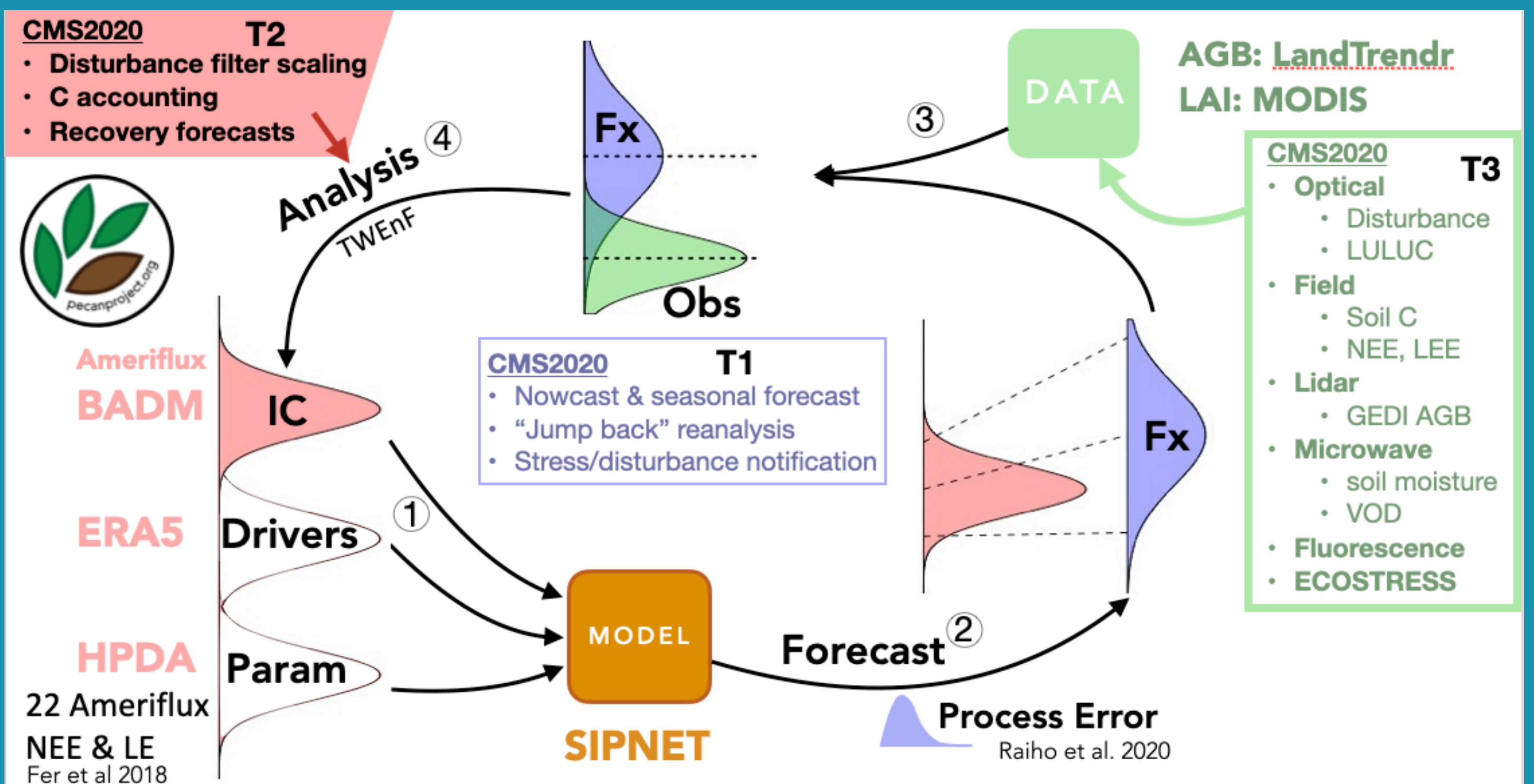


Multisensor data assimilation to support terrestrial carbon cycle and disturbance Monitoring, Reporting, Verification, and Forecasting

