

# In-Situ Bayesian Inversion of Methane Emissions in the Salt Lake Valley

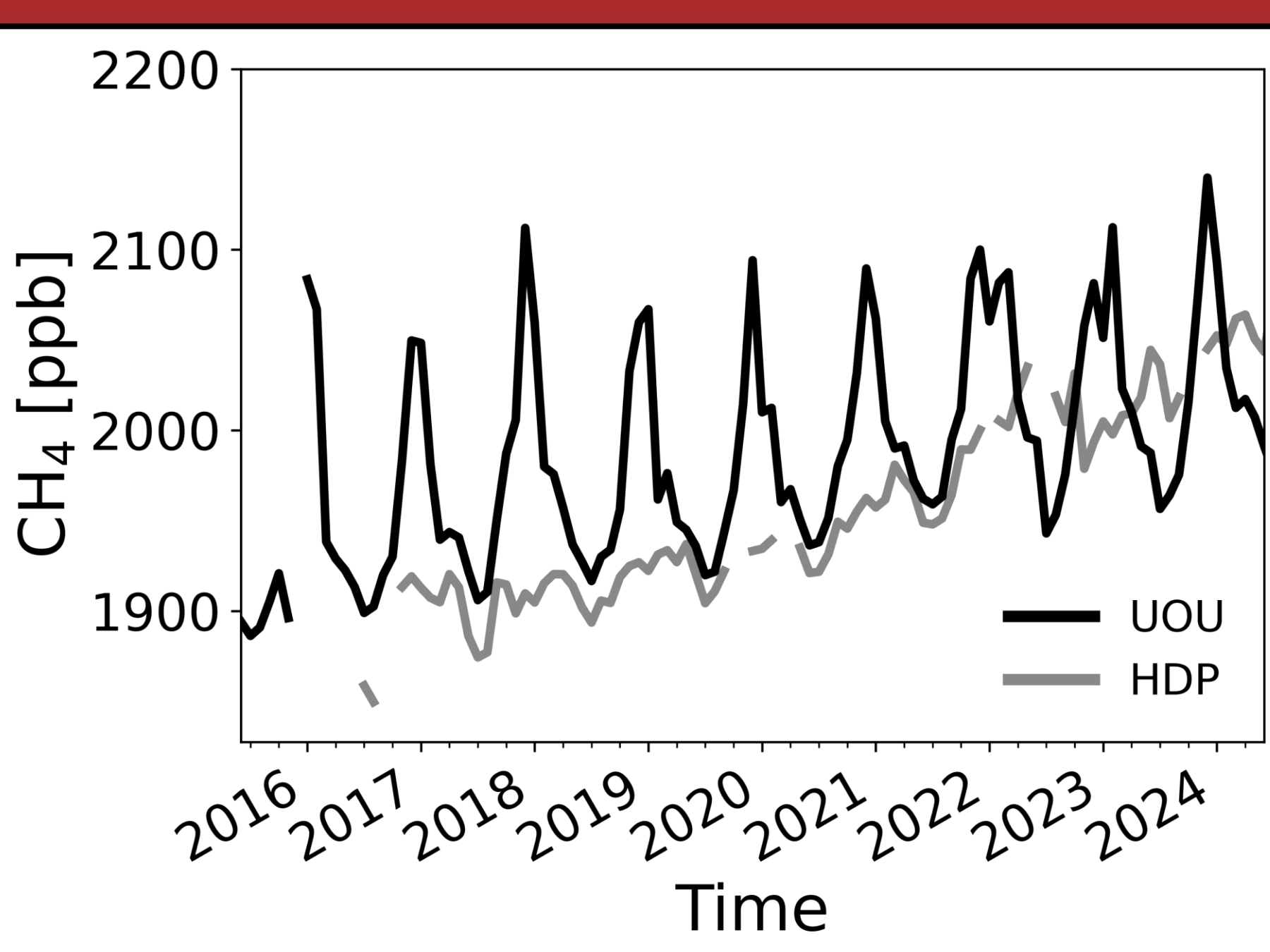


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**Goal** | Estimate monthly methane emissions for the Salt Lake Valley



