MethaneSAT™

Quantifying agricultural emissions using MethaneSAT, MethaneAIR and ground-based data

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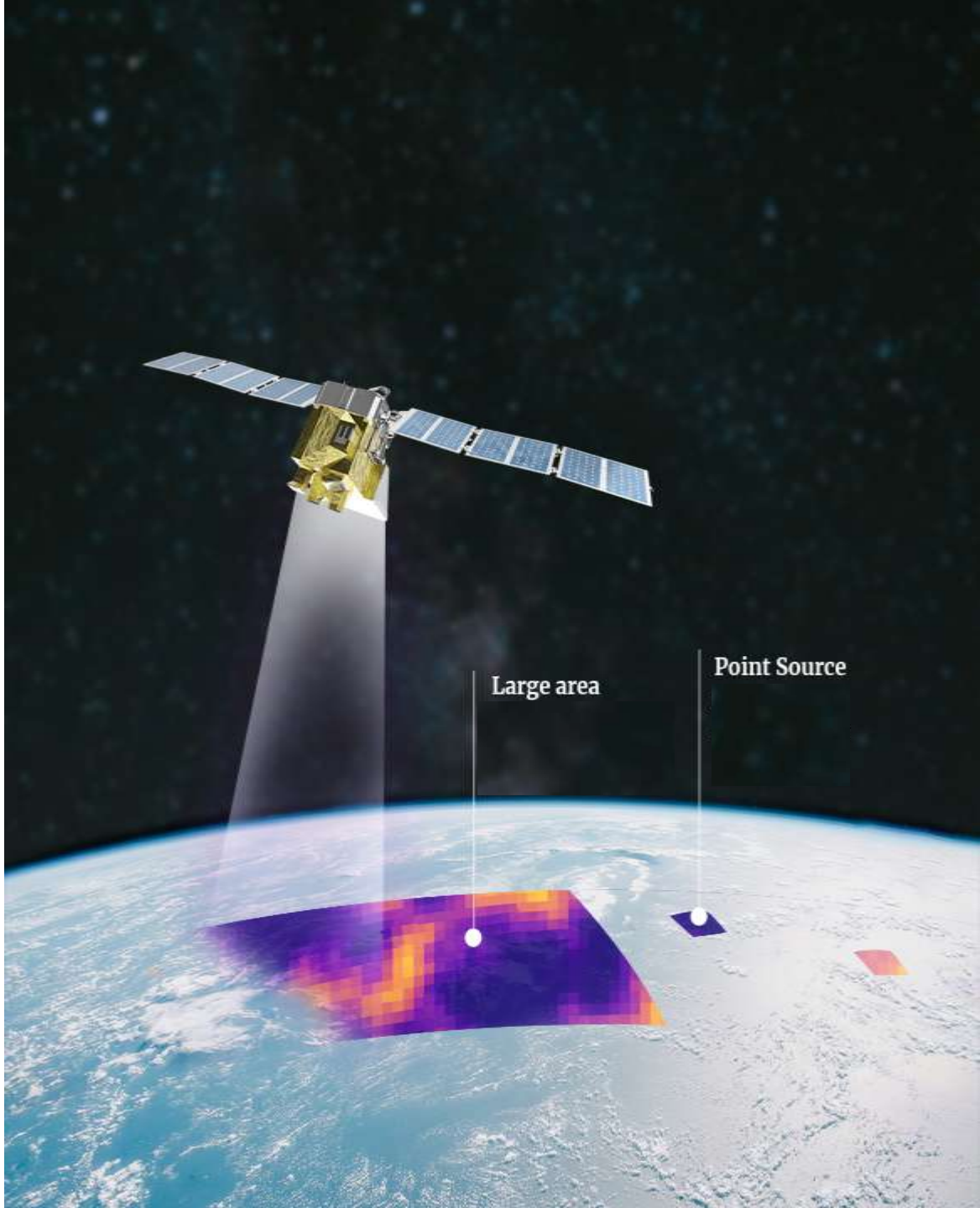
MethaneSAT™

Overview

- Project overview
- What can we see in intensive agricultural systems in the US?
- What can we see in dispersed agricultural systems in New Zealand?

MethaneSAT™

- **MethaneSAT:** Joint America-New Zealand space mission, funded primarily by charitable donations through Environmental Defense Fund
- **Core Mission:** CH_4 fossil emission reduction, Science Team: Harvard University and SAO (Smithsonian Astrophysical Observatory)
- **Aotearoa-New Zealand's role:** Remote sensing of agricultural methane emissions and identification of global agricultural targets



