

The background of the slide features a close-up photograph of several small green seedlings with two leaves each, growing out of a mound of dark brown, rich soil. The seedlings are at different stages of growth, with the one on the right being the tallest and most developed. The background is a soft, out-of-focus green, suggesting a natural, outdoor setting.

# A LOW-COST SENSOR PLATFORM FOR MEASURING SOIL RESPIRATION

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## ABOUT ME

- Undergraduate at Washington State University
- Major in Environmental and Ecosystem Sciences
- Minor in Engineering
- Honors College





# SEVILLETA NATIONAL WILDLIFE REFUGE



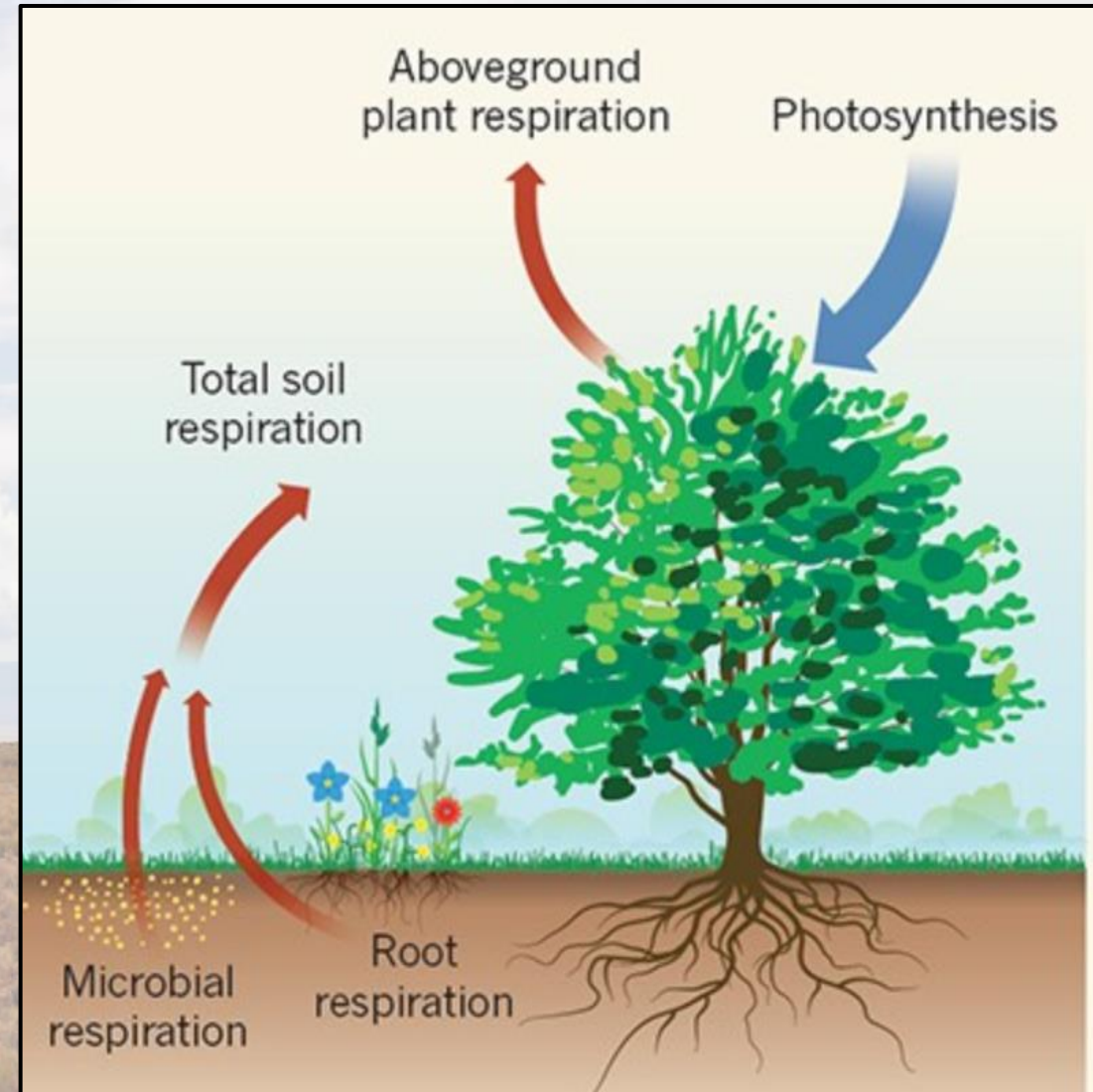
# RESEARCH QUESTIONS

- How does the data generated by low-cost sensors compare with data generated by commercial probes
- Are these low-cost sensors accurate enough for scientific research?