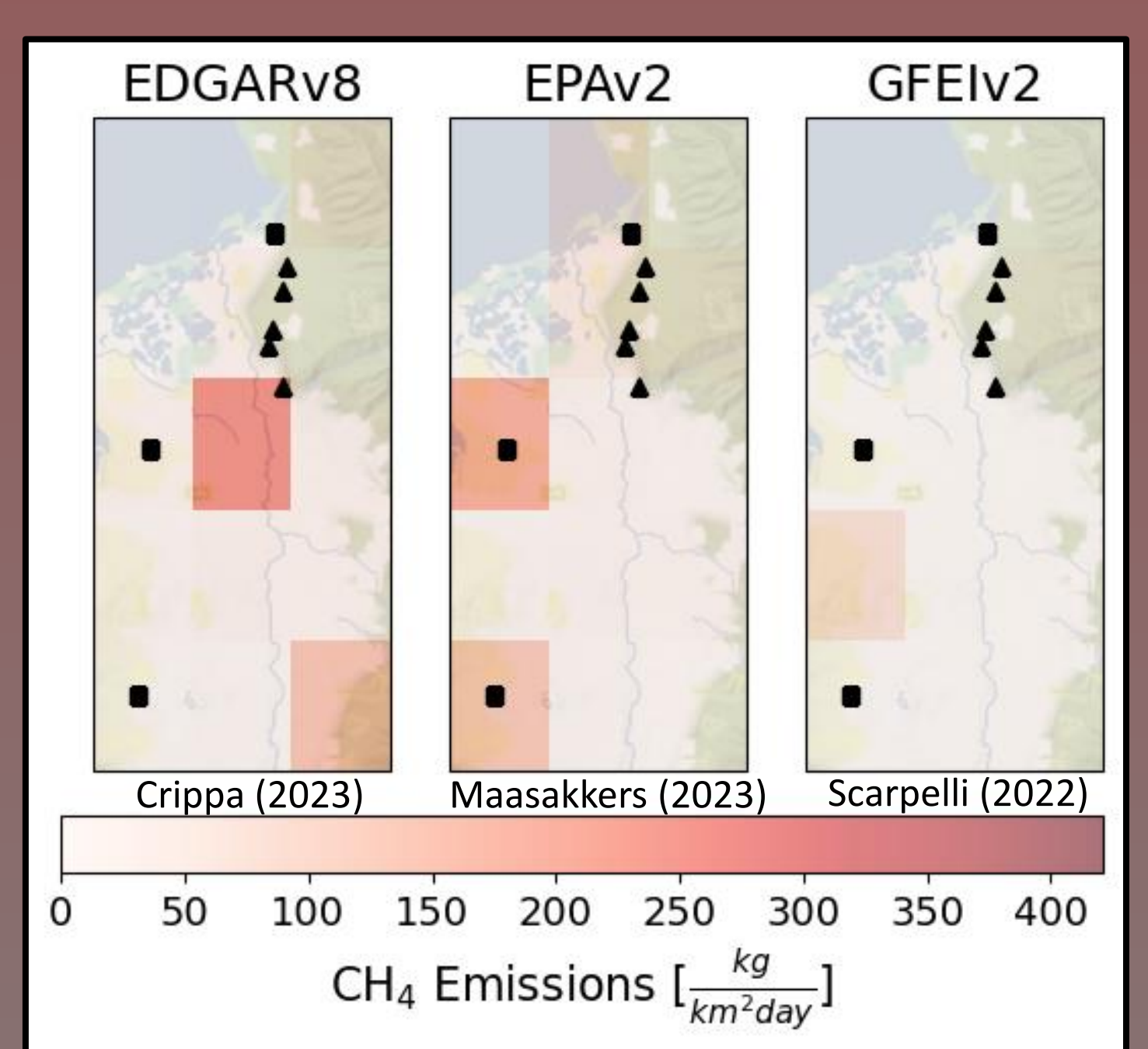
## Observations



- ≈ 8 years of in-situ observations
- Strong seasonal cycle
- Recent HDP observations contaminated by local sources