New Zealand as a natural laboratory

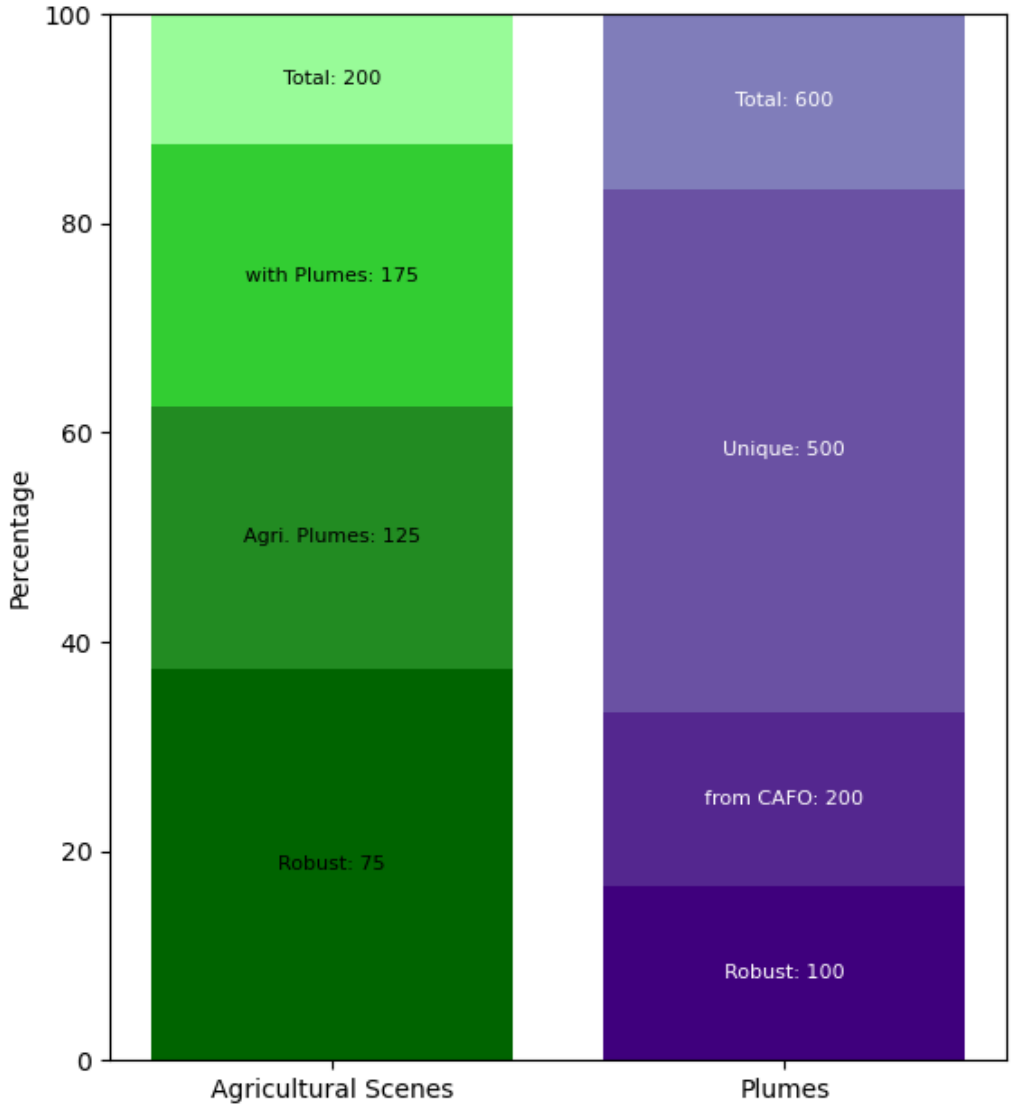
- CH_4 emissions are dominated by a single source.
- World class CH_4 measurement capability
- High resolution atmospheric modelling capability
- High quality inventory data