Landscape-scale forecasting and adaptive monitoring

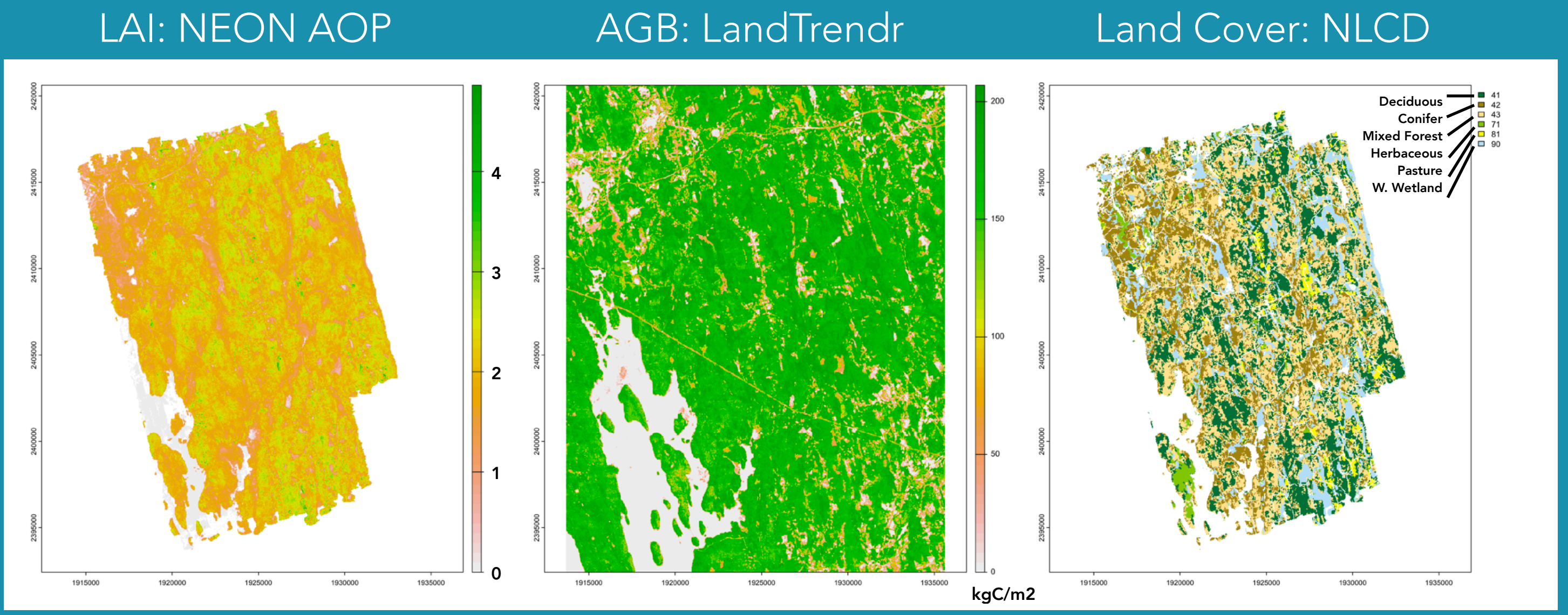
Larger Project



Specific Questions

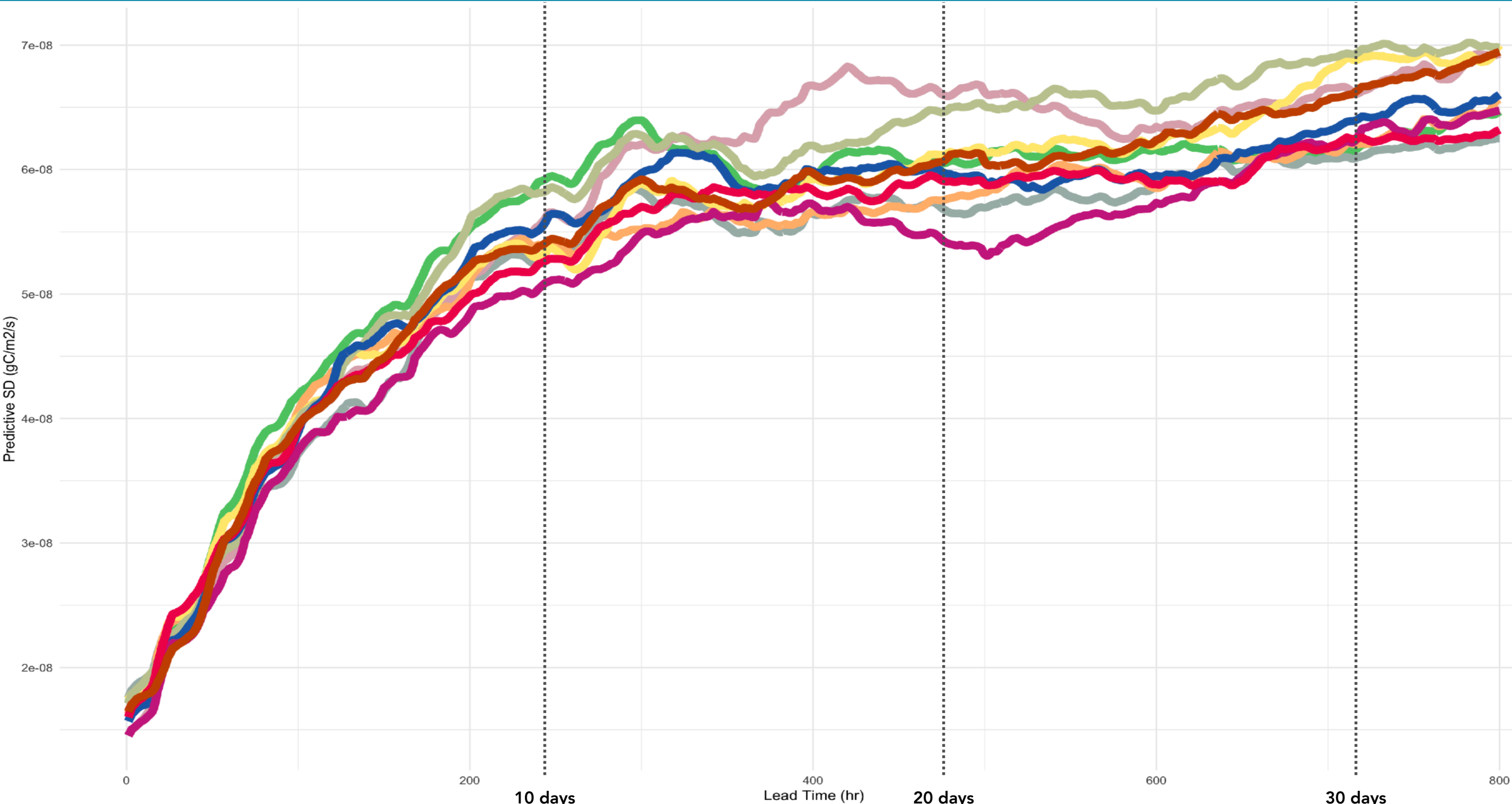
- Individual carbon project are often at a landscape scale, can we adapt iterative forecasting and assimilation techniques to these scales?
- Can we identify hotspots and hot-moments?
- Can we use fx to monitor adaptively?

