

Soils: Sensing the Last Frontier

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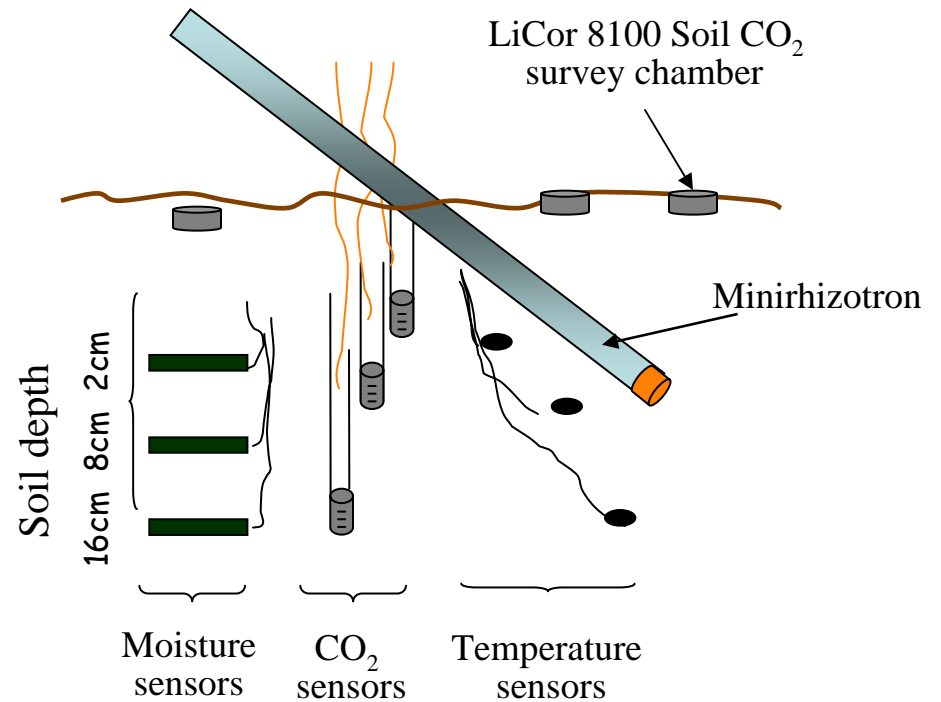
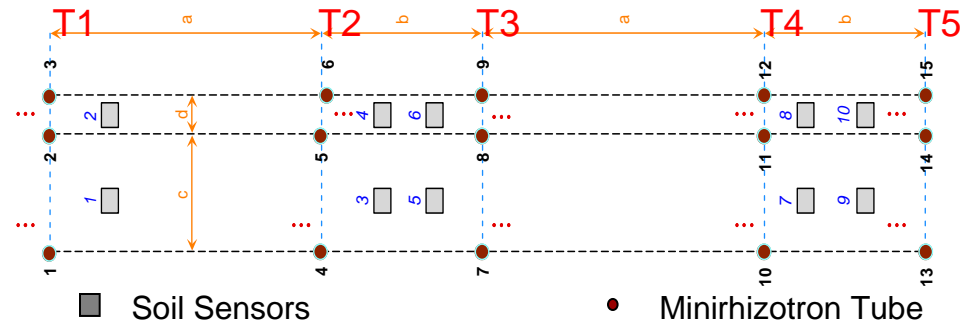
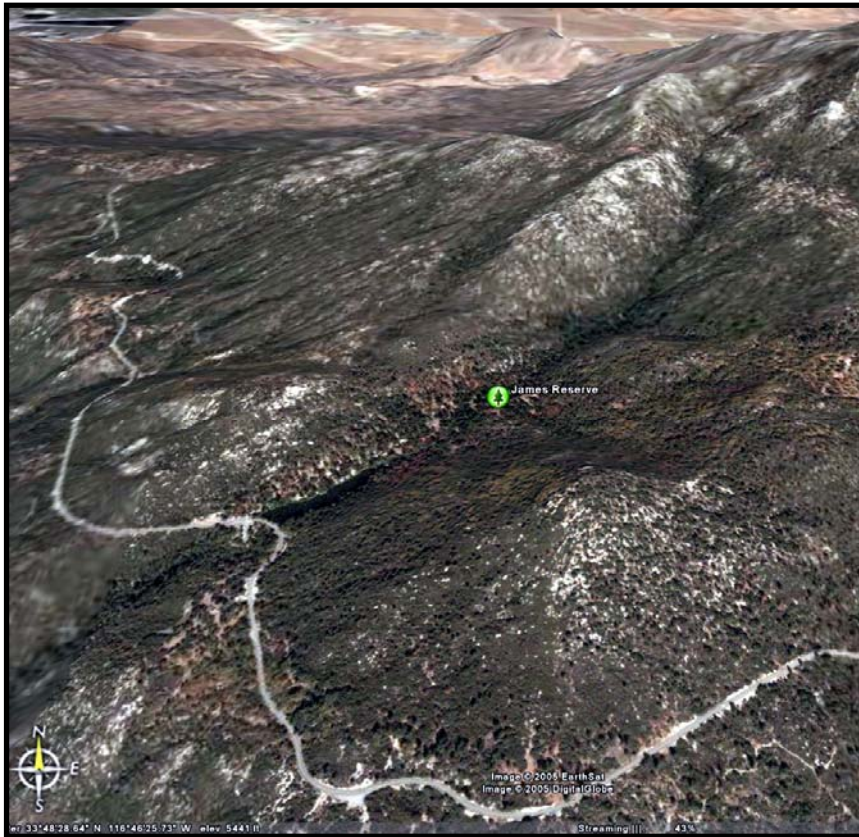
CCB, University of California, Riverside