Intensive emissions in the US

Penny Smale

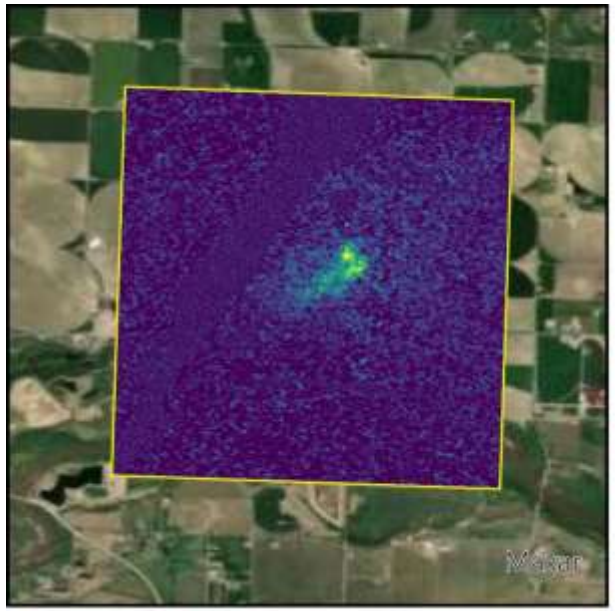
Alex Geddes

Ag MethaneAIR data by the numbers

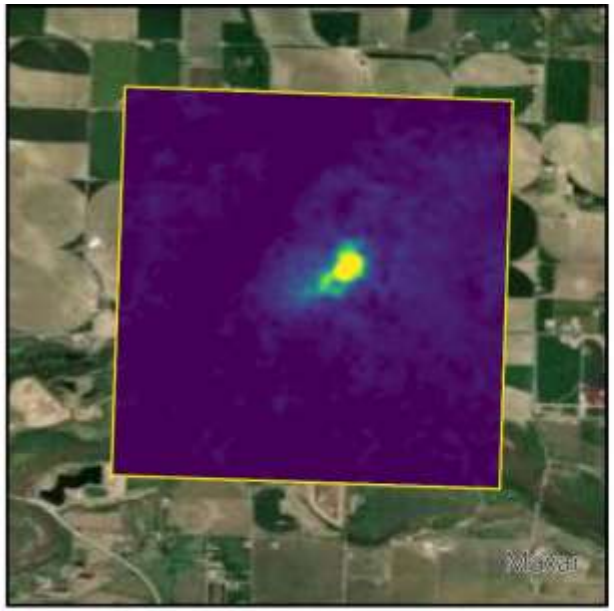


Example data: Diamond Feeders

xCH4



Denoised



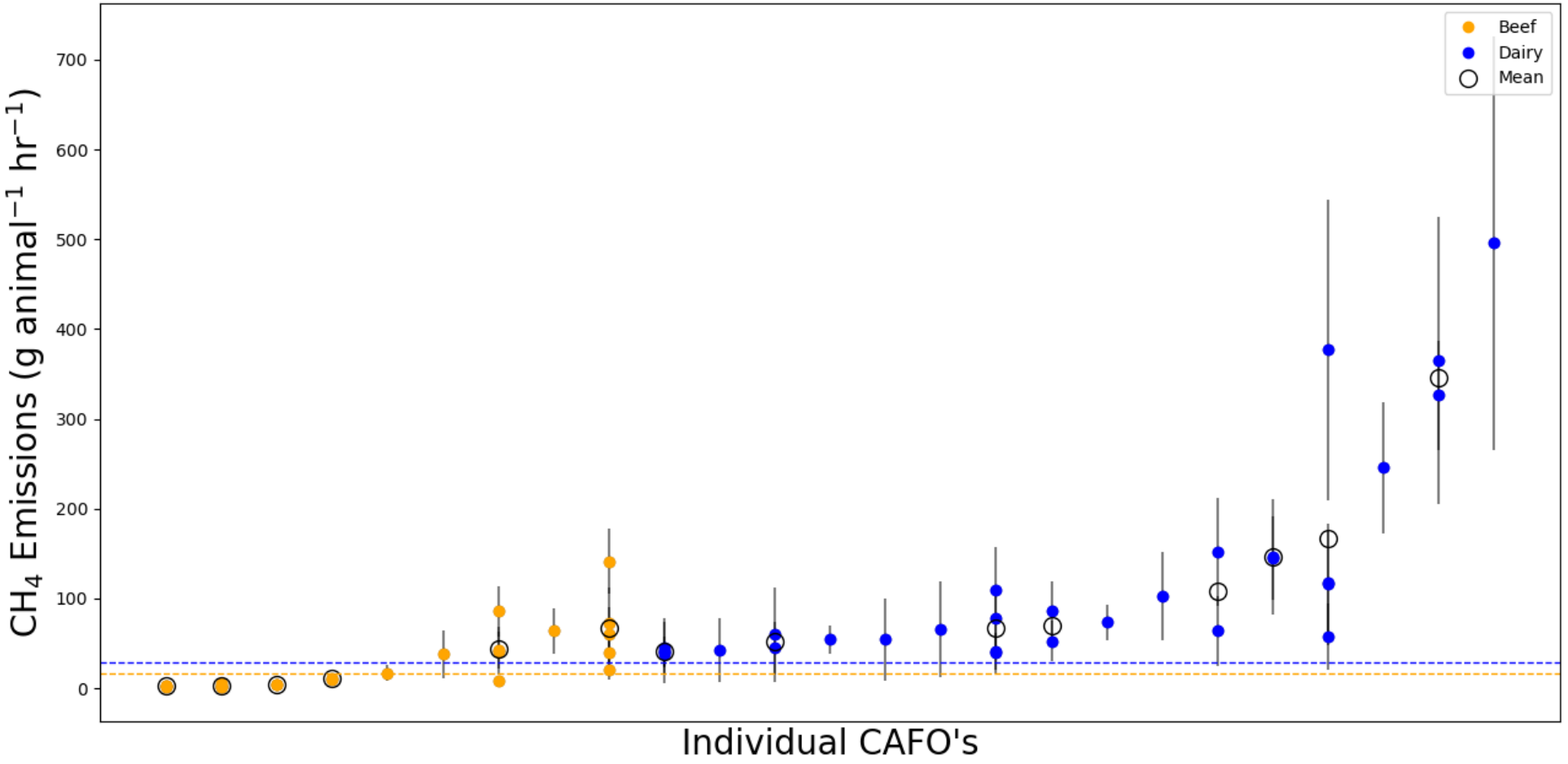
Masked Plumes

Plume (kg/hr)
Estimated*: 355