Methods

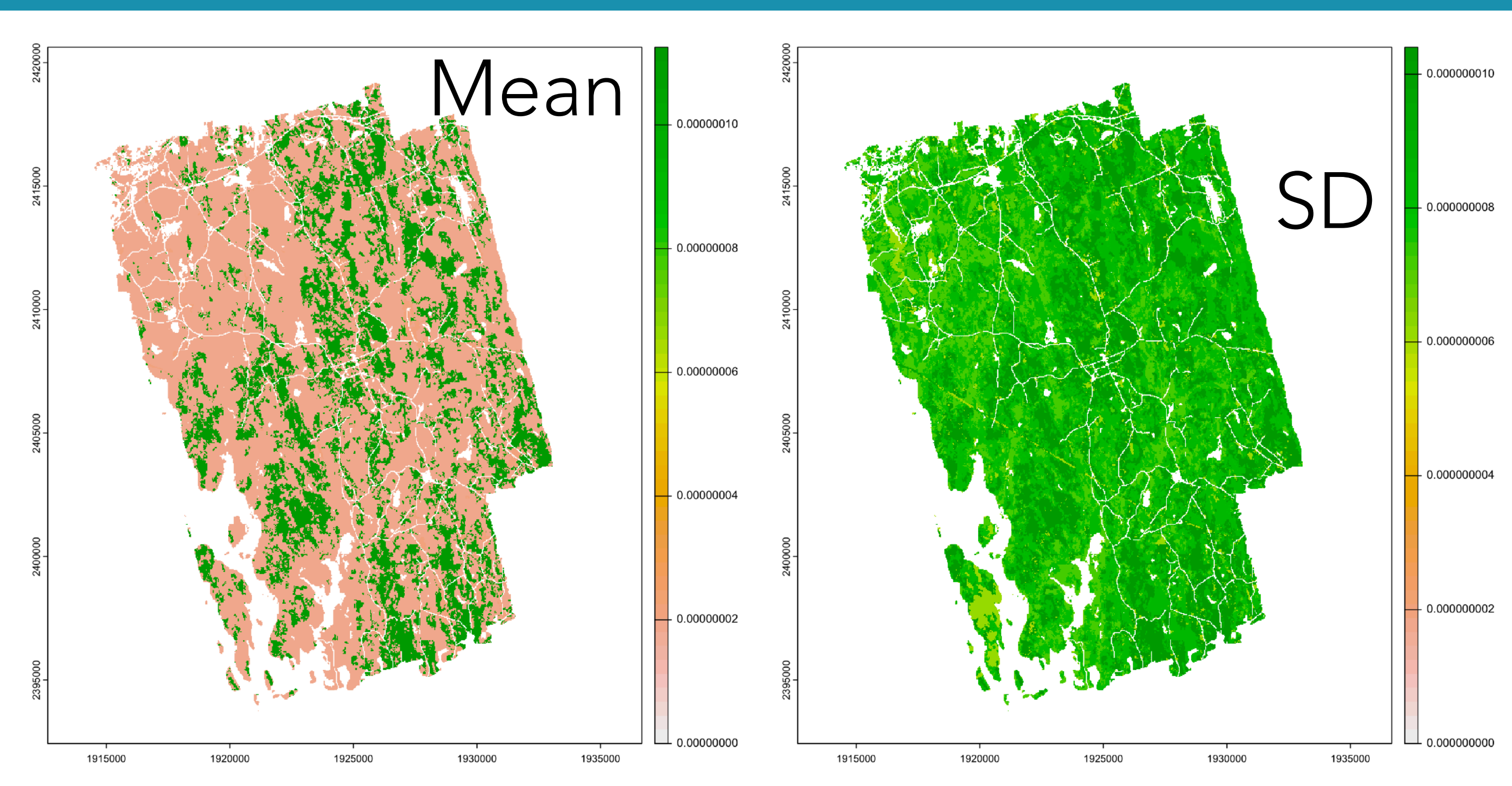


- Harvard Forest testbed
- 30m resolution, 10 clusters (k-means)
- Daily update, 35 day horizon, 1-hr timestep
- Initialized using remote sensing
- 100 ensemble SIPNET runs/day
- Sample met, parameters, IC

