A LOW-COST SENSOR PLATFORM FOR MEASURING SOIL RESPIRATION

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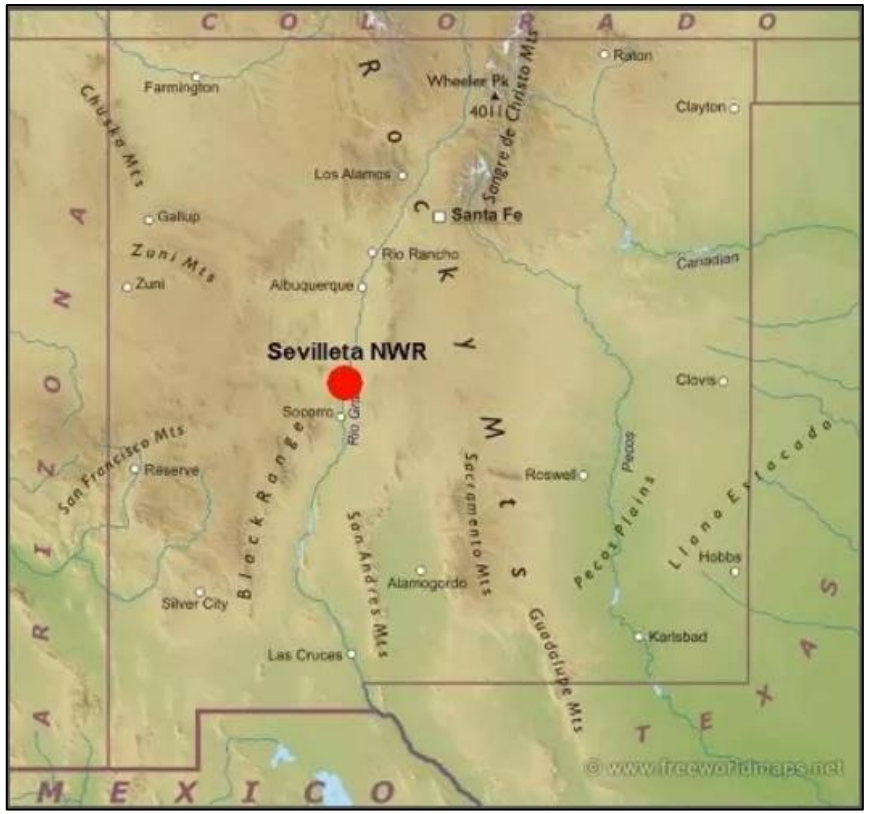
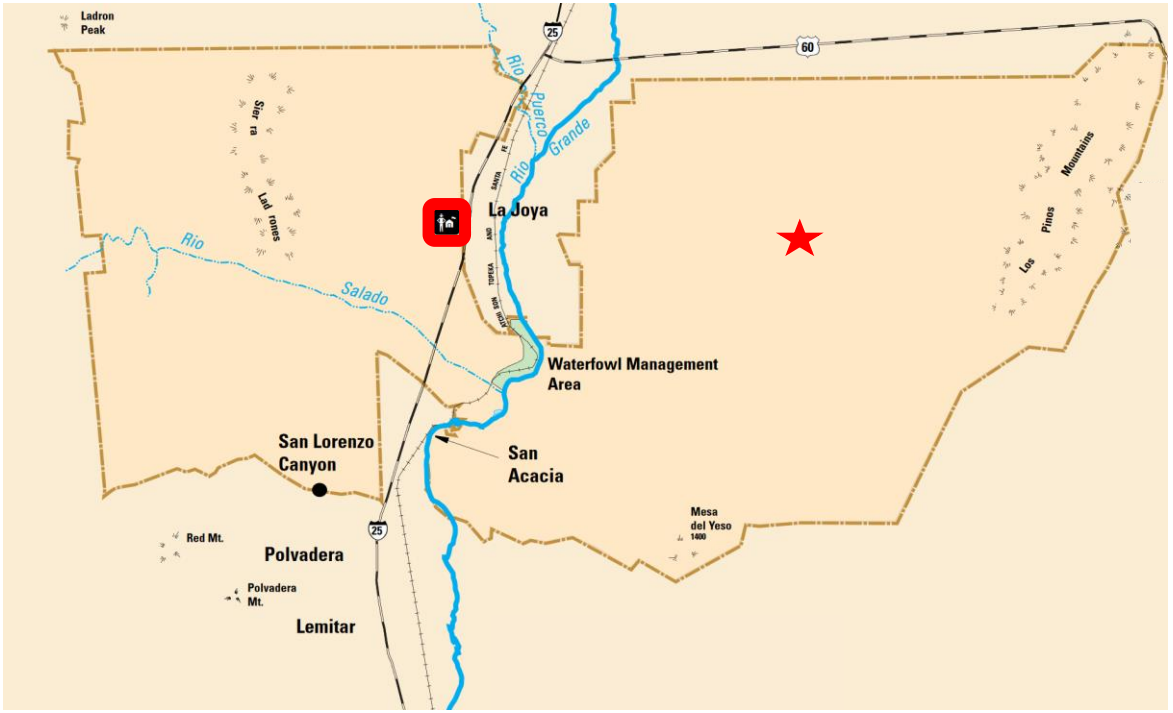
ABOUT ME