above plume: 846
Measured range: 171-1020

Per animal (g/hr)
EPA estimate for beef: 18
Above plume*: 42

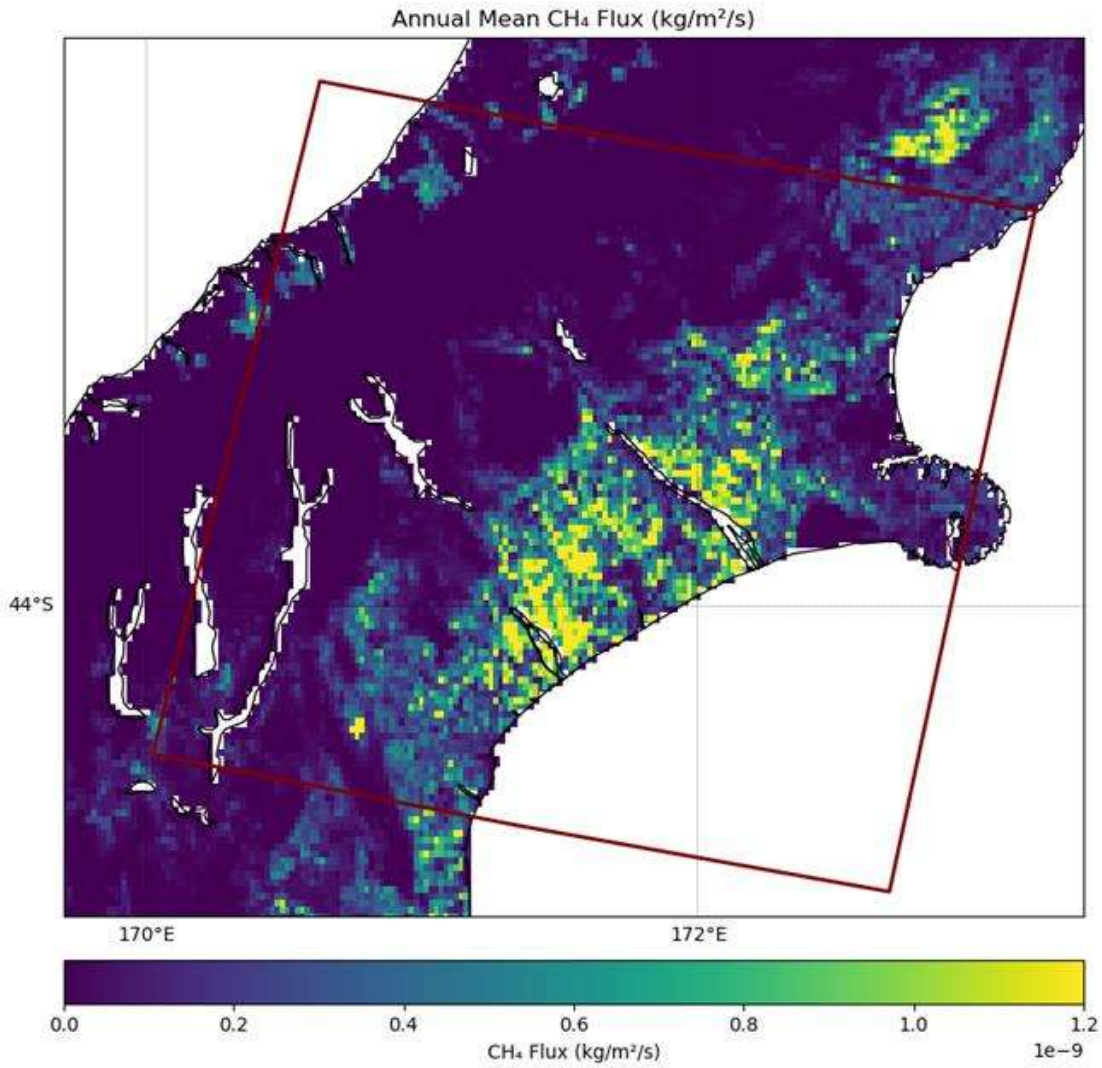
*Based on the maximum capacity of registered and permitted feedlots from Colorado State

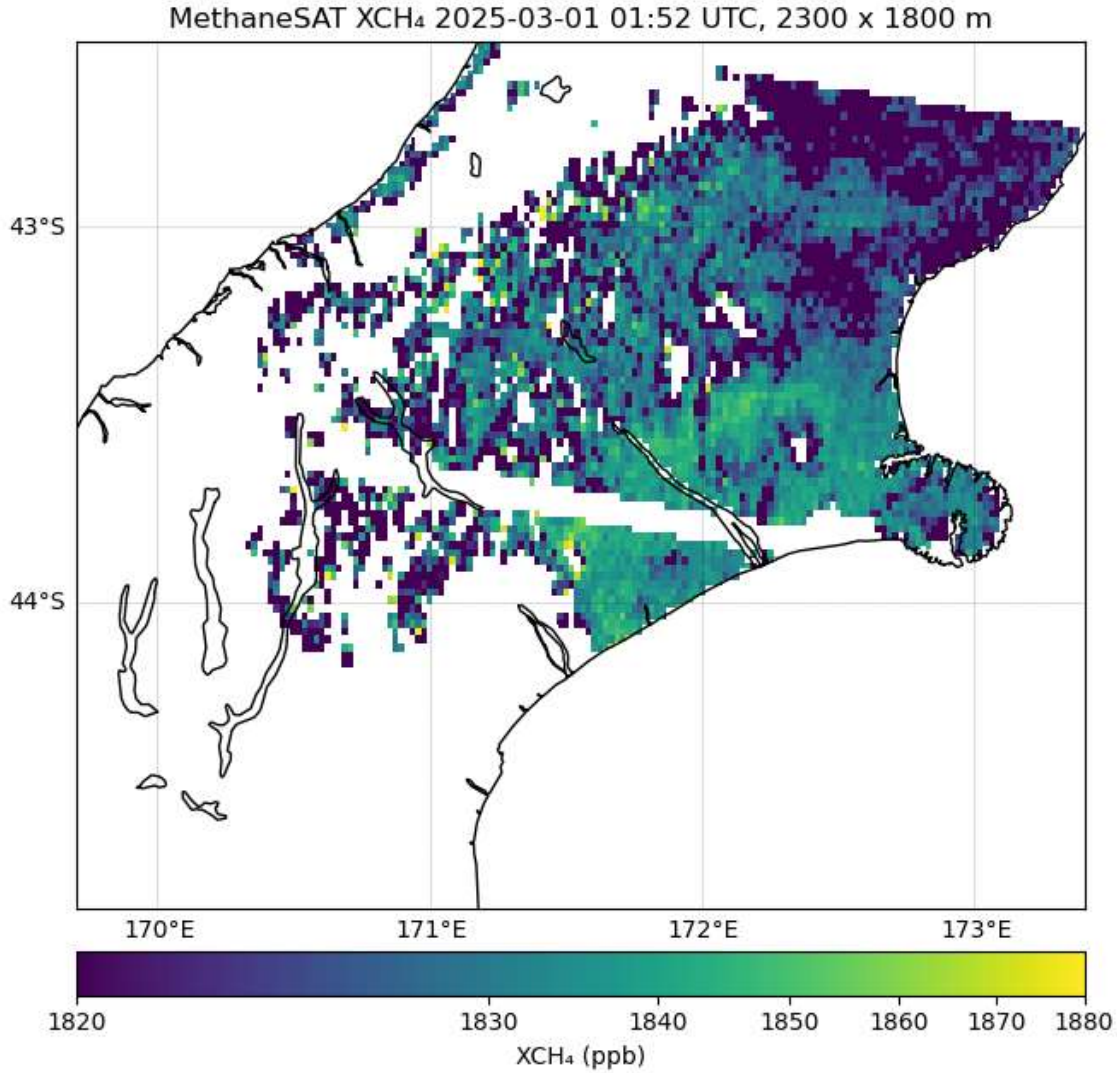
MethaneAIR flux estimates across Colorado