Results



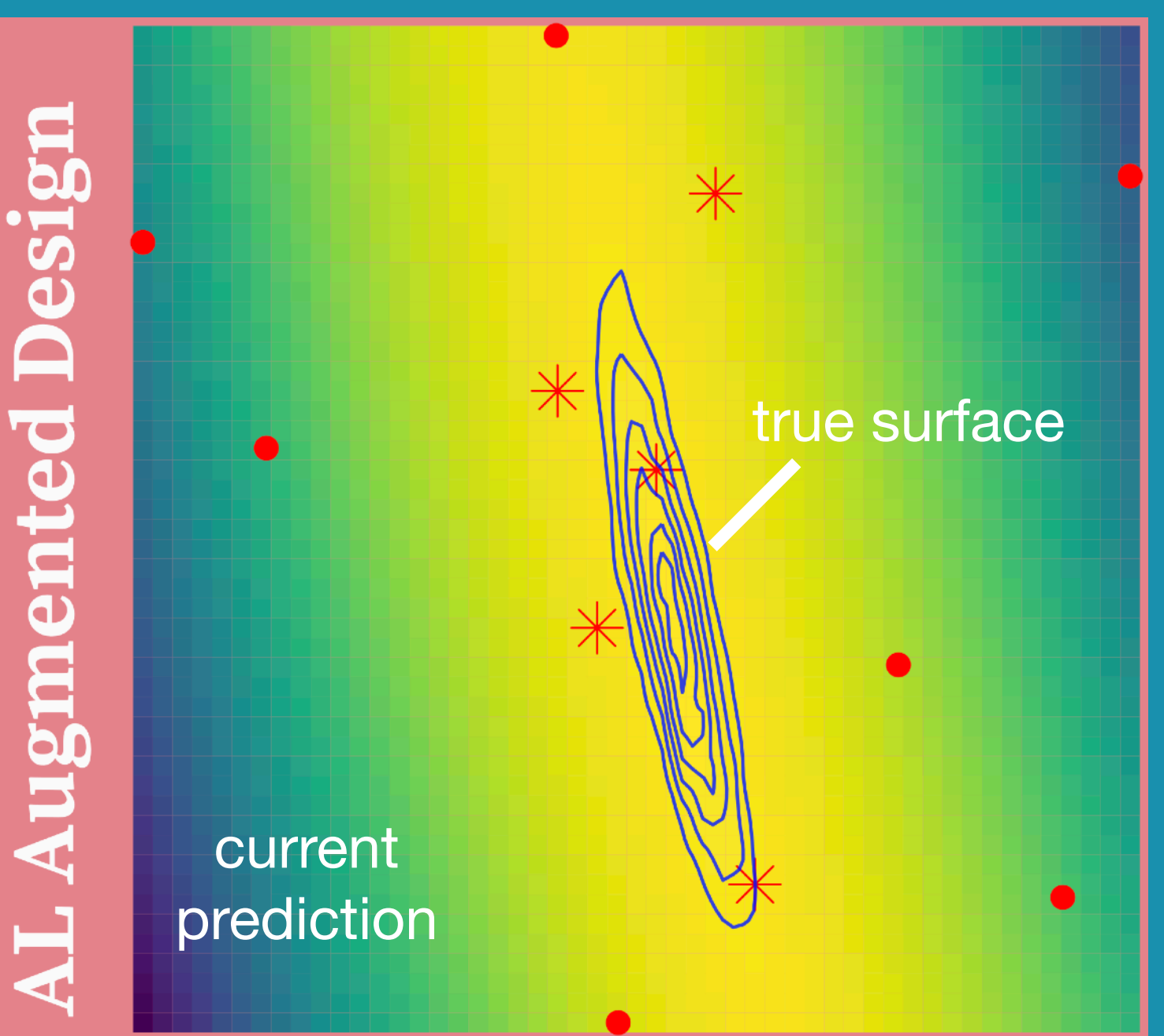
Forecast uncertainties are not substantially different across landscape clusters



Example spatial soil respiration forecast (2023-07-30)

Adaptive Monitoring

- Field MRV is a balance between cost and uncertainty
- Can we use forecasts to optimize what, where, and when to allocate limited monitoring resources?



