Florida Coastal Everglades LTER
FCE IV Year One Annual Report
For NSF Award DEB- 2025954

New platform at FCE site SRS-4 in Shark River, Photo: Rafael Travieso

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Principal Investigators

John Kominoski

James Fouqurean

Evelyn Gaiser

Kevin Grove

Jennifer Rehage

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Accomplishments

Major goals of the project

Since 2000, the Florida Coastal Everglades Long Term Ecological Research (FCE LTER) program has been revealing how the accelerating rate of sea-level rise interacts with climate variability and freshwater management to shape gradients of coastal ecosystem production, the movement of energy through food webs, and the value of ecosystem services to growing human populations. FCE long-term data, experiments, and models have shown rapid-paced changes associated with sea-level rise, extreme events, and freshwater flow diversion, threatening the persistence of vegetated habitat, dependent food webs, significant below-ground carbon pools, and associated ecosystem services. Everglades restoration is increasing seasonal freshwater pulses while a 2017 hurricane delivered a storm surge pulse to the FCE, offering an unprecedented landscape-scale test of the overarching question: **Will increased pulses of fresh and marine water and their associated resources maintain vegetated coastal ecosystems supporting highly connected food webs and valued ecosystem services while sea-level continues to rise?** The FCE IV conceptual framework integrates theoretical concepts of ‘ecosystem development’ and ‘pulse dynamics’ to understand how social-ecological responses to increasing climate variability and extremes depend on the magnitude, timing, and duration of these ‘pulses’ and their interaction with other persistent changes (‘presses’). Four hierarchical research questions ask: (1) how the climate drivers of hydrologic presses and pulses are changing, (2) how governance of freshwater restoration reflects changing values of ecosystem services, (3) how ecological landscapes serve as endogenous filters that feed back to the climate system, and (4) how ecosystem structural and functional responses influence long-term ecosystem trajectories. These questions will be addressed through continued long-term and new data collection along two transects with contrasting hydrologic presses and pulses, human dimensions research, a new ecosystem vulnerability experiment, process and landscape-scale modeling and scenarios approaches, and a large suite of collaborative projects sponsored by leveraged funding.

The proposed research expands the ecological disturbance theory through the integration of ecosystem development and pulsed dynamics. Social-ecological systems are linked by disturbance, disturbance may change system vulnerability to other environmental drivers, and feedbacks between ecosystems and disturbance drivers can influence trajectories of ecosystem development. The proposed research predicts that freshwater restoration will reduce the effects of sea-level rise and saltwater intrusion (a hydrologic press), and that hydrologic pulses (freshwater and marine) will control resource distribution and the long-term trajectories of coastal ecosystems and services. Freshwater restoration provides a landscape-scale test of how social-ecological systems are coupled in coastal regions exposed to accelerated sea-level rise and extreme events. Synthesis efforts will focus on comparative national and international research fostered to understand how chronic presses and increasing pulses determine ecosystem trajectories, addressing one of the most pressing challenges in contemporary ecology.

Major Activities

Climate Variability & Change

We seek to understand how increased greenhouse gasses may change regional climate variability and extremes particularly in the regional hydroclimate. Our initial analysis is a statistical analysis of the long-term precipitation and temperature data from stations throughout the state. Our first goal is to quantify the statistics of historical Florida precipitation data in the North, Central East, Central West, and Southern regions. Further analysis will quantify the trends in annual, interannual, wet season and dry season precipitation. Results of the historical observational data will then be used to compare with state of the science reanalysis data to identify how well the observed statistics are represented in the reanalysis. One key rational for the above-mentioned comparison is the representation of large scale regional and global climate phenomena like El Niño and the Southern Oscillation and regional monsoonal circulations as well as the availability of more extensive climate variables including but not limited to evapotranspiration, soil moisture, vegetation, and runoff critical to understanding the dynamics of South Florida. This information will be utilized to better quantify historical changes in Florida hydroclimate and lay the foundation for utilization of CMIP6 climate model output for understanding and predicting near- and long-term changes in the region.

Hydrologic Connectivity

We continue to collect rainfall and water levels at each of the SRS and TS/Ph sites (n = 14). We are also monitoring water levels, salinity and temperature of surface water and groundwater (both peat and limestone) at SRS-4 and SRS-6. We deployed EXO water quality sondes in groundwater wells and in the adjacent surface water at SRS-4 to estimate groundwater-surface water exchange of fDOC over neap and high tides. We collected surface water and groundwater at SRS-4 and SRS-6 for geochemical tracers and nutrient concentrations to decipher exchange of matter between the limestone bedrock, peat sediments and adjacent surface water. We collected peat cores at SRS-3, SRS-4 and SRS-6 and determined hydrologic properties (hydraulic conductivity, specific yields) of those sediments. We used Sentinel-1 SAR and InSAR satellite observations to detecting annual and seasonal water level changes in the Everglades, as well as explored the use of TanDEM-X bastic observations in determining absolute water levels. In addition, we combined empirical data of water levels and sea levels with modeled Comprehensive Everglades Restoration Plan (CERP) scenarios to evaluate the relative benefits of increasing freshwater deliveries to the FCE LTER in an effort to reduce the effects of sea level rise.

Social Landscape

Water Governance/Cultural & Economic Values: We conducted a survey of anglers fishing in Lake Okeechobee to understand the economic value they place on fishing experience and their preference for Lake management. We began interviews with FCE scientists, with the longer-term aim of creating an FCE oral history archive. We conducted a literature review of previous FCE work on cultural and infrastructural valuations of the Everglades, and governance practices. We conducted media and discourse analysis of recent revaluation of the ecosystem as infrastructure. We also conducted participant observation at invasive species capture trainings and interviews with python challenge participants.

ECOLOGICAL LANDSCAPE

Vegetation & Geomorphic Gradients: We measured sediment elevation change at satellite sites. We are quantifying coastal vulnerability. We are calibrating the marsh equilibrium model to simulate mangrove elevation change relative to sea level rise. We are calibrating the BISECT model to simulate changes in water level, hydroperiod, groundwater and surface water salinity and project changes due to water management and sea level rise. We used real-time kinematic elevation and vegetation height surveys to estimate bias in ground elevation products from airborne Light Detection and Ranging (LiDAR) data. We mapped high-precision plant communities using bi-seasonal satellite data and analyzed vegetation surveys to establish a baseline for directional change analysis of vegetation pattern as a response to hydrological regime change.

ECOSYSTEM STRUCTURE & FUNCTIONS

Abiotic Resources & Stressors: We continued high frequency water quality data (total and dissolved nutrients, salinity, water level) and conducted our annual surface soil survey at all FCE sites. We deployed HOBO water temperature sensors at all sites and flow meter at SRS 3.

Detritus & Microbes: We continued monthly water samples from SRS and TS/Ph sites for quantifying dissolved organic carbon (DOC) concentrations, dissolved organic matter (DOM) fluorescence characteristics, and DOM structural and isotopic composition, and breakdown rates of particulate organic carbon (POC). We have also characterized microbial communities in water column and associated with various POC components (leaf litter, periphyton, soil, and sediments).

Vegetation: We completed analysis of periphyton carbon and phosphorus accumulation rates from long-term deployments at the FCE sites. We continued monitoring of primary production and nutrient dynamics of seagrasses. We continued evaluating the long-term effects of Hurricane Irma on mangrove Net Primary Productivity (NPP) rates and the resilience capacity of these forested wetlands to hurricane disturbance. We continued measuring NPP rates for scrub mangroves in Taylor River. We developed and implemented a mass-balance-based hydrological model for riverine mangrove forests. We assessed the impact of tropical cyclones on mangrove carbon fluxes as particulate organic carbon (POC). We investigated the role of large roots and necromass on carbon storage capacity across different mangroves.

We used remote sensing observations to map the extent of mangrove forest damage induced by Hurricane Irma.

Consumers: Stable isotope data have been collected and analyzed. We continued our long-term electrofishing community sampling that tracks the abundance of pulsing freshwater prey and of their consumers. We continued our long-term sampling of bull shark abundance (and other consumers) via long line sampling. We continued tracking consumer movement using acoustic telemetry. We continued to track vocalizations by dolphins, which provide an index of abundance and foraging activity and started tracking new mobile consumers, Florida manatee, via side scan sonar surveys. We completed lab work and preliminary analyses from a food-web study of alligator ponds in Everglades freshwater wetlands. We completed analyses of the historic freshwater Everglades food web using stomach content and stable isotope data. We completed analysis of high frequency imaging sonar data used to characterized food web structure. Imaging sonar data were processed by using an automated fish tracking algorithm that was developed for this study by integrating computer vision techniques.

Carbon Fluxes: We are maintaining flux towers and establishing new towers. We are also setting up for new experiments.

Ecosystem Trajectories: We continued to advance a unique simulation tool for use in addressing integrative ecosystem dynamics across a heterogeneous landscape, by extending the multi-decadal hindcasting simulation period of the Everglades Landscape Model (ELM). This is a spatial model that explicitly integrates dynamic modules of 3D raster-vector hydrology with dynamic modules of biogeochemistry (TP, Cl, SO4), plant biology (growth/mortality of macrophytes and periphyton), soil processes (organic carbon accumulation/loss), and habitat succession. We updated the assessment of ELM history-matching performance for the dynamic ecosystem drivers of water depths and associated TP and Cl concentrations, over several decades (1984-2010) in a million-ha spatial domain.

Specific Objectives

Climate Variability & Change: Our objectives were to expand on the results of Abiy et al. (2019) who used Miami station data to argue that the annual and wet season precipitation in South Florida was increasing while the length of the wet season was decreasing. The author argued that the Miami station could be used as a proxy for all South Florida. Our initial analysis seeks to expand on and support the results of Abiy et al. (2019) and elucidate the changes in South Florida using data from surrounding stations including Ft Pierce, West Palm Beach, Fort Myers (west) and Key West. We also apply the same analyses to 17 additional stations in northern and central Florida.

Hydrologic Connectivity: Determine how increasing freshwater delivery to the coastal Everglades via specific CERP restoration scenarios can reduce the effects of sea level rise. Determine if there are differences in the hydraulic properties between sawgrass peat and mangrove peat and if those properties change when exposed to brackish water. Calibrate Sentinel-1 SAR and InSAR observations with USGS EDEN water level measurements made across the Everglades in order to further refine the method for detecting annual and seasonal water level changes across the Everglades. Explore the use of TanDEM-X bistatic observations in determining extract absolute water levels of the Everglades.

SOCIAL LANDSCAPE

Water Governance/Cultural & Economic Values: To estimate the economic value that anglers (recreational users) place on fishing in Lake Okeechobee, as well as preferences for Lake Okeechobee management and fishing experience. Improving the quality, quantity, timing, and flow of water through the Everglades ecosystem is largely dependent on water storage and delivery from Lake Okeechobee. The lake also serves as a premier Florida largemouth bass fishery, but is highly degraded. The results of this survey research will be used for the larger benefit-cost analysis of various restoration alternative. To examine prevailing valuations of the Everglades as nature and as infrastructure, as established in FCE literature, media and policy documents, and everyday scientific practice. To examine shifting forms of authority and expertise that guide decision-making in water governance.

ECOLOGICAL LANDSCAPE

Vegetation & Geomorphic Gradients: (i) To reduce model errors and uncertainty for vegetation dynamics, hydrological and geomorphological models we developed multiple algorithms and methods to improve accuracy and precision of spatially exhaustive digital elevation terrain models, vegetation time-series maps, and water surface estimates from remotely sensed data. The resulting products will improve spatially explicit modeling of horizontal hydrologic connectivity. (ii) To assess the vegetation dynamics in response to sea-level rise and freshwater management regimes we developed a method to detect vegetation change patterns using remote sensing. (iii) To understand the establishment and distribution pattern of mangroves into freshwater marshes and prairies multi-scale vegetation dynamics are mapped and modeled as response to changing hydrological variables of water depth, hydroperiod length and salinity gradients. (iv) To improve detection of patterns of coastal vulnerability, extend representativeness, and improve modeling capabilities, we are setting up new field sites for biomass, hydrology and sediment elevation change monitoring and using field observations to improve model output.

ECOSYSTEM STRUCTURE & FUNCTIONS

Abiotic Resources & Stressors: We evaluated the trends and variance structure of the long-term water N:P and salinity data relative to determine spatiotemporal dynamics of press and pulse of these critical resources and stressor. An ongoing collaborative effort led by collaborator P. Julian is evaluating this structure using a larger, compiled dataset from stations throughout FCE domain.

Detritus & Microbes: Our objectives were to understanding patterns of dissolved and particulate organic matter and microbial decomposers along salinity and P gradients of SRS and TS/Ph by (i) synthesizing of long-term DOC concentrations, dissolved organic matter (DOM) fluorescence characteristics, and DOM structural and isotopic composition, (ii) quantifying breakdown rates of labile and recalcitrant particulate organic matter standard substrates, and (iii) characterizing assemblages of water-column and benthic microbial communities.

Vegetation: We assessed the foundational species' (seagrass, sawgrass and mangrove) as well as periphyton contribution to carbon and nutrient budgets and analyzed long-term organic and inorganic carbon and total phosphorus accumulation rates at FCE sites. We quantified macrophyte species composition and aboveground Cladium biomass and ANPP at all plant quadrats in Taylor Slough [TS/Ph1 (S-332D), TS/Ph2 (MPR), TS/Ph3 (LC) and TS/Ph6 (AH). At TS/Ph 7, 8, 9, 10 and 11 we quantified ANPP and nutrient dynamics for seagrasses and calcareous macroalgae. We also evaluated the effect of Hurricane Irma on annual and seasonal patterns of mangrove NPP, and mapped the extent of mangrove forest damage and resilience as a result of Hurricane Irma impacts. We determined NPP rates for R. mangle dominated scrub mangrove forests in Taylor River using a methods comparison. We modeled long-term changes in porewater salinity using the RHYMAN model and assessed the impact of Irma on export of POC in mangroves along Shark River estuary. We investigated the role large roots and necromass in carbon storage capacity and sequestration potential across mangrove sites of varying forest types due to soil fertility gradients. Finally, we mapped mangrove forest damage and resilience post-Irma as a result of Irma's impacts in the FCE.

Consumers: In order to examine the effects of hydroclimatic variation on green vs. brown trophic channels, we continue collection and processing of food web stable isotope samples across coastal gradients. Multi-site, long-term isotope data are used to identify changes in resource contributions to consumers over seasonal and spatial gradients in salinity and primary productivity across the freshwater-estuarine-marine habitat mosaic, with the long-term goal of predicting how SLR and restoration will interact to reorganize energy landscapes. We integrate consumer movement and trophic ecology (from stable isotopes) to examine variation in consumer-mediated trophic coupling and consumer-mediated nutrient transport across habitat boundaries as a function of the interaction of SLR and restoration effects. We examine effects of hydroclimatic factors on long-term fish community structure at the marsh-mangrove ecotone. We quantify spatiotemporal food-web dynamics using contemporary and historic data to examine effects of long-term water management practices and biological invasions by nonnative fishes. We evaluate the role of American Alligators as ecosystem engineers creating dry-season refuges that serve as nutrient hot-spots with implications for food-web function. We examine the potential effects of mercury toxicity for juvenile Bull Sharks. Since juvenile bull sharks use both freshwater and marine food webs, understanding mercury impacts on consumers helps us understand the importance of hydrological shifts in food webs and associated toxicity. We link our food web and movement ecology findings to human dimensions (e.g., recreational angling) and engage with key stakeholder groups.

Significant Results

Climate Variability & Change: Historical precipitation data were collected across Florida (Fig. 1) and compared among 4 regions (Fig. 2). In South Florida, there is variation in wet-season onset and duration (Fig. 3). Variation in precipitation trends are driven by interactions between local and regional climate changes (Fig. 4).

Figure 1. Map of the station data used in the analysis.

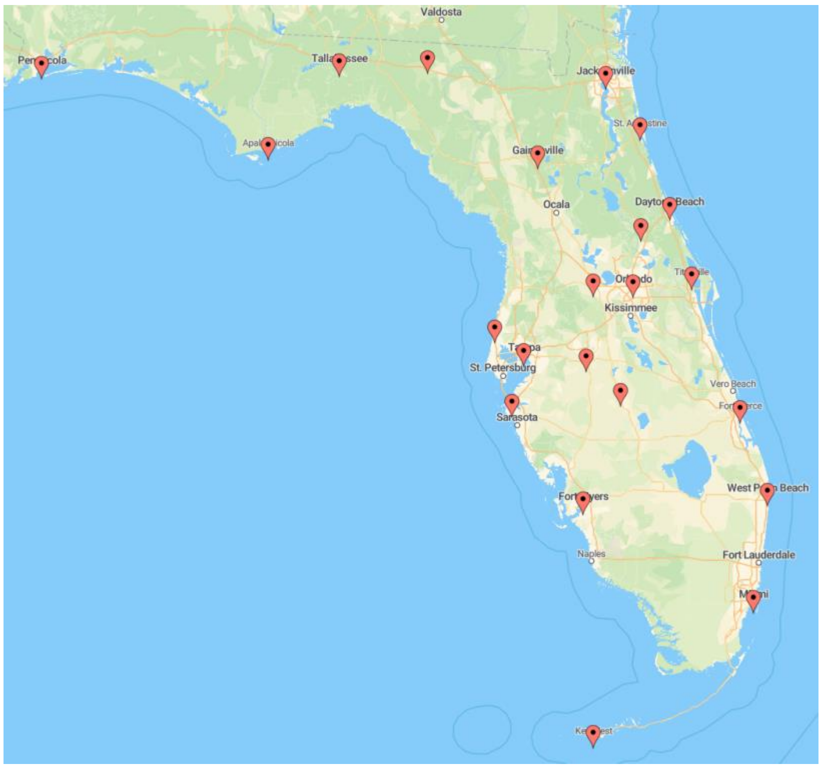


Figure 2. Box and whisker plot of monthly precipitation rate data over the period 1906-2016 from 22 stations by region North, East Central, West Central, and Southern Florida. Units are mm/month.

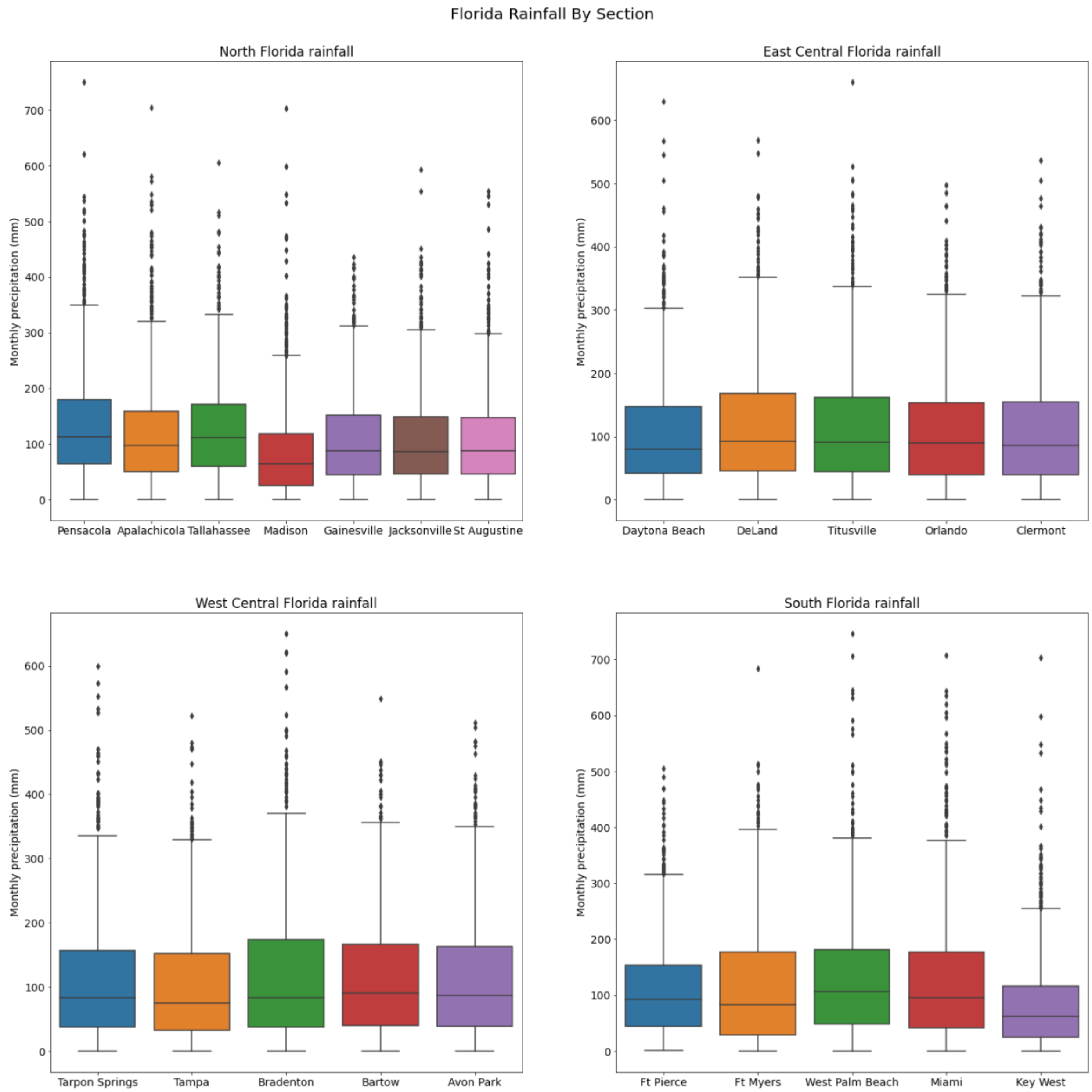


Figure 3. Box and whisker plot of monthly precipitation data over the period 1906-2016 from 5 South Florida stations highlighting rainfall seasonality. Units are mm/month.