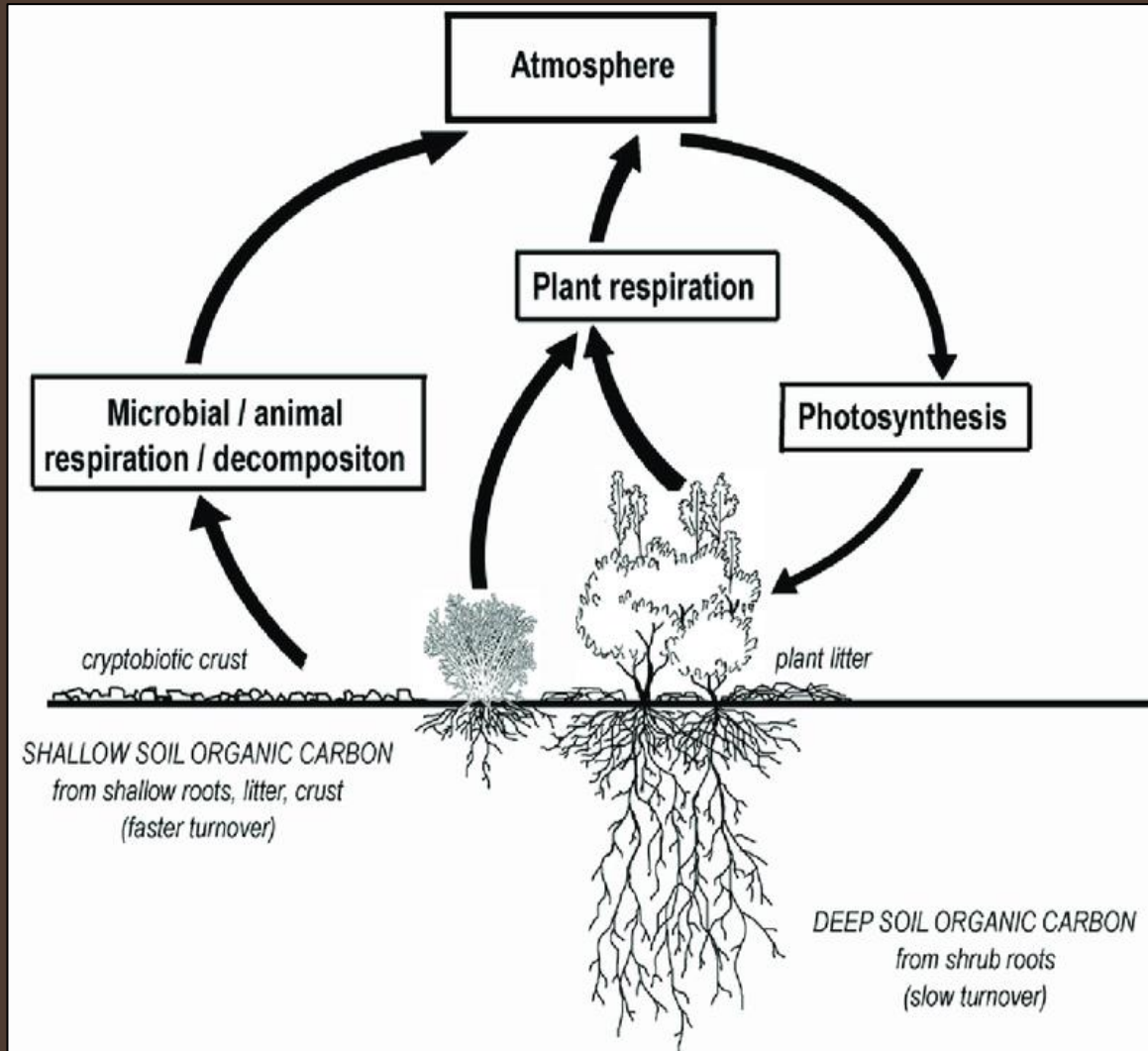
# SOIL RESPIRATION

- Plant roots and microbes in the soil release CO<sub>2</sub>
- CO<sub>2</sub> passes from soil to atmosphere



# CARBON FLUX

- Net amount of carbon passing through the soil
- Soils
  - Largest terrestrial carbon pool
  - Second largest source of terrestrial carbon flux
- Carbon dynamics poorly understood