Example: Augmented Learning work by Andrew Roberts

$$\theta_{n+1} := \operatorname{argmin}_{\theta} \alpha_n(\theta)$$

Select optimal location n+1

$$\alpha_n(\theta) := \mathbb{E}_{\theta'} \mathbb{E}_{\Phi(\theta)} \operatorname{Var}(\hat{\pi}_n(\theta') | \theta, \Phi(\theta))$$

Acquisition Criterion

$$\mathbb{E}_{\theta'}$$

weight by current prediction

$$\mathbb{E}_{\Phi(\theta)}$$

average over forecast uncertainty

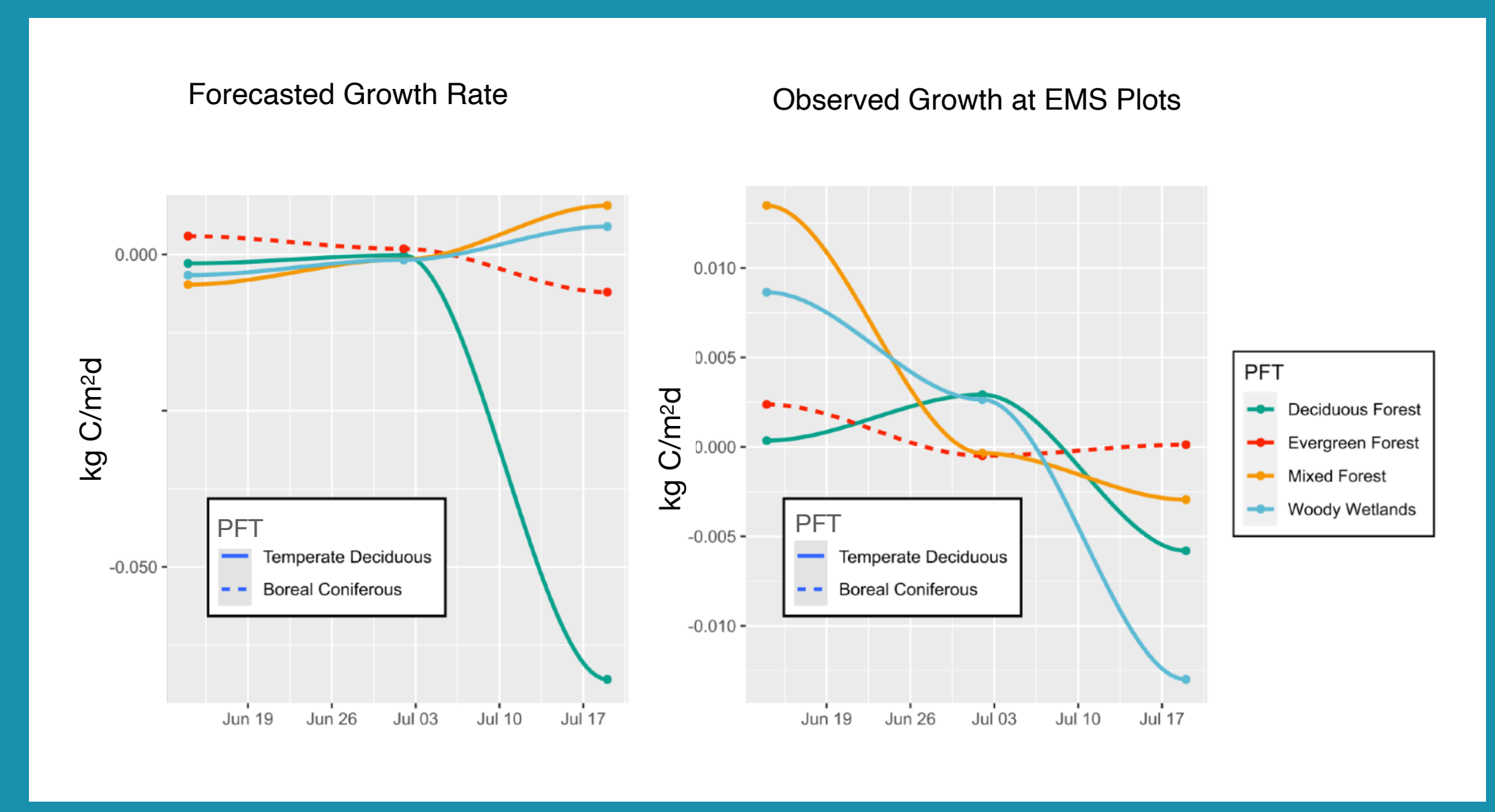
