TIME SERIES SOIL OXYGEN DATA HELP IDENTIFY HOT SPOTS AND HOT MOMENTS OF GREENHOUSE GAS EMISSIONS FROM WETLANDS

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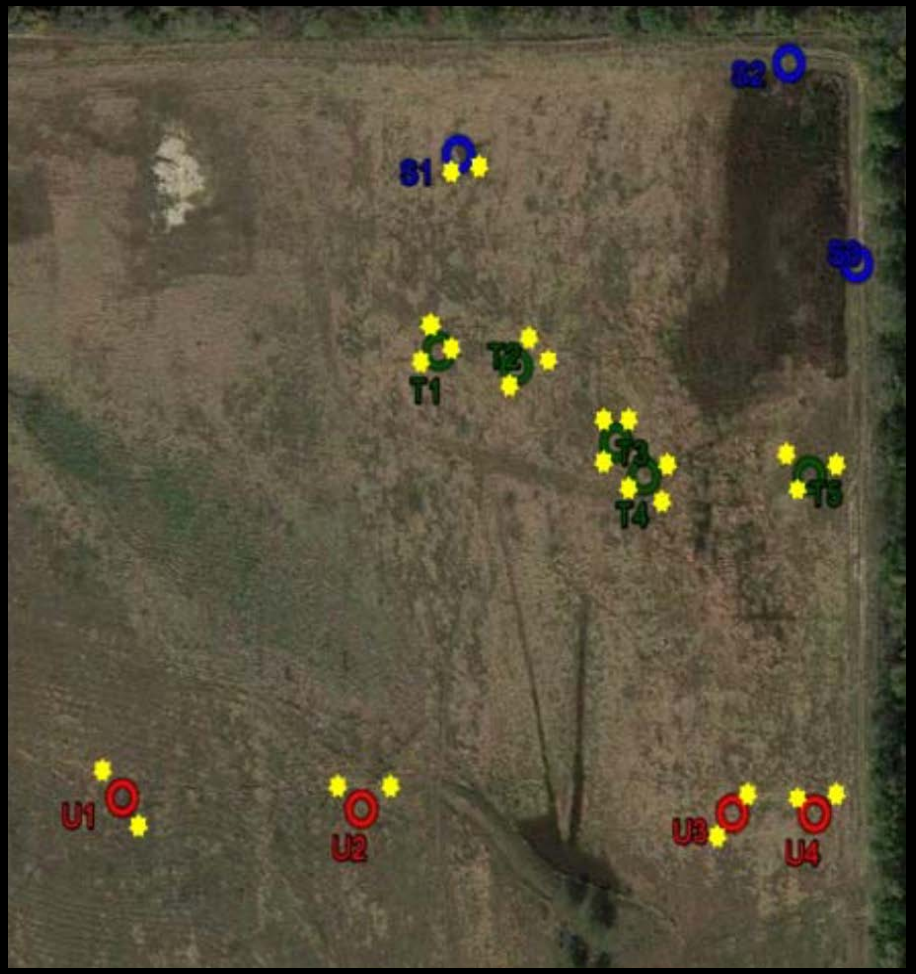
Fondriest Environmental