UOU: Urban environment HDP: High-elevation background

## Prior Estimate

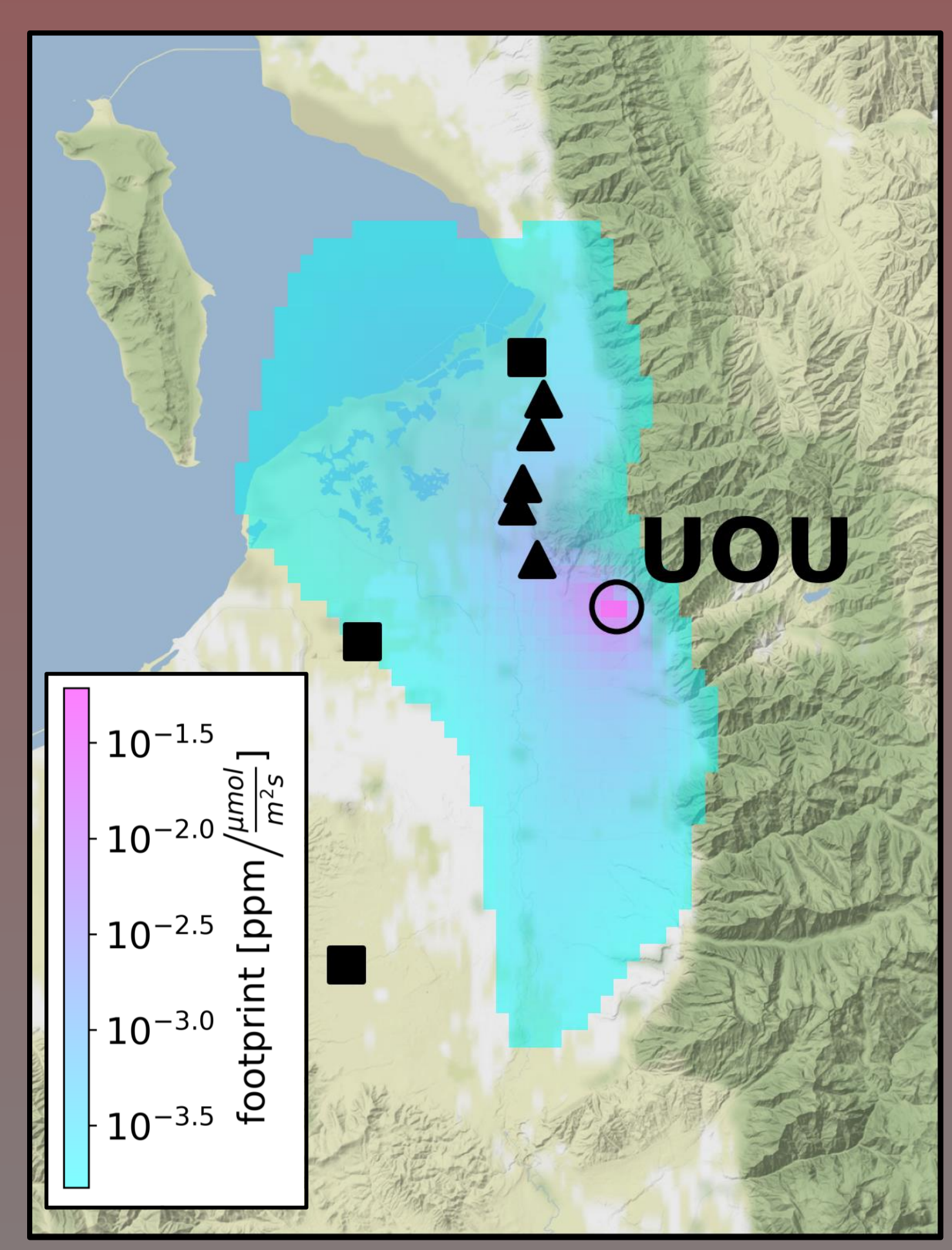


Bottom-up estimates from source activity of average methane emissions for the Salt Lake Valley