Dashed lines show EPA values for Colorado

Dispersed emissions in New Zealand

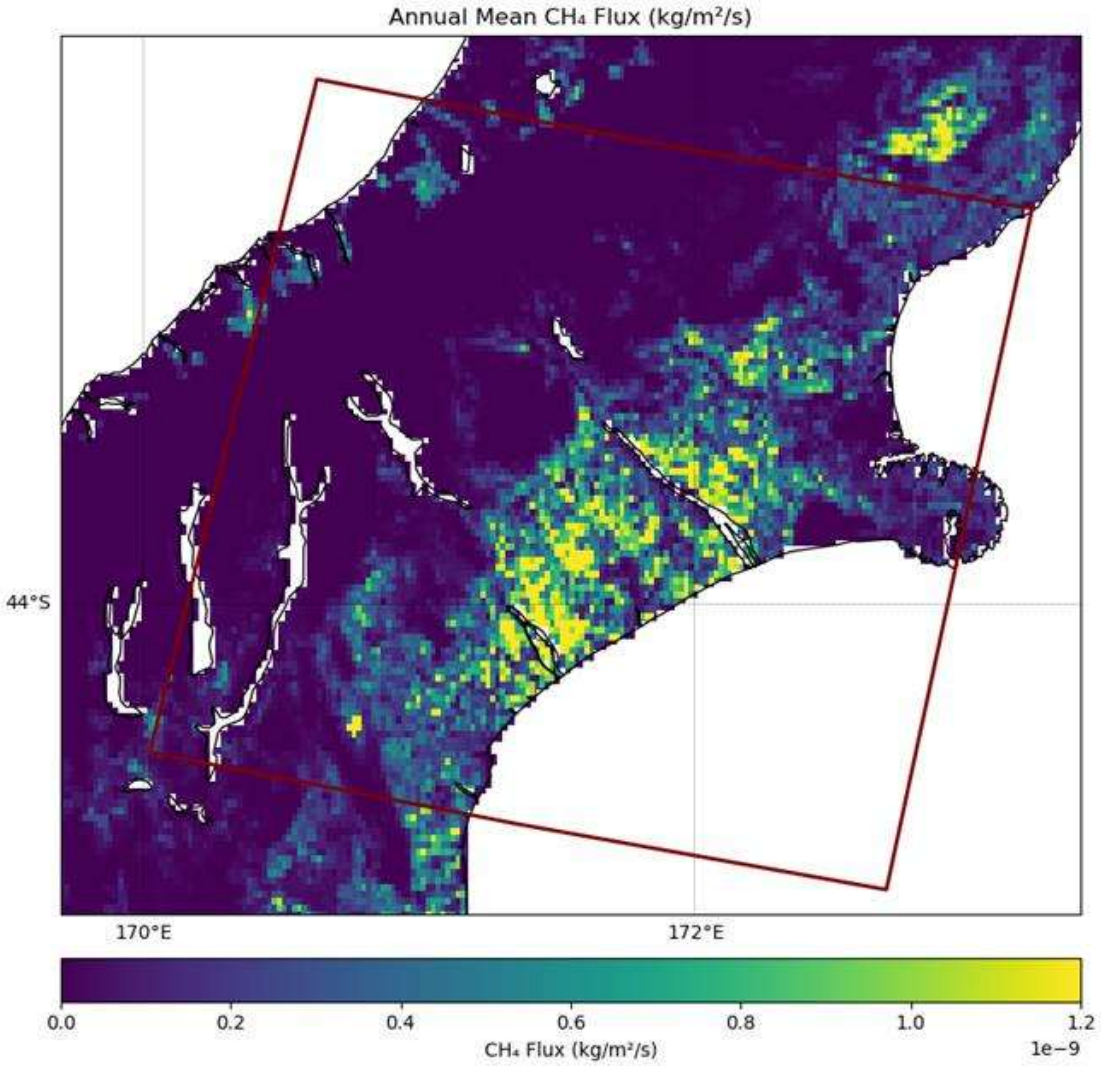




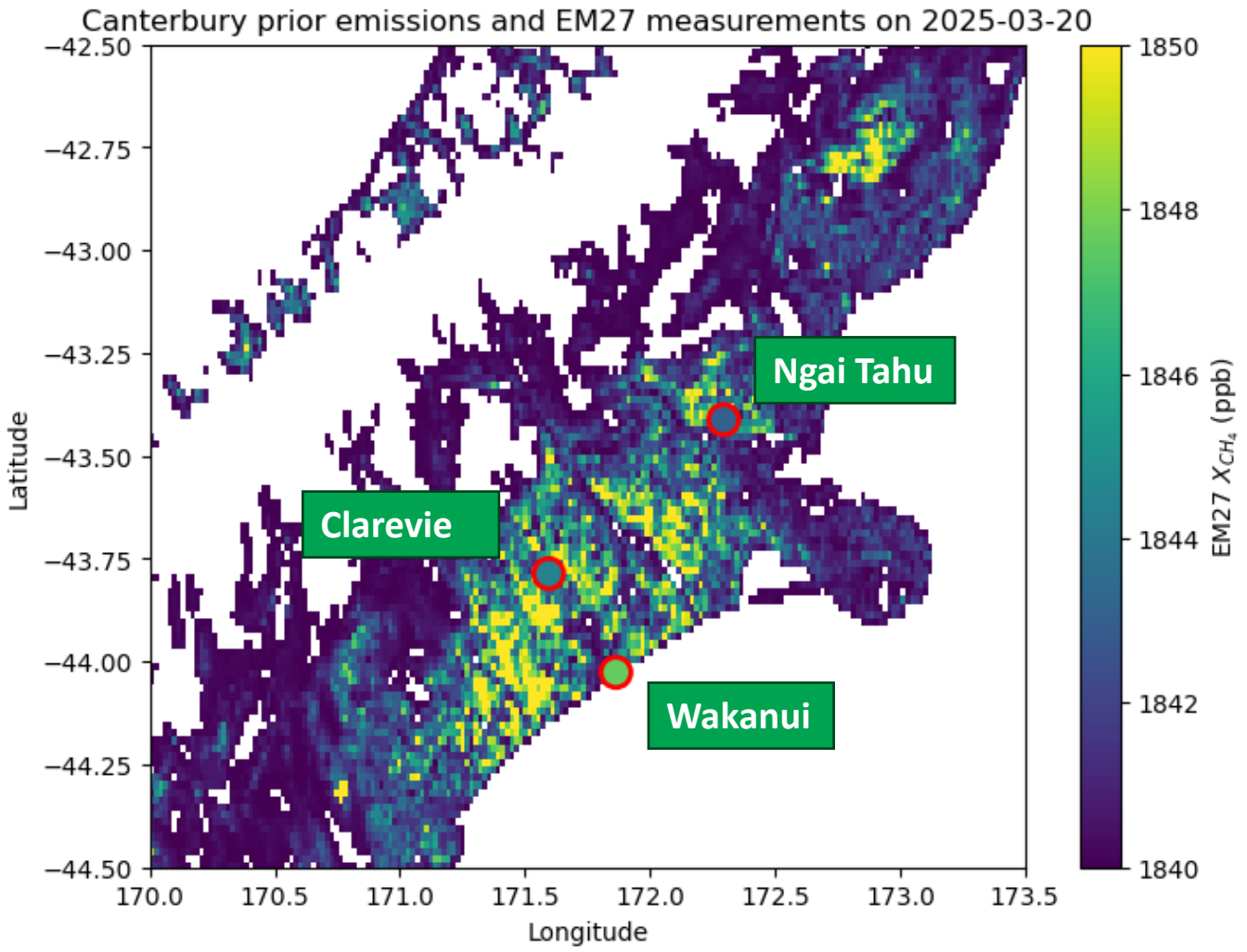
Canterbury Plains field campaign

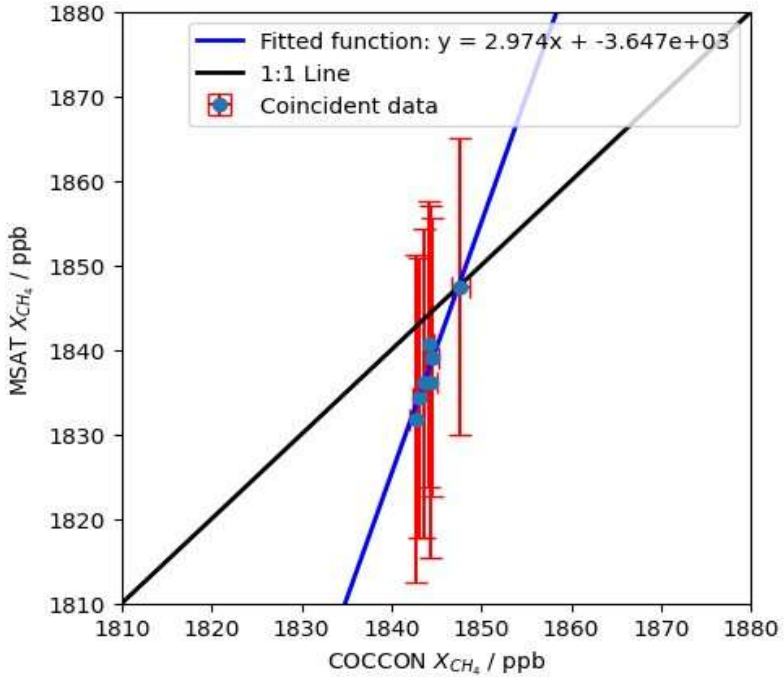
Dave Pollard

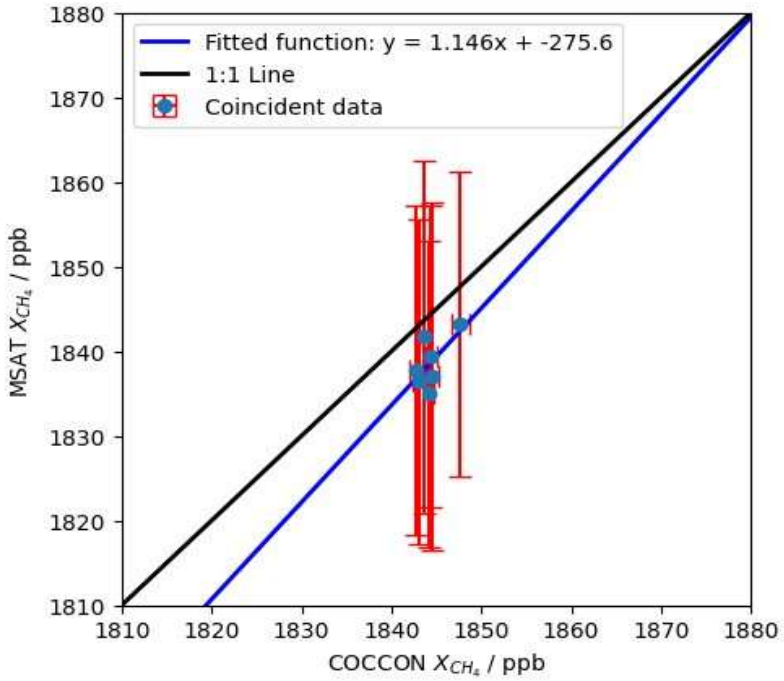