A Sensor Network at a Restored Wetland

Soil O_2, Soil Temperature and Soil Moisture Sensors



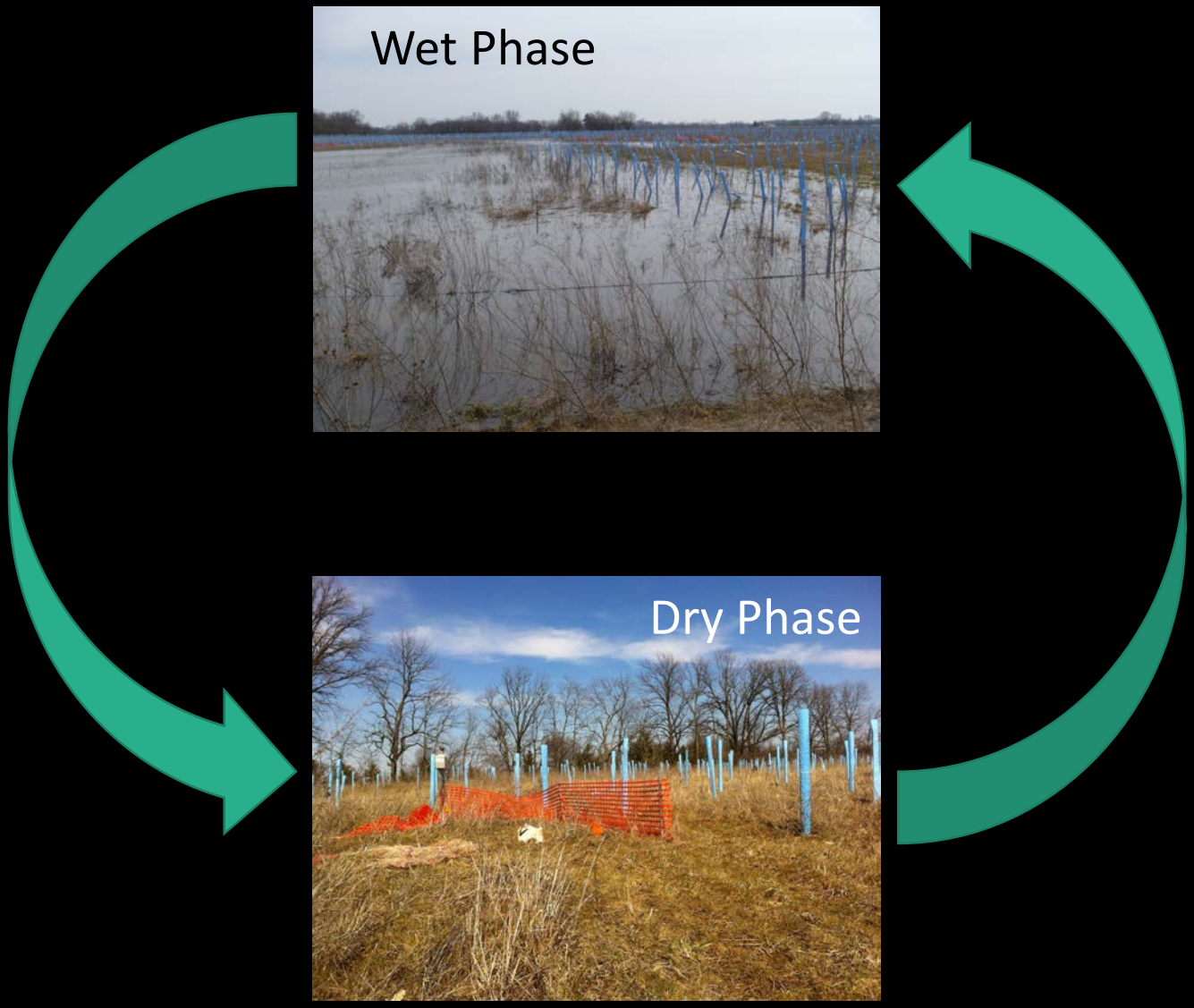
Controls on Greenhouse Gas Emissions

- Sensor readings every 30 minutes
- Weekly greenhouse gas flux sampling

Does having continuous data from sensors help improve GHG fluxes estimates in wetlands?

What sensors provide the most information about GHG fluxes?