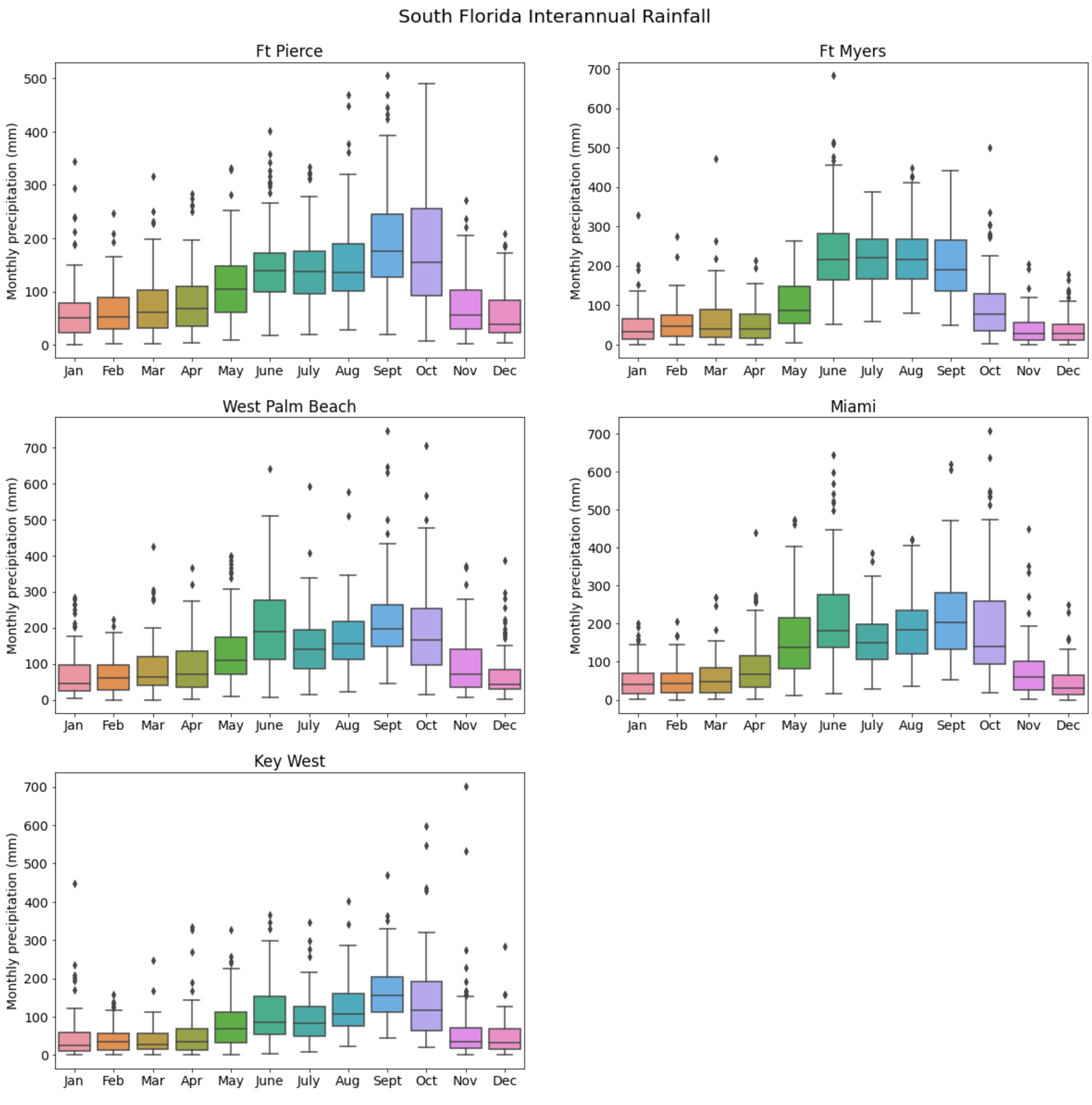
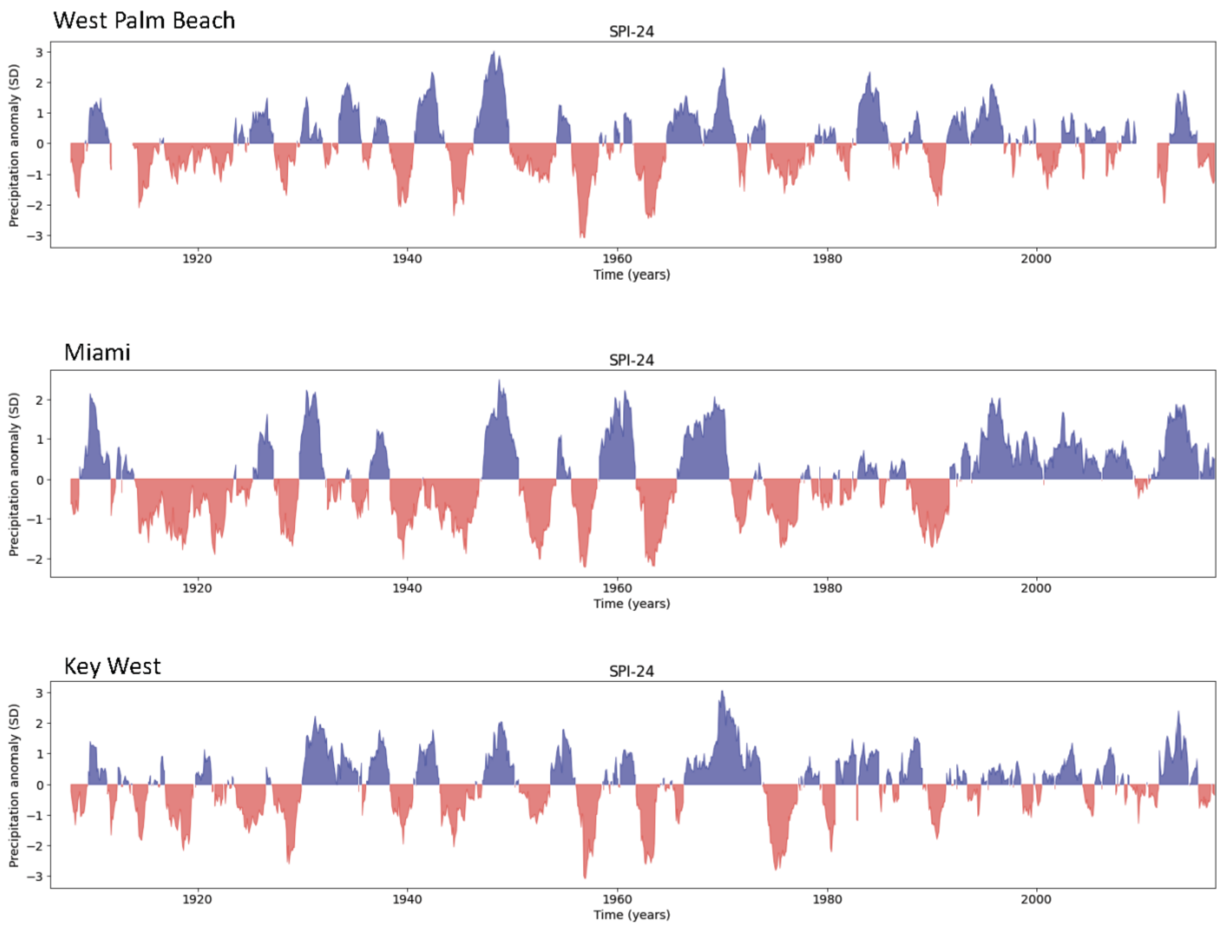


Figure 4. 24-month Standardized Precipitation Index (SPI) for West palm Beach, Miami, and Key West stations.



Hydrologic Connectivity: Simulated increases in water levels in both TS and SRS increased the Fresh-to-Marine Head Difference (FMHD), reducing the vulnerability to sea level rise and saltwater intrusion (Fig. 5). SRS is expected to benefit more from restoration efforts than TS (Fig. 6). The vertical hydraulic conductivity of sawgrass peat cores was higher than mangrove peat cores (Fig. 7). By utilizing 91 Sentinel-1 images acquired over a three-year period (Sep 2016 to Nov 2019), we could generate routine 12-days Interferograms and correspondingly 30 m spatial resolution water level change maps over the entire Everglades (Fig. 8). We processed two datasets of TanDEM-X bistatic observations acquired on August 26 and 31, 2015. The estimated absolute water level maps were compared to median stage data interpolated from USGS EDEN interpolated water surface maps created from ground-based daily median stage data (Fig. 9).

Figure 5. Model simulated monthly average Fresh-to-Marine Head Difference (FMHD) for (a) SRS and (b) TS as determined for an existing conditions baseline (ECB), full CERP implementation (CERP0), Central Everglades Planning Project with the Everglades Agricultural Area Reservoir (CEPPP) and the natural/pre-drainage system scenario (NSM). Adapted from Dessu et al., 2021.

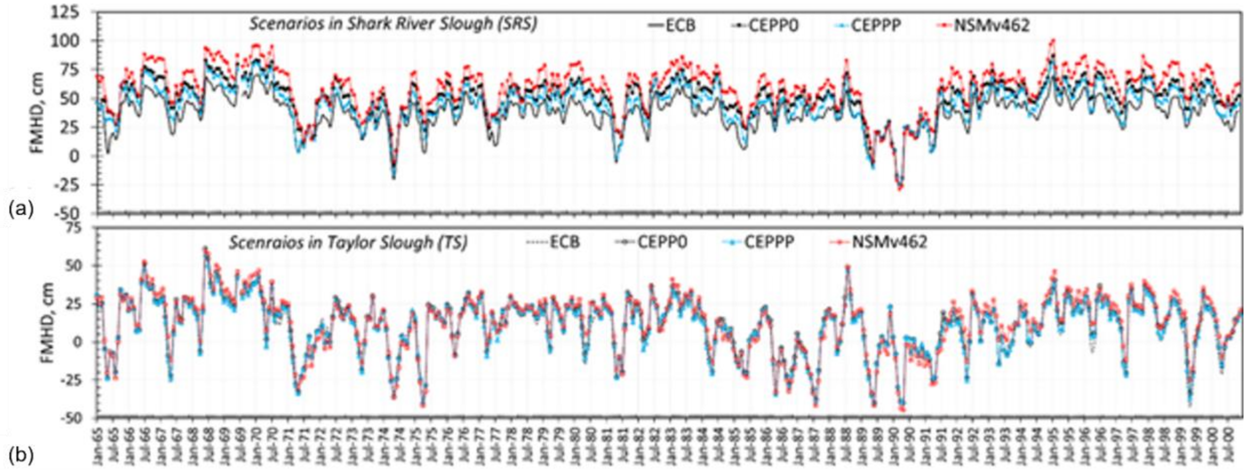


Figure 6. Monthly comparison of incremental restoration benefits (IRBs) of FMHD from CER0 and CEPPP scenarios from 1965 to 2000 in coastal SRS and TS. Adapted from Dessu et al., 2021.

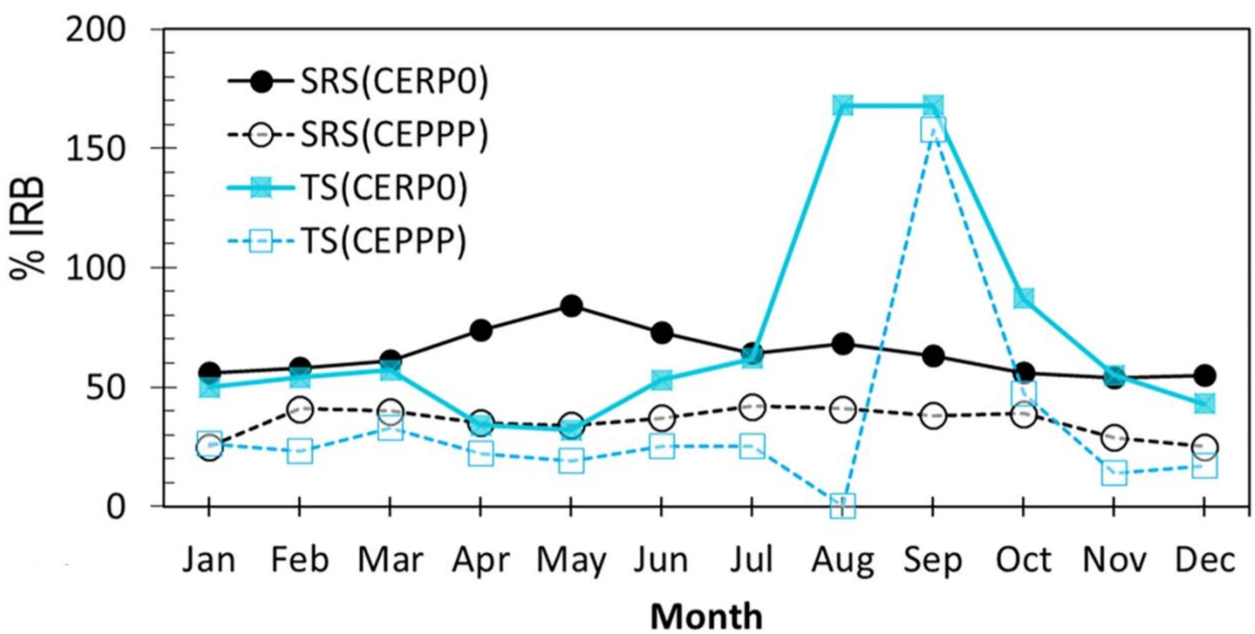


Figure 7. Vertical hydraulic conductivity (cm/s) as determined in mangrove peats and sawgrass peat cores collected in SRS using insitu water (Control) and then exposed to 30 ppt water (Treatment). Source: [Cordoba et al., 2021](#).

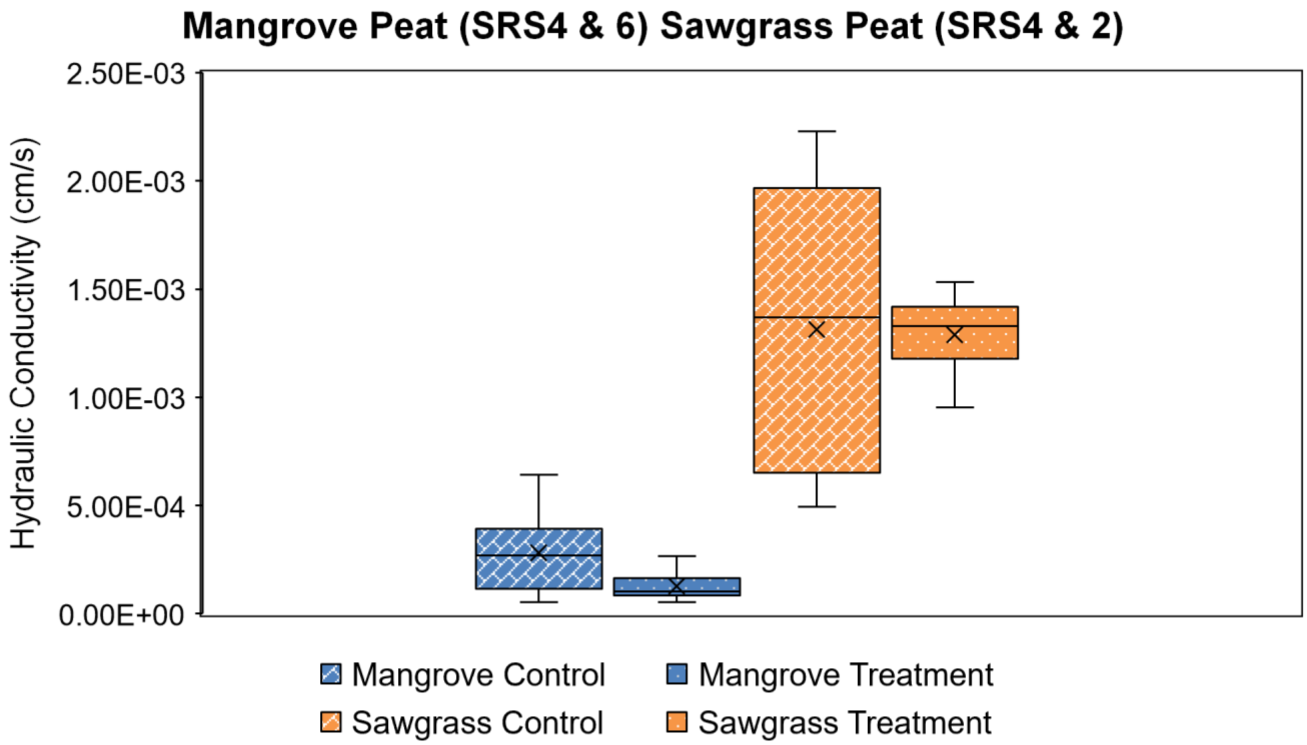


Figure 8. Sentinel-1 SAR Interferometry for water level measurement and its accuracy assessment over the entire Everglades. Subplot (a) shows our study area and the EDEN gauge distribution. Each red point stands for a gauge at its location. (b) An example interferograms generated with Sentinel-1 SAR acquisitions on Oct 9, 2016 and Oct 21, 2016, in which hydrological signal within the WCAs are prominent. (c) The accuracy of water level change derived from InSAR compared with EDEN gauge measurements. Red squares, cross and plus stand for outliers that have been excluded for comparison. Source: Liao and Wdowinski (2020).

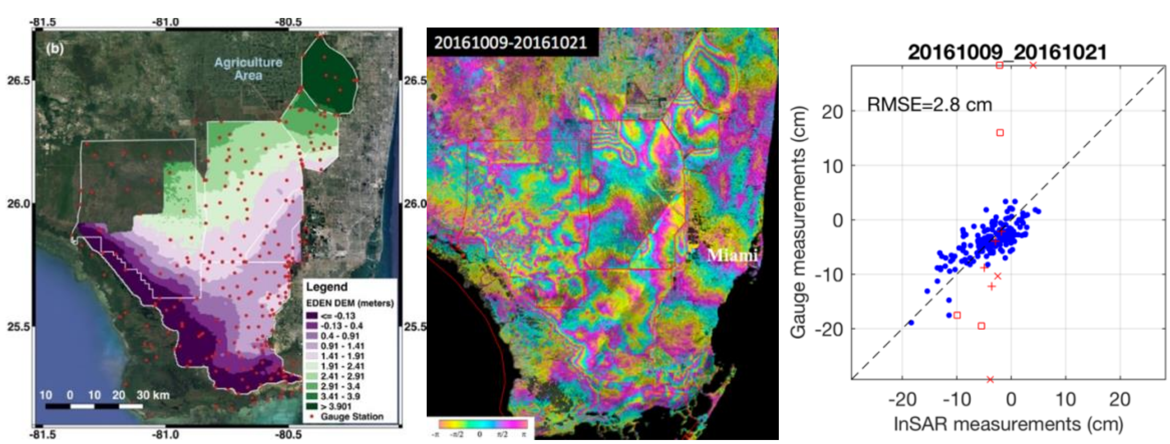
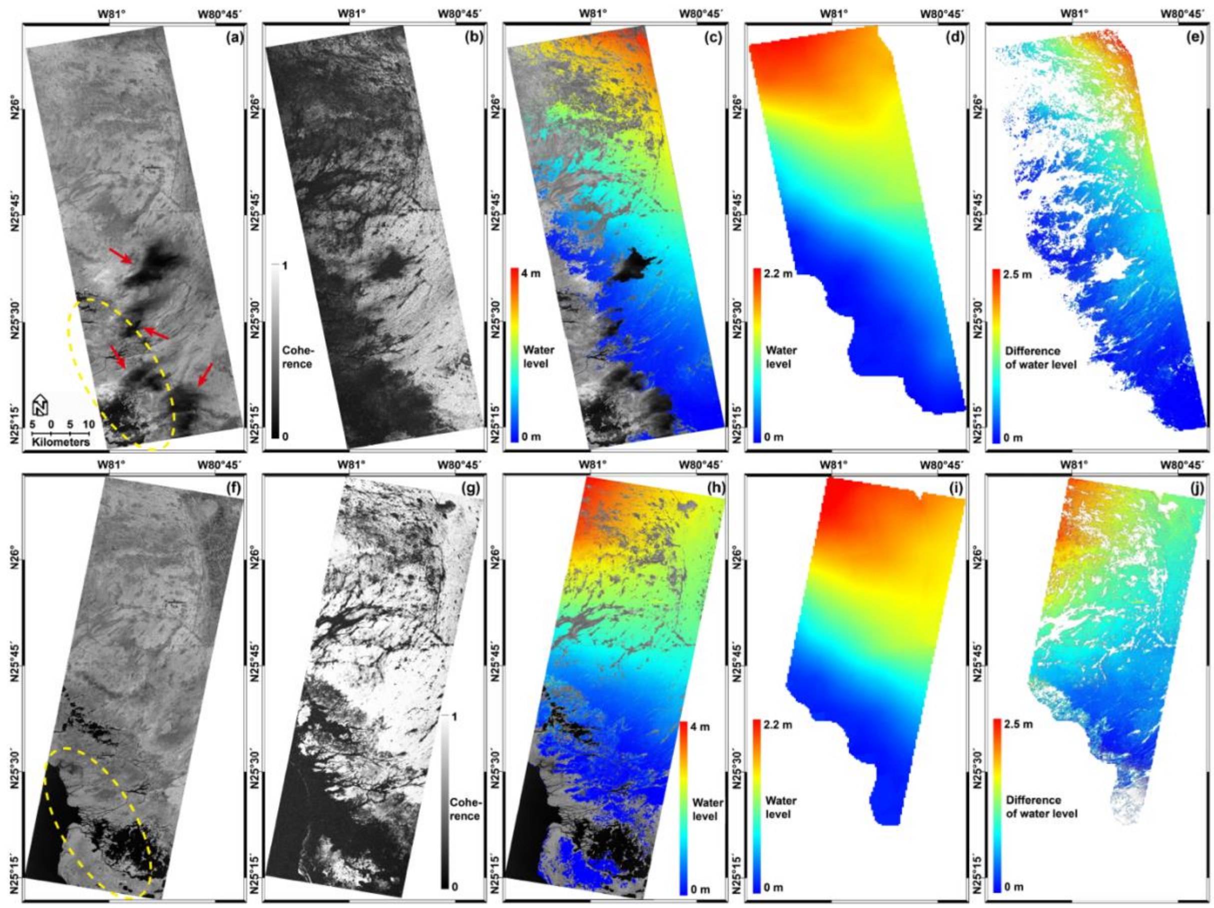


Figure 9. Water Level in the Florida Everglades Using TanDEM-X Bistatic Science Phase Observations. (a) and (f) Backscattered amplitude images and (b) and (g) coherence maps of the August 26 (top) and 31 (bottom) 2015 acquisitions. Severe coherence degradations were detected in the high and dense vegetated areas and tree islands [yellow dot ellipse in (a) and (f)]. Significant radar signal attenuation by atmosphere was identified in the middle and lower part of images, marked by red arrows in (a), leading to a loss of coherence. (c) and (h) Extracted absolute water level maps scaled from 0 to 4 m. (d) and (i) EDEN interpolated water surface maps obtained from the daily median stage data [14]. (e) and (j) Residual map between the InSAR-derived and EDEN water surfaces showing deviation up to about 2.5 m. Linear ramps in both residual maps indicate systematic disagreements between the two maps. Source: [Hong et al. (2021).]



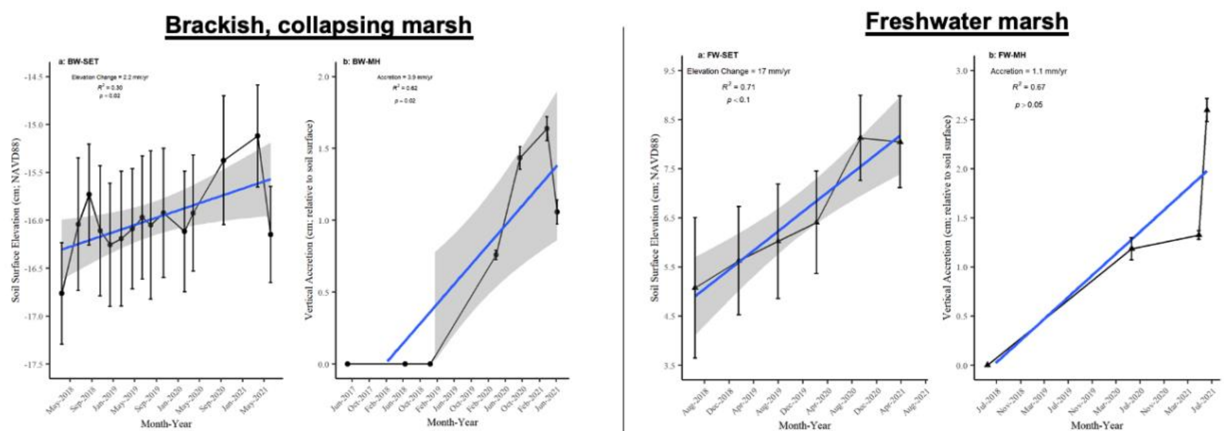
Social Landscape

Water Governance/Cultural & Economic Values: Everglades valuation as urban infrastructure is becoming more influential within regional environmental governance because it allows environmental science to provide information on systemic conditions that will impact future urban system functioning, and thus future urban risks. A survey reveals that: (i) anglers spend 23 days/year fishing in Lake Okeechobee, (ii) 87% are interested in fishing for largemouth bass, (iii) 46% experienced recent algae blooms, (iv) 36% fished in Lake Okeechobee less in comparison to recent years, due to degraded water quality.

Ecological Landscape

Vegetation & Geomorphic Gradients: We detected changes in and modeled the relationship of plant community, hydrology, and soil accretion or loss processes for peat and marl forming soils to improve understanding of these geomorphological processes and predict elevation change for a combination of freshwater pulse and sea-level press scenarios (Figs. 10, 11).

Figure 10. Surface elevation change at peat-forming marsh sites in the FCE.



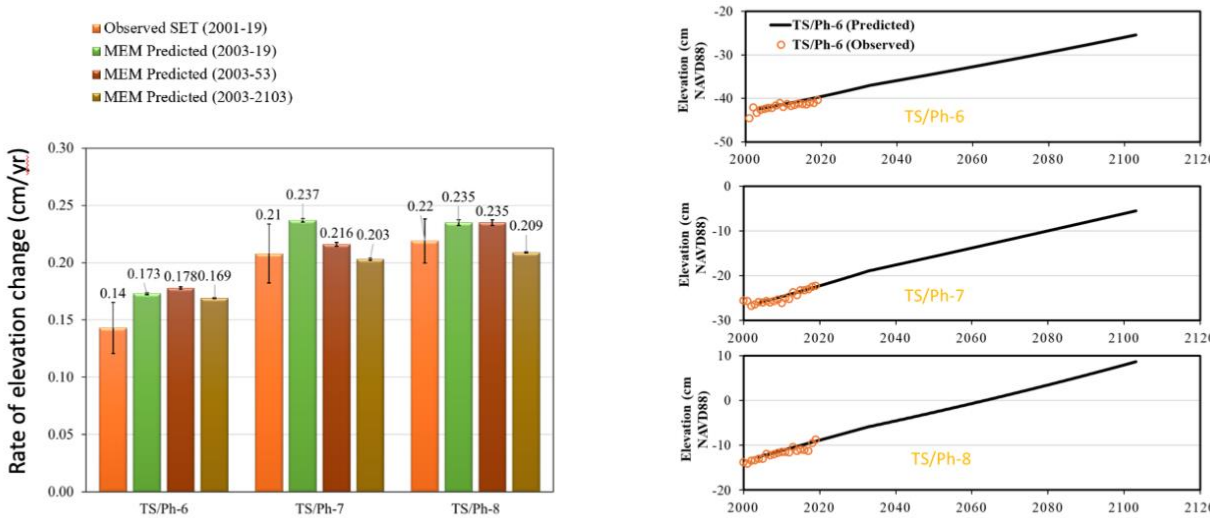
(a) Surface elevation change relative to the North American Vertical Datum of 1988.