Harrison O’Sullivan-Moffat



EM27 Measurements



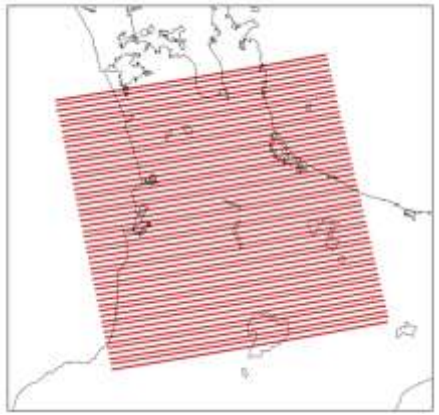


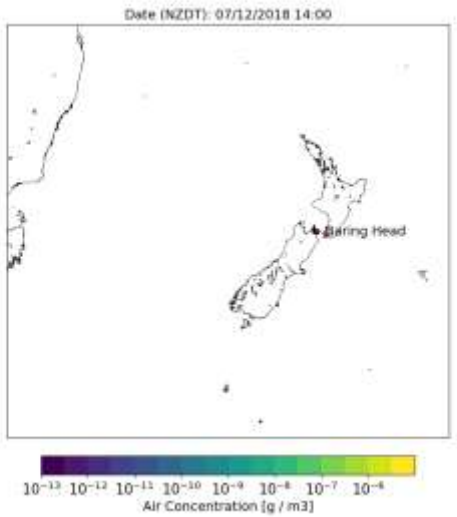


Modelling framework

Transport model

NAME III Lagrangian dispersion model
200x200 km, 0.01 x 0.035 deg (lon x lat)
~13 levels, up to 5 km