The Challenge of Predicting Fluxes from Wetlands



Current methods do not capture dynamic nature

Sensors and Fluxes

Discrete Model

GHG ~ Point Measurement

Continuous Model

GHG ~ Point Measurement + Previous Measurement + Rolling Window

- Previous Measurement
  - 0.5 days
  - 1 day
  - 3 days
  - 7 days
  - 14 days
- Rolling Window
  - Variance
  - Mean
  - Max
  - Min

Sensors and fluxes

Machine Learning: Training Set and Validation Set
Step-wise AIC model selection

CH_4 Fluxes

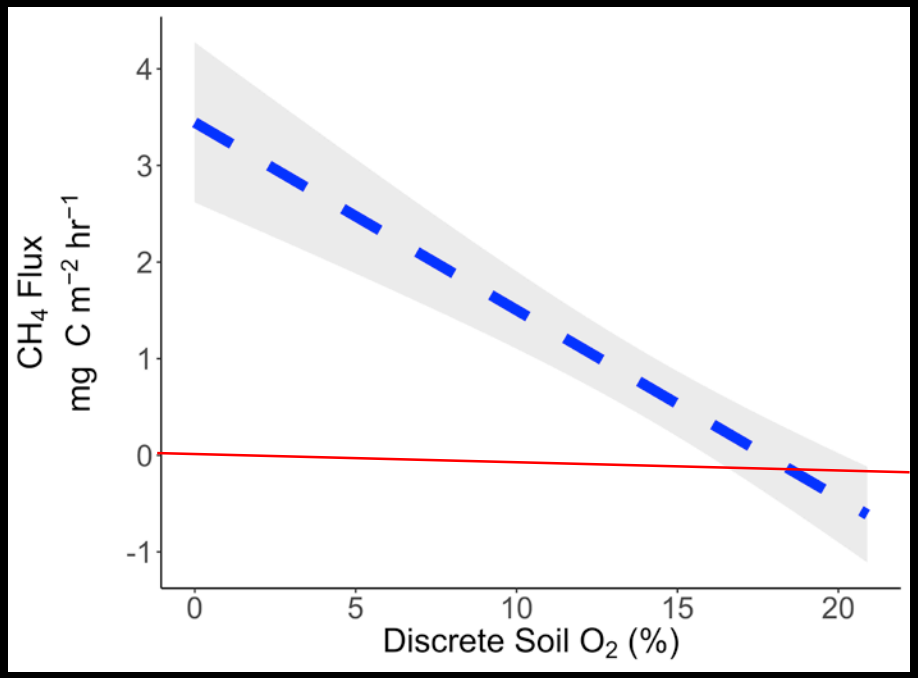
Sensor	Discrete	Continuous
Soil O_2		✓
Temperature		✓
Water Filled Pore-space		✓