Ford et al. (2012)





## CARBON SEQUESTRATION

- Soils store twice as much carbon as the atmosphere
- 4 per mille Soils for Food Security and Climate initiative
- Sequestration by improved soil management
- More data needed



# QUANTIFYING RESPIRATION

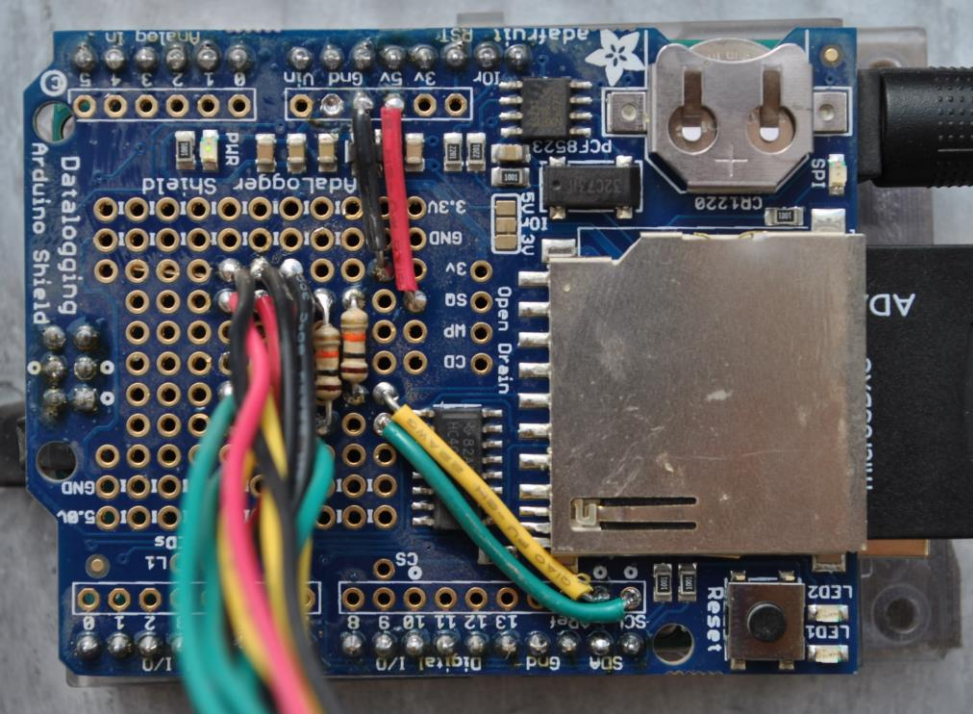
- Autonomous sensors can capture change over time
  - Long term data with little labor involved
- IRGA sensors
  - High quality data
  - Expensive





# RESEARCH OBJECTIVE

- Reduce cost barriers associated with soil respiration measurements
  - Commercial Probes: ~\$700
  - Low-cost Probes: ~\$70
- Increase spatial resolution of respiration processes



## DATALOGGER PROTOTYPE

- Based on design by Gyawali et al. (2019)
- Three low-cost CO<sub>2</sub> sensors
  - Wrapped in gore-tex
- Arduino microcontroller
- Datalogger shield
  - SD card
  - Real-time clock





# MONSOON RAINFALL MANIPULATION EXPERIMENT

- Evaluate effect of precipitation variability on ecosystem processes
- Two rainfall treatments
  - Small weekly
  - Large monthly