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





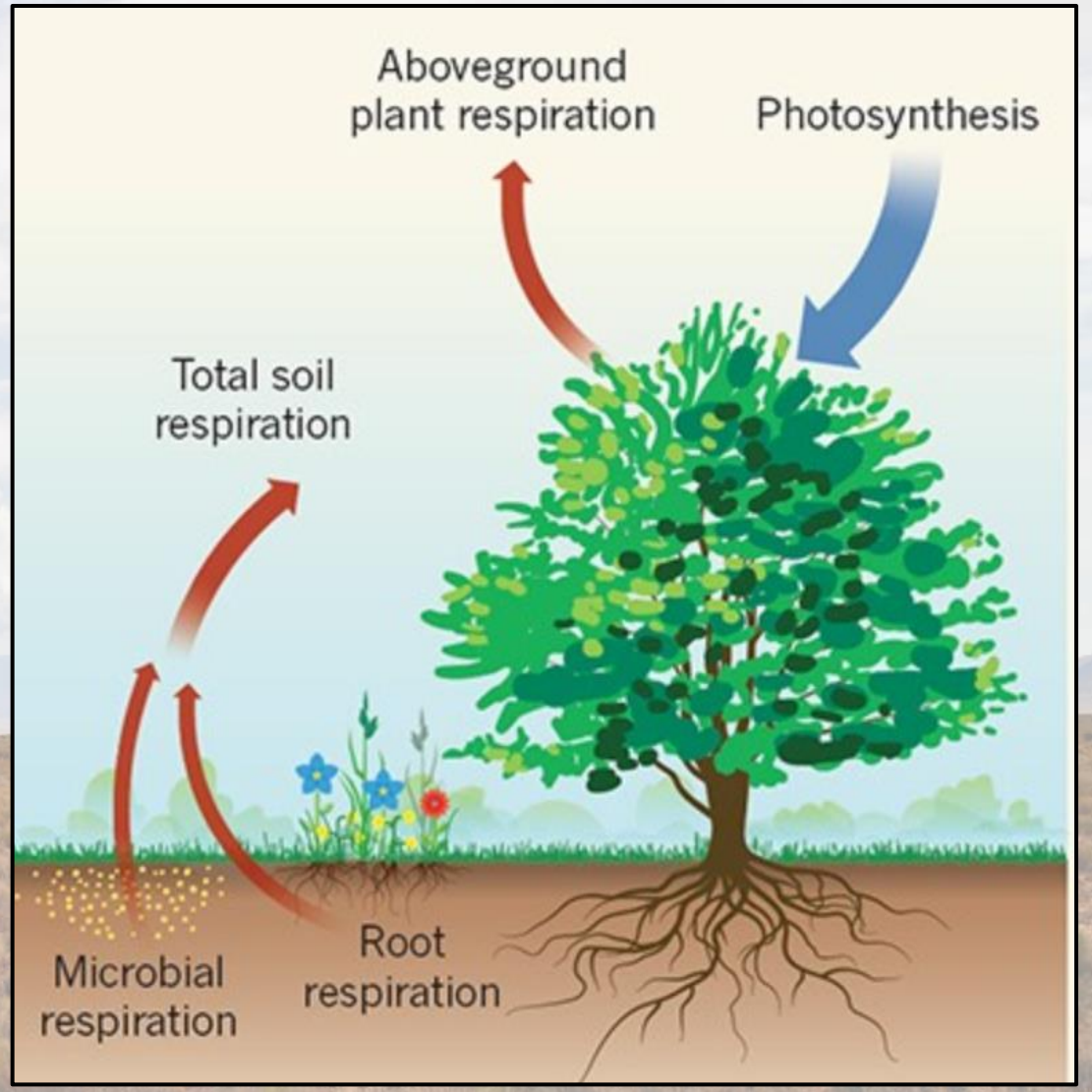
SEVILLETA NATIONAL WILDLIFE REFUGE

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?