Tom Schoellhammer

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The AMARSS Transect at the James San Jacinto Reserve



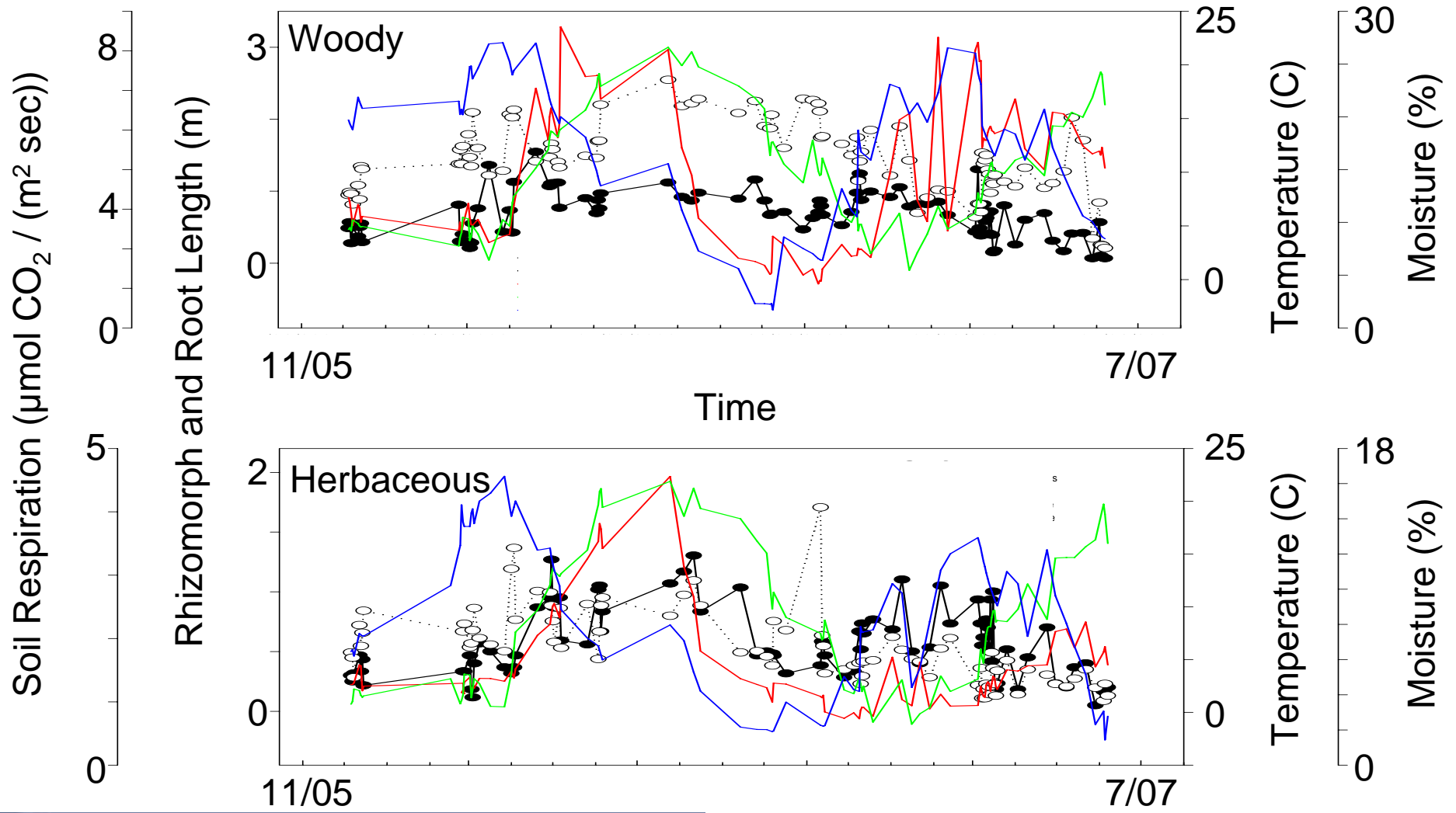
Spatially Stratification of the AMARSS

- Woody vegetation
 - High rate of soil respiration
 - More abundant roots and rhizomorphs (Summer 2006)
- Herbaceous vegetation
 - Low rate of soil respiration
 - Less abundant roots and rhizomorphs
 - Less soil moisture