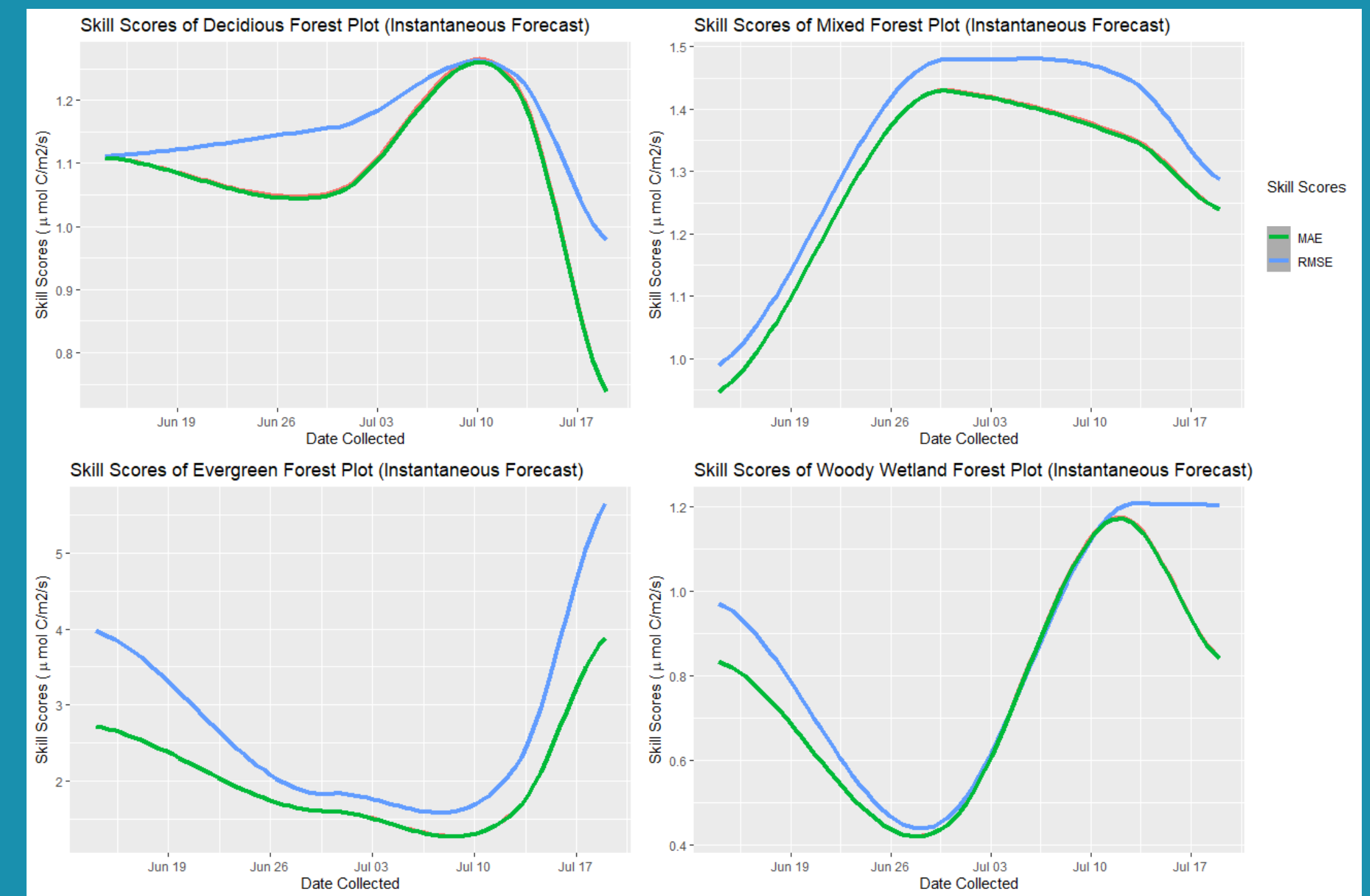
$$\hat{\pi}_n$$

forecast model | existing n data

• = existing locations * = proposed locations

Dietze, Zhang, Li, Serbin

Adaptive Validation Pilot Project



Soil Respiration



Isa Kazen



Tree Growth

In Progress: Observation Operators

- Fractional mapping between multi-resolution data (e.g. remotely sensing) and model pixels
- Flux tower observation operator requires running a daily flux footprint model