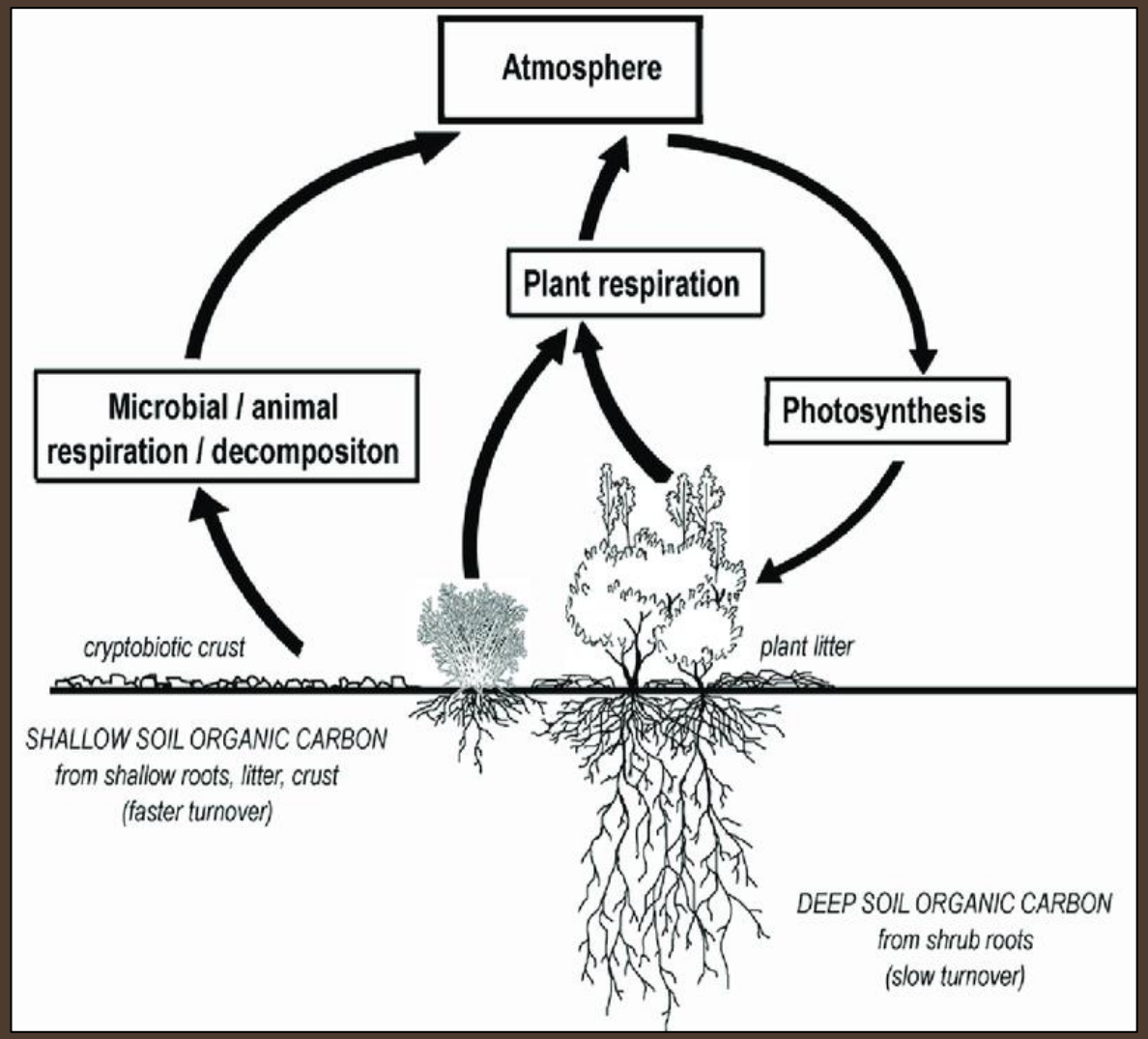
SOIL RESPIRATION

- Plant roots and microbes in the soil release CO2
- CO2 passes from soil to atmosphere



(Ogle, 2018)

CARBON FLUX



Ford et al. (2012)

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