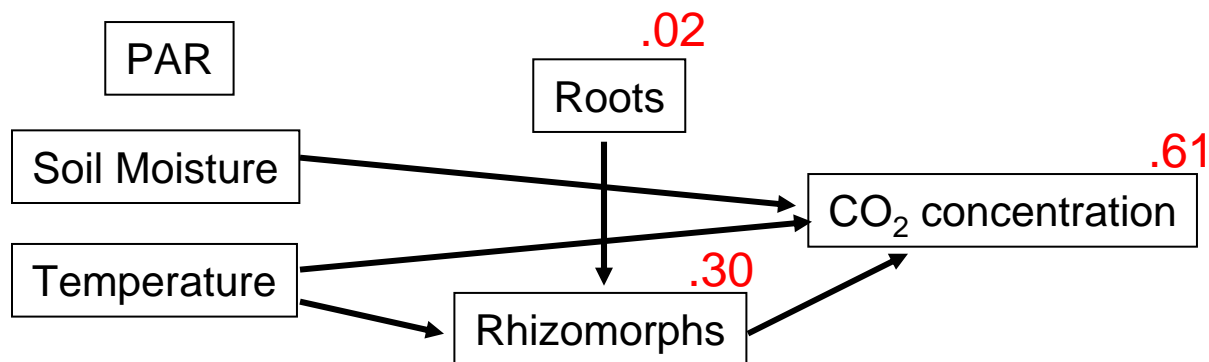
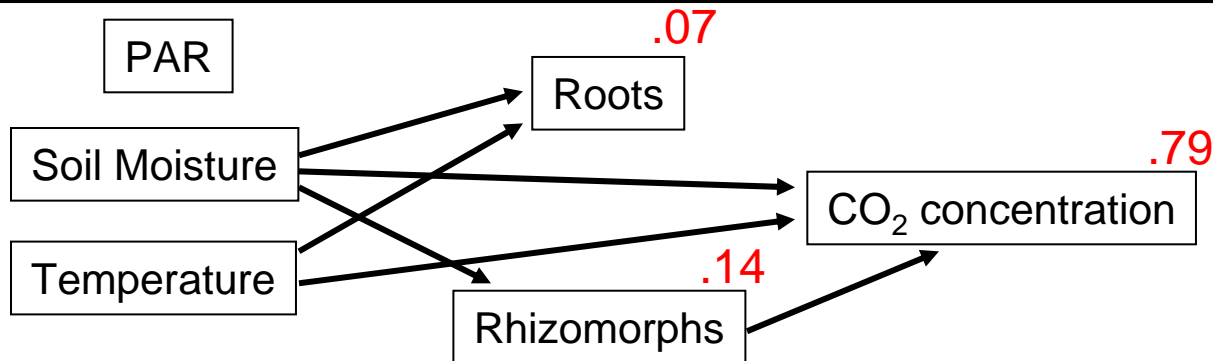
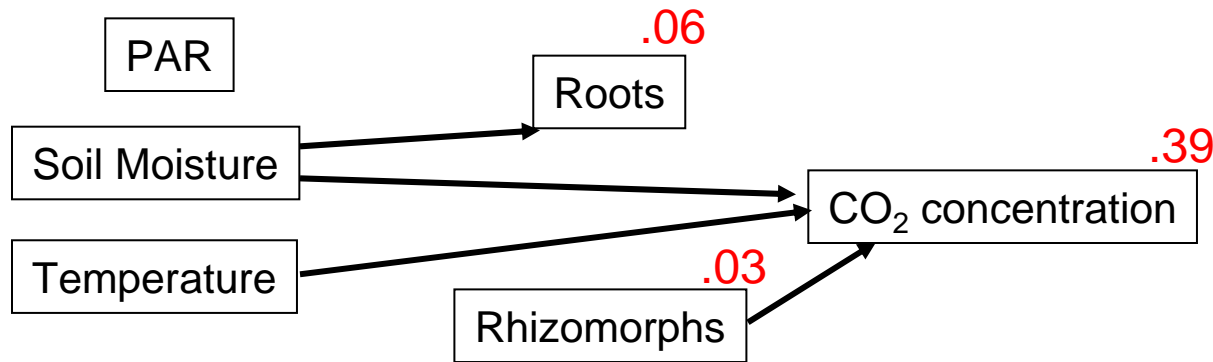


