Nitrous Oxide (N_2O) Emissions form California based on Airborne Measurements during CalNex

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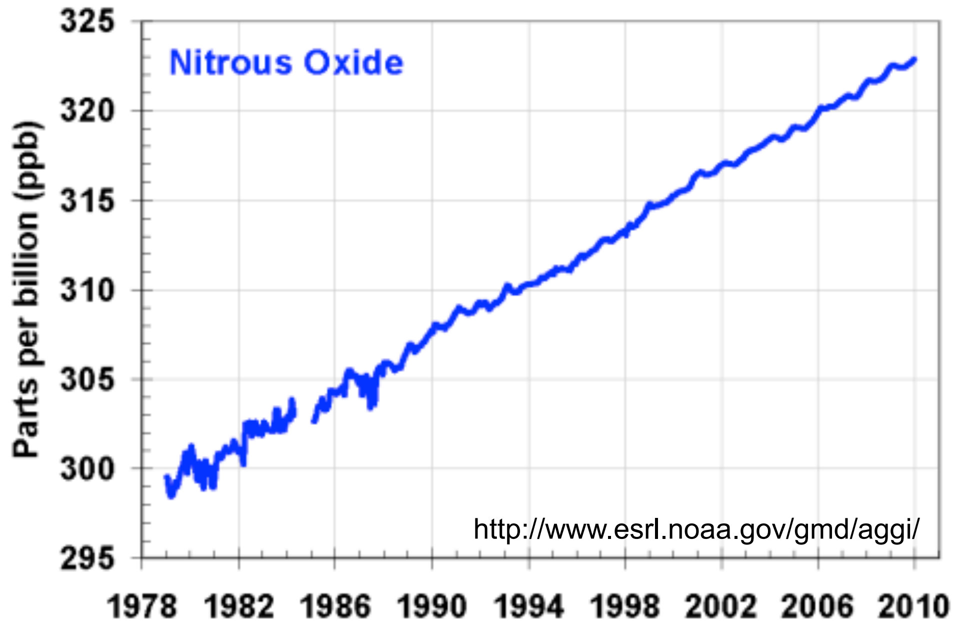