(b) Accretion measured by feldspar marker horizons.

(a) Surface elevation change relative to the North American Vertical Datum of 1988.

(b) Accretion measured by feldspar marker horizons.

Figure 11. Preliminary calibration results for simulation of mangrove elevation change using the Marsh Equilibrium Model (MEM)/CWEM9.0.



Ecosystem Structure & Functions

Abiotic Resources & Stressors: Surface water TP has exceeded means values at some sites and appeared to correspond with dry down and rewetting events, including early wet season, intermittent pump operation, hurricane activity or after prolonged dry downs, resulting in a trend of increasing TP concentrations with higher mean values in 2020-2021 (Fig. 12). Water N:P molar ratio continued to decline along the freshwater to marine gradient as P becomes more available relative to N with proximity to marine sources (Childers et al. 2006) (Fig. 13). Variability is largely controlled by disturbance events and legacies (Kominoski et al. 2020), although P continues to increase at upstream locations along the TS/Ph transect. Relative to the mean, variance in N:P is declining at most sites. Salinity is increasing at downstream locations of both mangrove transects (Fig. 14).

Figure 12. Long-term (2008-2021) total phosphorus concentrations in surface water at Argyle Henry (AH, TS/Ph-6a) and Taylor River mouth (TM, TS/Ph-7) from autosampler collections at each site.

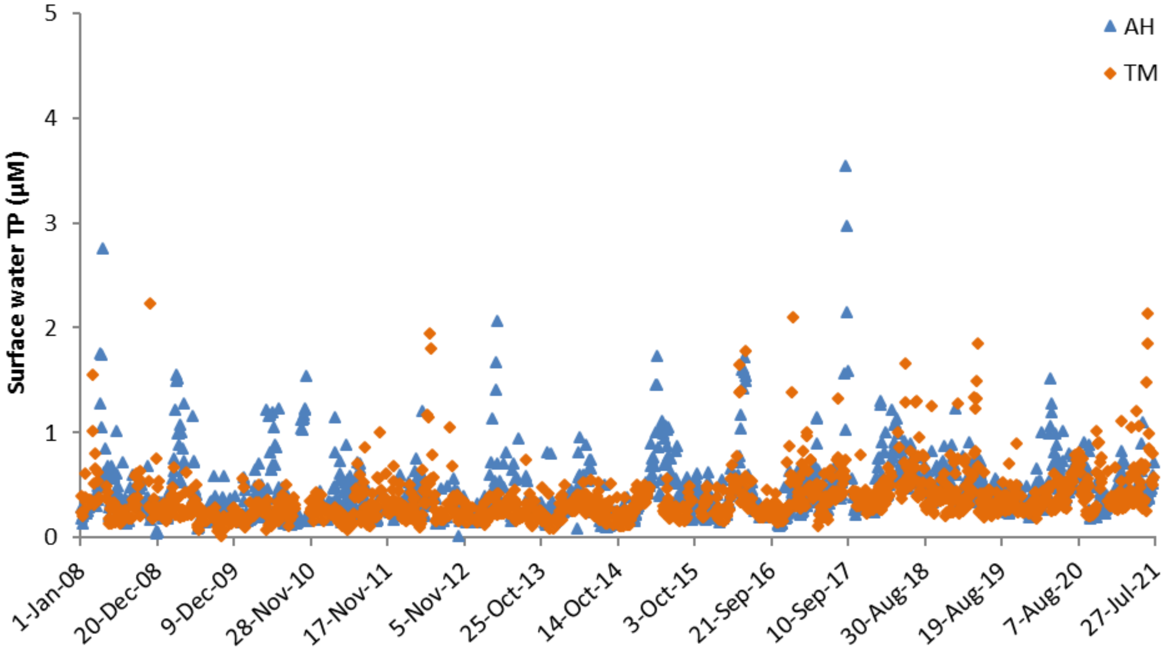


Figure 13. Surface water molar N:P ratios from freshwater marshes (blue shades) to mangrove estuaries (green shades) along the SRS drainage (top panel), TS/Ph drainage (middle panel), and seagrass meadows (orange shades) of Florida Bay (bottom panel), showing the upside-down estuary gradient ([Childers et al. 2006](#)) and evidence of P pulses and legacies associated with Hurricanes Wilma (2006) and Irma (2017) ([Kominoski et al. 2020](#)).

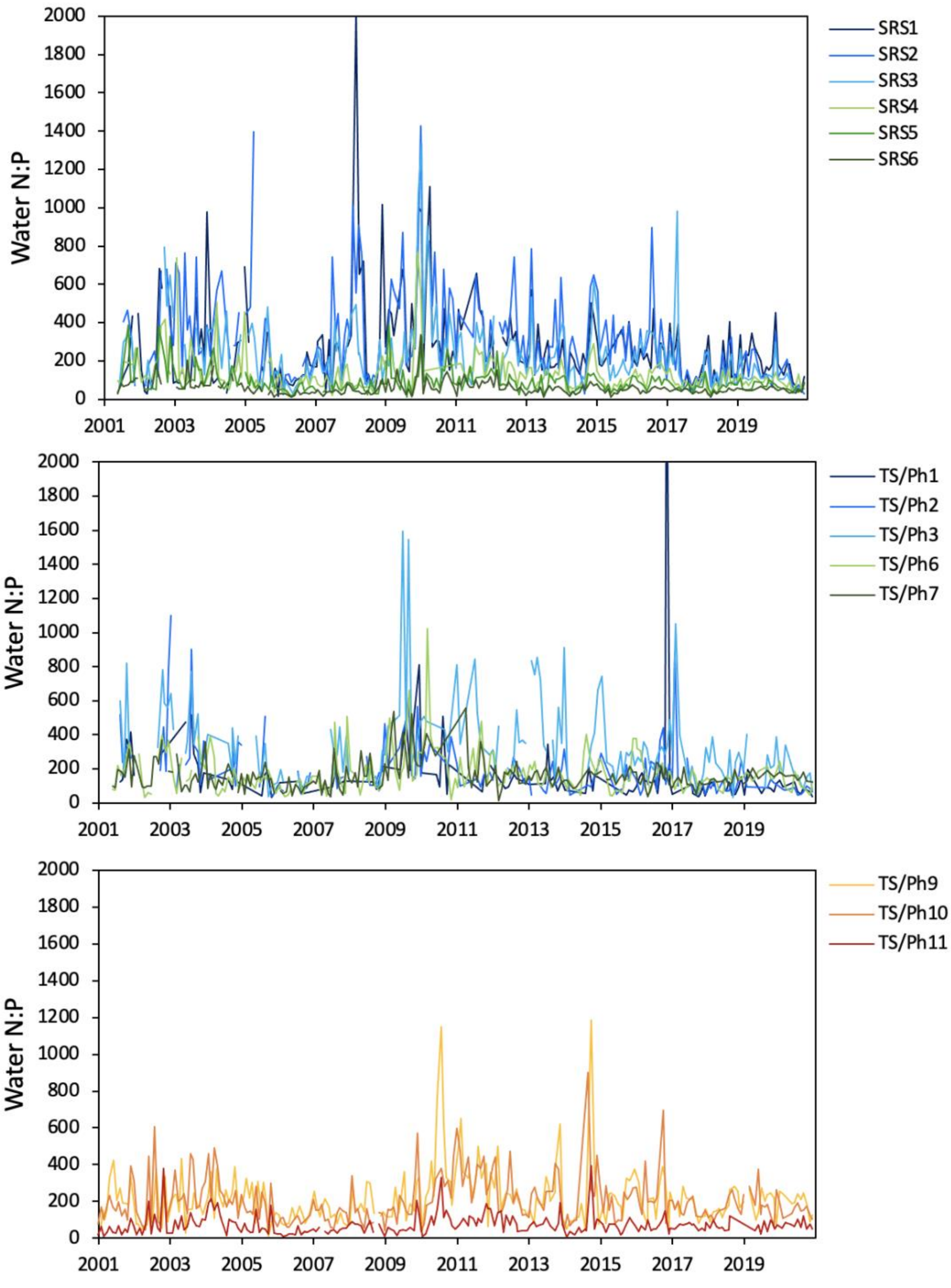
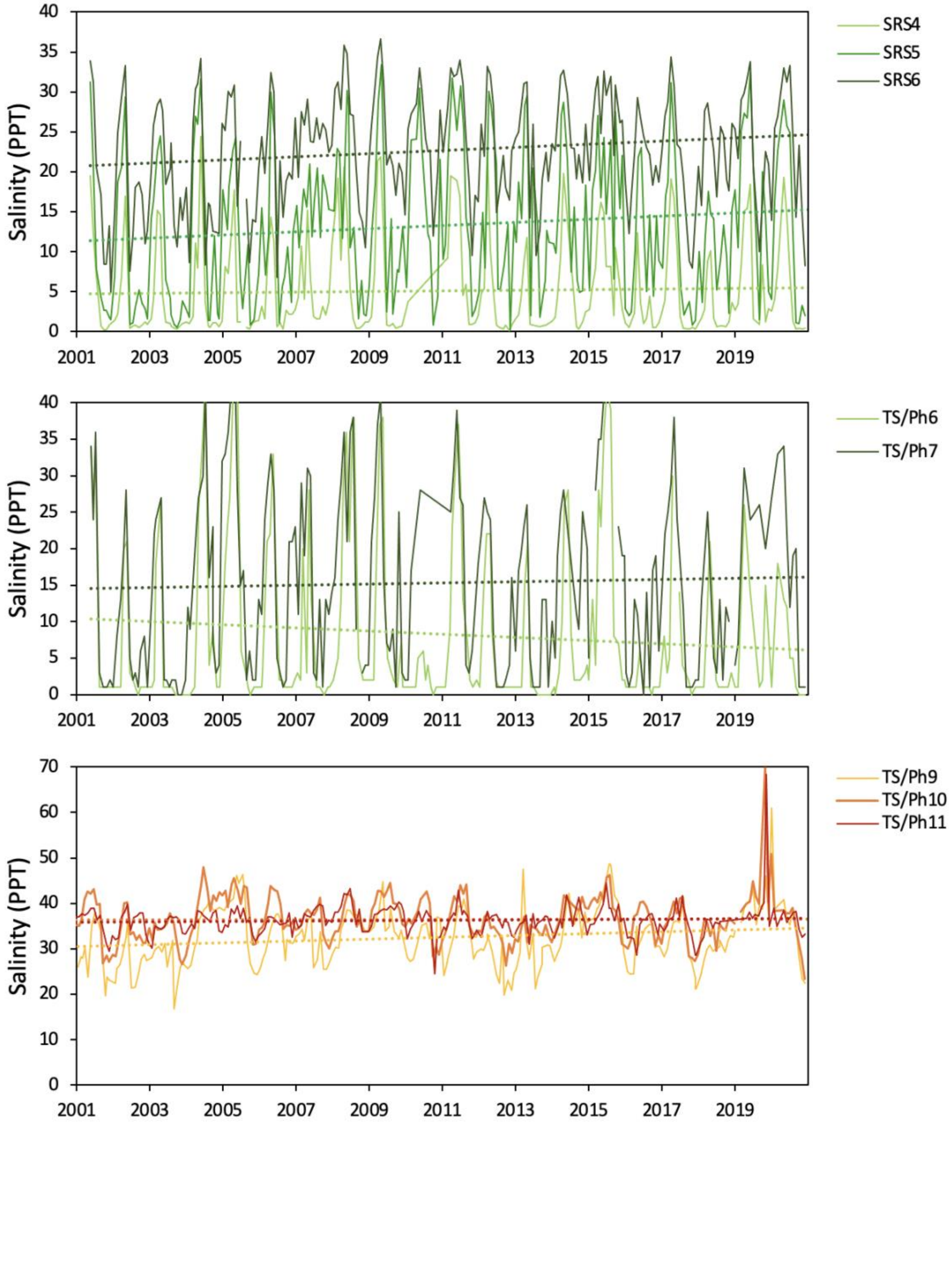
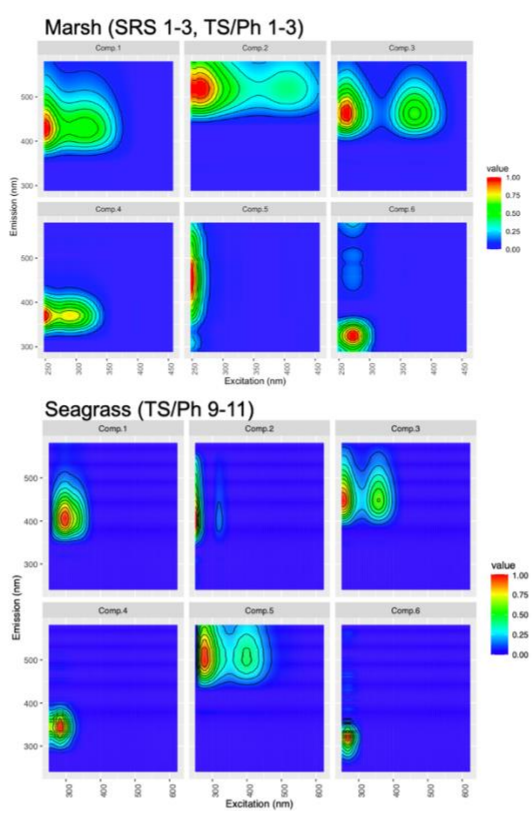


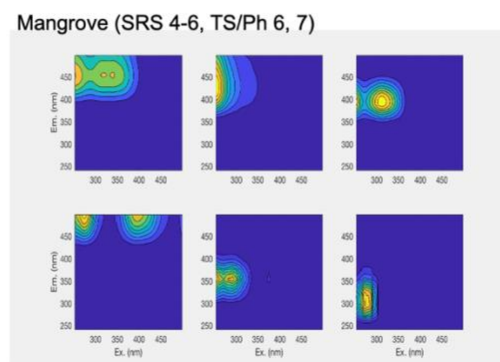
Figure 14. Surface water salinity from mangrove estuaries (green shades) along the SRS drainage (top panel), TS/Ph drainage (middle panel), and seagrass meadows (orange shades) of Florida Bay (bottom panel), showing the coastal salinity gradient and evidence of increasing salinity at downstream mangrove estuaries and spikes in Florida Bay due to prolonged droughts.



Detritus & Microbes: Models identify distinct carbon sources to DOM (Fig. 15). DOC concentration gradients from marsh-to-mangrove reversed in SRS and increased in seagrasses following Hurricane Irma (Fig. 16). DOC concentrations (and variation) decreased from upstream marshes to downstream mangrove estuaries (Figs. 17A-17C). Bacterioplankton productivity increased rapidly in the past decade throughout all wetlands (Figs. 17A-17C). Fluorescent properties of DOM respond differently to hurricane pulses, upstream freshwater restoration, and between marl- and peat-dominanted wetlands (Figs. 18-20). Mangrove (Rhizophora mangle) and seagrass (Thalassia testidinum) litter is less recalcitrant than marsh litter species (Cladium jamaicense, Eleocharis cellulose) (Fig. 21), which in addition to having higher foliar P content explains why mangrove and seagrass litter breakdown rates are higher than that of marsh litter species regardless of which ecosystem the litter is decomposing (Fig. 22). Differences between pre- and post-Irma were more pronounced in downstream mangroves compared to upstream marshes (Fig. 23). Soil and periphyton samples are clearly distinct from each other and from detritus microbial communities. Detritus microbial communities cluster mostly based on ecosystem, e.g., marine, ecotone, marsh, independent of litter origin, with the exception of Eleocharis-litter that seems to be degraded by distinct communities in the marshes/ecotone sites (Fig. 24). Soil- and sediment microbial communities showed distinct prokaryotic community patterns in freshwater sites, mangrove sites, and Florida Bay seagrass sites, whereas fungal communities showed less clear separation by ecosystem type (Figs. 25, 26).

Figure 15. Parallel factor analysis (PARAFAC) models of fluorescent DOM from marshes, mangroves, and seagrasses reveal distinct and common contributions to fDOM composition.





How distinct are DOC compositions among marsh, mangrove, seagrass ecosystems?

	C1	C2	C3	C4	C5	C6
marsh	M	T	T	P	T/M/P	P
mangrove	T	T	M	T	M	P
seagrass	M	M	T	P	T	P

Figure 16. DOC concentrations among marshes, mangroves, and seagrasses illustrate different landscape patterns in peat-dominated (declines from marshes to mangroves) and marl-dominated wetlands (declines in seagrasses and inland marshes relative to scrub mangroves). Pulsed storm surge and freshwater flooding temporarily reversed the DOC concentration gradient along SRS.

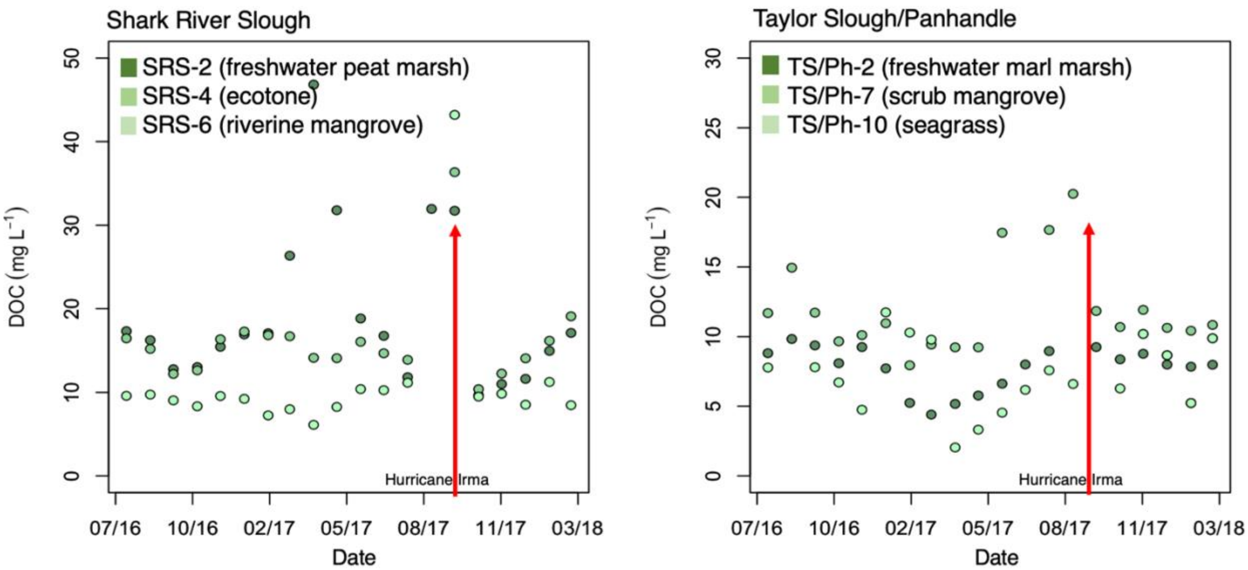
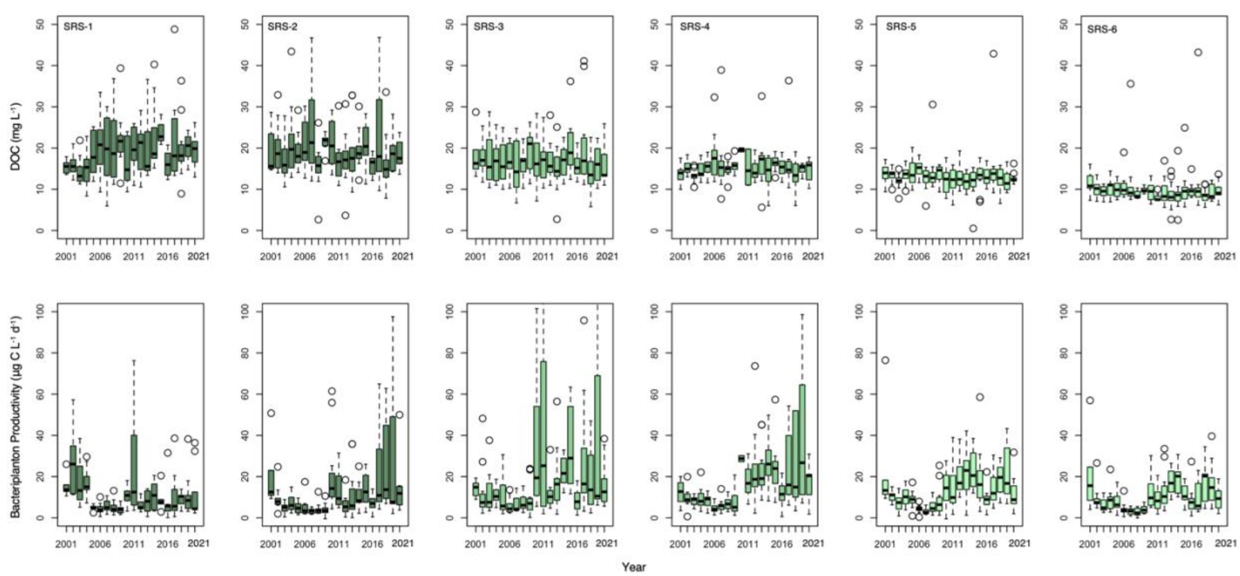
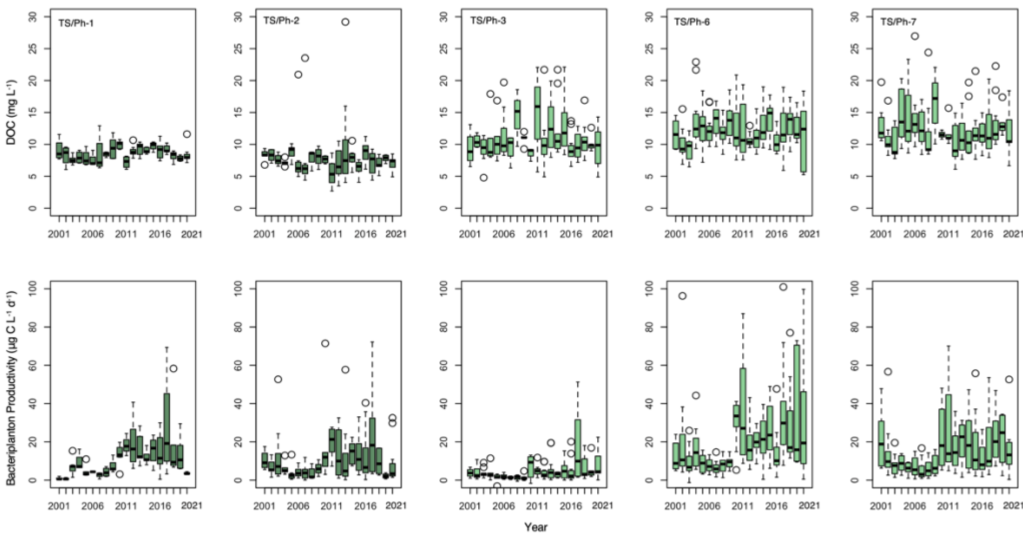


Figure 17A-17C. Long-term (2001-2020) patterns of DOC concentrations and bacterioplankton productivities along marsh-to-mangrove gradients and across seagrasses of Florida Bay.