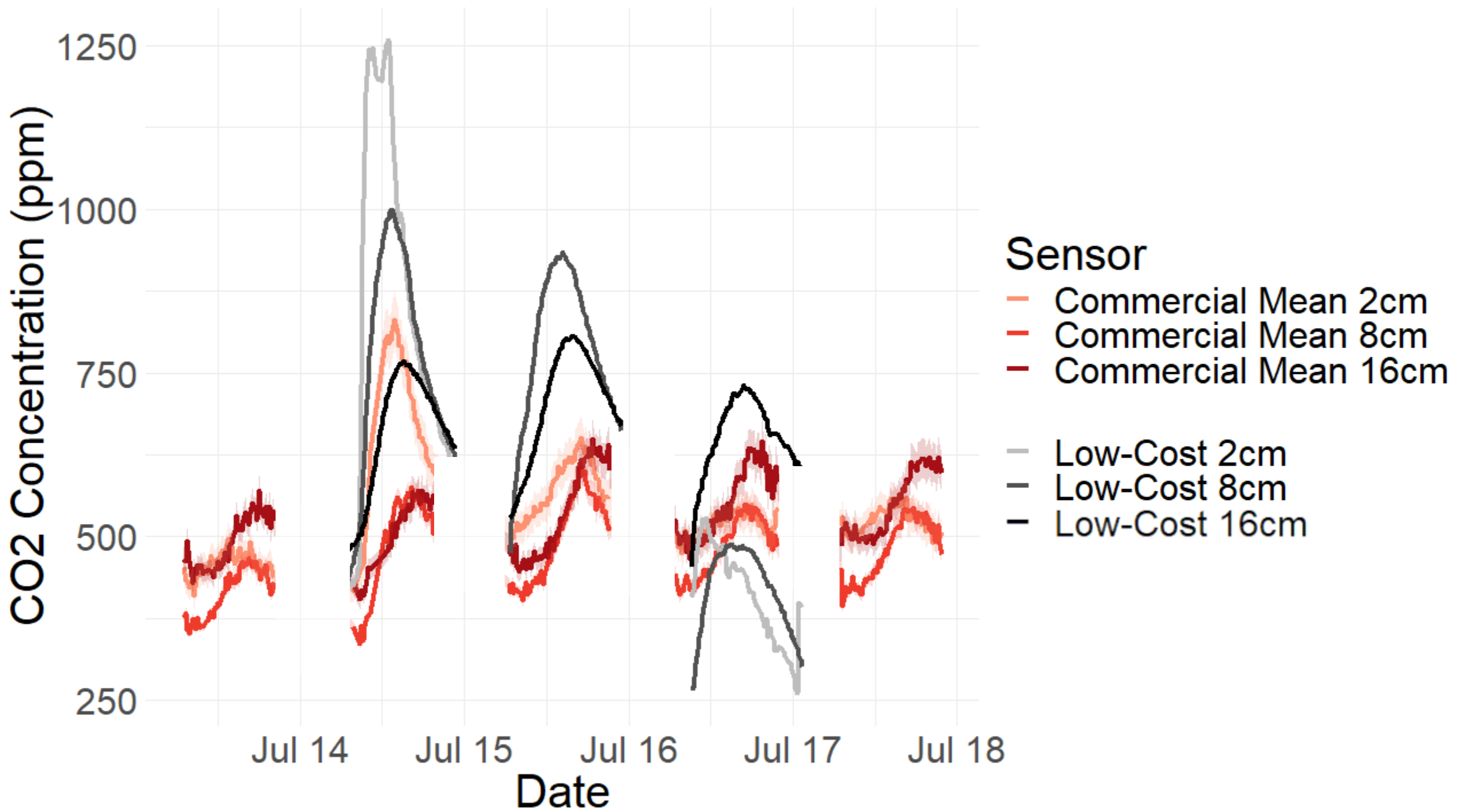
# RESULTS

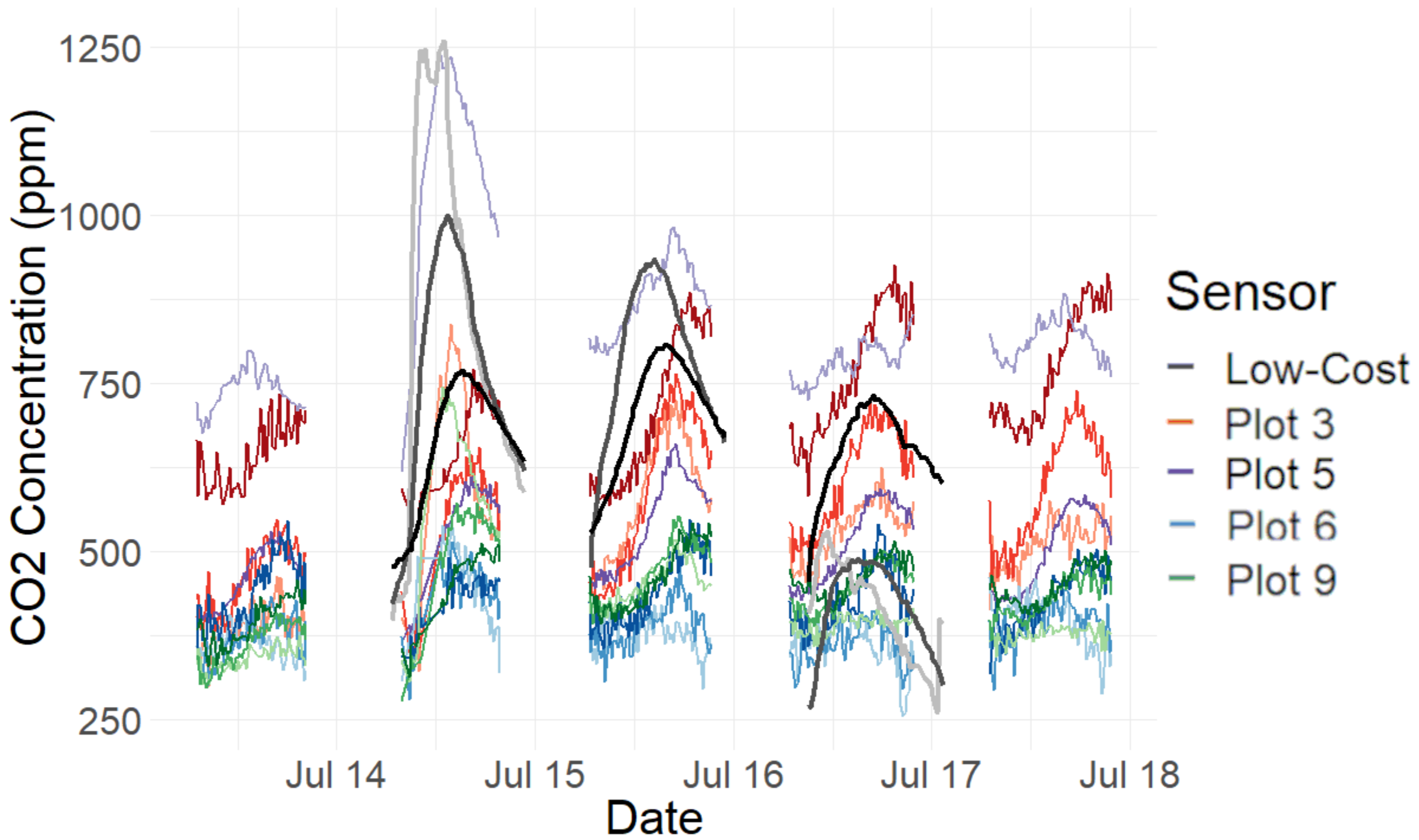


## ROADBLOCKS

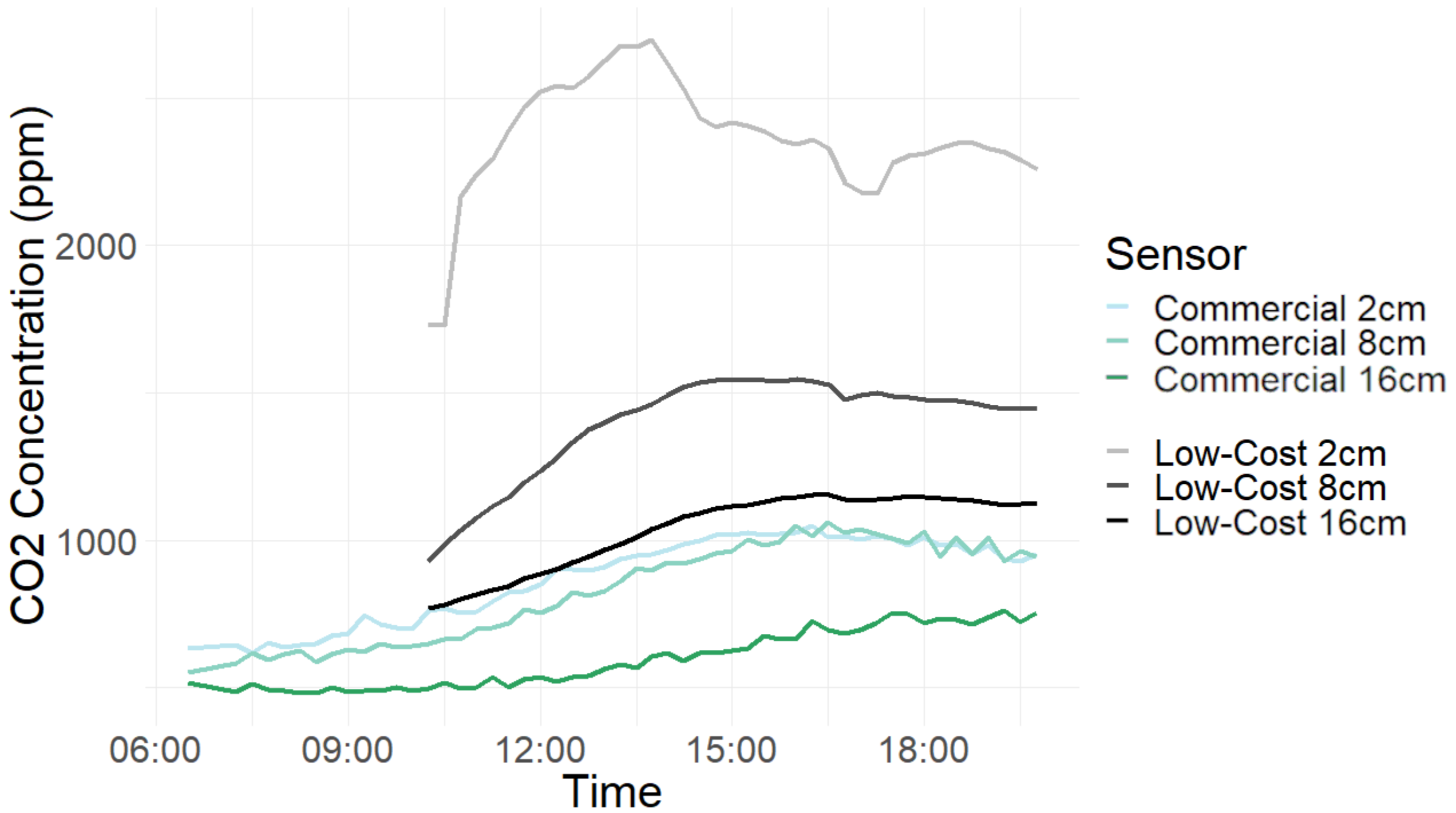
- Battery life: ~16 hours
- 12V Solar infrastructure on site
- Components failed
- Unstable power
- Opportunities for growth











