Extreme events alter carbon dynamics across the Florida Everglades

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Background

- Florida Everglades are composed of multiple wetland ecosystem types, including freshwater marsh, prairie and mangrove forests.
- Carbon processes in wetlands are mainly driven by environmental factors, such as **water levels, air temperature**, etc., and therefore, are sensitive to extreme climate events, such as El Niño Southern Oscillation cycles (ENSO) and low temperatures.
- Determining the sensitivities of carbon fluxes in wetland ecosystems to extreme events is crucial for understanding the role of wetlands in global carbon cycling under the scenario with an **increasing frequency of extreme events** in the future.

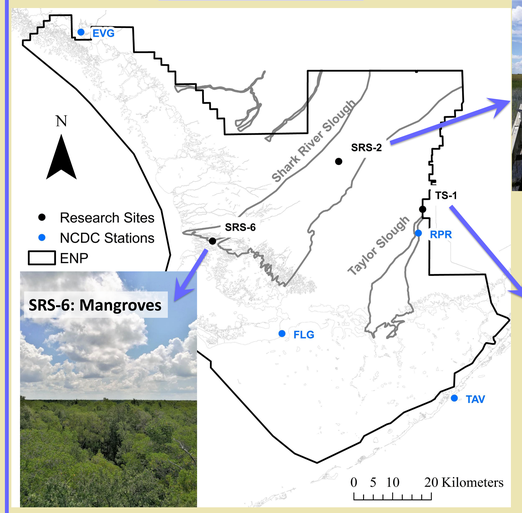
Objectives

- *Determine the variation in sensitivities of different Everglades wetland ecosystems to disturbances from **El Niño Southern Oscillation cycles (ENSO)** and **low temperature events**.*

Method

Eddy covariance (EC) is an approach to directly and continuously measure **net ecosystem CO_2 exchange (NEE)** between ecosystem and atmosphere.

Study sites

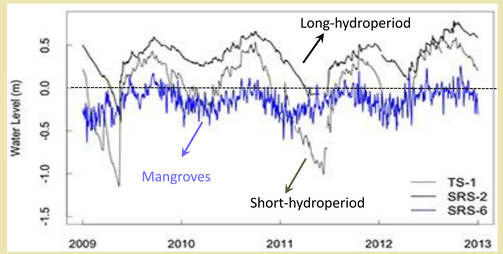


SRS-2: Long-hydroperiod marsh

SRS-6: Mangroves

TS-1: Short-hydroperiod prairie

Water levels

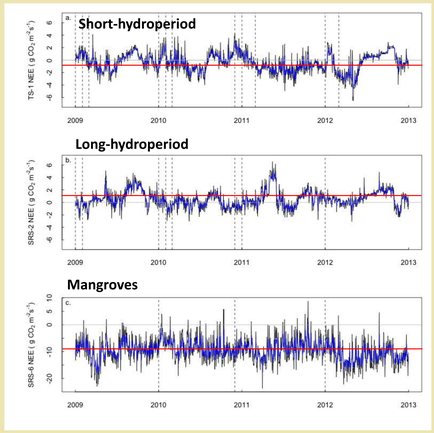


NEE

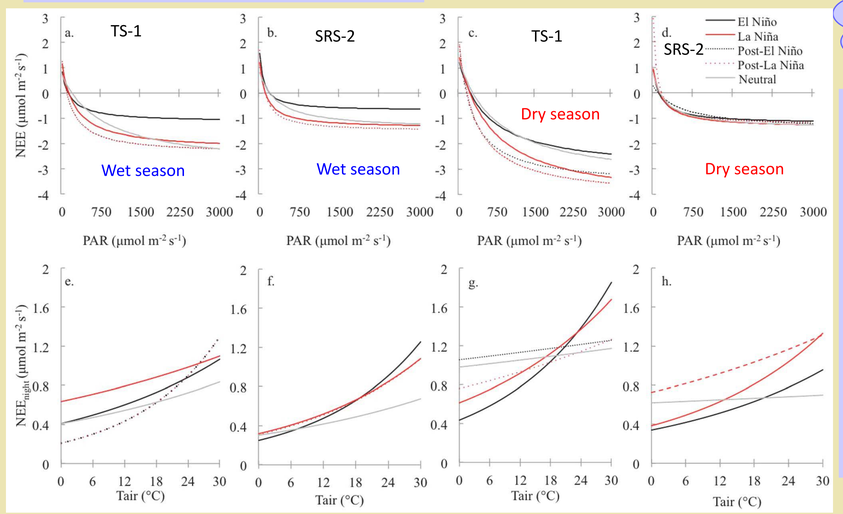
Short-hydroperiod prairie:
A small **sink** of CO_2

Long-hydroperiod marsh:
A small **source** of CO_2

Mangroves:
A big **sink** of CO_2



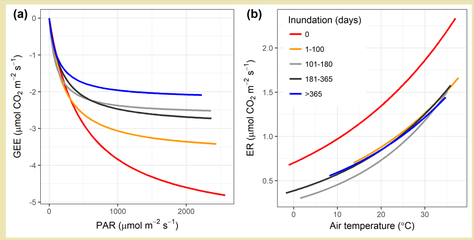
Sensitivities to ENSO



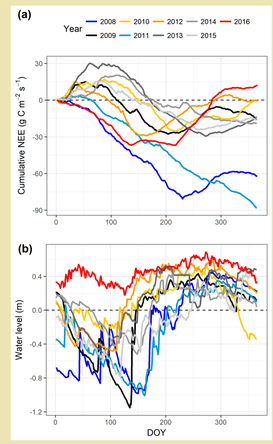
El Niño ➡ Wetter
La Niña ➡ Drier

- El Niño **decreases** the CO_2 uptake rates during wet season while La Niña has no effect.
- La Niña **enhances** CO_2 uptake rates during dry season at short-hydroperiod site but not the long-hydroperiod site.
- El Niño and La Niña both **enhances** CO_2 emission when air temperature >15°C during both wet and dry seasons.
- El Niño and La Niña also **decreases** CO_2 emission when <12°C during dry season.

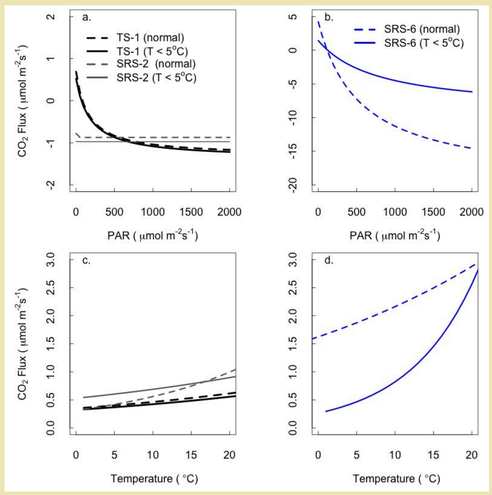
Extended flooding in 2016 (El Niño)



- Sensitivity of gross ecosystem CO_2 exchange (GEE, CO_2 uptake) to photosynthetically active radiation (PAR) **decreased** as inundation period prolonged.
- The sensitivity of ecosystem respiration (ER, CO_2 emission) to air temperature **decreased** as the ecosystem was inundated; however, the sensitivity was irresponsive to the extension of inundation period.
- In 2016, the study site experienced a year-round inundation and the inundation turned the ecosystem **from a CO_2 sink to a source**.



Low temperature (< 5°C)



- Low temperature events **decreased** both CO_2 uptake and CO_2 emission at the mangrove site while showed **limited effect** on freshwater marsh and prairie sites.
- Mangroves are **more sensitive** to low temperatures than marshes and prairies.