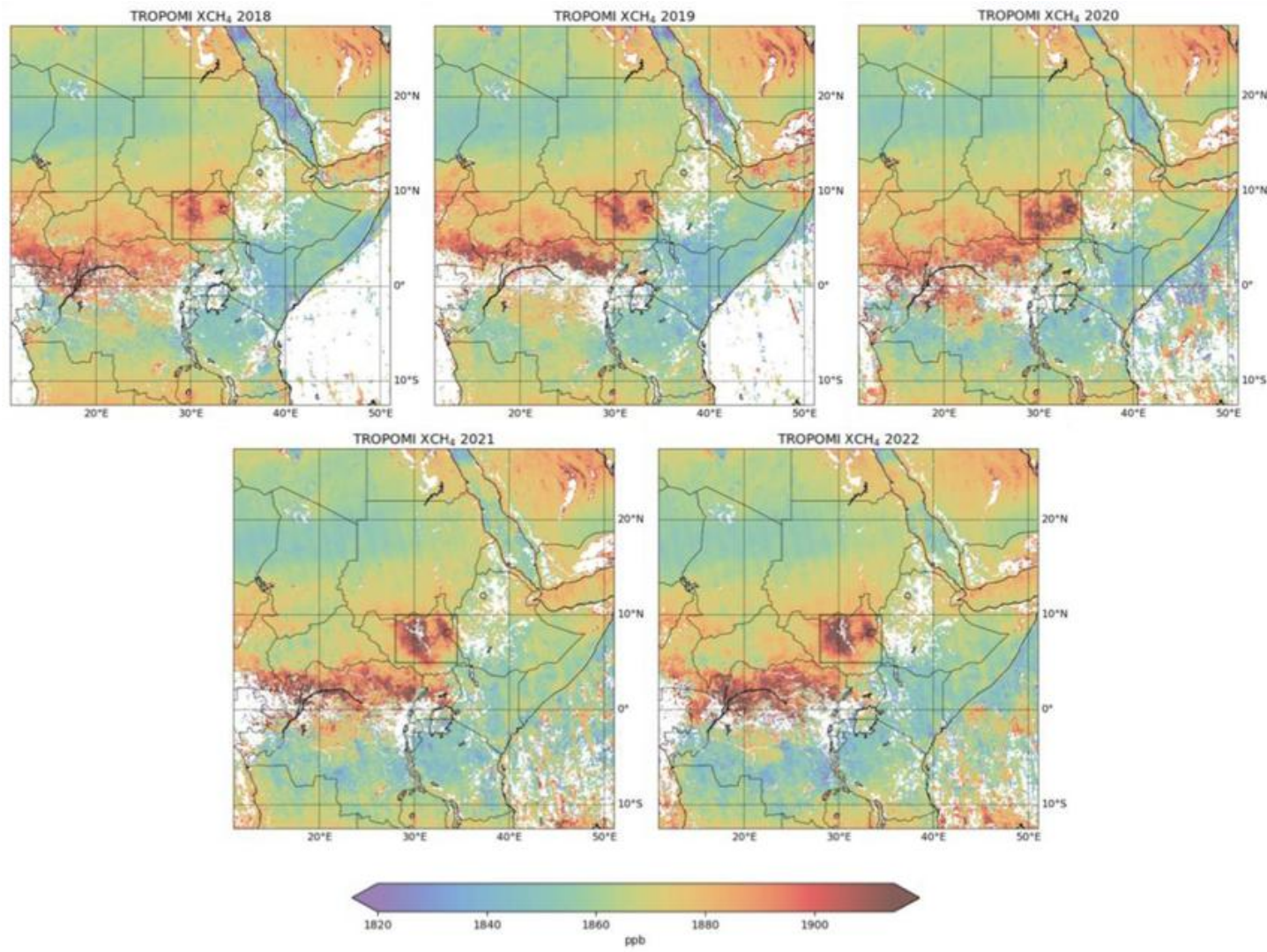
EMISSIONS AND SINKS

In teragrams of CH₄ per year (Tg CH₄ / yr) average over 2009-2019

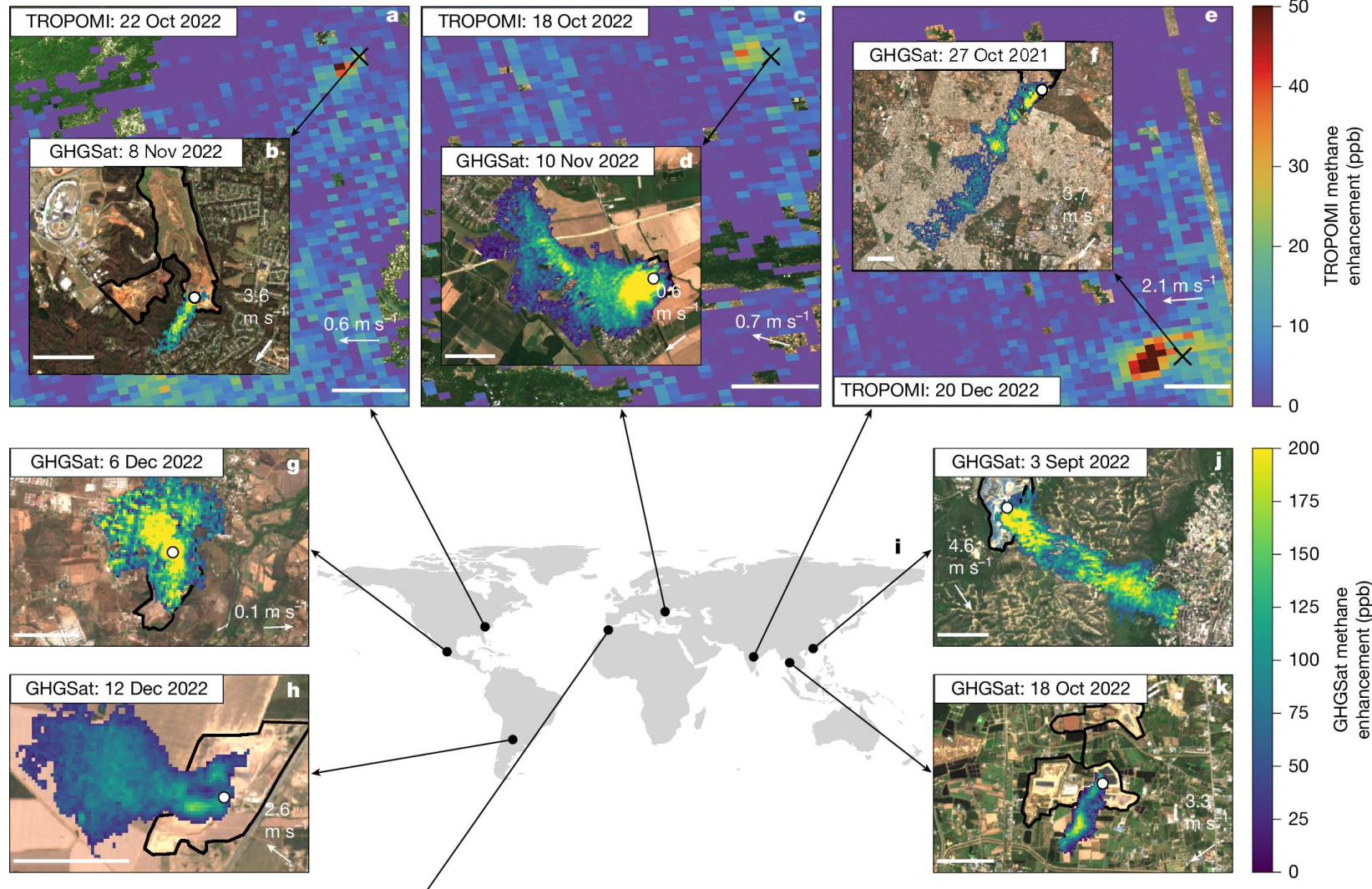
The observed atmospheric growth rate is 20.9 (20.1-21.7) Tg CH₄ / yr. The difference with the TD budget imbalance reflects uncertainties in capturing the observed growth rate.

▮ Direct anthropogenic fluxes
 ▮ Natural fluxes
 ▮ Natural and indirect anthropogenic fluxes





*TROPOMI Methane Emissions in
South Sudan Wetlands*
Albuhaisi et al., Remote Sensing (2024)



*Global satellite survey reveals uncertainty in
landfill methane emissions
Dogniaux et al., Nature (2025)*