CARBON SEQUESTRATION

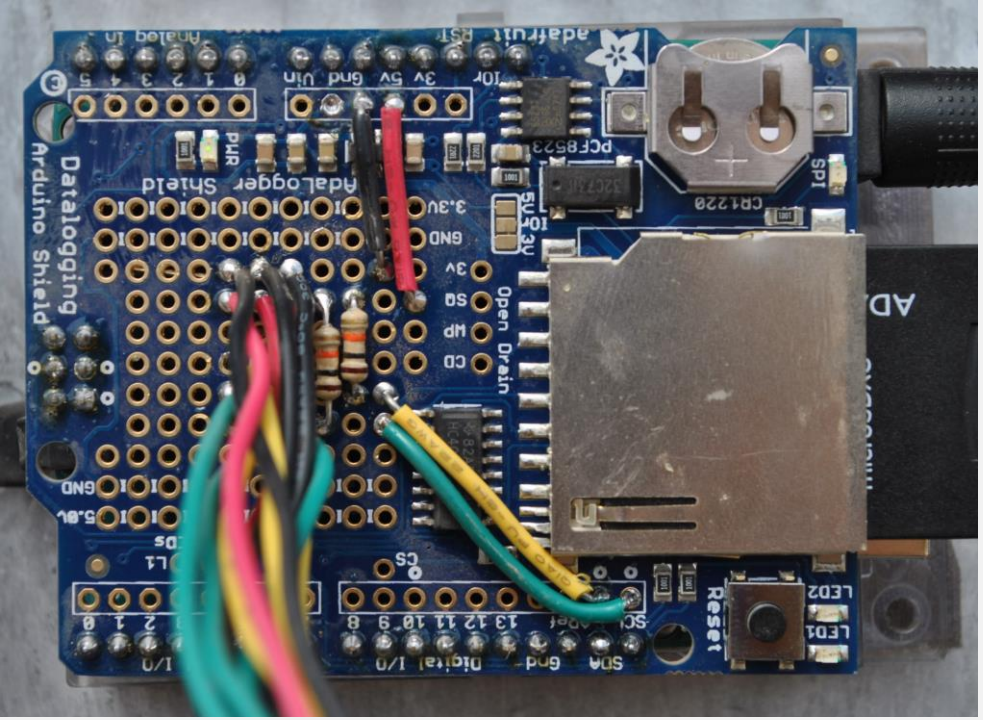
- Soils store twice as much carbon as the atmosphere
- 4 per mille Soils for Food Security and Climate initiative
- Sequestration by improved soil management
- More data needed