A. SRS 1-6



B. TS/Ph 1-3, 6, 7



C. TS/Ph 9-11

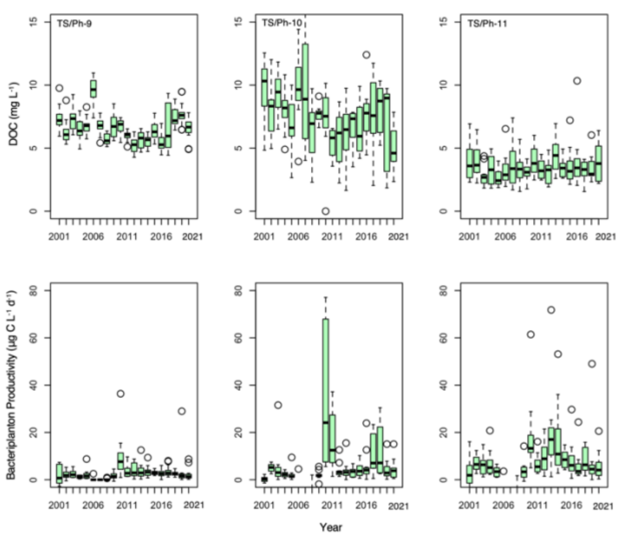


Figure 18. Storm surge and freshwater flooding pulses temporarily reduced aromaticity of DOM in peat-dominated but not marl-dominated wetlands.

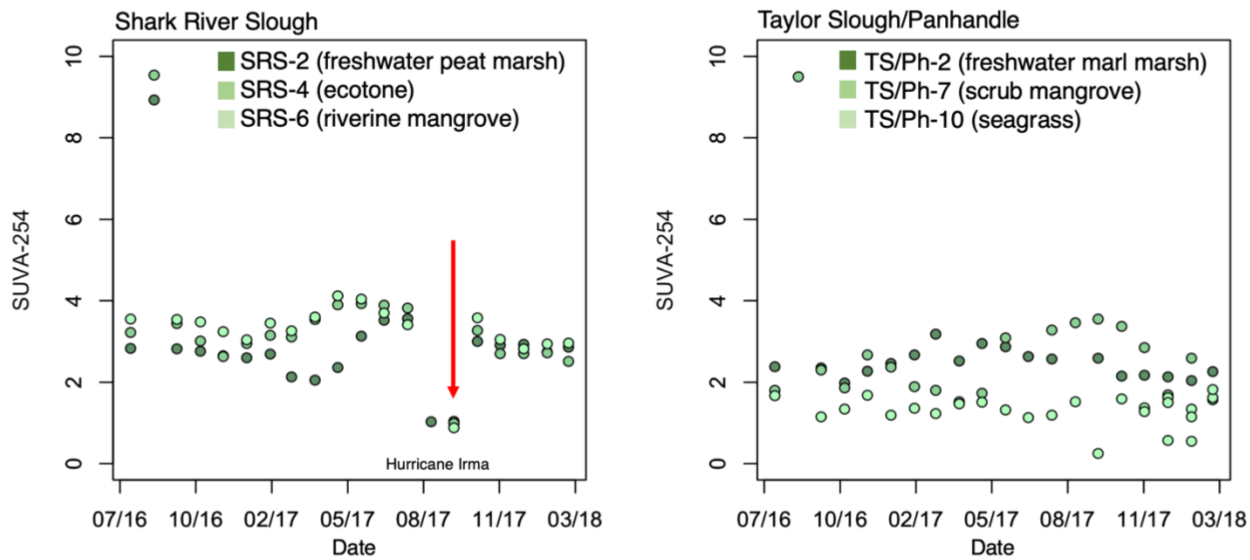


Figure 19. Long-term (2012-2020) patterns in the autochthonous production of DOM (biological index, BIX) indicate a steady decrease in this contribution is occurring in freshwater peat marshes of SRS.

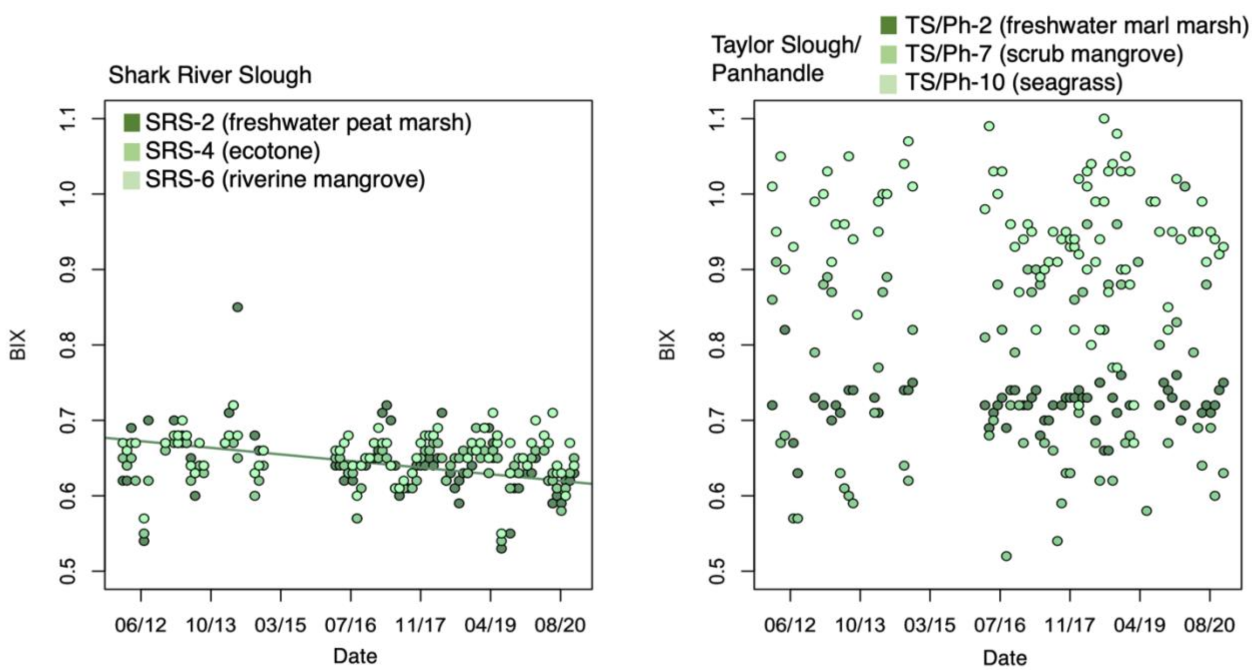


Figure 20. Long-term (2012-2020) patterns in the fluorescence index (FI) indicate a steady increase in terrestrial loading of DOM is occurring in freshwater peat and marl marshes as well as along SRS with increases in upstream freshwater restoration.

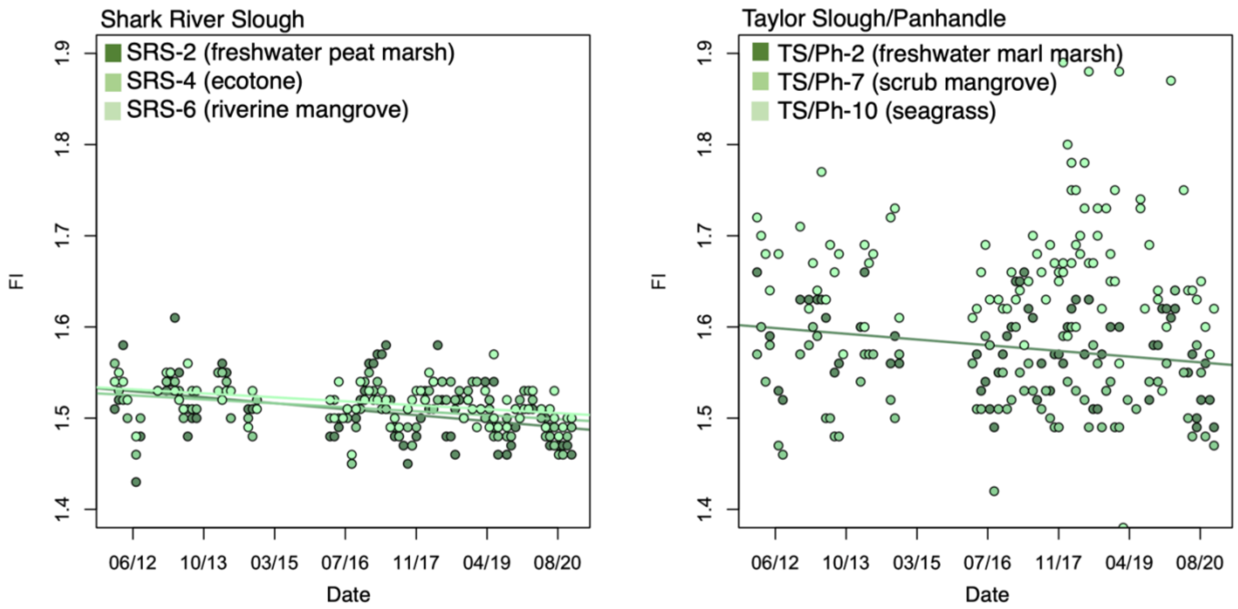


Figure 21. Ramped pyrolysis used to compare the relative recalcitrance of leaf litter species among marshes, mangroves, and seagrasses.

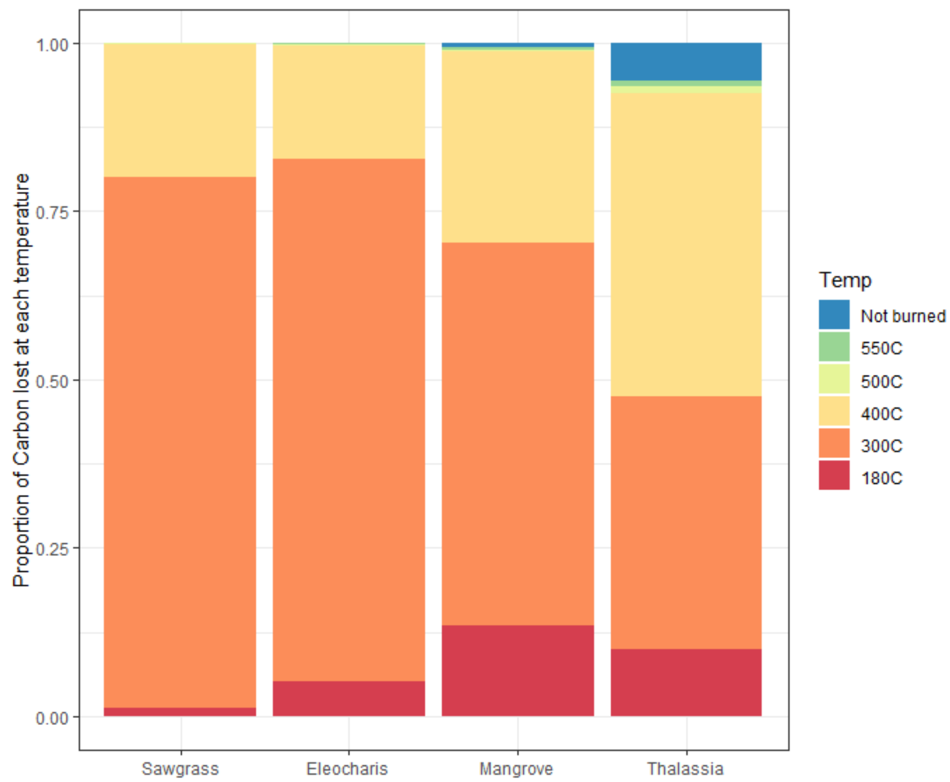


Figure 22. The breakdown rates (*k*) of dominant leaf litter species reciprocally incubated in marsh, mangrove, and seagrass ecosystems.

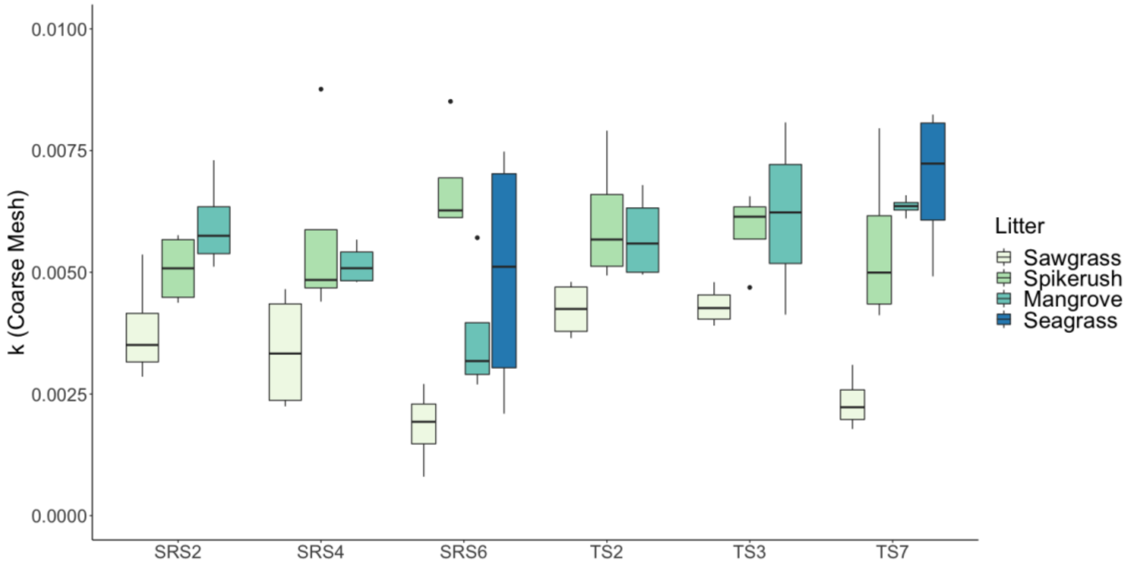


Figure 23. Summary of all 16S rRNA amplicon data from this project. The panels show main bacterial groups (upper panels) and subgroups of Gammaproteobacteria (lower panels) for Shark River Slough and Taylor Slough (TS/Ph).

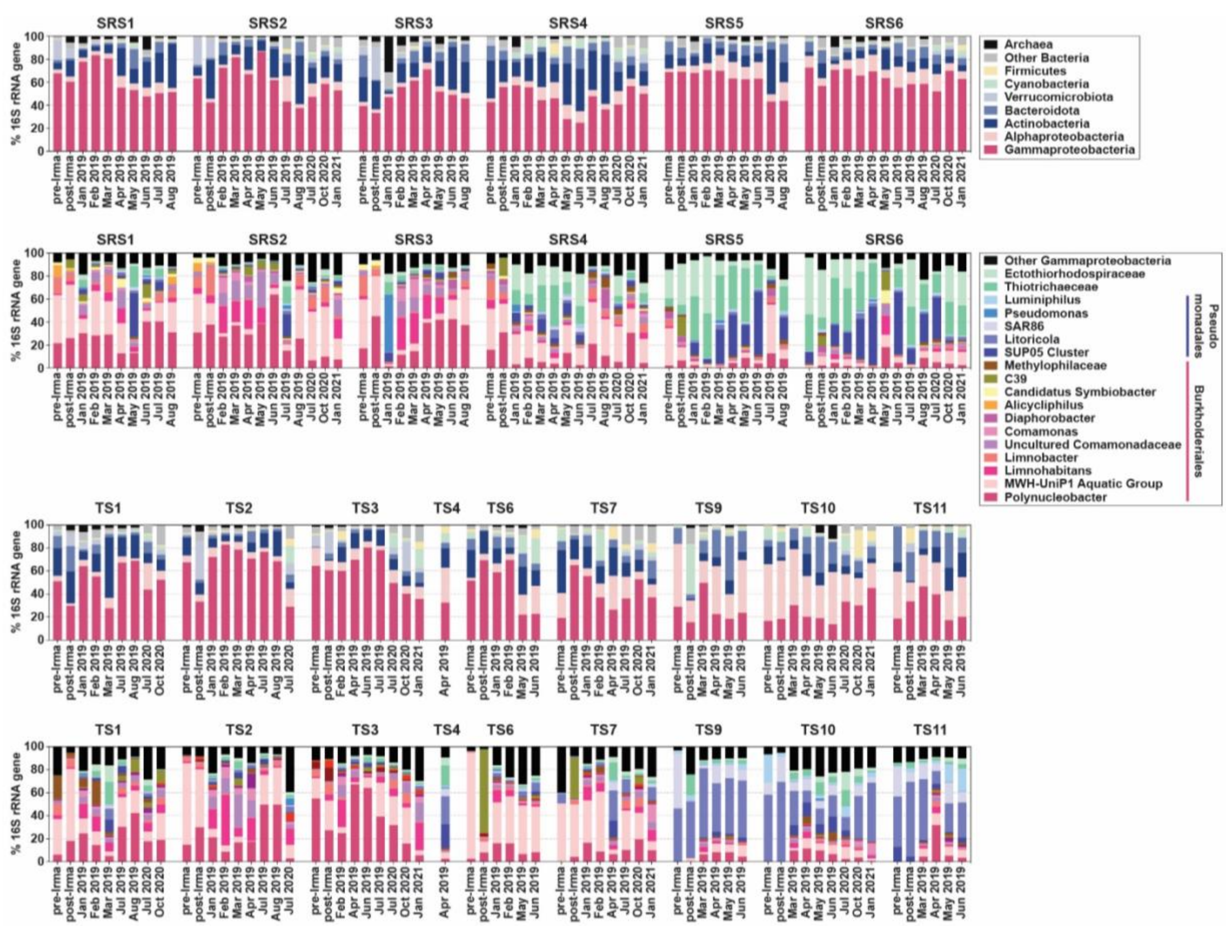


Figure 24. Taxonomic composition of messenger RNA retrieved from soil (SO), periphyton (PE), and litter samples (SE=seagrass, SA=sawgrass, EL=Eleocharis, MA=mangrove) at selected LTER core sites in the marshes, ecotones, mangrove-dominated, and coastal/oceanic sites. (software only allowed for 6 symbols; therefore: S = SRS, TS = TS/Ph sites).

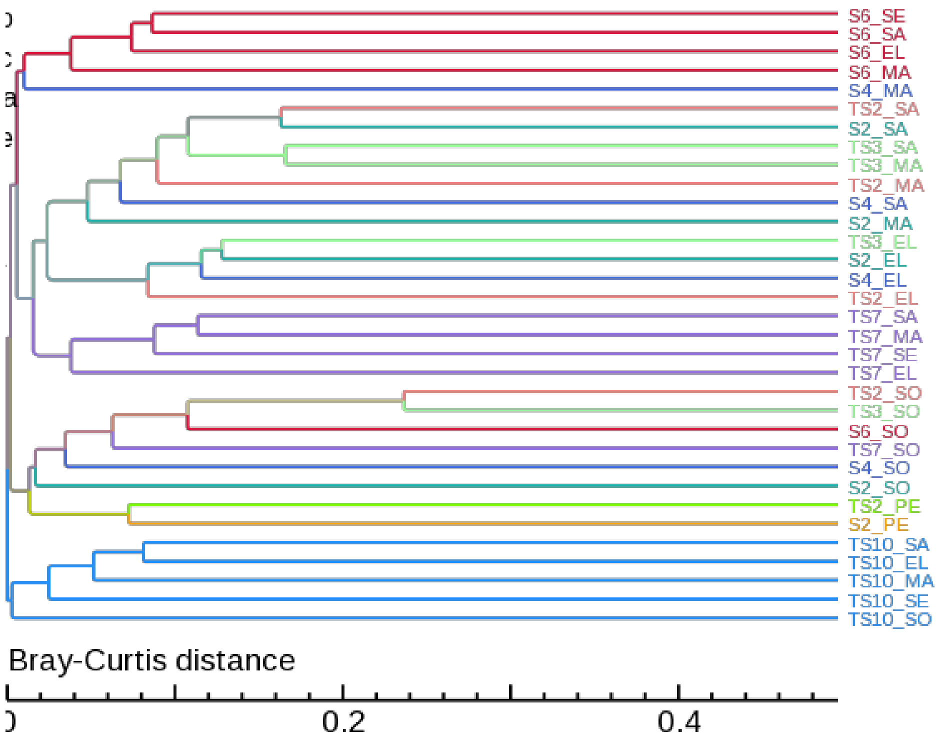


Figure 25. Principle Coordinate Analysis of Soil and sediment microbial community structure of Shark River and Taylor Slough transects separates freshwater wetland, mangrove wetland, and seagrass bed sediments.

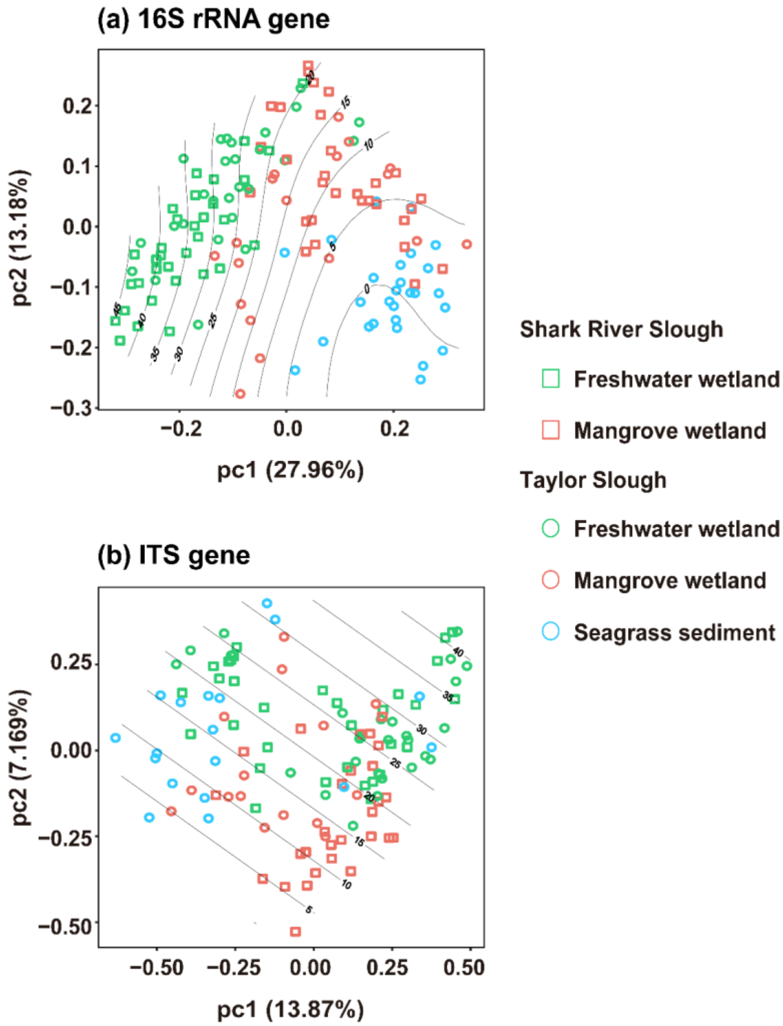
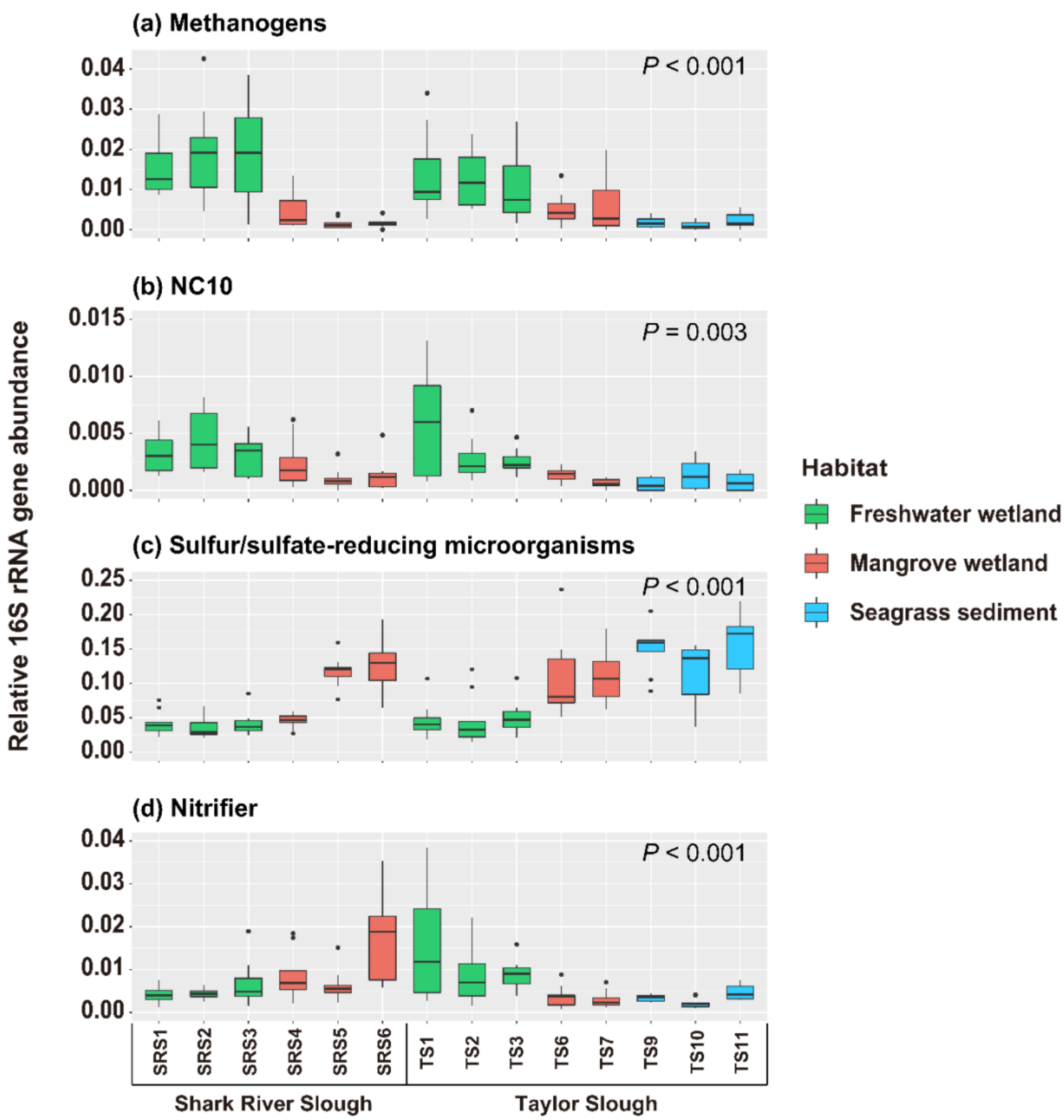


Figure 26. Relative abundances of selected prokaryotic functional guilds trace the freshwater-marine transition of methanogenic to sulfidogenic organic matter processing. Shown are relative abundances of (**a**) methanogens, (**b**) NC10 methanotrophs, (c) sulfur- and sulfate-reducing microorganisms, and (d) aerobic nitrifiers in Shark River and Taylor transects from February 2019 to October 2020. Main habitat types are color coded.