Sensing Data From November 2005 to June 2007

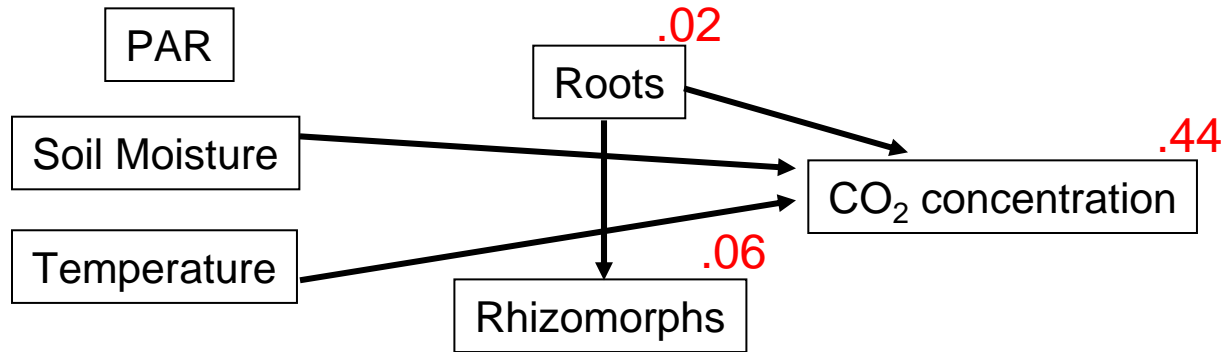
Respiration Roots Rhizomorphs Temperature Moisture