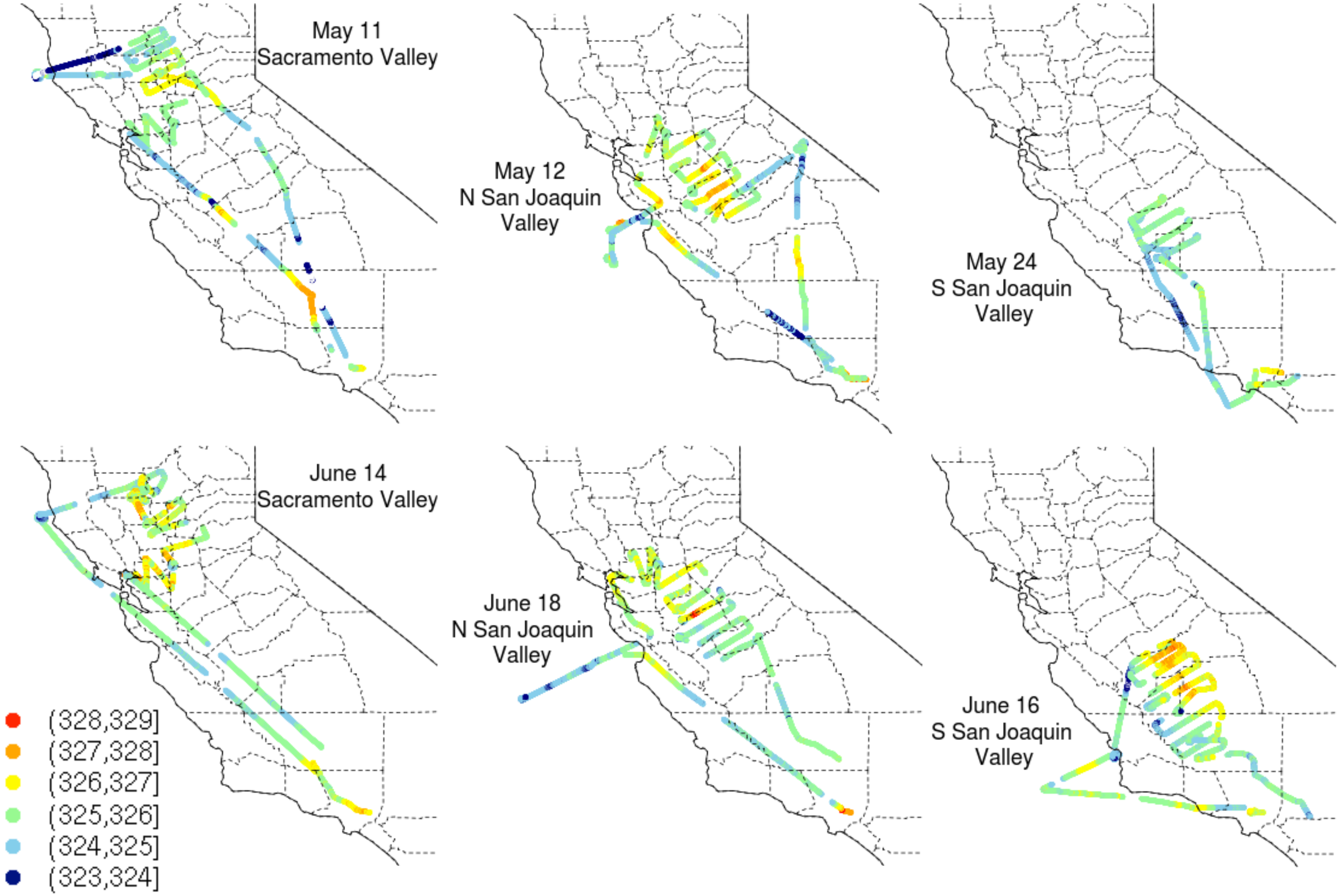
Atmospheric importance:
Third most important long-lived GHGs
Top stratospheric ozone-depletion gas

Global emission:
2/3 natural, 1/3 anthropogenic

Annual increase rate: 0.2 – 0.3% steady

Budget uncertanty:
20% ~ 30% imbalance between sources and sinks

CalNex Agricultural N_2O Profiles



Question to Answer:

How can we improve the regional N_2O emission inventories for the state of California using CalNex observations?

Top-Down Method

- **Transport model STILT** (Stochastic Time-Inverted Lagrangian Transport)

  Meteorology (WRF v3.2 provided by Wayne Angevine, NOAA)
- **Boundary condition** (HIPPO3 data)
- **A priori input** (N_2O emission inventories, California land use maps)