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

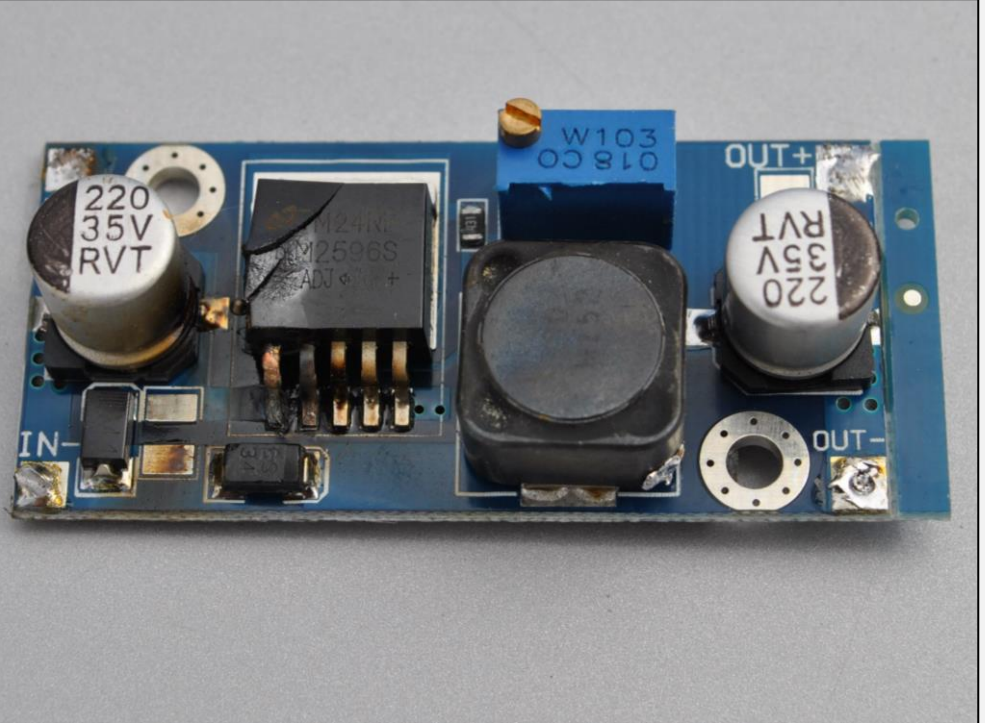
- Based on design by Gyawali et al. (2019)
- Three low-cost CO2 sensors
  - Wrapped in gore-tex
- Arduino microcontroller
- Datalogger shield
  - SD card
  - Real-time clock