Vegetation: Periphyton TOC, TIC, and TP accumulation vary among ecosystems (Fig. 27). Sawgrass Cladium aboveground biomass is decreasing at all sites, except recently at TS/Ph-6 (Fig. 28). Eleocharis densities are high at wetter marsh sites and are recently increasing at TS/Ph-6 (Fig. 29). Mangrove litterfall declined after Hurricane Irma, but rates are recovering (Fig. 30). Seasonal pulses of litterfall are higher in wet- than dry-season (Fig. 31), and cyclones contribute critical lateral litter-POC flux, currently unaccounted in global C budgets and similar to C burial rates and dissolved inorganic carbon export. We detected the highest NPP rates in scrub mangroves that correspond to the highest surface TP concentrations reported (Fig. 32). Increased porewater salinity occurred with decreased freshwater inflow and increased sea-level rise (Fig. 33). Necromass contributed to refractory organic matter pools in the soil (Fig. 34). We documented the largest mangrove dieback on record (10,760 ha) in southwest Florida as a result of Hurricane Irma (Fig. 35). Mangroves on well-drained areas (83%) resprouted within a year and showed high to intermediate resilience. Mangrove dieback was concentrated in forest dominated or co-dominated by *Avicennia germinans* in low-lying areas (Fig. 35). Seagrass meadows at TS/Ph-10 were quasi-stable in species composition and biomass (Fig. 36).

Figure 27. Mean accumulation rates of total organic carbon (TOC – top row), total inorganic carbon (TIC – middle row), and total phosphorus (TP – bottom row) in periphyton on artificial substrates incubated quarterly at FCE marshes (SRS 1-3, TS/Ph 1-3) and seagrass meadows (TS/Ph 9-11). Left panel: Site means and standard errors of accumulation rates on glass slides over the period of record. Middle panel: Trends in mean annual accumulation rates on glass slides by habitat/site type. Right panel: Mean and standard error of accumulation rates on artificial blades and glass slides incubated in Florida Bay

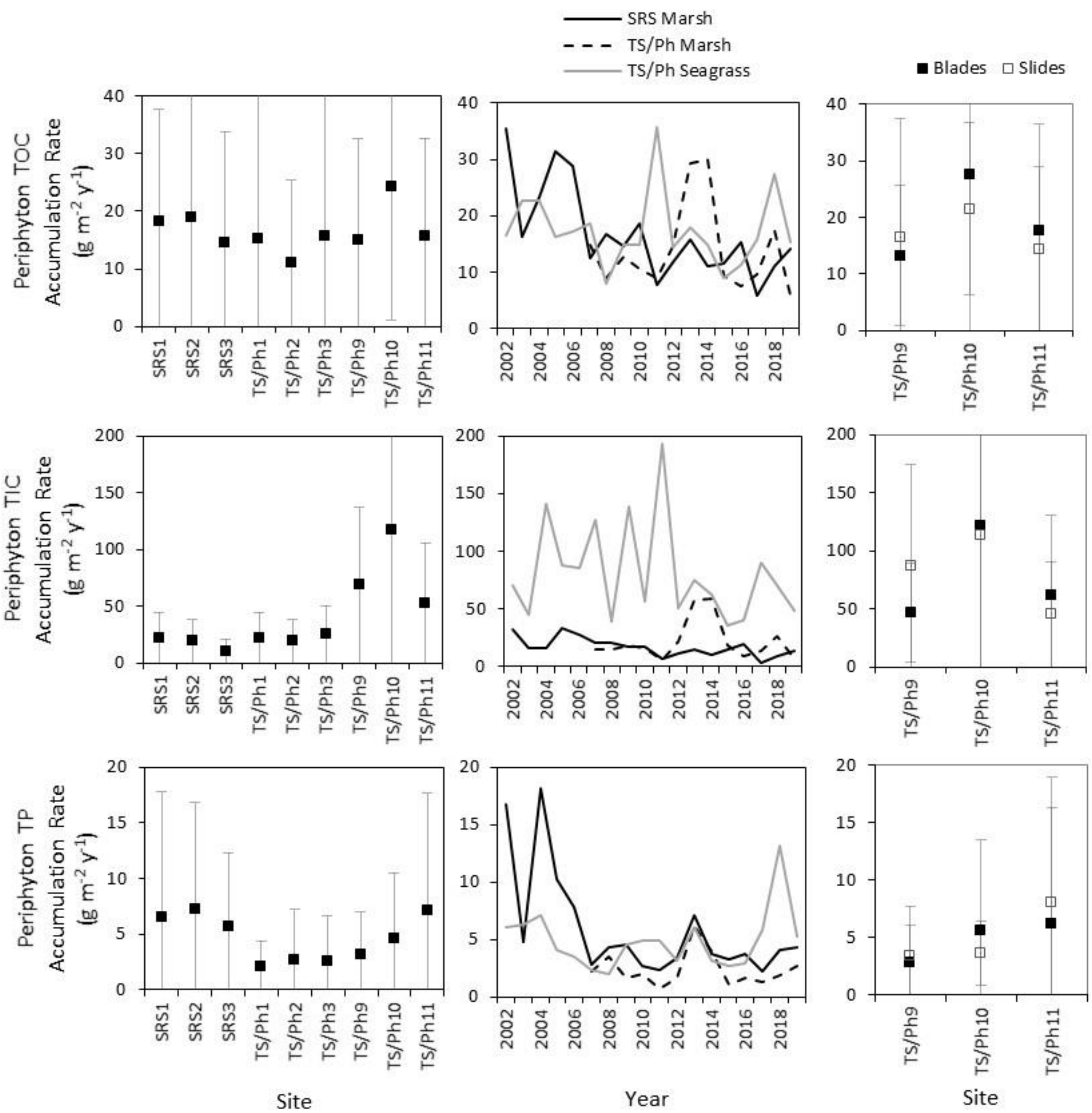


Figure 28. Long-term (2006-2020) annual *Cladium* ANPP at Taylor Slough marsh sites S332D (TS/Ph-1), Main Park Road (TS/Ph-2), Lower Central (TS/Ph-3), and Argyle Henry (TS/Ph-6).

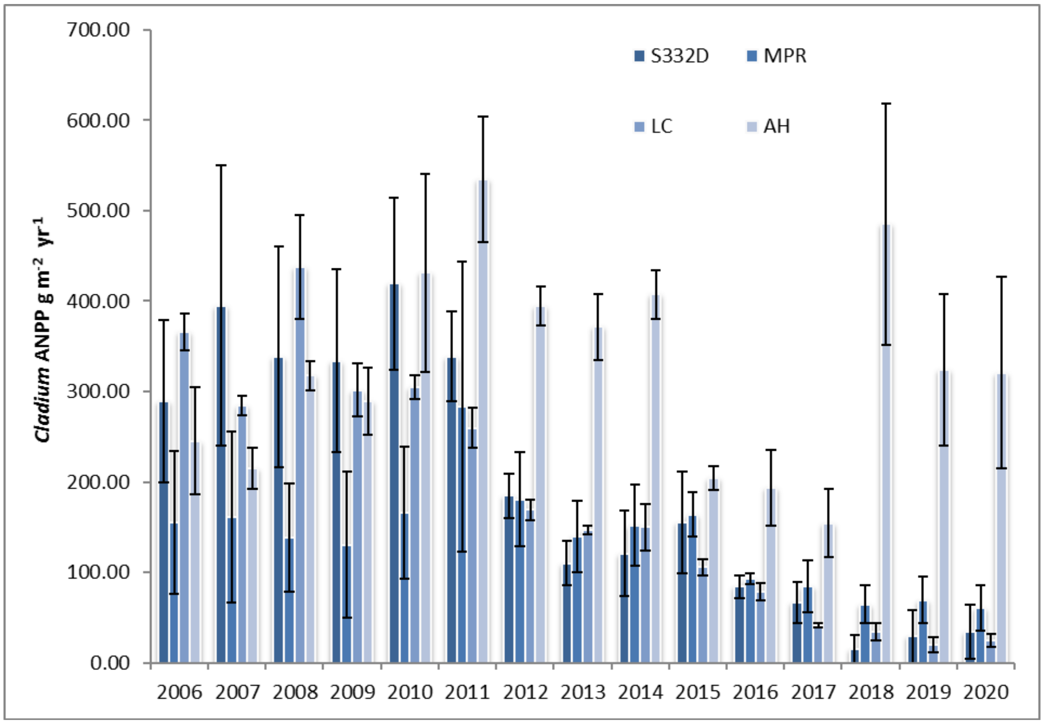


Figure 29. Long-term (2006-2021) *Eleocharis* stem density at Taylor Slough marsh sites S332D (TS/Ph-1), Main Park Road (TS/Ph-2), Lower Central (TS/Ph-3), and Argyle Henry (TS/Ph-6).

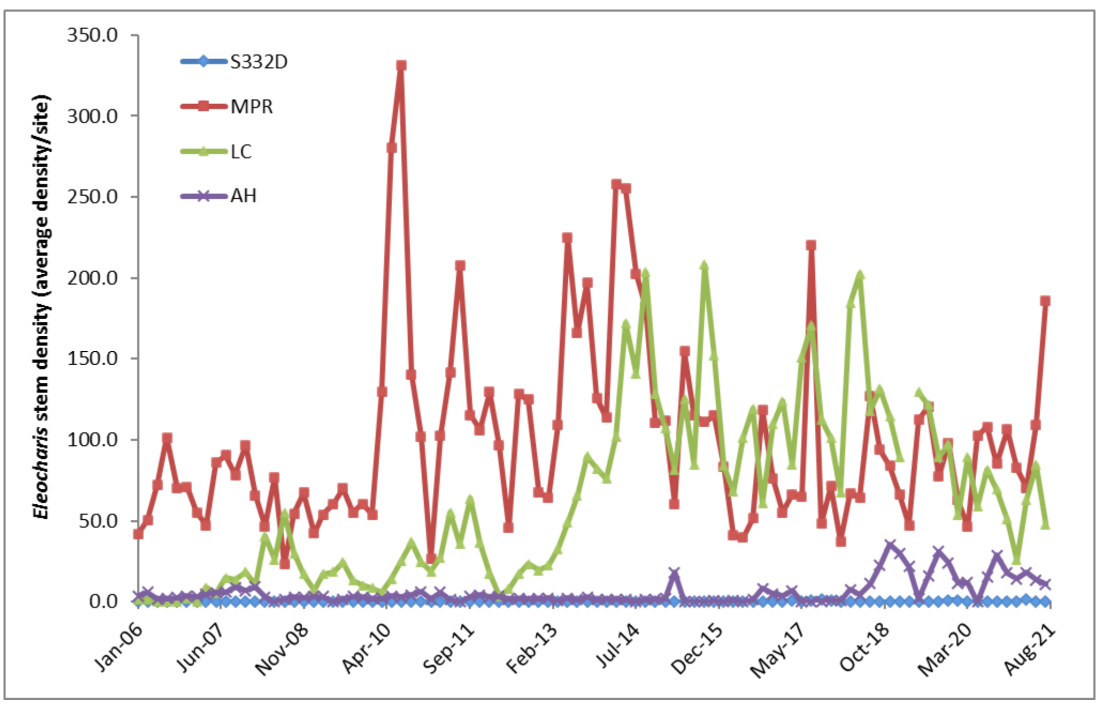


Figure 30. Long-term (2001-2020) variation in total annual litterfall production in mangrove forests along Shark River estuary before and after the passage of Hurricanes Wilma (October 2005) and Irma (September 2017) across the FCE.

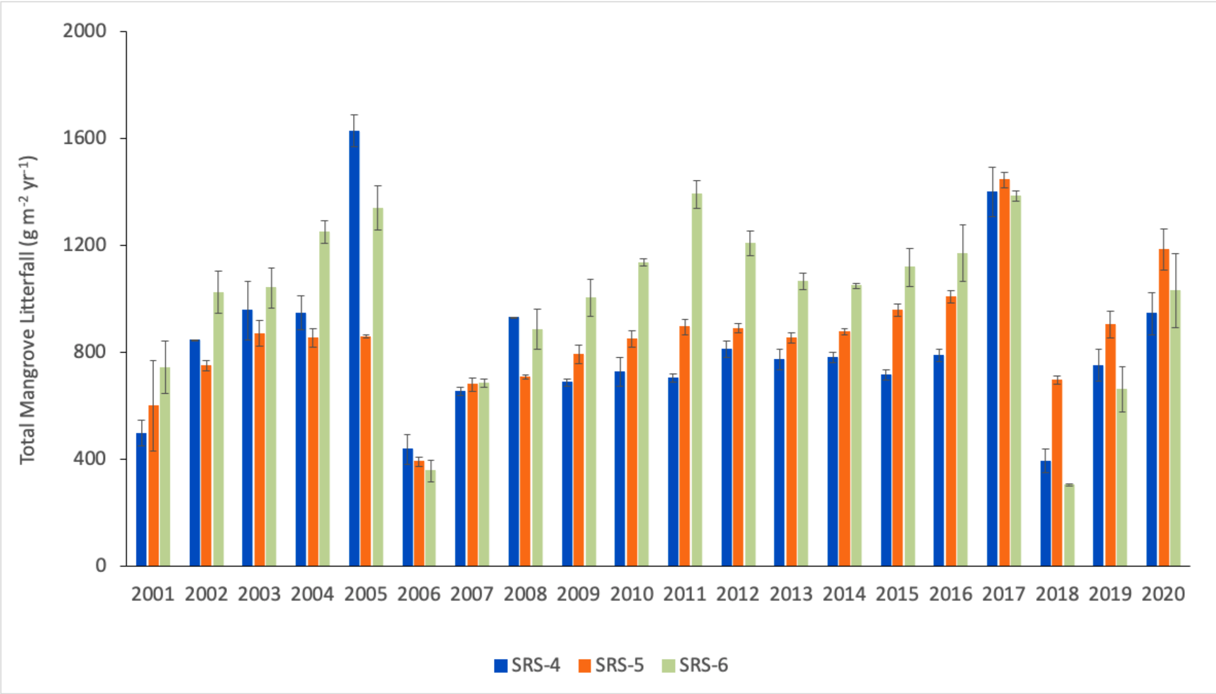
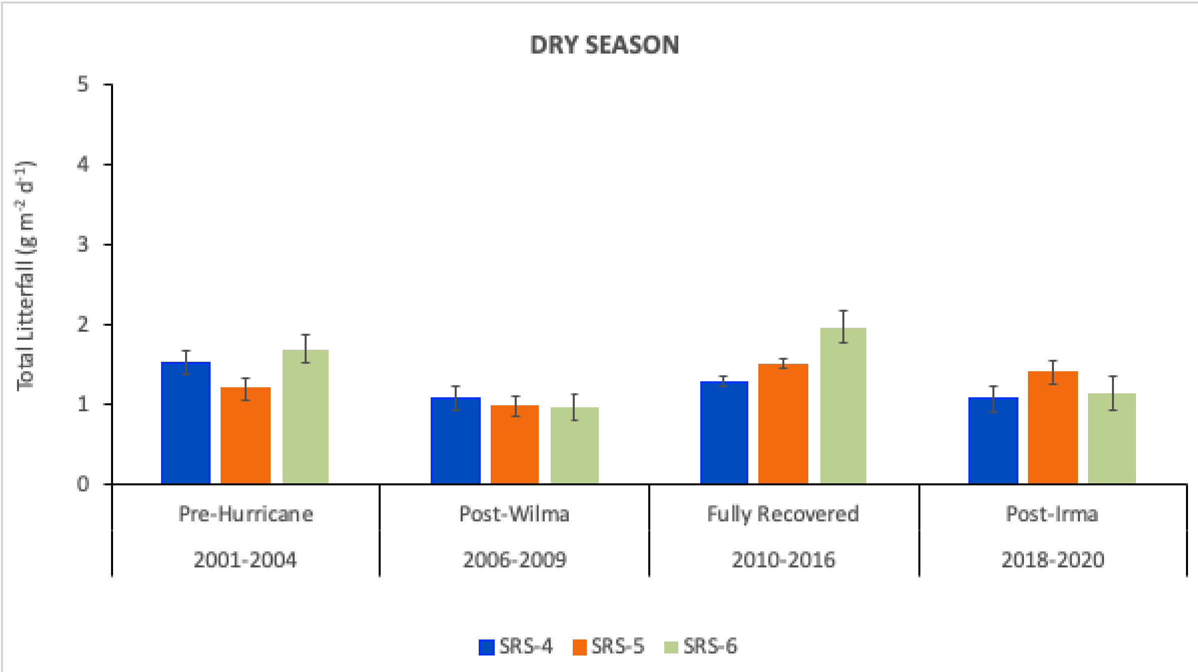


Figure 31. Long-term (2001-2020) seasonal variation in daily rates of litterfall production in mangrove forests along Shark River estuary before and after the passage of Hurricanes Wilma (October 2005) and Irma (September 2017) across the FCE.



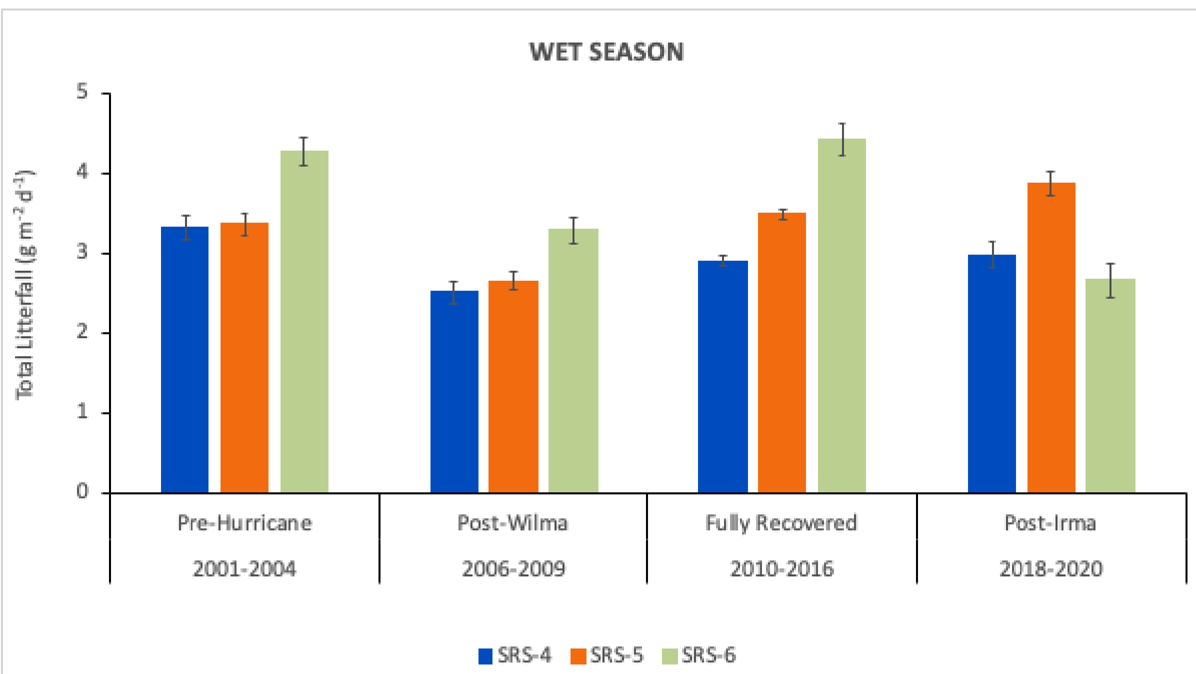


Figure 32. Long-term (2012-2020) variation in total annual leaf NPP rates of *R. mangle* dominated scrub mangrove forests along Taylor River estuary using a leaf tagging methods comparison (i.e., direct vs. ring markers).

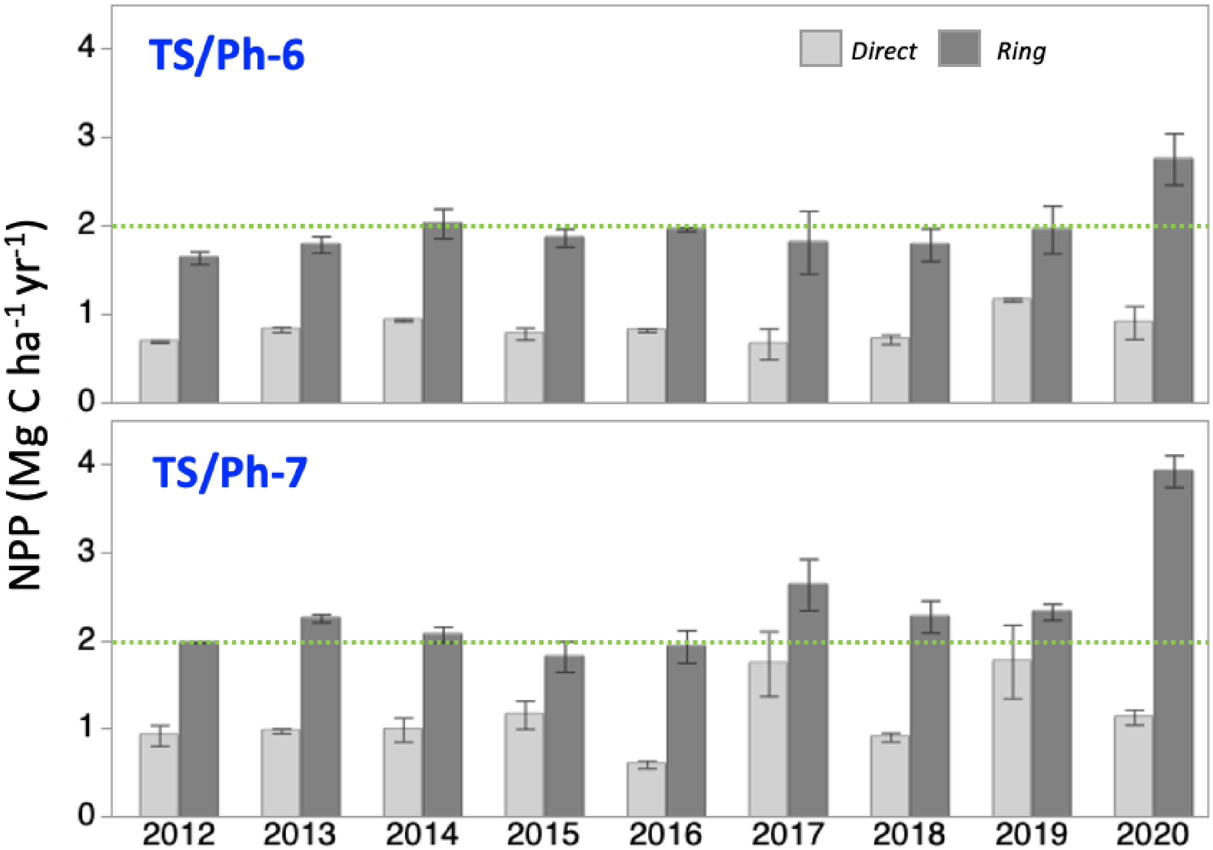


Figure 33. Linear regressions between soil porewater salinity (PWS) field measurements and RHYMAN model simulation results at each study site along the Shark River estuary. Field measurements were obtained in the period from 2004 to 2016 in the dry and wet seasons. Light gray area indicates the 95% confidence interval for the full model (black line).