$$N_2O_{simulated} = N_2O_{boundary} + N_2O_{enhancement}$$

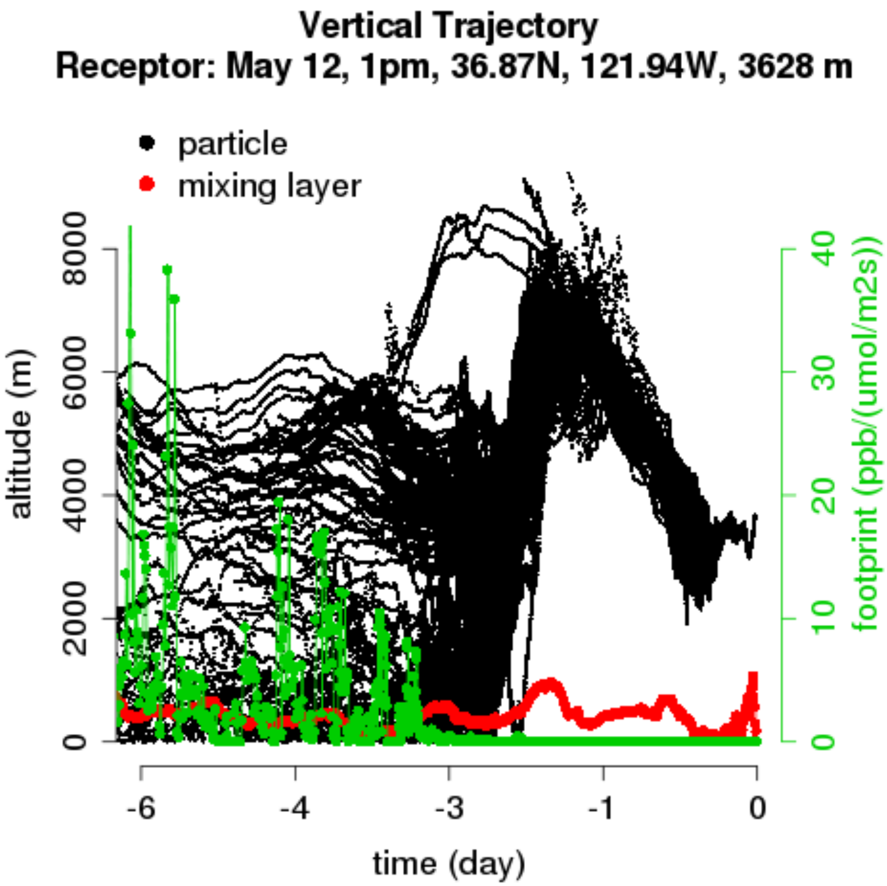
$$= N_2O_{ocean} + N_2O_{remote\_land} + N_2O_{local\_land}$$

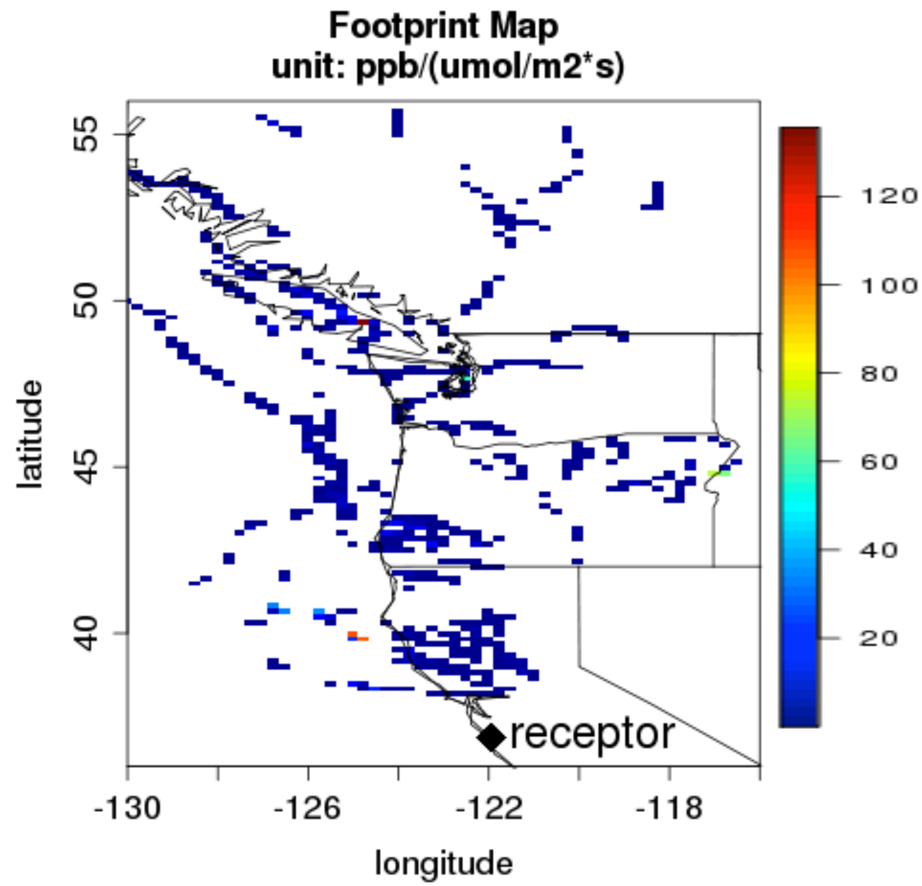
$$= N_2O_{ocean} + N_2O_{remote\_land} + (footprint \times surface\_flux)$$