Structural Equation Analysis – Woody Vegetation

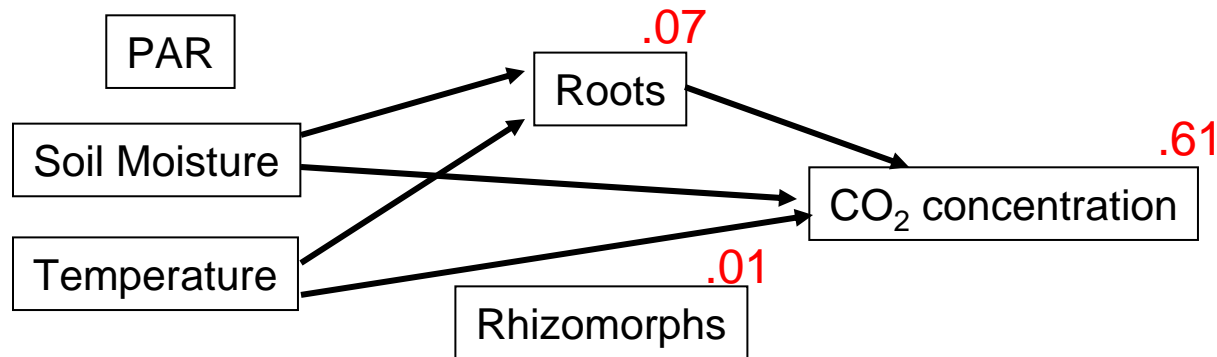


Structural Equation Analysis – Herbaceous Vegetation



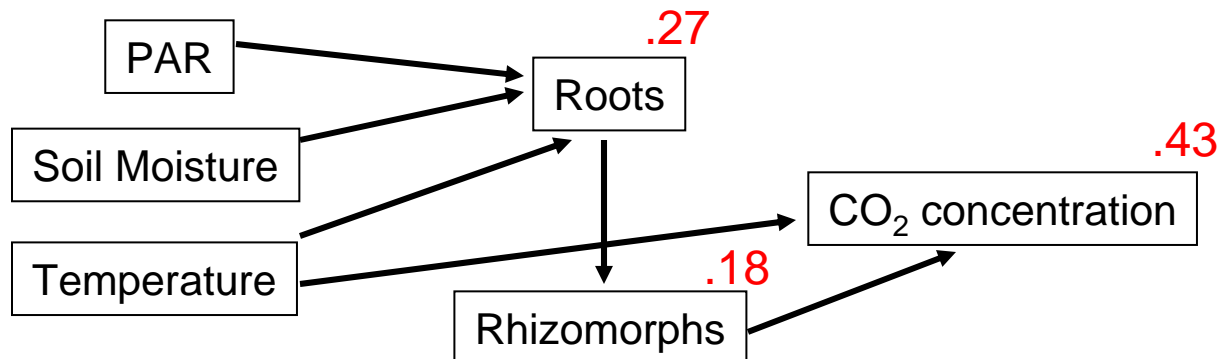
2cm depth

$p = 0.000$



8cm depth

$p = 0.0001$

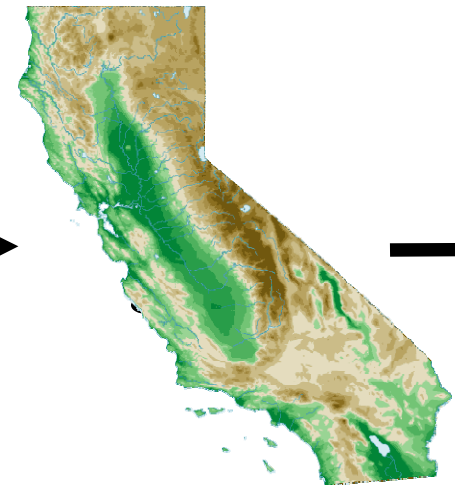


16cm depth

$p = 0.09$

Larger Scale Deployments are Needed

- Considerable spatial and temporal variation in soil respiration
- Progress in understanding soil respiration
 - Better predicting power with increasing soil depth
- In order to better understand variations in soil respiration we need
 - Better monitoring of soil microbes
 - Scale up the number monitoring sites to help characterize a larger region