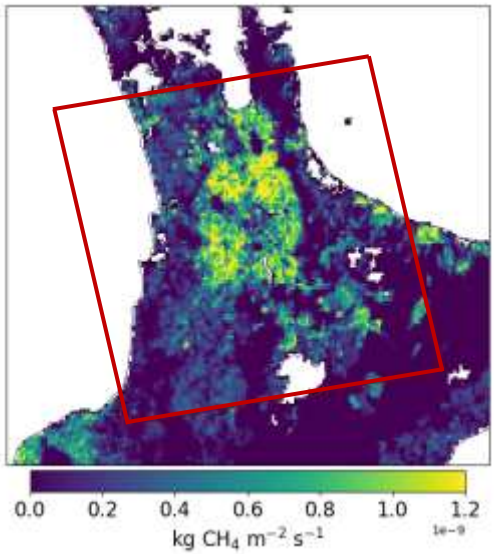




x

Prior fluxes

Agricultural CH_4 fluxes
MPI, Manaaki Whenua - Landcare Research



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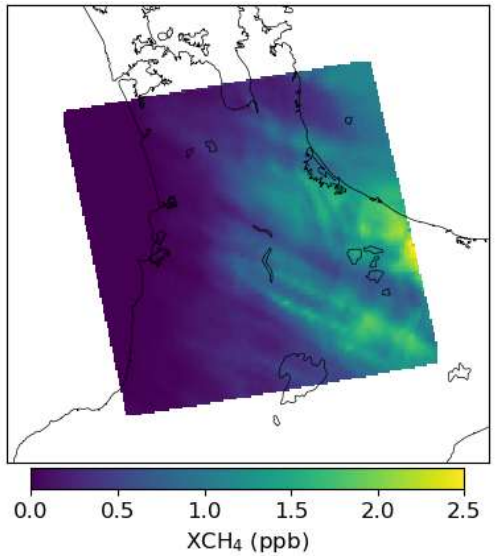
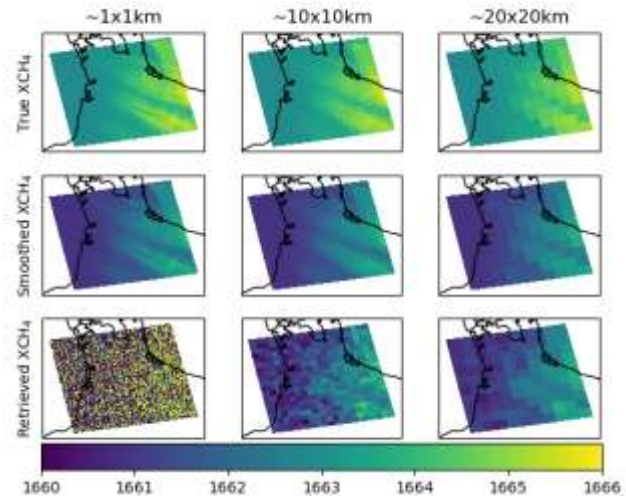
Modelled XCH_4