Model-Data Assimilation

- Multiple linear regression

STILT Transport Model

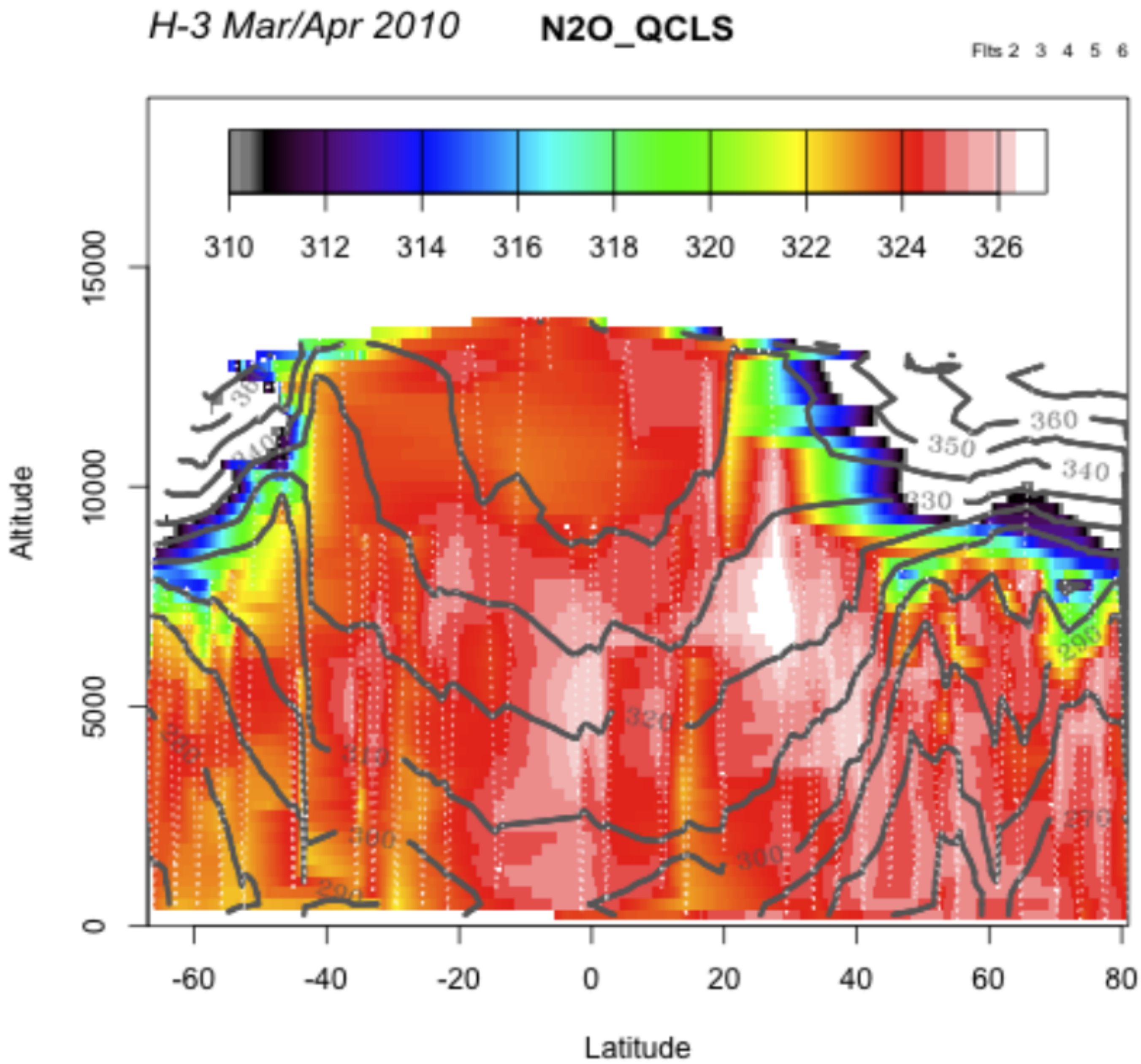


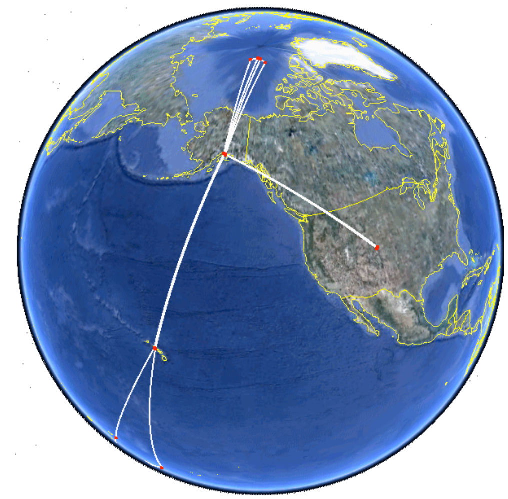


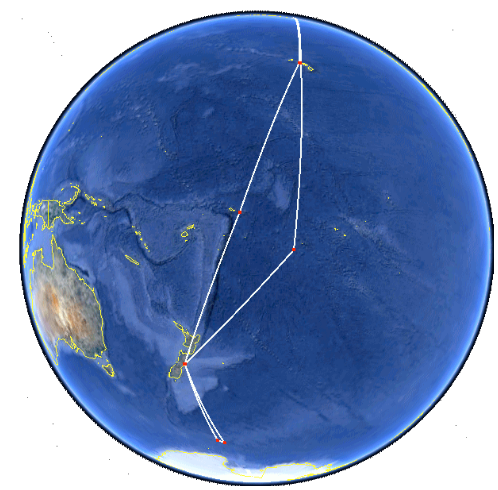
$$f\left(x_r, t_r \mid x_j, y_k, t_i\right) = \int_{t_i}^{t_i+\Delta t} dt \int_{x_j}^{x_j+\Delta x} dx \int_{y_k}^{y_k+\Delta y} dy \int_0^h dz \frac{\rho\left(x_r, t_r \mid x, t\right)}{N_{tot}}$$

$$N_2O_{enhancement}(x_r, t_r) = \sum_{i,j,k} f(x_r, t_r \mid x_j, y_k, t_i) \bullet F(x_j, y_k, t_i)$$