Manageability Threatened at Scale

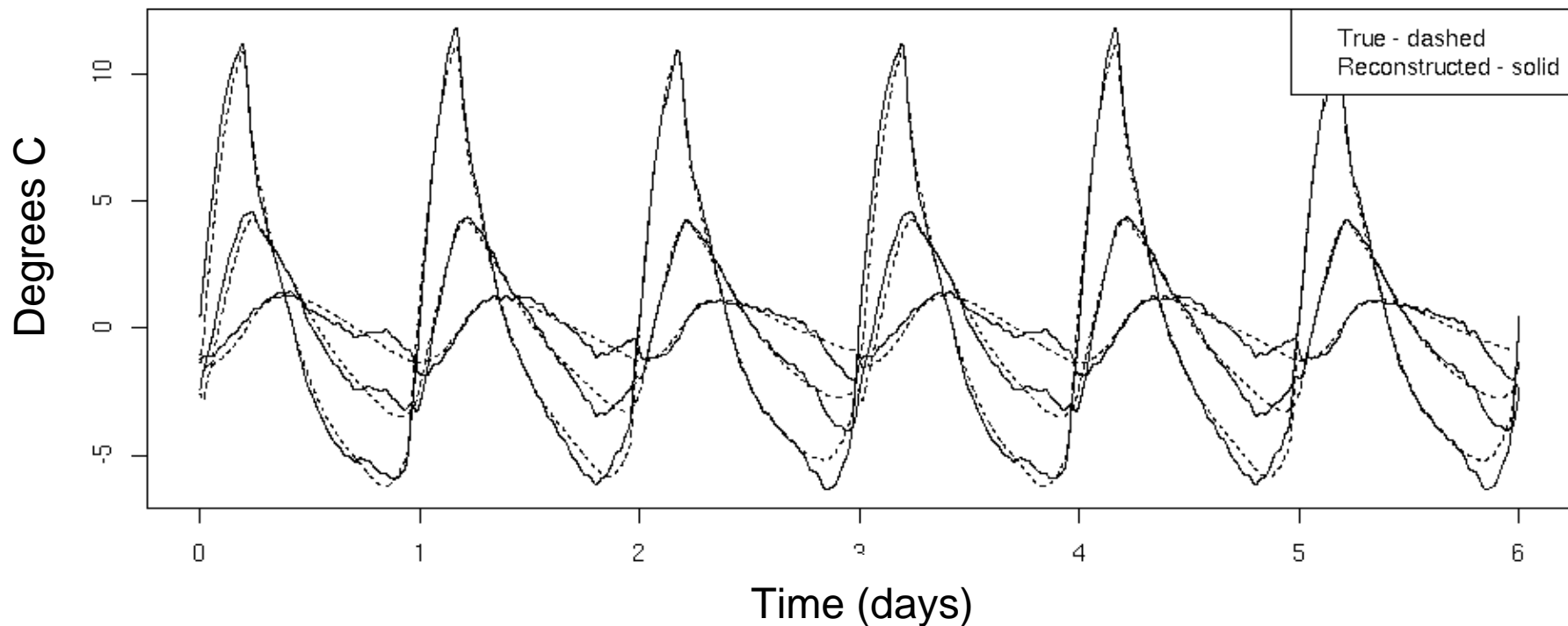
- Sensor network administration
 - Maintain reliable data back haul
 - Responsible for producing data
 - Detect and respond to failures
- Missing and faulty data can impact the science interpretation
- Our metric for system health needs to be the science application!
- **Tools to deal with missing or faulty data**



Modeling Can Fill In Missing Data

- Correlations can be leveraged to fill in data
 - Below ground temperature modeled from surface temperature using first principles
 - This adds uncertainty to the raw sensor data