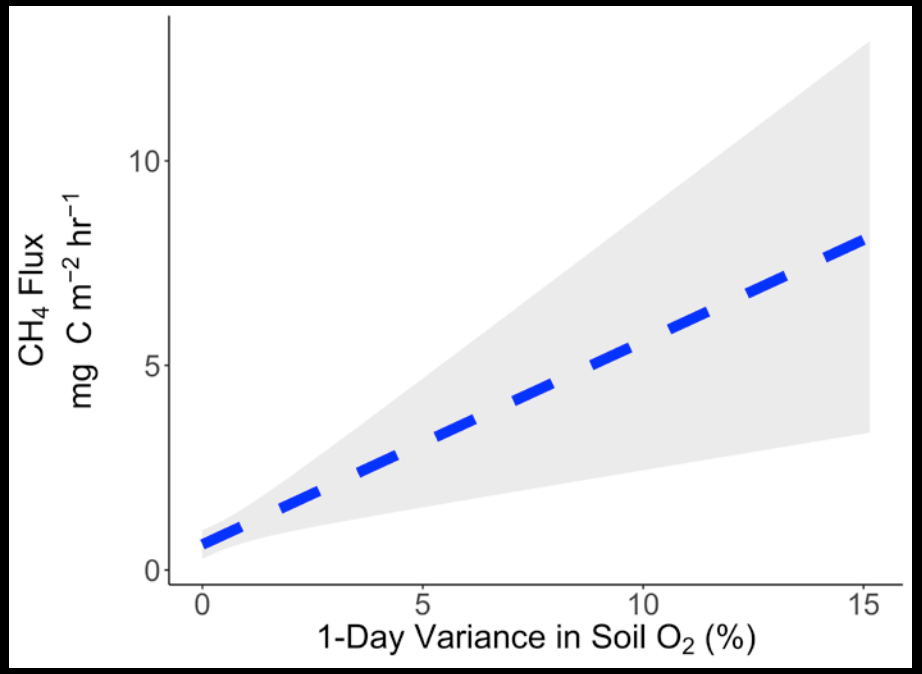
27% of Variance Explained

Why The Soil O_2 Sensor?

Anoxic conditions → Methanogenesis

Oxic conditions → Methane Oxidation





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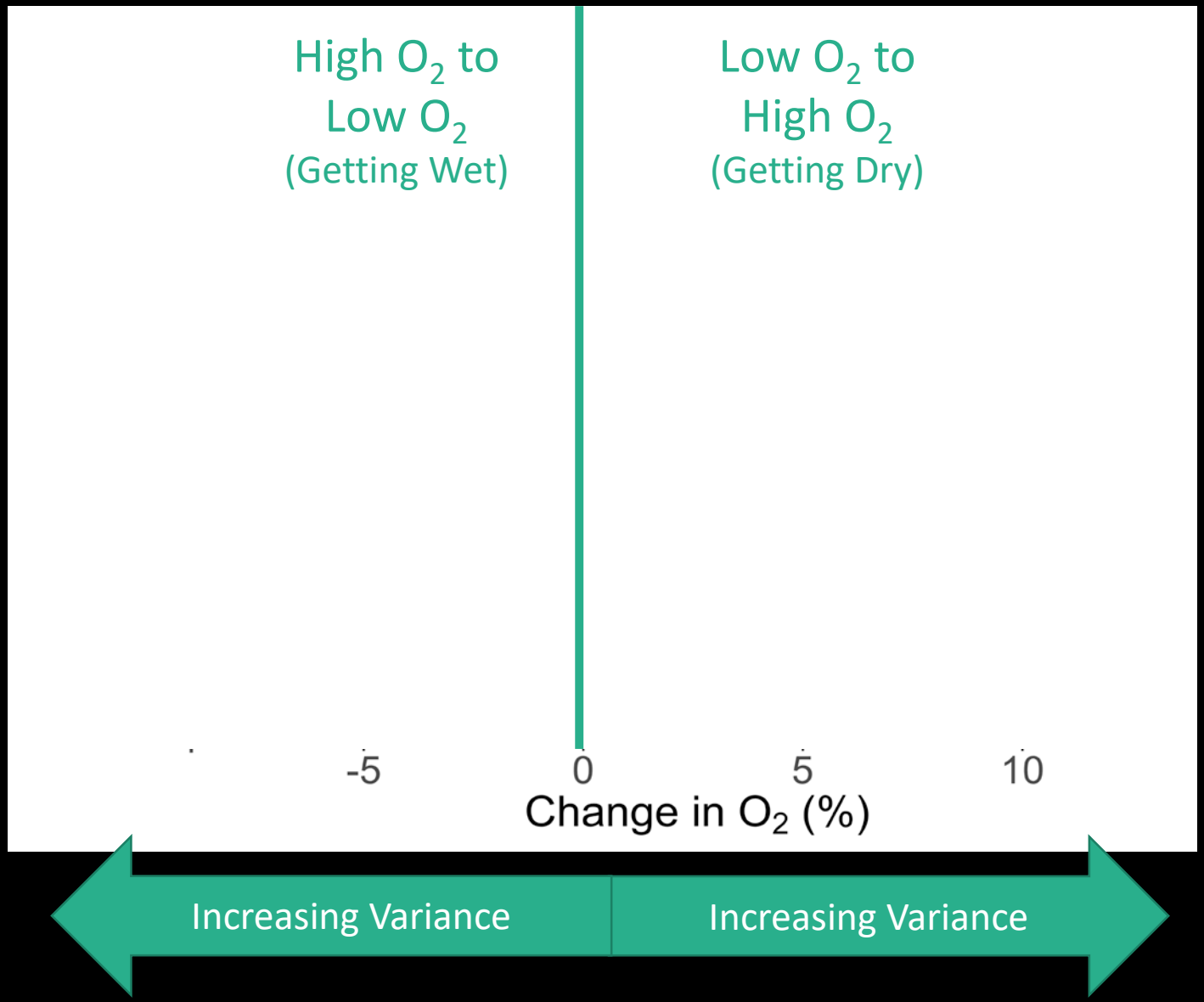
One-Day Variance in Soil O_2