Northern Pacific N_2O Boundary

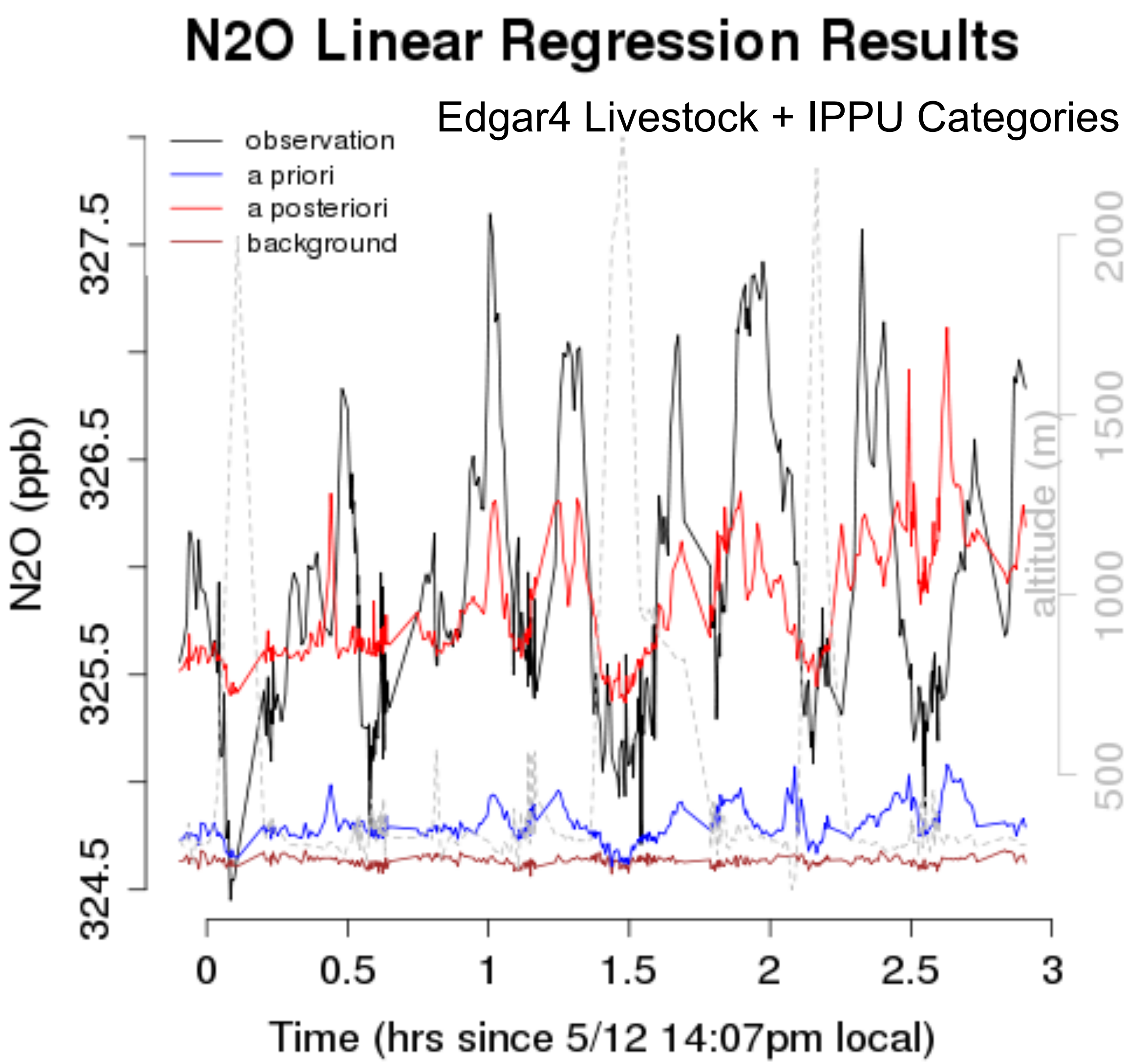


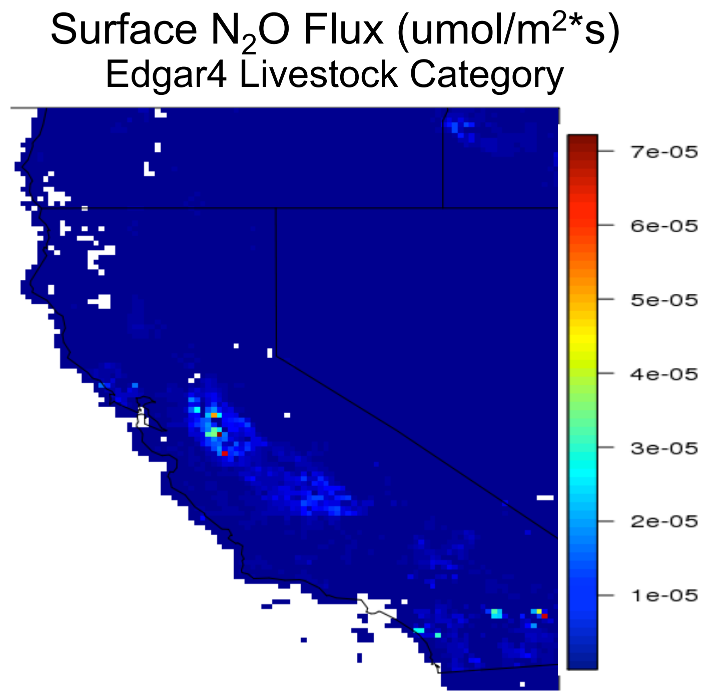




Model-Data Assimilation

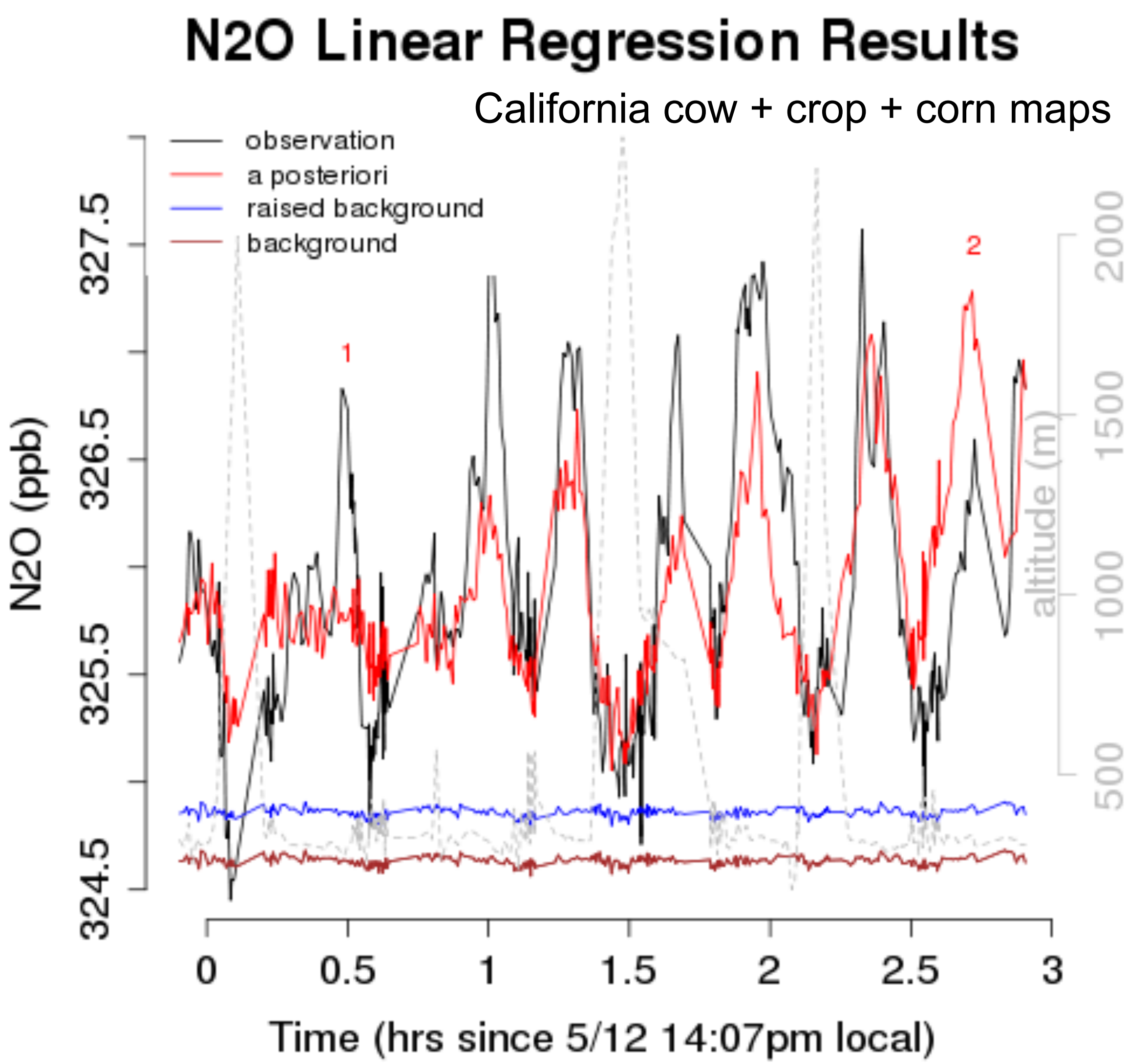
Use existing emission inventories