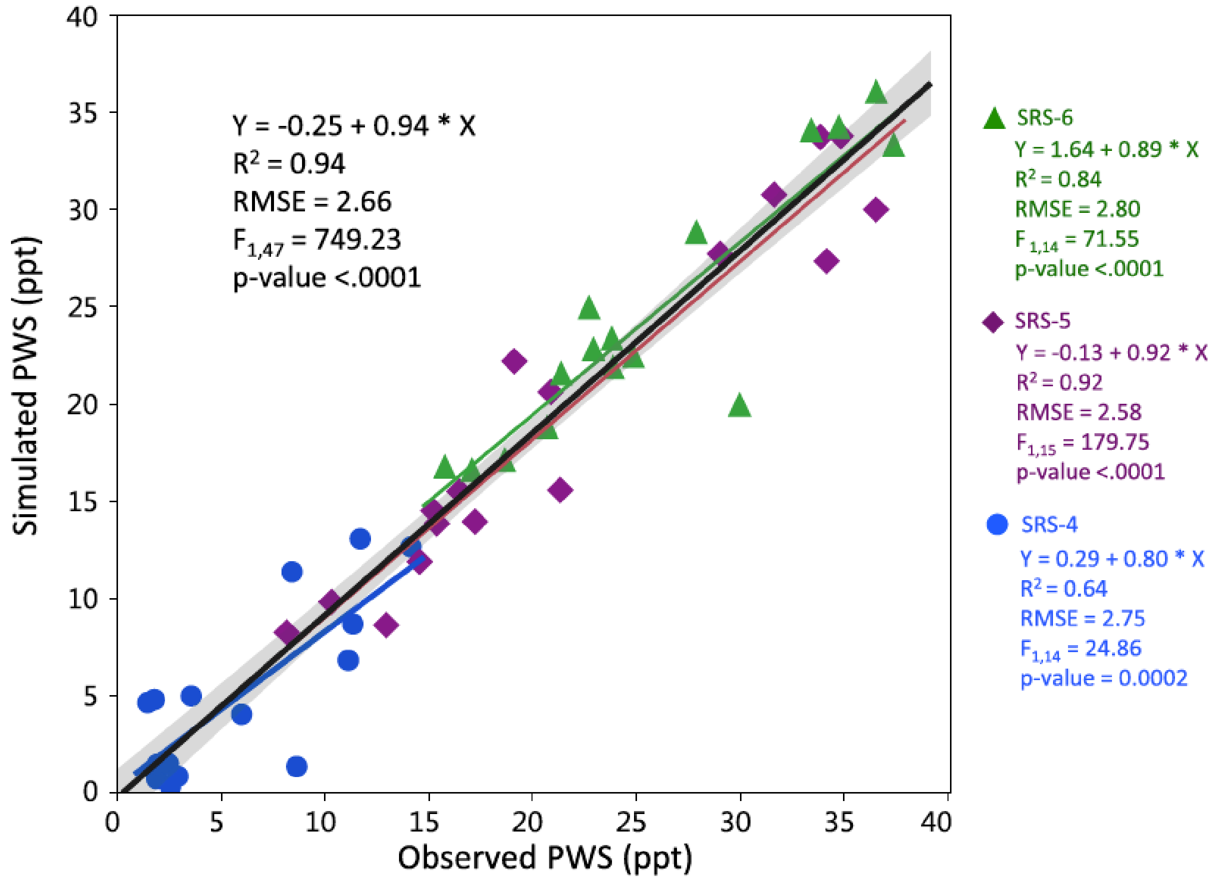


Figure 34. Mean (± 1 SE) root biomass, root necromass, and total root mass (biomass plus necromass) to 0.4 m in Mg ha^{-1} at each mangrove site in Shark River (SR, SRS-6), Rookery Bay (RB), and Taylor Slough (TS, TS/Ph-7) (n = 3). Letters indicate significant differences between means.

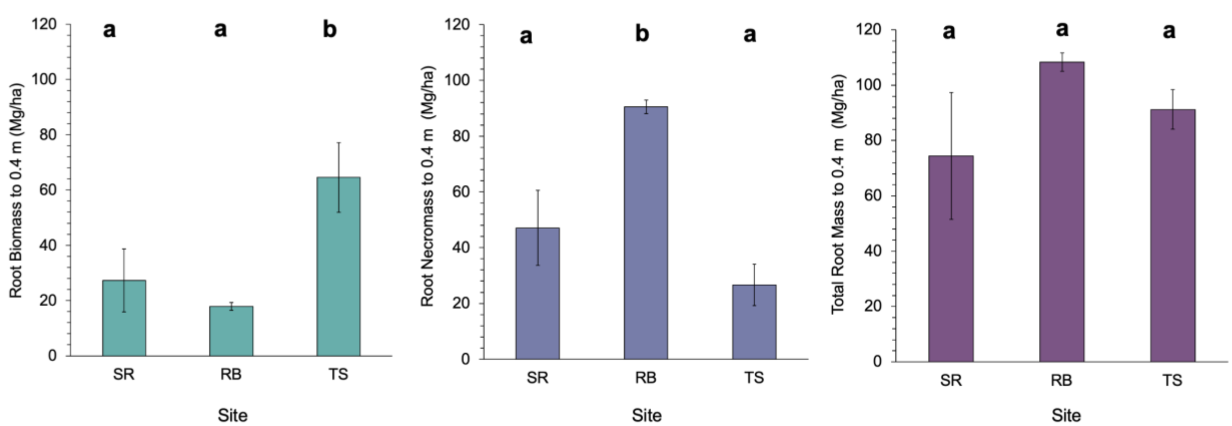


Figure 35. Mangrove forest dieback was concentrated in low-lying areas that are typically dominated by *A. germinans*, the most salt-tolerant species in the neotropics. Hotspots of dieback are highlighted for Ten Thousand Islands, Gopher Key, and Cape Sable/ Flamingo. a) Distribution of resilience class across southwest Florida. b) Distribution of ground elevation for each resilience type. Dashed lines indicate the median elevation values per class. c) Cumulative frequency of storm surge above ground by resilience class. d) Area of resilience class by dominant mangrove species.

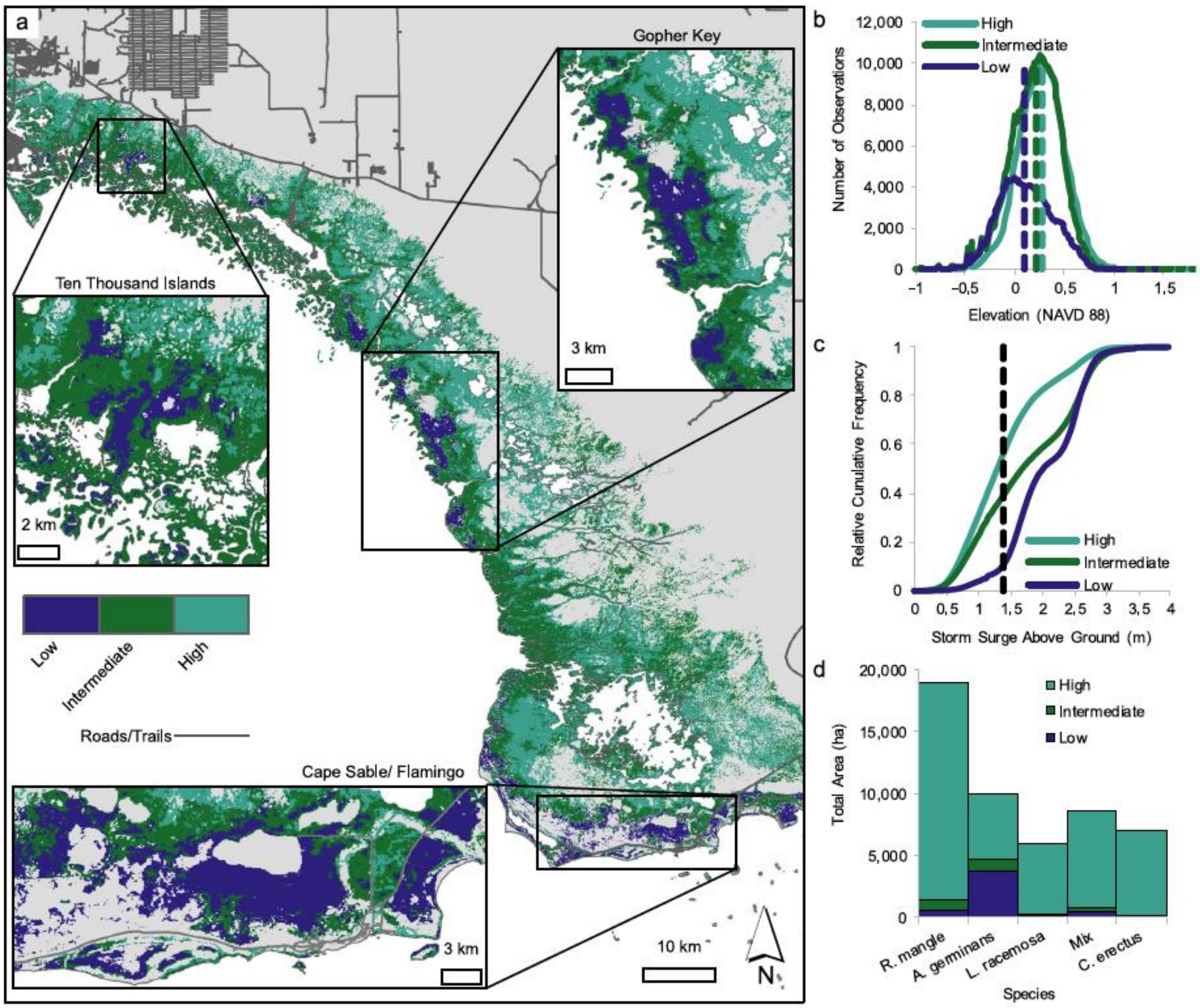
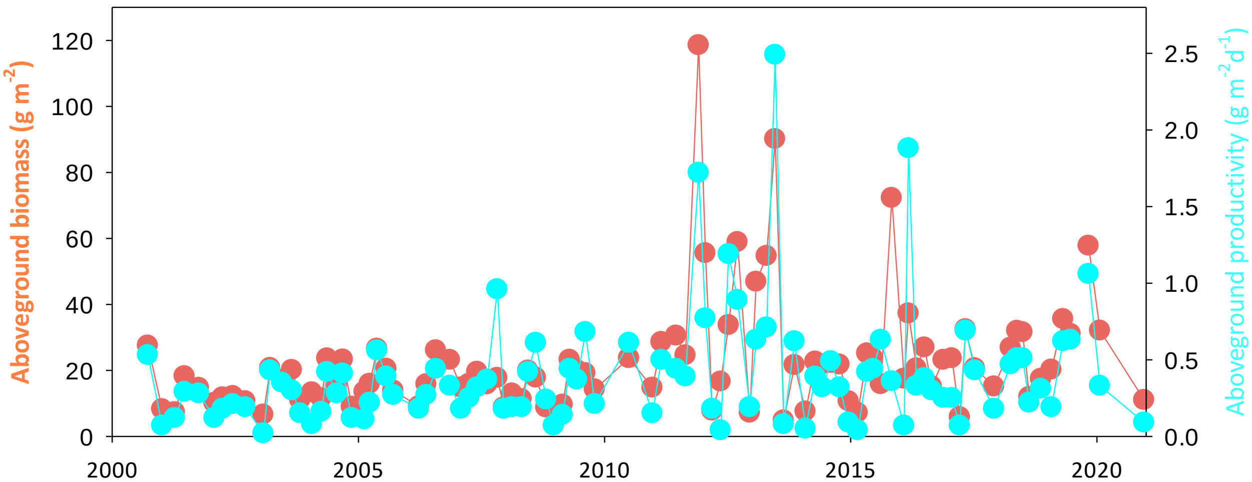


Figure 36. ANPP and aboveground seagrass biomass show inter-annual variability but no long-term trends at TS/Ph-10. Source: Van Dam et al. (2021).



Consumers: In marshes, periphyton (set/dry season) and floc (dry season) contributed most to consumers. In mangroves, epiphytic microalgae was most important, followed by particulate organic matter, including phytoplankton, and detritus was least important. In seagrasses, epiphytic microalgae was the most important and seagrass was secondarily important to consumers (Figs. 37, 38). Freshwater fish prey pulses are variably linked to winter water temperatures (Fig. 39). Alligators are ecosystem engineers that influence local nutrient enrichment and food-web heterogeneity of oligotrophic freshwater marshes (Figs. 40, 41). Spatiotemporal trophic dynamics were driven by seasonal flood-pulse recession, and the proportion of basal resources and prey to predator ratio increased during water recession (Table 1). Seasonal water drawdowns result in local aggregations of consumers, largely driven by improved foraging opportunities (Fig. 42), and prey availability are higher in marshes during wetter years (Fig. 43).

Figure 37. Mixing model output showing the posterior distribution of the proportion of each source contribution to primary consumer diets for: A) marsh (TS/Ph3), B) mangrove (Tarpon Bay) and C) seagrass sites in Florida Bay. Producers in green channels are shown in shades of green, while brown channel producers are shown in shades of brown. Producers analyzed included periphyton, floc and macrophyte material in A), epiphytic microalgae, suspended particulate organic matter (SPOM), and mangrove leaves in B), and SPOM, epiphytic algae, mangrove, and seagrass material in C). On the right, shown are % brown and green contributions to consumers in the dry and wet season for each habitat.

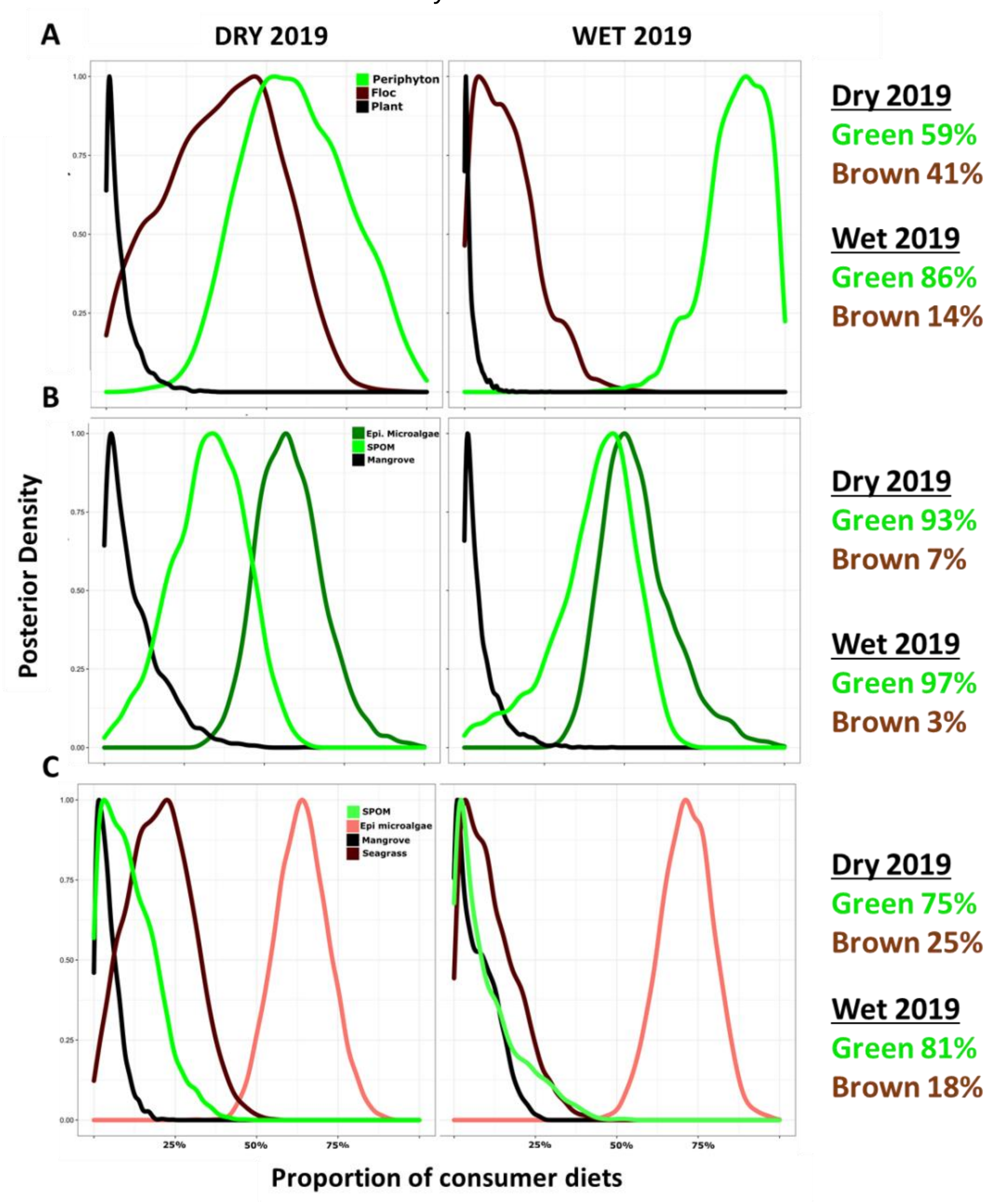
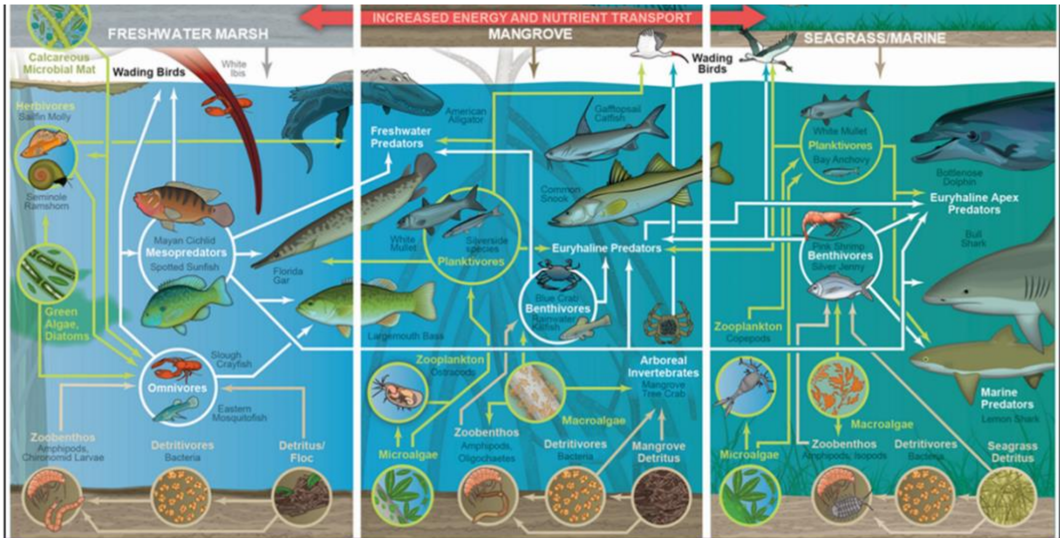


Figure 38. Summary of the proportion of green vs. brown trophic channel contributions to marsh, mangrove and seagrass consumers (averaged across wet and dry seasons) from mixing models. Everglades food webs are green food webs, with brown pathways being secondary yet more important in marsh and seagrass habitats, and least important in mangrove food webs.



Source contribution to consumers

	Freshwater Marsh	Mangrove	Seagrass/Marine
Green:	72%	95%	78%
Brown:	28%	5%	22%

Figure 39. Sunfish species contribution to A) total abundance and B) total biomass at dry-season peak emigration from marshes to the ecotone upon marsh dry down, shown across 16 years of data. C) Distance-based redundancy analysis of multivariate sunfish species (at peak yearly abundance data) of all years showing yearly structure, species driving structure, and the role of minimum water temperature and flooding duration to structuring.

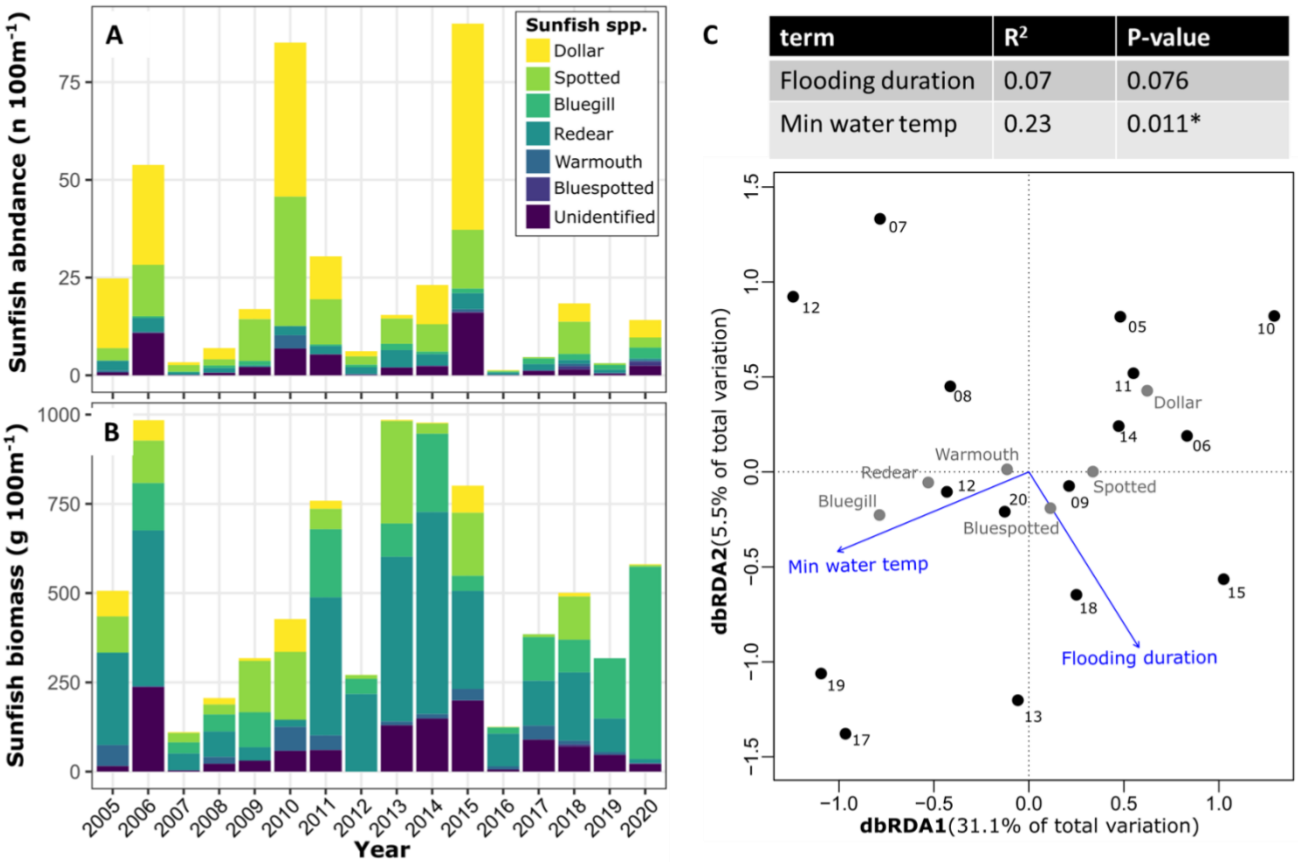


Figure 40. Floc C:N:P for paired marsh, near-pond, and alligator pond habitats at ten sites in Taylor Slough and Shark River Slough in the wet (A) and dry seasons (B). Some dry seasons were not able to be collected particularly for near pond habitats for sites in Taylor Slough.