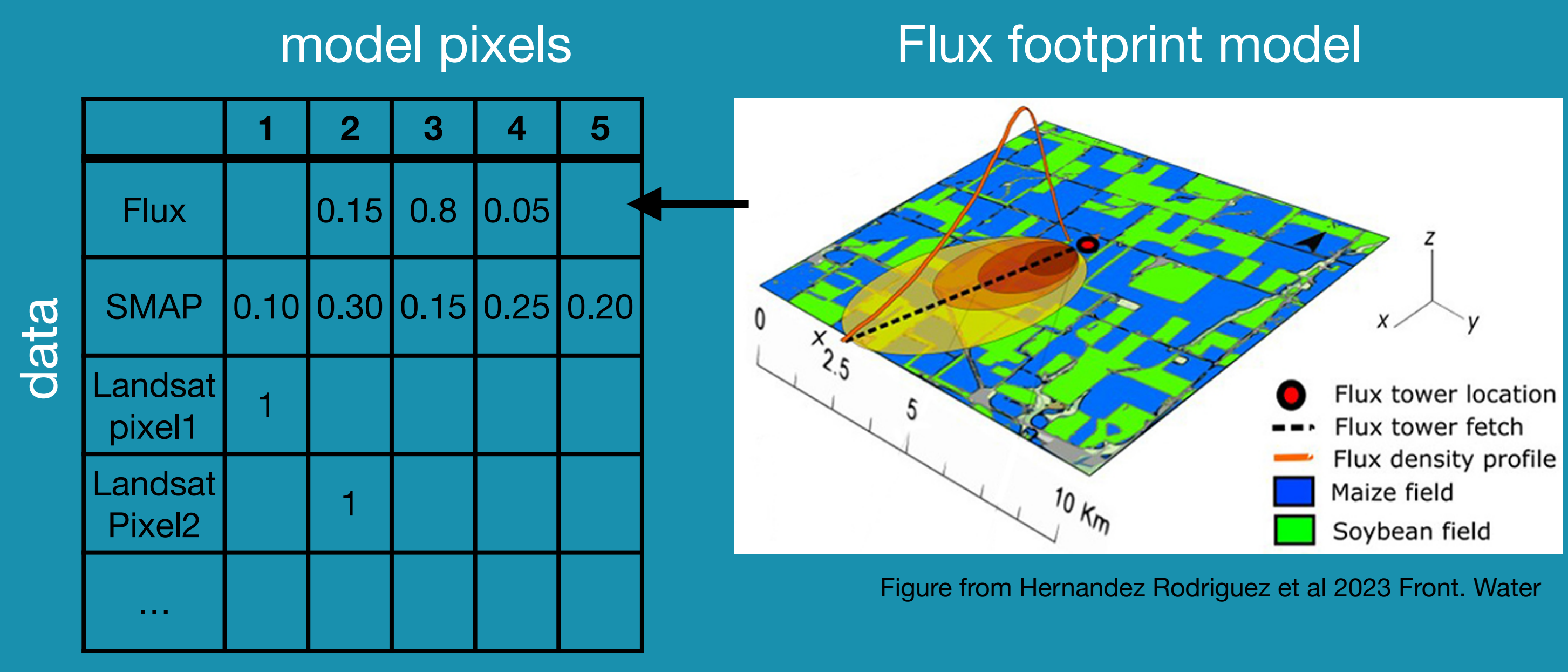


Figure from Hernandez Rodriguez et al 2023 Front. Water