- Limited urban understanding
- Coarse resolution
- Poor spatial allocation

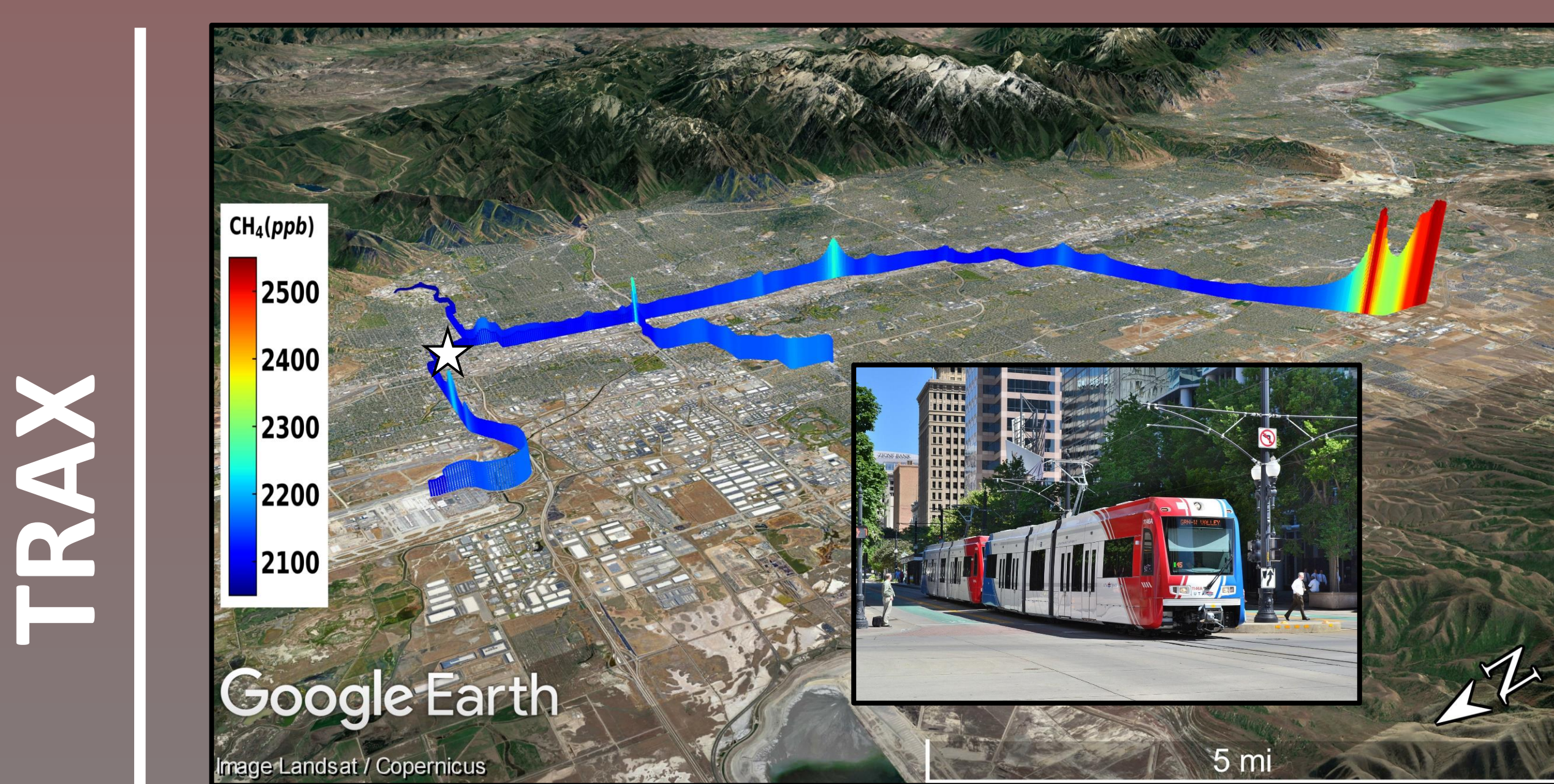
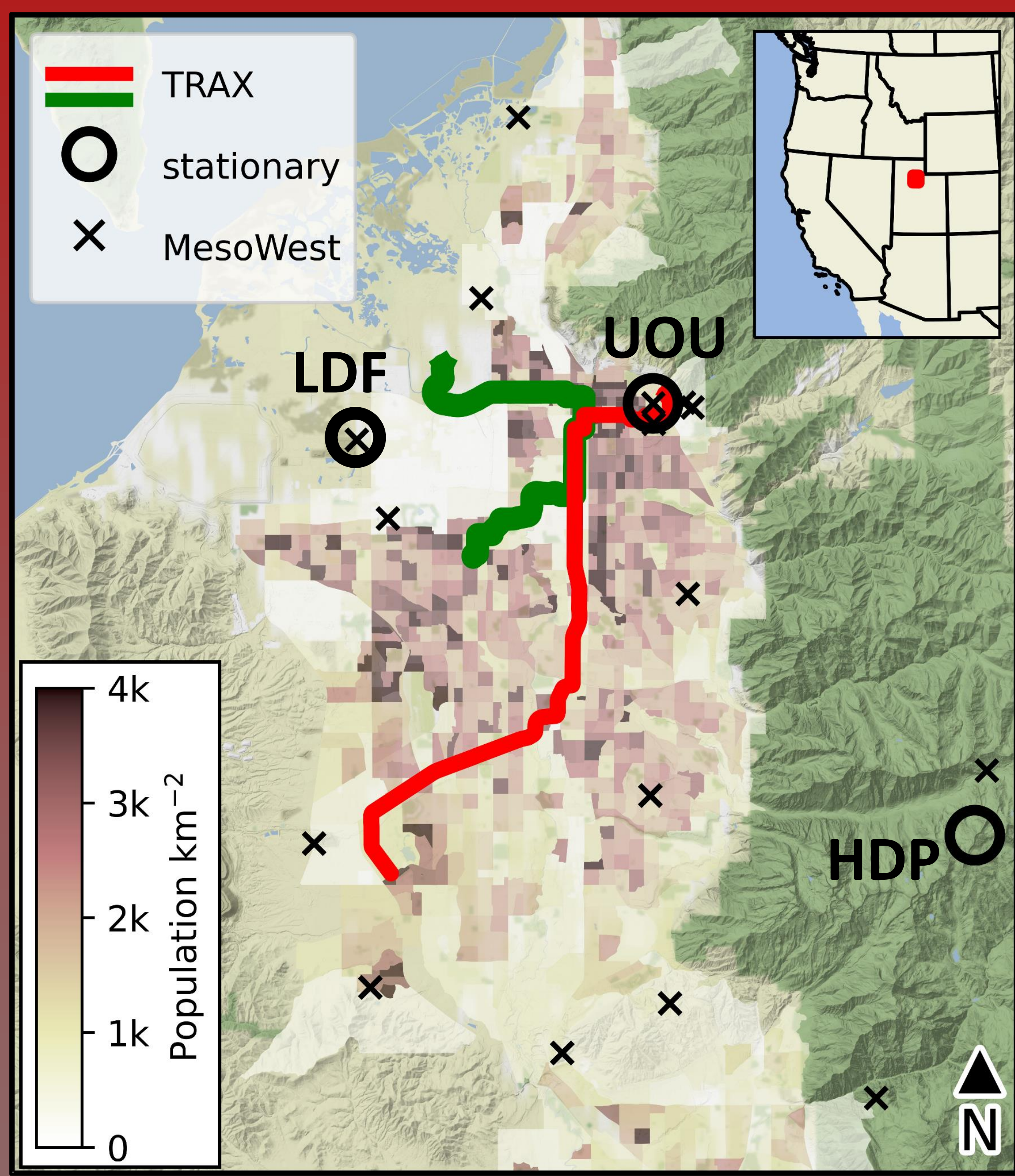
■ — landfill ▲ — refinery