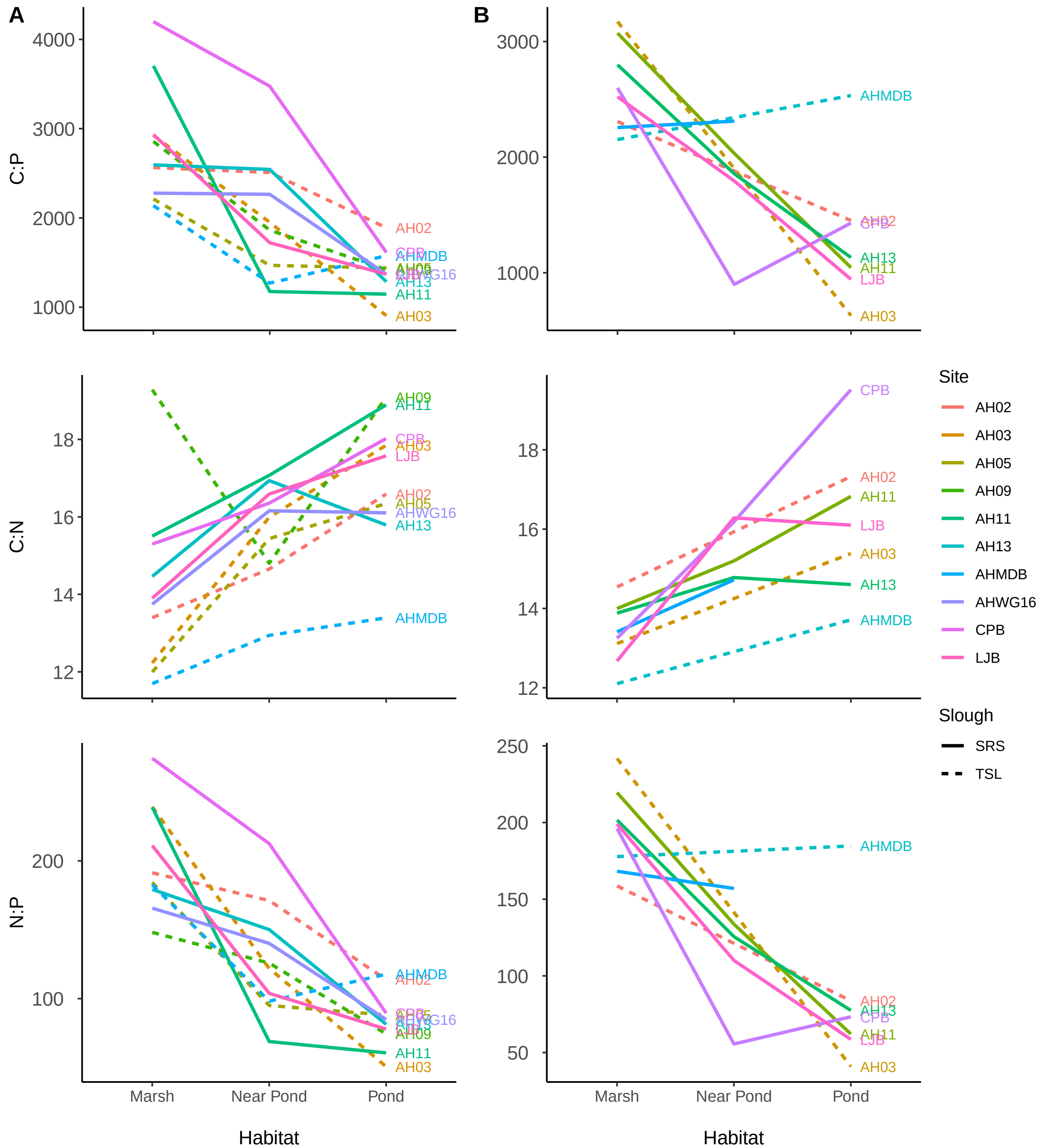


Figure 41. Non-metric multidimensional scaling biplot revealing aquatic consumer compositional similarity among paired marsh, near-pond, and alligator pond habitats from throw trap, minnow trap, and drift fence sampling performed at five sites in Shark River Slough in the 2018 wet (green) and 2019 dry seasons (brown). Ellipses represent 1 standard deviation and are outlined and shaded to represent habitats: pond (blue), near-pond (green), and marsh (brown). Freshwater taxa are abbreviated as the first three letters of genus and species.

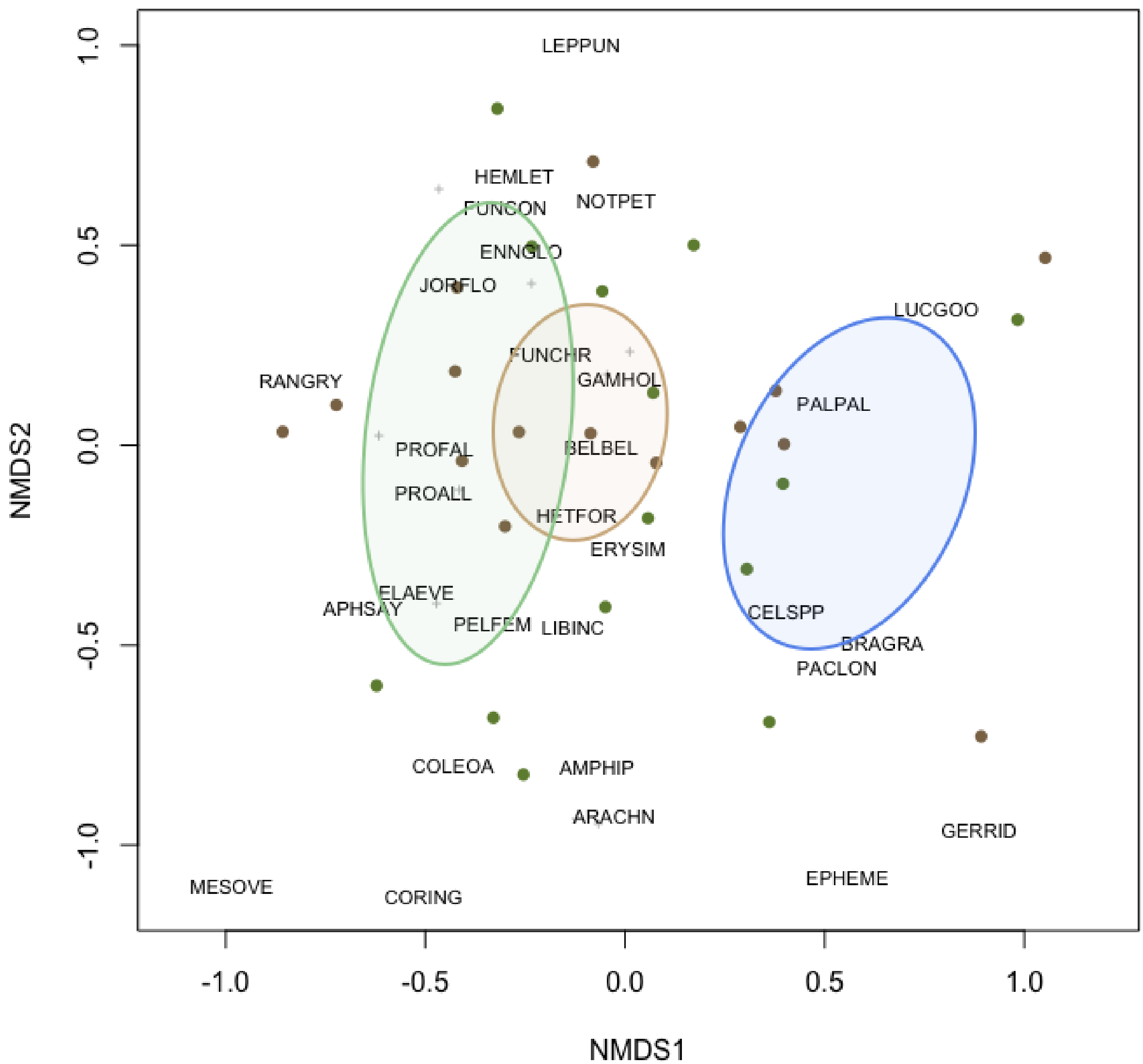


Table 1. Food-web network metrics for each habitat-season level (Prop. Omni. – proportion of omnivores, Prop. Cann. – proportion of cannibalism, Num. trophic positions – number of trophic positions, Prop. Basal – proportion of basal taxa, Prop. Intermediate – proportion of intermediate consumers, Prop. Top – proportion of top consumers, Prop. Herb. – proportion of herbivores, Prey:Predator – prey to predator ratio).

Network Metrics	Pond		Spikerush		Sawgrass	
	Wet	Dry	Wet	Dry	Wet	Dry
Species richness	40	37	34	35	33	32
Total # Links	298	225	209	197	188	169
Connectance	0.19	0.16	0.18	0.16	0.17	0.17
Link density	7.45	6.08	6.15	5.63	5.70	5.28
Prop. Omni	0.60	0.54	0.47	0.46	0.52	0.47
Prop. Cann.	0.40	0.38	0.29	0.26	0.24	0.28
Num. trophic positions	9	8	9	9	9	9
Prop. Basal	0.13	0.14	0.15	0.20	0.15	0.19
Prop. Intermediate	0.68	0.76	0.82	0.77	0.82	0.78
Prop. Top	0.20	0.11	0.03	0.03	0.03	0.03
Prop. Herb.	0.28	0.30	0.32	0.31	0.33	0.34
Prey:Predator	0.91	1.03	1.14	1.21	1.14	1.19

Figure 42. A) Average snook CPUE in electrofishing samples (log-transformed), B) proportion of snook detected in acoustic telemetry, and C) average snook movement rate (km/day plotted as a function of river stage (m NADV88) (b) at the SRS headwaters. Shaded areas represent 95% confidence intervals. Data points in A) are 35 seasonal estimates of CPUEs across 12 years of electrofishing. Data points in B) are 11-day bins of standardized daily proportion of fish detected at the headwaters across the 4 years of tracking data. Datapoints in C) 11-day bins of daily movement rates (averaged across individuals) for the 4 years of tracking data (From Rehage et al. 2021).

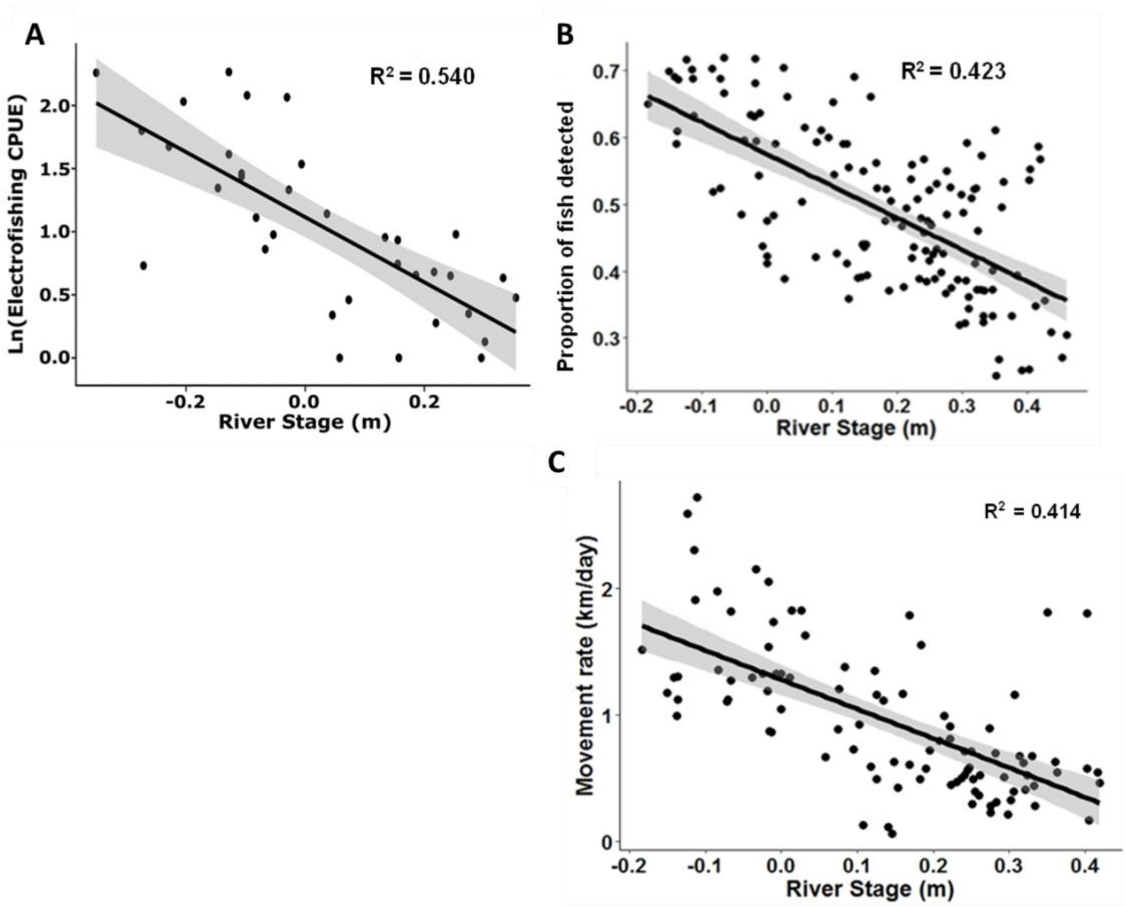
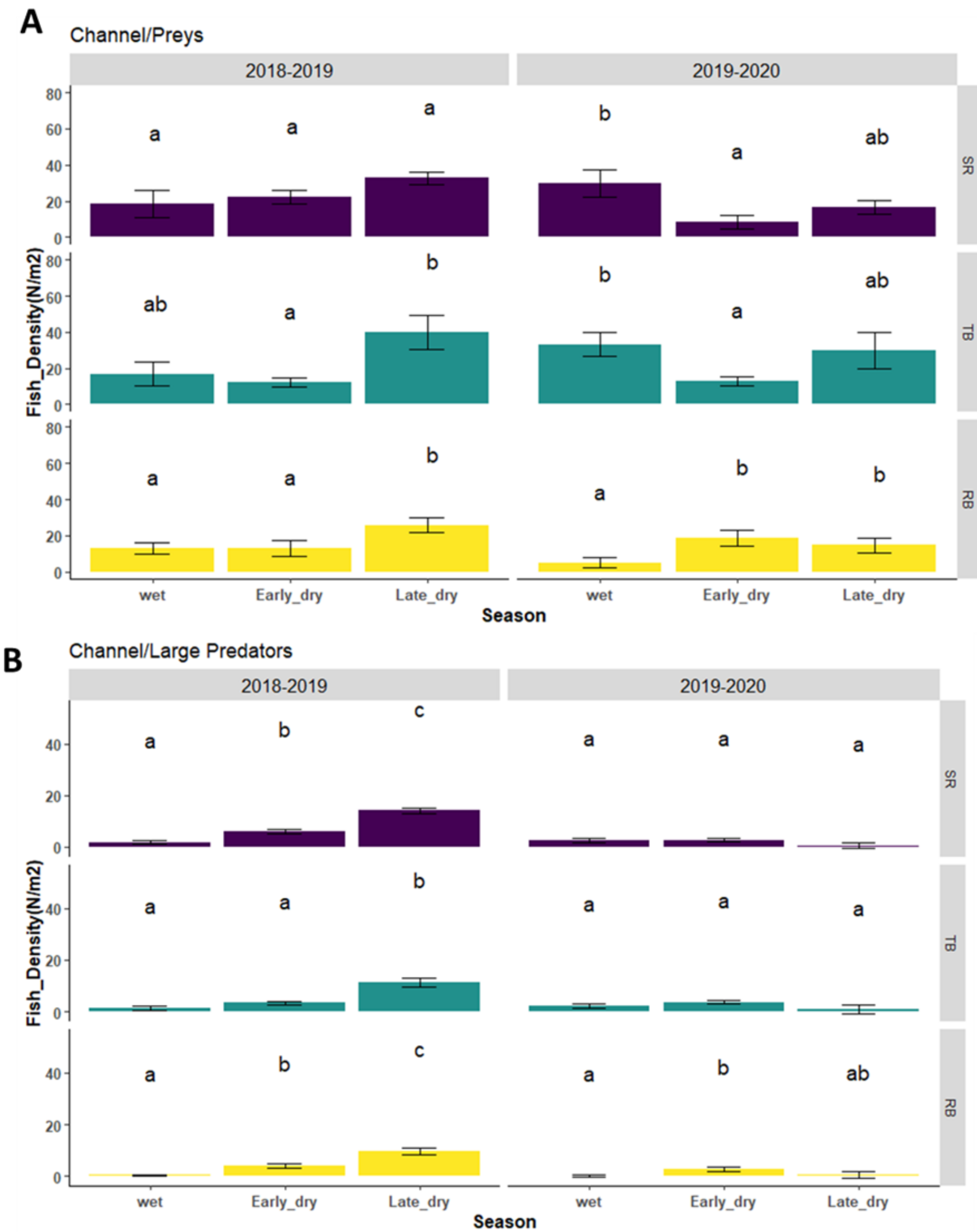


Figure 43. A) Least-squared means (and SE) of prey (< 20 cm) density (Count/m2), and B) of large predators (> 40 cm), by Region (SR=Shark River; Tb=Tarpon Bay; RB= Rookery Branch-downstream to headwaters SRS transect), Season and Year in the channel habitat. Letter symbols shows different means at alpha=0.05.



Carbon Fluxes: Water inundation decreased plant photosynthetic capacity (Fig. 44). Higher inundation, due to the water management and climate change, may weaken the dominance of muhly grass in freshwater wetlands. Short- and long-hydroperiod marshes are methane sources (Fig. 45). Carbonate mineral production can drive net CO_2 emissions from seagrasses, challenging the concept of net "Blue Carbon" sequestration in these carbonate systems (Fig. 46).

Figure 44. Marginal mean values (±1 SE) of photosynthetic capacity (*A*max, A, B) and dark respiration (*R*d, C, D) measured on leaves of sawgrass (*Cladium jamaicense*, A, C) and muhly grass (*Muhlenbergia filipes*, B, D) over time of inundation in different water level treatments. Different lowercase letters indicate significant differences among water level treatments for each measurement time ($P < 0.05$) based on post-hoc Tukey HSD tests on the corresponding mixed effects model. Days without significant differences are not marked.

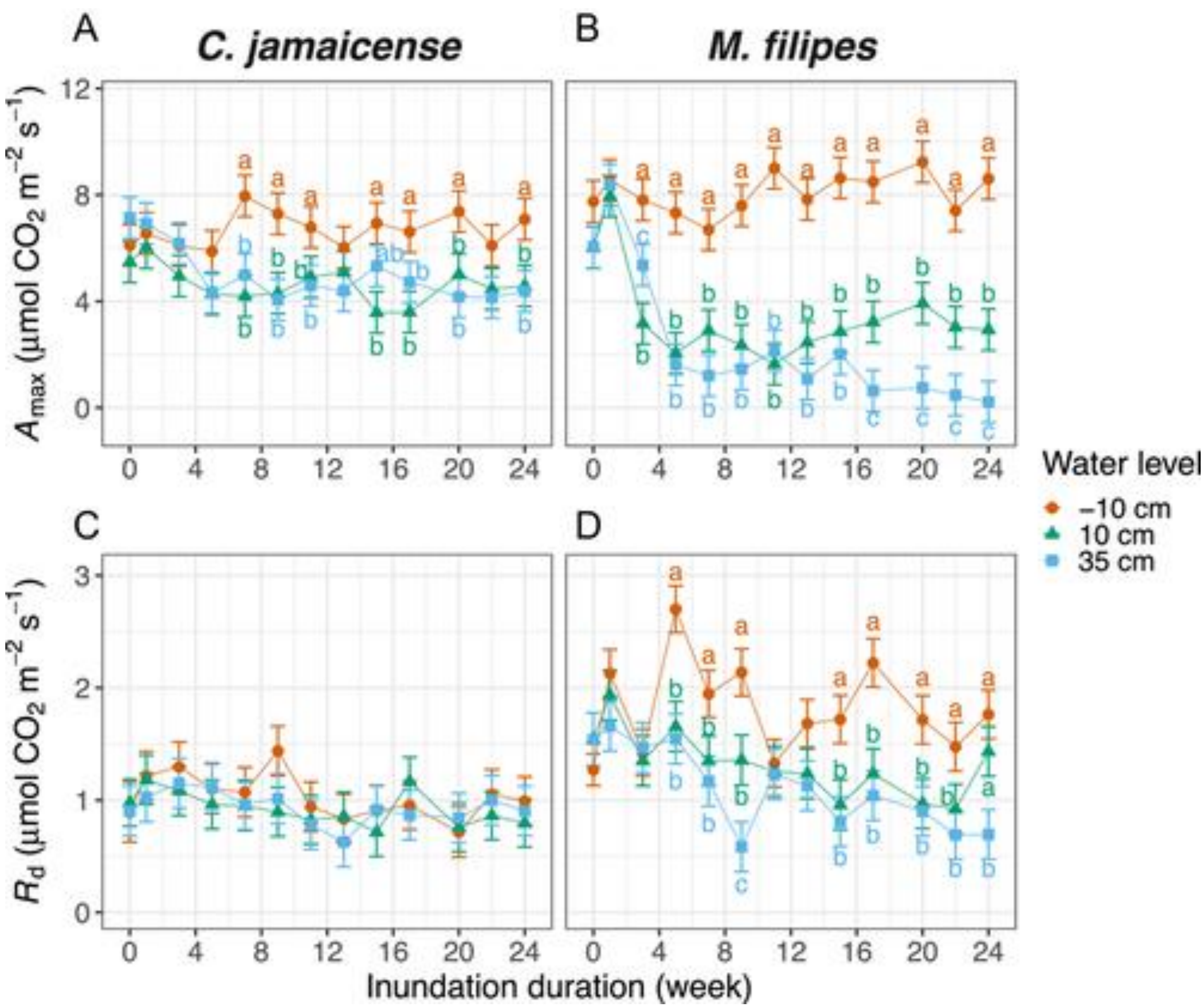


Figure 45. CH_4 budget for Everglades freshwater wetlands sites at (a) TS/Ph-1 and (b) SRS-2 in g CH_4 m^{-2} yr^{-1} by filtering treatment. The circle denotes the annual budget and the error bars show the prediction interval for the annual budget (± 1 standard error; grey section: error from unrestricted predictors model; dark blue section: error from restricted predictors model).