Agricultural enhancements



Level 2



Level 4

Divergence Integral

CORE Inversion

Bayesian Synthesis Inversion

Point sources/emissions
Area (total) emissions

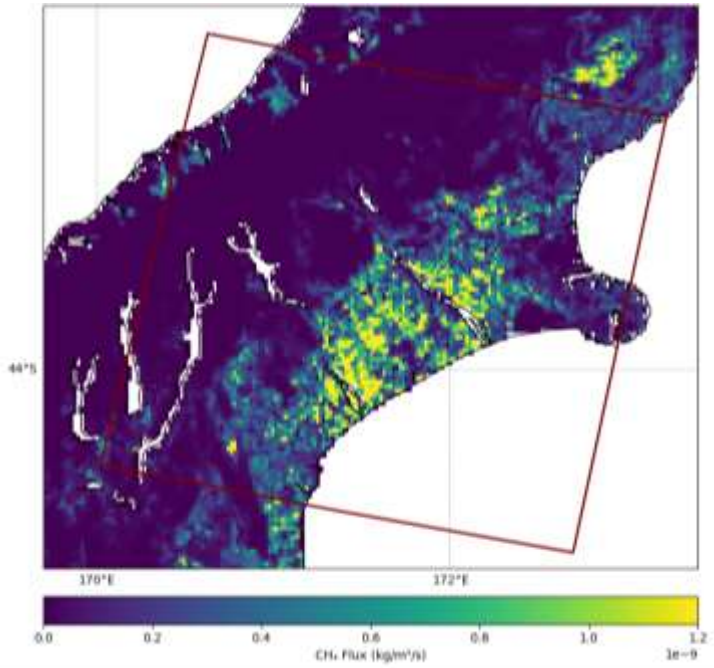
*Driven by meteorology from NZCSM (1.5 km)
(Local configuration of the UK Met Office Unified Model)

OSSE* framework example
*Observing System Simulation Experiment

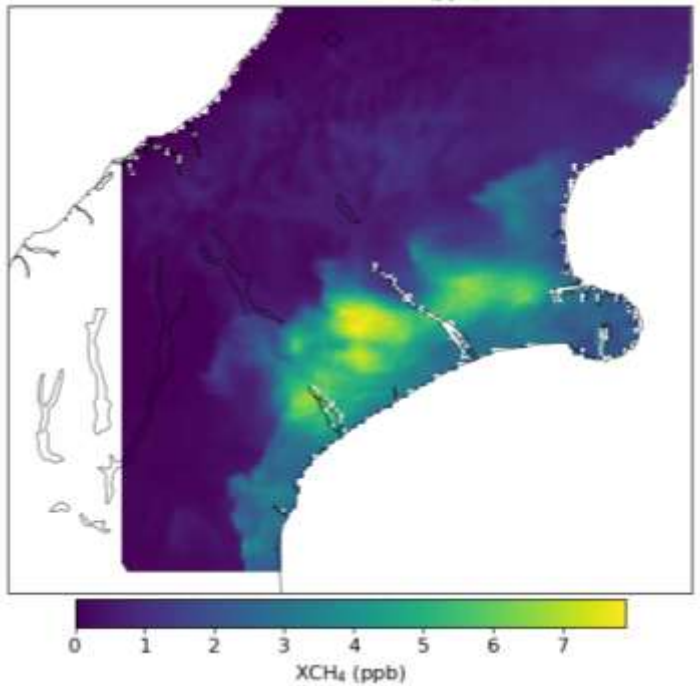
Dispersed emissions in New Zealand

Beata Bukosa

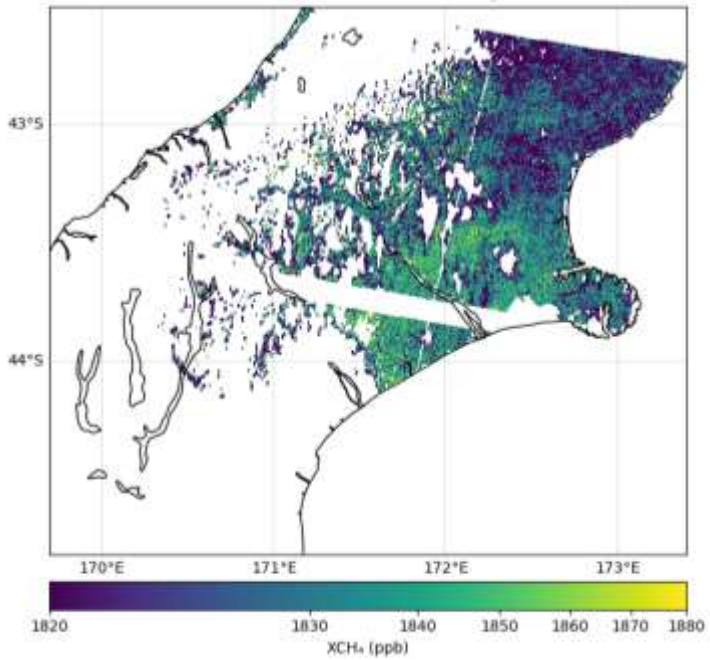
Prior fluxes



Modelled XCH_4 enhancements (NAME III)



MethaneSAT XCH_4 2025-03-01 01:52 UTC



NIWA
Taihoro Nukurangi

Summary

- MethaneAIR data suggests that agricultural emissions from intensive agriculture in the United States may be underestimated
- The first MethaneSAT data over New Zealand is in good qualitative agreement field campaign data and modelling.
- Next steps: level 4 estimates from MethaneSAT data, quantitative comparison to measurements

Acknowledgements

- MBIE and NIWA for funding
- MethaneSAT team
- UK Met Office and NIWA weather and Lagrangian modelling teams
- New Zealand eScience Infrastructure (NeSI)

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MethaneAIR

- Airborne sister instrument to MethaneSAT
- 10x10m, 4.5km swath
- Opportunistic measurements of agriculture
- Over 50 agricultural targets analysed across 13 different flights
- Divergence integral estimates, comparisons with independent estimates, and consistency assessment