MONSOON RAINFALL MANIPULATION EXPERIMENT

- Evaluate effect of precipitation variability on ecosystem processes

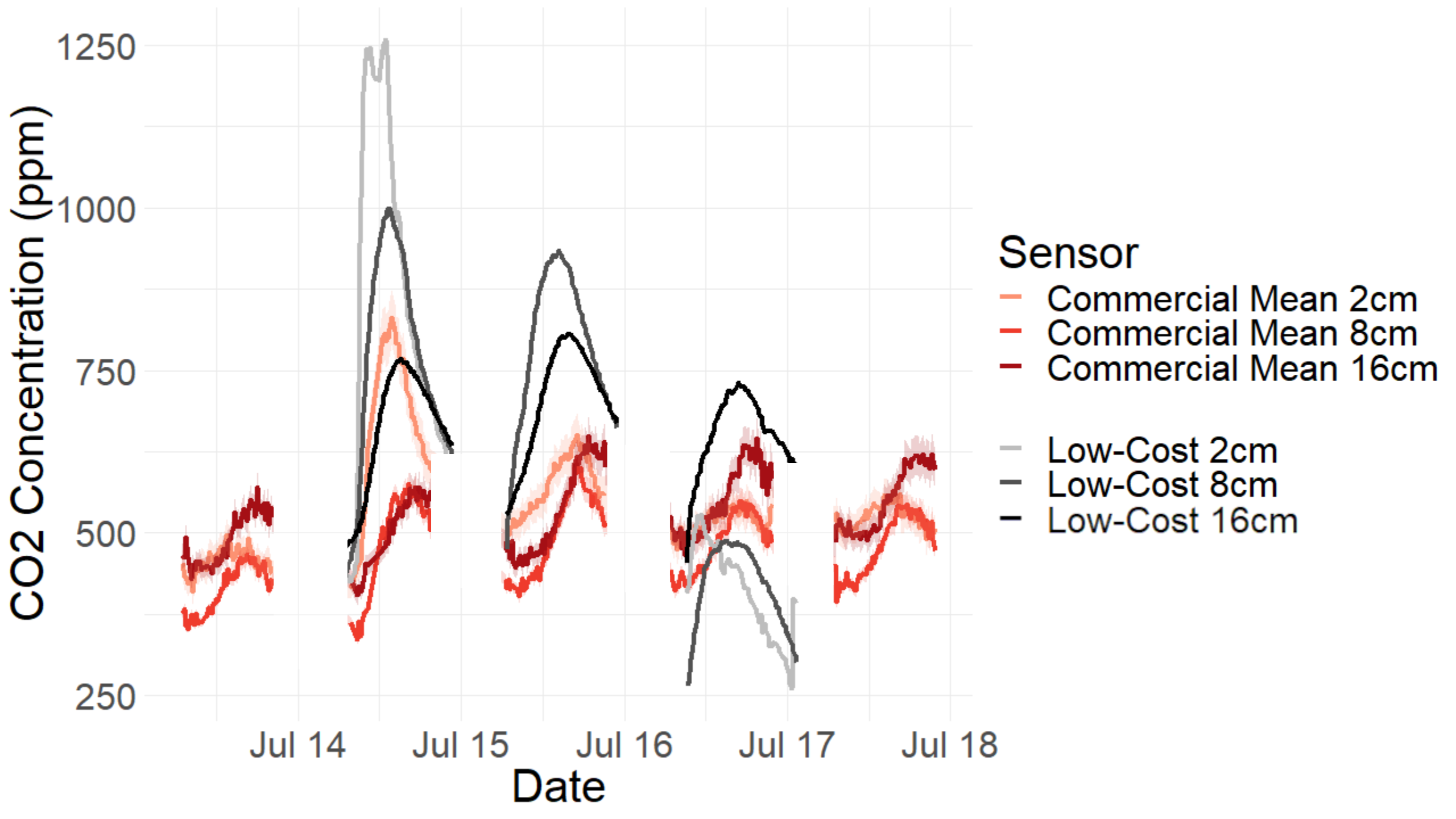
- Two rainfall treatments
  - Small weekly
  - Large monthly