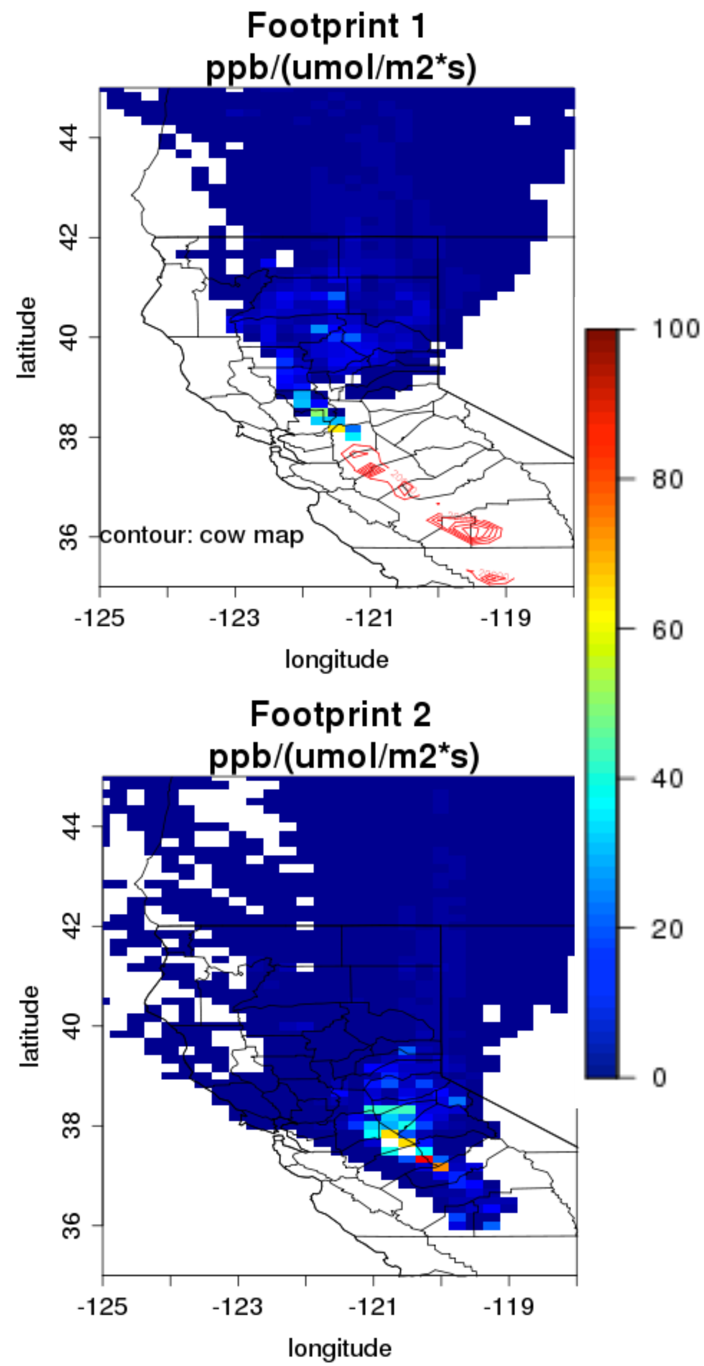




Model-Data Assimilation

with land use maps





Conclusions from Preliminary Results

- ❖ Existing emission inventories too low for California

- ❖ Manure management and fertilizer application are the major contributors for N San Joaquin Valley N_2O emission

- ❖ Need to explore point sources and other source categories to improve the model data assimilation.