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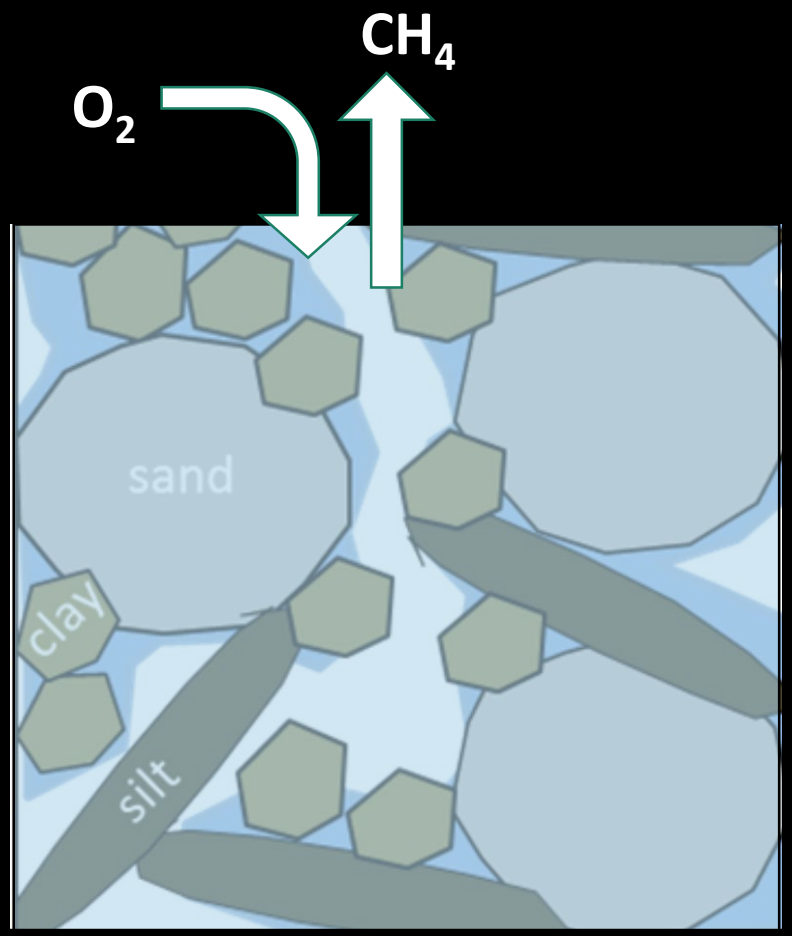
CH_4 is released as soils dry and are re-connected to the atmosphere



N_2O Fluxes

Sensor	Discrete	Continuous
Soil O_2		✓
Temperature		✓
Water Filled Pore-space		✓

13% of Variance Explained


Continuous data from sensors help explain greenhouse gas fluxes better than discrete data alone.

Multiple Sensors

Take Home Messages

- Continuous data help
  - More sensors are slightly better
- Sensor data to gap-fill
  - Linear interpolation misses hot moments
- Limitation: Other sources of variance?
- CH_4 fluxes: Soil O_2 Sensor
- N_2O fluxes: Soil Moisture Sensor

Sensors

A helpful tool in our toolbox

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