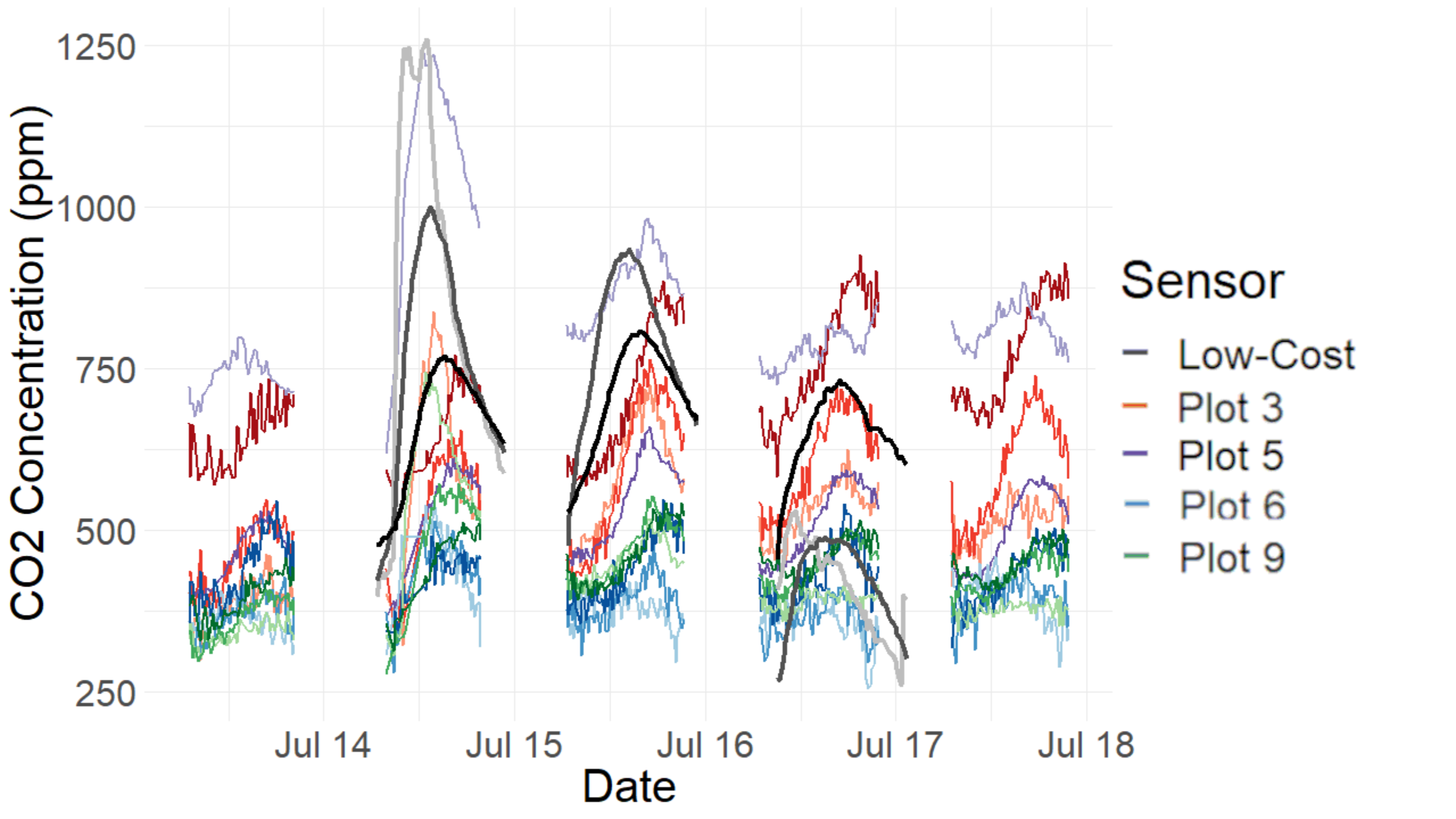
RESULTS

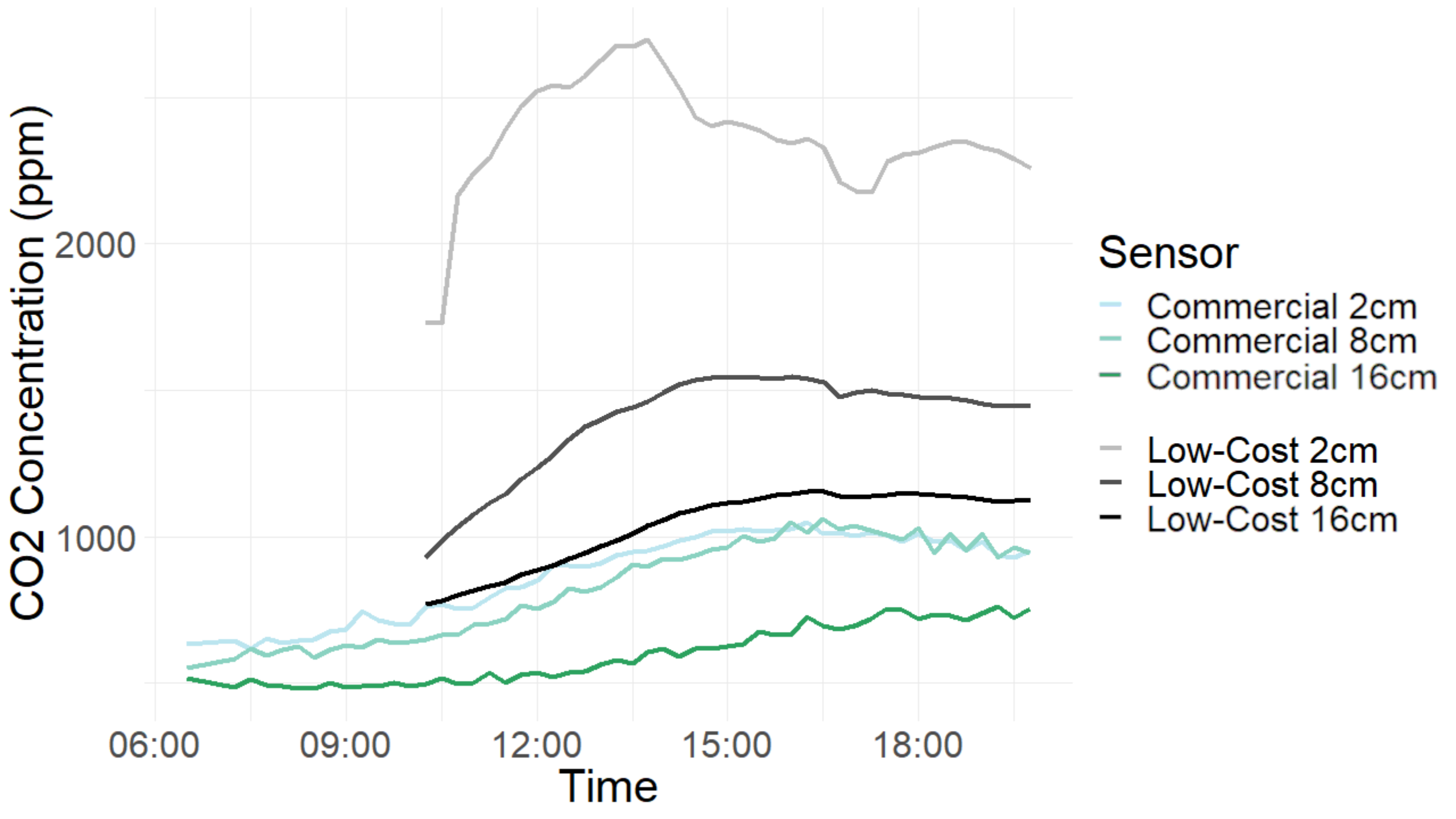


ROADBLOCKS

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


1250
1000
750
500
250
CO2 Concentration (ppm)
Jul 14
Jul 15
Jul 16
Jul 17
Jul 18
Date
Sensor
Commercial Mean 2cm
Commercial Mean 8cm
Commercial Mean 16cm
Low-Cost 2cm
Low-Cost 8cm
Low-Cost 16cm


1250
1000
750
500
250
CO2 Concentration (ppm)
Jul 14
Jul 15
Jul 16
Jul 17
Jul 18
Date
Sensor
Low-Cost
Plot 3
Plot 5
Plot 6
Plot 9


CO2 Concentration (ppm)
2000
1000
06:00
09:00
12:00
15:00
18:00
Time
Sensor
Commercial 2cm
Commercial 8cm
Commercial 16cm
Low-Cost 2cm
Low-Cost 8cm
Low-Cost 16cm

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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NSF

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