## STILT Footprints



STILT footprints identify sensitivity to upwind source regions

- Poor sensitivity to the Southwest corner of the valley

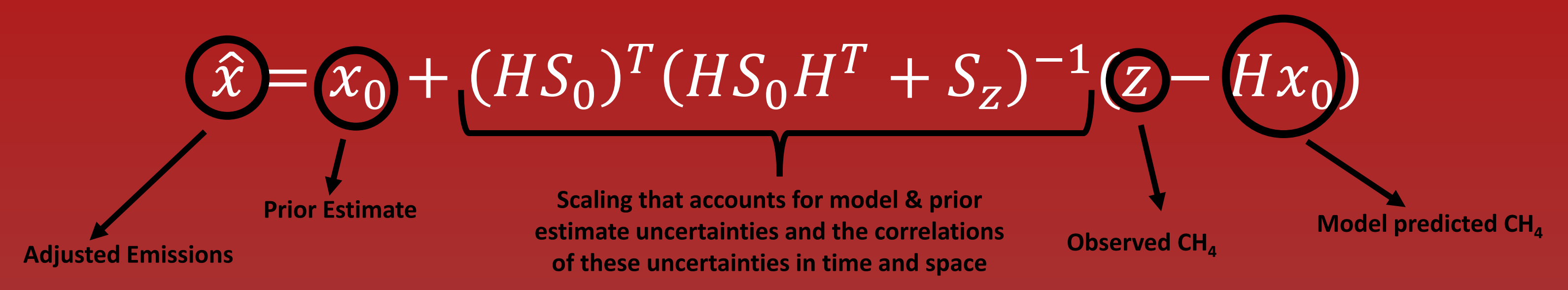


TRAX

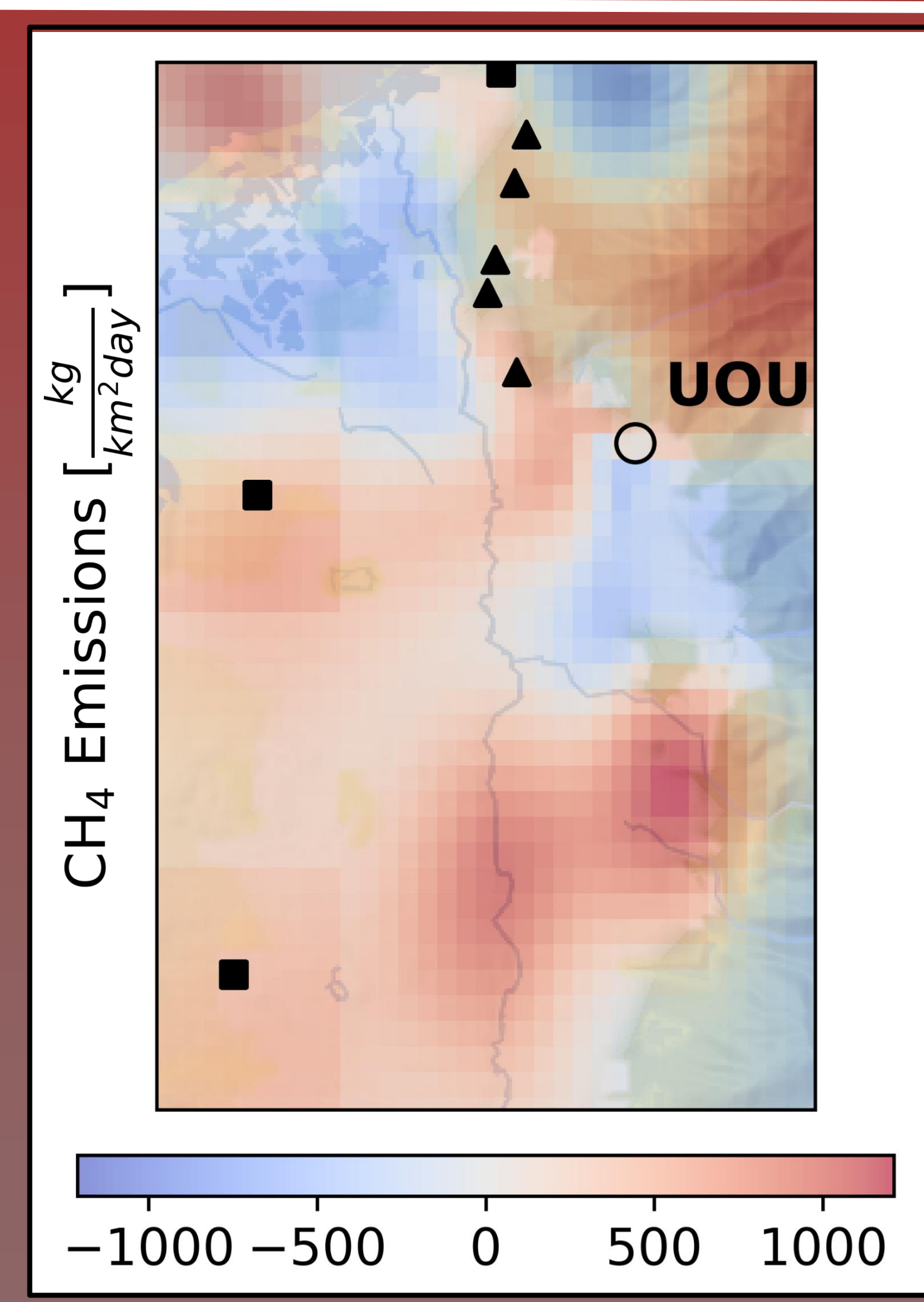
- Average spatial CH<sub>4</sub> concentrations along light-rail line
- Hotspots observed with otherwise near-background levels
- Large spatial coverage provides needed constraint