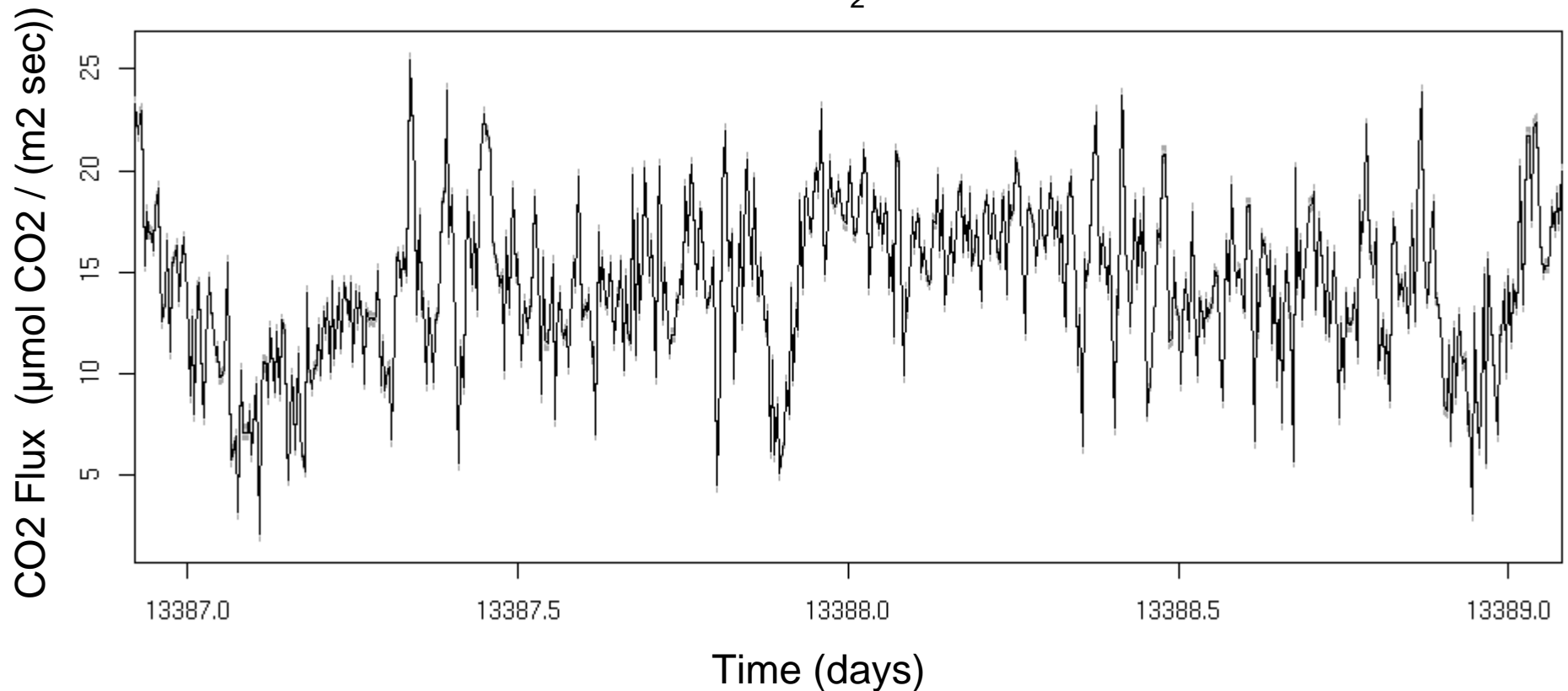
Predicted Temperature vs. Time



The Impact of Filling In Data

- Quantify the uncertainty in model outputs caused by uncertainty in model inputs

Estimated CO₂ Flux vs. Time



Improved System Health Monitoring

- Previously, system health metrics focused on quantities unrelated to the science application
- We're building a system health monitoring tool that will use the science application's performance as the metric of system performance
 - Quantify the impact of missing data on the application

