

# Compounded effects on wetland greenhouse gas fluxes from climate change and water management along a saline to freshwater gradient

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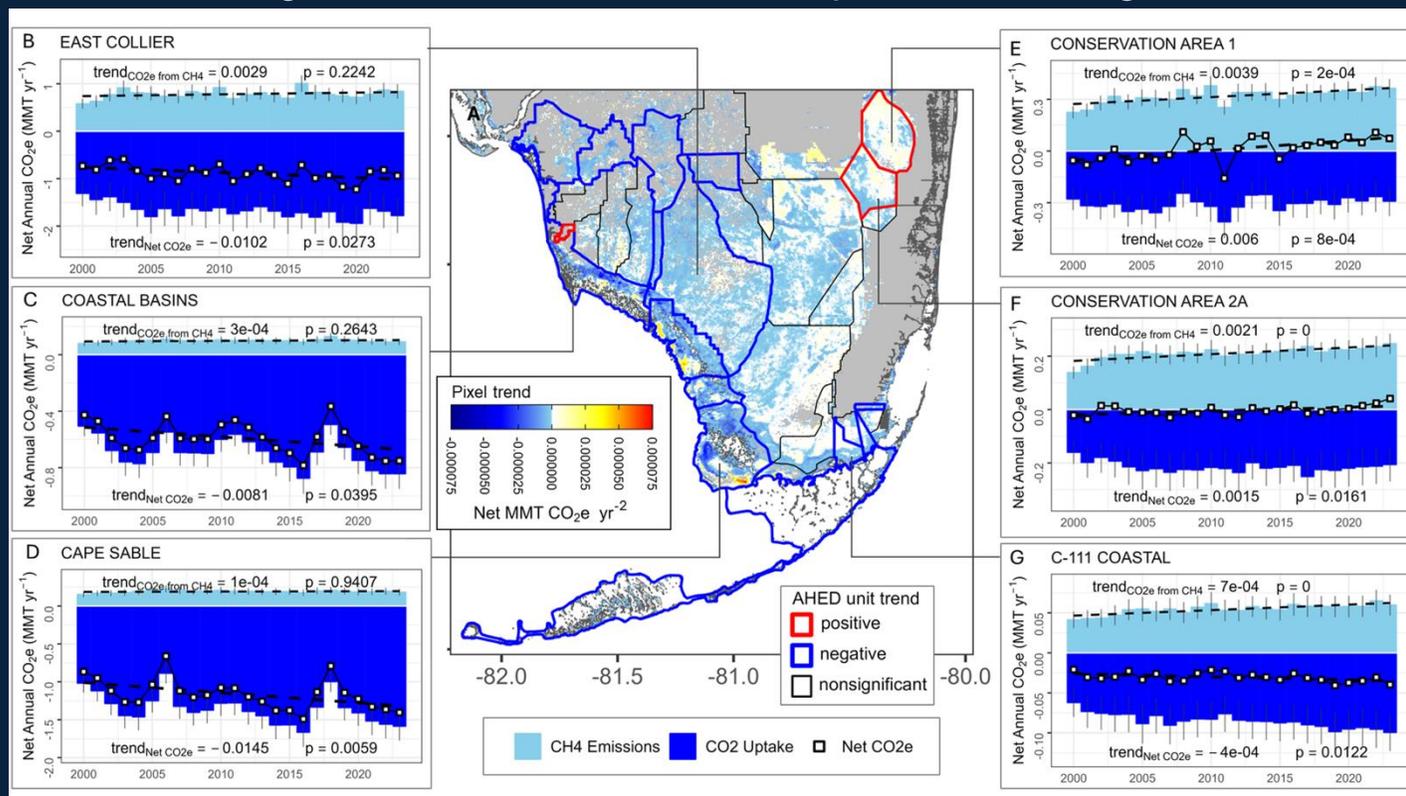
**Key Research Result:** Southern Florida's natural wetlands remove ~14 MMT of CO<sub>2</sub> per year, yet emit ~6 MMT y<sup>-1</sup> of methane (in CO<sub>2</sub> equivalents). Water management and hurricanes drive certain wetlands to become C sources, revealing unique geographic and historical perspective that can be used to understand future management decisions and the response of the region's carbon cycle and potential benefits for climate mitigation.

**Significance:** Coastal and freshwater ecosystems worldwide have been in decline over the past century due to human activities. Wetlands are one of the most productive ecosystems on the planet, removing carbon dioxide from the atmosphere and storing carbon in vegetation and submerged sediments. Yet, managing wetlands as net C sinks requires monitoring of both CO<sub>2</sub> uptake and methane emissions over time due to human and climate drivers.

**NASA assets and data:** We paired ground and airborne CARAFE flux measurements with 23 yrs of MODIS satellite imagery to develop ensemble AI/ML upscaling models on NCCS Discover. Our daily CMS prototypes are public on NASA EARTHDATA.

**Reference publication:** Doughty et al. PNAS (2026)  
<https://doi.org/10.1073/pnas.2513685123>

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Trends in CO<sub>2</sub>eq from CO<sub>2</sub> and CH<sub>4</sub> fluxes. (A) Long-term (2000 to 2023) trends per pixel and per AHED water management unit. Annual time series of net CO<sub>2</sub>eq uptake and emissions from CO<sub>2</sub> and CH<sub>4</sub> fluxes for selected AHED units: (B) East Collier, (C) Coastal Basin, (D) Cape Sable, (E) Conservation Area 1, (F) Conservation Area 2A, and (G) C-111 Coastal. Error bars show the SD from ensemble predicted fluxes in CO<sub>2</sub>eq from CO<sub>2</sub> and CH<sub>4</sub> fluxes (MMT y<sup>-1</sup>).