## Bayesian Inversion

$$J(x) = (x - x_0)^T S_0^{-1} (x - x_0) + (z - Hx)^T S_z^{-1} (z - Hx)$$



## Posterior Estimate

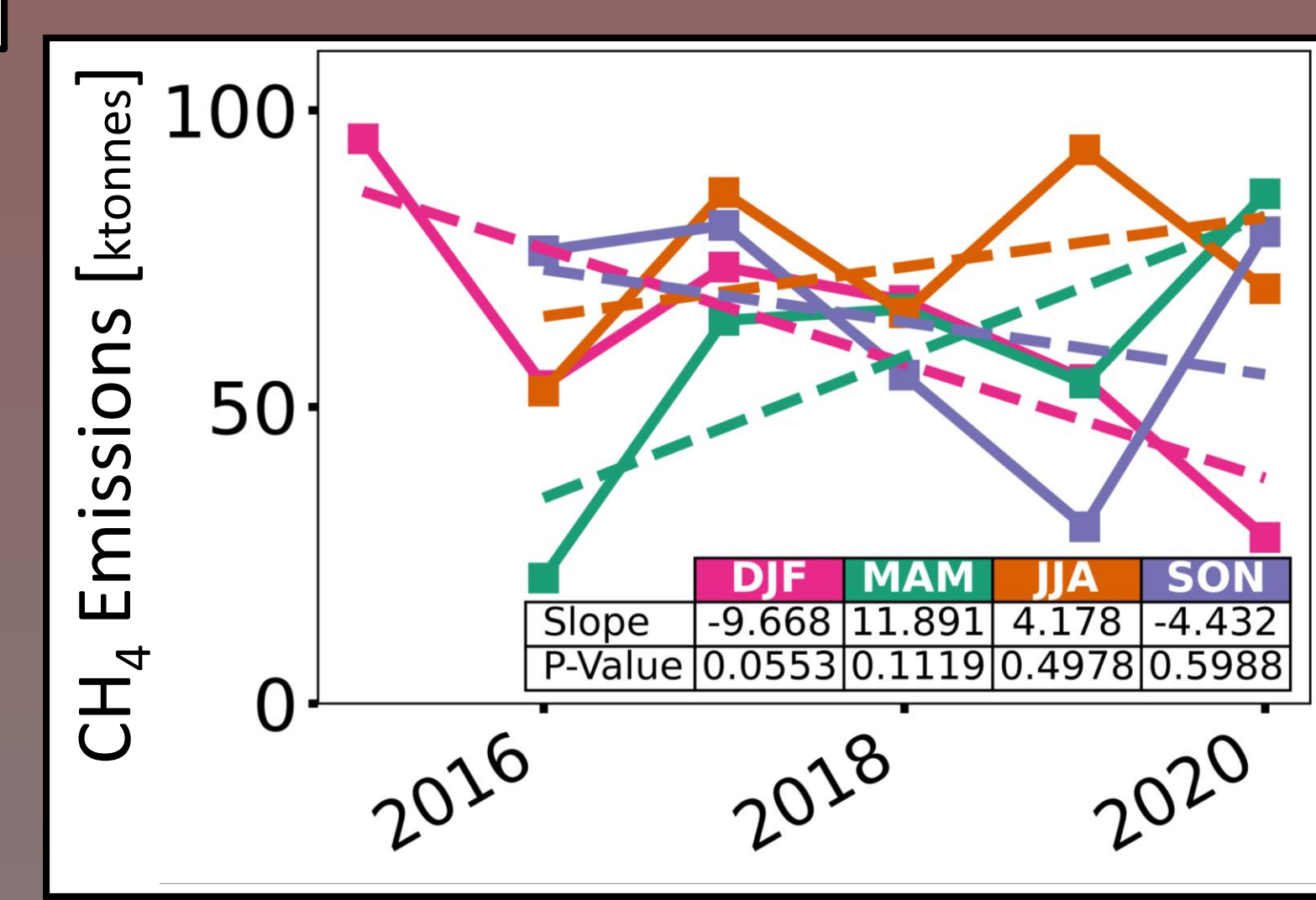


Optimized average methane emissions from Bayesian Inversion

Estimate monthly methane fluxes for the Salt Lake Valley using UOU observations and the EPA prior estimate for 2016-2020

- Strong negative fluxes (unrealistic)
- Unknown sources in the Southeast
- Strong sources to the Northeast (old coal mine?)
- CH<sub>4</sub> originating from landfills, refineries, & wetlands

## Emission Trends



Seasonal trends in Salt Lake Valley emissions

- No significant trend in emissions
- Monthly Avg: 65 ktonnes
- Negative fluxes are ignored

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