# OVERALL

- More data needed
- Stable power supply
- Lessons learned





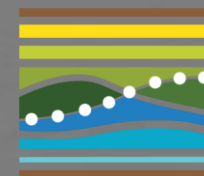
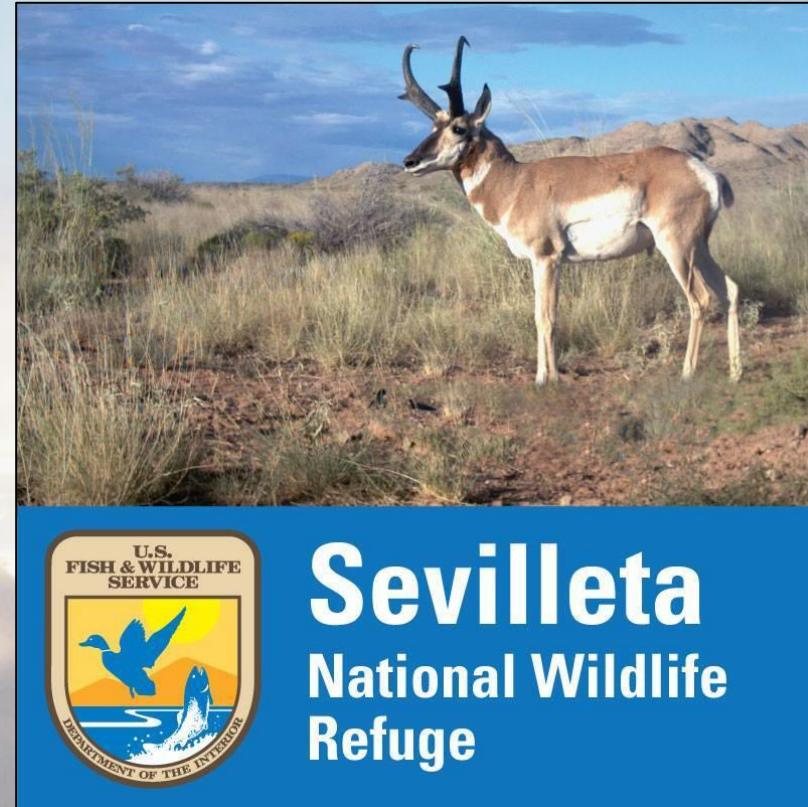
# GOING FORWARD

- Continue to collect data throughout the monsoon season
- Potential testing in the lab
- Long term deployment in remote settings
  - Different configuration
- How to connect to existing infrastructure



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- University of New Mexico
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LONG TERM ECOLOGICAL RESEARCH