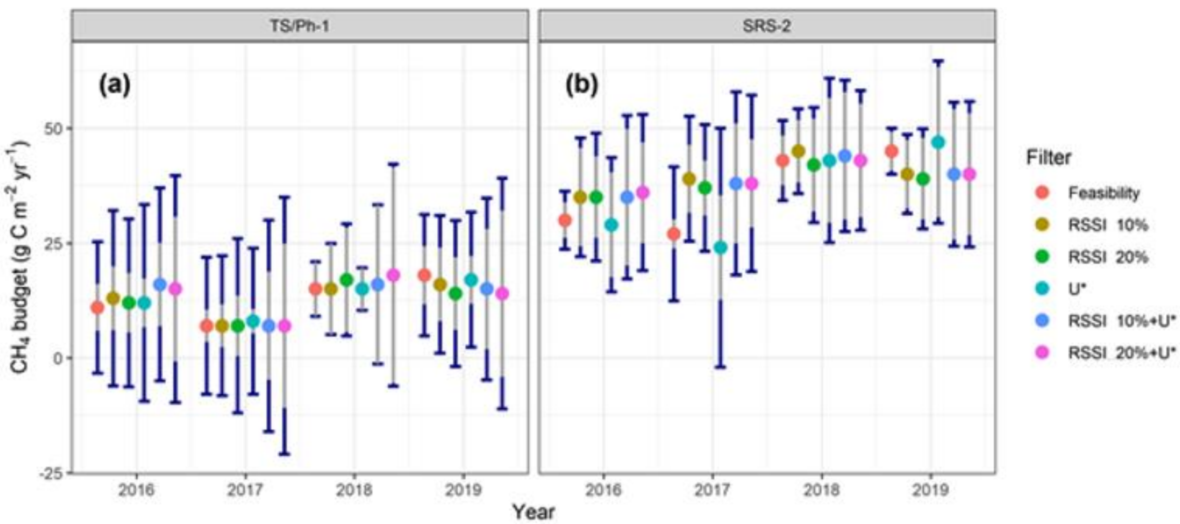
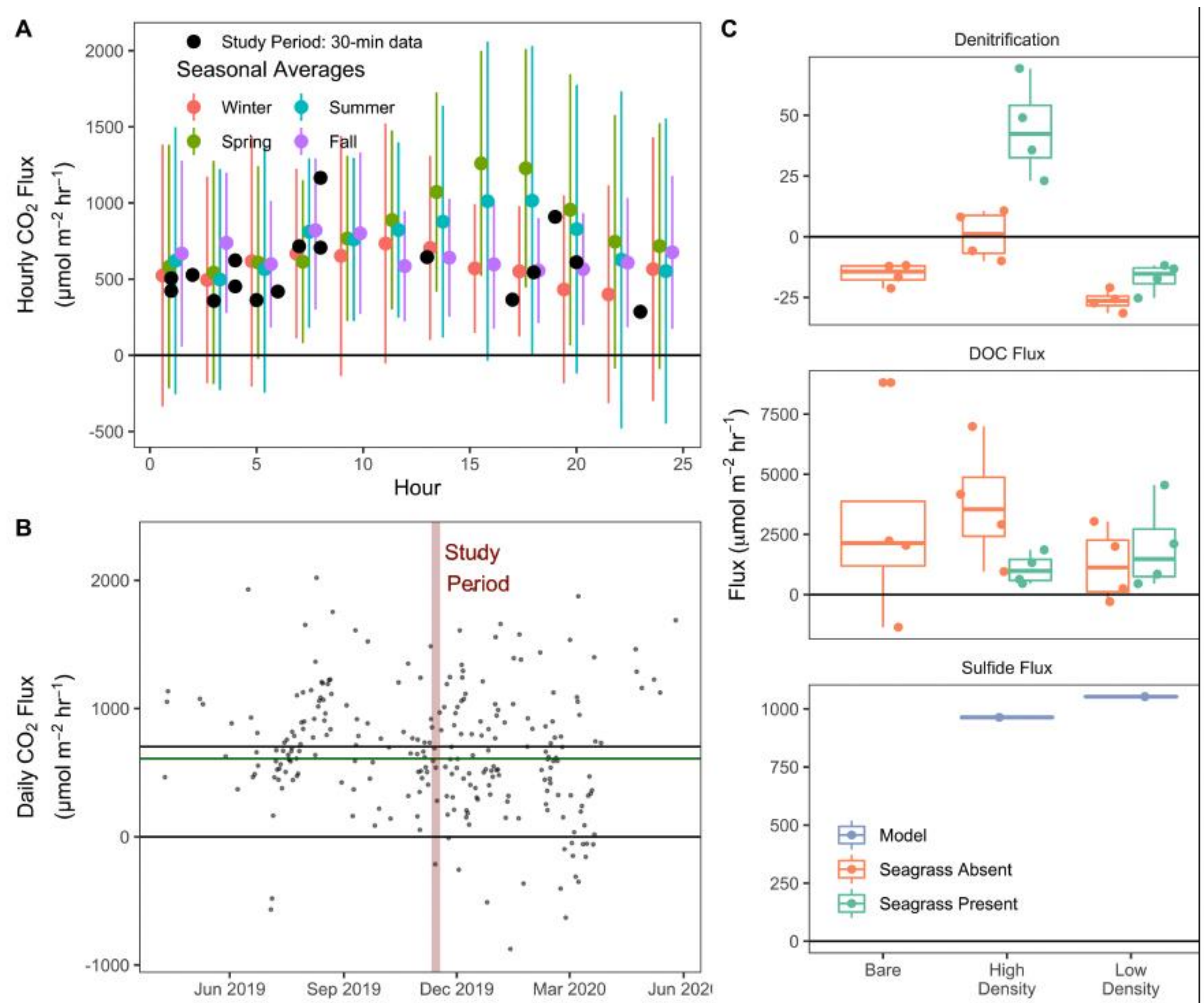
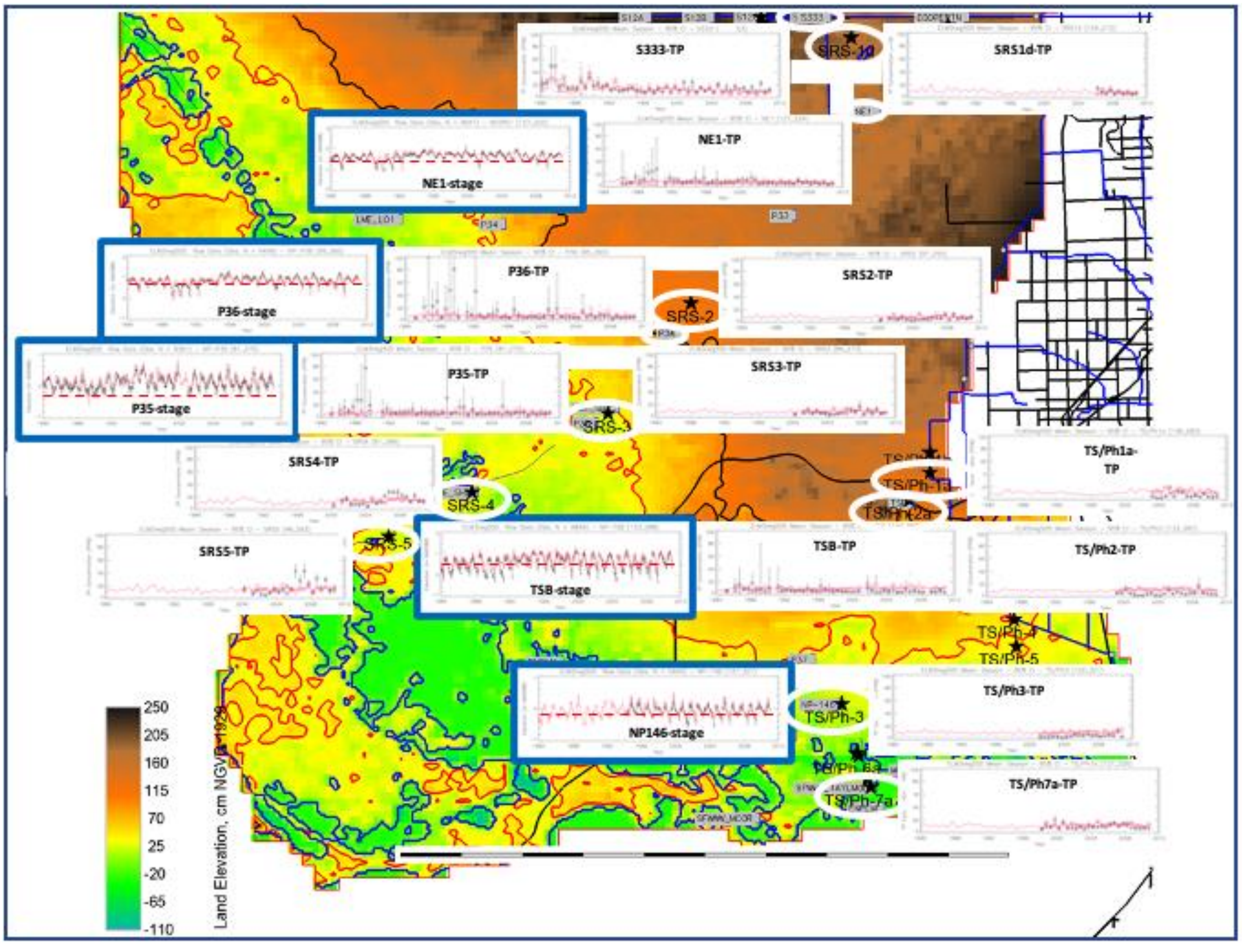


Figure 46. Summary of measured air-water and sediment-water fluxes. Diel trend in CO_2 flux presented as discrete 30-minute measurements during the study period (black circles) and annual mean fluxes for the year surrounding the study period, binned in 2-hour intervals (colored circles [$\bar{x} \pm SD$]) (Figure 1A). Daily mean CO_2 fluxes for the year surrounding the study period (Figure 1B), where the timeframe of the one-week study period is highlighted in red, and mean CO_2 fluxes from the study period and annually are shown as the green and black horizontal lines, respectively. Average net N2 flux (denitrification), dissolved organic carbon (DOC) fluxes, and sulfide fluxes, separated by site (Bare, High Density, Low Density) along the x-axis (Figure 1C). Note that all sulfide measurements from the continuous flow experiment were below the limit of quantification, so only fluxes calculated in PROFILE are presented here. By convention, release from sediments or water are reported as positive fluxes. All error bars represent $\bar{x} \pm SD$.



Ecosystem Trajectories: Modeled estimates of long-term TP and water levels across the FCE are used to simulated surface elevation, which will be used to build landscape-scale scenarios of elevation with SLR (Fig. 47).

Figure 47. Plots of a suite of sites of 27-year simulated vs observed data along the SRS and TS/Ph transect gradients, superimposed over the background map of land surface elevation. Plots show observed (black dots/lines/symbols) and simulated (red dots/lines/symbols) data, during the historical time domain of 1/1/1984 - 12/31/2010, for representative sites in the transects.



Key outcomes or other achievements

Hydrologic Connectivity

- Increased freshwater flows and water levels from Everglades restoration plans can help offset saltwater influxes from sea level rise. TS/Ph is more vulnerable to sea level rise and salt water intrusion due to lower elevation and lower hydraulic gradient compared to SRS. Increasing surface water flows into the lower portion of TS should be considered to offset sea level rise.
- Sawgrass peat has a higher vertical hydraulic conductivity compared to mangrove peats, suggesting increased hydrologic connectivity between surface water and groundwater in sawgrass areas.
- There was no measurable change in the vertical hydraulic conductivity of either sawgrass or mangrove peat cores when exposed to higher salinity (30 ppt) water for one week.
- We found that InSAR accuracy level for the Everglades was higher for the flow-controlled areas (1.7–3.3 cm) compared with the natural-flow areas (3.4–4.4 cm). By implementing tropospheric corrections to InSAR datasets, we were able to increase the accuracy level by 13%.
- TanDEM-X bistatic observations seem promising in estimating absolute water levels across the Everglades, except in areas of dense vegetation and tree islands.

Detritus & Microbes

- Freshwater restoration pulses and tropical storm disturbances are altering the spatiotemporal patterns of dissolved organic carbon (DOC) concentrations, dissolved organic matter (DOM) composition, and processing in coastal wetlands.
- Marl marsh and mangrove wetlands have higher bacterial and algal-based and lower terrestrial/humic contributions to DOM than peat-based wetlands.
- Bacterioplankton productivity is steadily increasing in peat- and marl-dominated wetland drainages with increases in fresh and marine water levels and hydrologic connectivity but appear unrelated to DOC concentrations; whereas episodic increases in bacterioplankton productivity in seagrasses are linked to seagrass die-offs and pulsed increases in DOC concentrations.
- POC litter recalcitrance and P concentrations drive breakdown rates despite differences in environmental conditions among marshes, mangroves, and seagrasses.
- Water column microbial assemblages are similar among freshwater marshes but different among brackish marshes, and hydrologic pulses from tropical storms alter mangrove microbial communities but not marsh microbial communities.
- Soil prokaryotic and fungal microbial communities reflect methanogenic to sulfidogenic carbon processing pathway transition in the freshwater – marine gradient in the study area. Increased temporal variation of soil microbial communities track extended dry periods associated with rise of aerobic bacterial taxa. Influence of aerobic microorganisms and carbon processing is limited to surface layer due to temporal variations in inundation and oxygen supply.

Vegetation

- Periphyton TOC accumulation rates are lowest in the marl prairie (TS/Ph-2) and highest in central Florida Bay (TS/Ph-10).
- Surface TP concentrations have increased during the last 3 years at all TS/Ph marsh sites and values have exceeded means values at TS/Ph-6 for the first time.
- Reduced long-term mangrove litterfall rates occurred across Shark River sites due to canopy defoliation after Irma's impact, with annual rates 2-4 times lower during 2018 and 1-2 times lower during 2019 when compared to the long-term 2010-2016 rate. During 2020, litterfall rates at all sites are similar when compared to the 2010-2016 rate, except at SRS-6 where rates are still lower. These results suggest the high resilience capacity of mangroves to hurricane disturbances.
- Long-term leaf NPP rates of scrub mangroves revealed that NPP is higher at TS/Ph-7 than TS/Ph-6. The highest rates were measured during 2020 for both sites. It's likely that the highest surface TP concentrations.
- RHYMAN model results showed that freshwater inflow and SLR are key drivers controlling mangrove wetlands PWS in this karstic coastal region. A commensurate increase in PWS over a thirteen-year period (2004-2016) indicates a long-term reduction in freshwater inflow coupled with sea-level rise (SLR).
- RHYMAN model scenarios indicate that increasing freshwater inputs will significantly reduce PWS by 17-27% when compared to the baseline scenario. Moreover, the high SLR scenario will increase PWS up to 1.1 to 2.5 times of control values.
- The lateral litter-POC flux estimate in Shark River mangroves induced by cyclones kinetic energy (IKE) constrained the C budget assessment for riverine mangroves in this region.
- The NUMAN model with the inclusion of necromass allowed us to better evaluate and predict realistic accretion rates and carbon sequestration rates across diverse mangrove typologies in South Florida.
- We documented the largest mangrove dieback on record (10,760 ha) in southwest Florida after Hurricane Irma. 62% of mangroves suffered canopy damage with the largest impacts in tall forest (>10 m). Mangroves on well-drained areas (83%) resprouted within a year and showed high to intermediate resilience; whereas poorly-drained sites in low-lying areas experience the largest dieback and low resilience post-disturbance.

Consumers

- Using a combination of stable isotopes and consumer tracking, we are able to: 1) examine producer contributions to secondary production across the landscape, 2) quantify spatiotemporal variation in food web structure and consumer-mediated trophic coupling, and 3) account for the magnitude of consumer-mediated nutrient transport across habitat boundaries.

- Everglades food webs are primarily green, with contributions of green energy channels ranging from 59% to 97% to consumer diets (Figure 38). Food webs in mangroves were greenest (>90%), seagrass food webs had the second highest and consistent green contribution (>75%), whereas marsh food webs had the most variable food webs (59% green in dry vs. 86% green in wet season). While food webs were primarily green, the contribution of brown, detrital pathways became more important in the dry season across all habitats. Brown pathways were secondary yet more important in marsh and seagrass habitats, and least important in mangrove food webs.
- Alligators are important ecosystem engineers in Everglades freshwater marshes. Food-web models of the freshwater Everglades should include not only top-down effects from alligators, but should also incorporate potential mechanisms for bottom-up effects generated by engineering activities.
- Diverse, flexible trophic responses to seasonality across habitats may be pivotal to nutrient and energy cycling and maintaining ecosystem stability and resiliency, especially in regularly perturbed environments. Seasonal fluctuation typical of wetlands may require inter-habitat relocation, leading to the types of food-web changes we document.
- The DIDSON sonar technology can provide reasonably good estimates of fish abundance with error rates ranging from 5% to 18%. Reliable estimates of fish abundance are possible when the right detection threshold is used and the movement of the fish that enter the complex structure of the mangrove roots is tracked and predicted.

Carbon Fluxes

- The American Journal of Botany put our site on the cover.
- Data from TS-1 and SRS-2 sites have been downloaded ~400 times this year from Ameriflux.
- All sites are up and running.
- A new tower site has been approved.

Ecosystem Trajectories

- The SRS and TS/Ph flow and nutrient gradients were effectively captured by the ELM simulation, as seen in Figure 47 showing the combination of a decade of FCE water quality data, plus other agency multi-decadal monitoring data. The model (and observed) data reflect the dynamic drydowns that are more prevalent in TS/Ph than in SRS, along with the variable and higher TP concentrations in some sites in the 1980s-1990s. The extended (-2010) historical time period is allowing us to directly use a range of FCE-specific research experiments, and provides FCE researchers with additional understanding of this model's truly integrated hydro-ecological capabilities.

Opportunities for training and professional development

K-12 Schoolyard Activities: In FCE IV, our Education and Outreach program has been developing programming that addresses the NSF's Strategic Plan Goal to "*advance the capability of the Nation to meet current and future challenges with K-12 programs that will support the development of the next generation of researchers*" with the goals of: (1) providing mentoring to K-12 students and teachers through our new *LTeaER* litter breakdown study and participatory science program, (2) facilitating presentation of their findings at science fairs, professional meetings, and annual FCE All Scientists Meetings, and (3) pursuing supplemental sources of funding to support high school and teacher participants.

Under the direction of Education & Outreach Coordinator N. Oehm, we are collaborating with the FIUteach program to address each of these goals by designing and delivering professional development opportunities for teachers through our Research Experience Programs. Over the last year, we have resumed the majority of FCE Education and Outreach initiatives. This summer, our RETs returned to campus with 2-3 group meetings/week from July until their mid-August return to school. Since then, we have continued with biweekly zoom meeting and conducting all lab/field work after school and on the weekends.

RET Cristina Whelan requested an extension for her sampling permit and was able to resume her *LTeaER* field work studying the effects of relative flow on litter breakdown in the Cutler Slough at the Deering Estate in September. She is now joined by her BioTECH Senior High School and 2020 RET Beatriz Guimarães who is studying at the effects of salinity on litter breakdown in the Cutler Slough.

Since last reporting, we have secured new supplemental funding to support an additional two Research Experience for Teachers (RET) fellows for two years. Using this funding, FCE welcomed Amanda Hernandez and Lacey Simpson to the *LTeaER RET* team. Both Hernandez and Simpson are working on *LTeaER* litter breakdown projects based at FCE research sites and all four RETs are including students in their research and are scheduled to collect their first round of samples by mid-December. Working in collaboration with the *FIUteach* program, we have conducted initial interviews of all four RETs. These interviews will be used to improve the future design of our RET program and in comparison with exit interview responses alongside pre/post responses to the *Teaching Science as Inquiry (TSI)* survey for measuring teacher self-efficacy in teaching of science as inquiry.

Training of Undergraduates and Early Career Scientists: FCE scientists train and mentor all levels of early career scientists by recruiting diverse undergraduates to assist in FCE research and engaging them in our research. This year, FCE scientists mentored 10 undergraduates from diverse communities with funding for five students through FIU's Coastal Ecosystems Site REU, three through the Everglades Foundation John Marshall fellowship, and two using FCE base funding to provide stipend support. All of our undergraduate mentees were included as members of CE-REU Site where they participated in cohort-building, networking opportunities, social events, and weekly field trips. Each participant presented their results at the CE-REU Site Symposium and will be invited to present at the annual FCE All Scientist Meeting and are being encouraged to present at a national and/or international conference.

Graduate Students: FCE scientists are dedicated to mentoring our large graduate student organization by engaging them in all aspects of the FCE program. Our graduate students: are included and participate as members of our working groups; present their work at our annual meetings; assist with the mentoring of new graduate students, teachers, undergraduates, and high school students; and mentored in communicating their research results to both the general public and scientific audiences. This year, 23 of our graduate students have been recognized for their outstanding work with 27 awards totaling over $150,000.

Our post-doctoral and junior faculty members are included in site leadership roles through the Internal Executive Committee and are involved in the co-production of research with senior faculty mentors.

Communicating results to communities of interest

The FCE Communications Team, consisting of the PI, Program Manager, Education & Outreach Coordinator, and collaborator S. Davis (Director of Communications for Everglades Foundation) coordinate communications through regular updates through our *News from the Sloughs* monthly newsletter, press releases and social media, our *Wading Through Research* student blog, public events and exhibits, and an annual partnership impact report. This year, 50 FCE researchers have been covered 181 times in 82 pieces of media across 48 media outlets.

Plans to accomplish goals during the next reporting period

We plan to complete the objectives of our year 4 research and finalize existing research conducted during the no-cost extension. We will prepare for, conduct, and integrate feedback from our program's Mid-Term Review. We will integrate long-term data among our four research focal areas following our conceptual framework and theoretical expectations that address how an accelerating rate of sea-level rise interacts with climate variability and freshwater management to shape gradients of coastal ecosystem production, the movement of energy through food webs, and the value of ecosystem services to growing human populations. We will use synthesized long-term data to address our overarching question: Will increased pulses of fresh and marine water and their associated resources maintain vegetated coastal ecosystems supporting highly connected food webs and valued ecosystem services as sea-level rise accelerates?

Impacts

Impact on the development of the principal disciplines

FCE science advances basic, theoretical, and applied approaches to forecasting and understanding change in coastal ecosystems. We use general ecological theory to test broadly applicable questions that challenge ecology as a discipline.

Impact on the development of human resources

Broadening Participation
FCE is addressing the Big Idea of NSF INCLUDES and contributing to broadening participation of underrepresented communities in STEM fields with guidance from the NSF Strategic Plan (FY 2018-2022). We provide access to underrepresented students to conduct research with our scientists by recruiting from diverse populations at FIU, the nation's fourth largest university (n = 58,063) and largest Hispanic Serving Institution (n = 37,272; 64%). The leadership team of FCE is also diverse, with 7 women, 3 Hispanics, 1 Asian, 1 Non-Hispanic Black, and 3 LGBT members representing a membership where 42% and 42% of senior personnel, collaborators and postdocs and 38% and 41% of graduate students identify as female and underrepresented ethnic groups, respectively. The FCE program honors the identity of all participants and maintains an atmosphere that represents and embraces diverse cultures, backgrounds and life experiences that reflect the multicultural nature of South Florida and the global society. We are working with FIU's *STEM Transformation Institute* and the *Office to Advance Women, Equity & Diversity* to identify and implement best practices for retaining diversity across our membership through Diversity Advocacy training in mentoring, hiring, leadership, and advising.

Impact on teaching and educational experiences

Participatory Science

The FCE Schoolyard LTeaER decomposition project is our participatory citizen science projects modeled after the Tea Bag Index (TBI) study (Keuskamp et al. 2013). Aligned with the research objectives of our *Detritus & Microbes* working group, the *LTeaER* project is used to engage our community in a long-term decomposition study to test hypotheses about the drivers of organic matter transformation and contribute to the global TBI research project. With samples deployed at each of our research sites in SRS and TS/Ph, these data are being used by our REUs, RETs and our FCE scientists. We facilitate the presentation of findings by K-12 students and teachers at science fairs, professional meetings, and annual FCE All Scientists Meetings.

Impact on physical resources that form infrastructure

Supplemental funds associated with this award supported replacement of critical aging infrastructure that support the continuation of key FCE long-term datasets.

Impact on information resources that form infrastructure

Information Management

FCE IM Team: Information Manager Kristin Vanderbilt and Program Manager Mike Rugge comprise the FCE IM Team. Mike has been with the FCE LTER since its inception. Kristin has worked for the FCE LTER since 2016.

FCE Databases: The FCE Information Management System (FCE IMS) contains 181 datasets which are available on the FCE LTER's website (https://fcelter.fiu.edu/data/) and in the EDI Data Repository. Four datasets were added and 22 long-term datasets were updated between 03/01/2021 and 08/31/2021. All datasets are publicly accessible except when an embargo has been granted while a graduate student publishes on a dataset or where a dataset was not collected using FCE LTER funds. A table of titles and DOIs for FCE LTER datasets deposited in the EDI Data Repository is included as a supporting file in the Products section of this report.

Data Processing: FCE LTER uses the XLSX2EML Perl program, written and maintained by the Program Manager, to translate metadata from an Excel template to EML. To support generating EML 2.2, the Program Manager updated the Excel template and accompanying Perl program this year to include annotation and funding elements. The IM is updating existing templates with appropriate metadata as new data are submitted to extend long-term datasets. This XLS2EML program works extremely well for datasets that have only a single data entity. For data packages with multiple entities, or new time-series data, the IM generates EML using EDI's EMLAssemblyline R package. For one-off data contributions, the IM has begun recommending that researchers submit data and metadata to her using EDI's ezEML web-based metadata editor.

Data Use: Use of FCE LTER data is steady. A manual search of Google Scholar for DOI's from the EDI Data Repository detected 2 papers published since 3/1/2021 that contain 2 citations of FCE LTER datasets. Downloads of FCE datasets suggest that the data are being used more frequently than they are cited. The EDI Repository recorded 23,996 non-robot downloads of FCE datasets between 3/1/2021 and 8/31/2021. Seven datasets had about 3000 downloads apiece, most of which are checksum requests from DataONE. A better estimate of downloads from PASTA is thus about 4,575 when unidentifiable user agents and repetitious DataONE requests are filtered out. This indicates considerable interest in FCE data.

Supporting local and LTER Network science: The FCE information management team supports site and network level science by making high quality FCE data and metadata accessible through the FCE LTER website, the EDI Data Repository, and Network-level cross-site databases. Updates to long-term FCE datasets are regularly published on the FCE website and in EDI in compliance with the FCE Data Management Policy and LTER Data Release Policy. FCE is contributing meteorological data in the CUAHSI format to support the development of a new version of ClimDB, the cross-site climate database. The Program Manager makes periodic updates to both the all-site bibliography and personnel databases.

The FCE information management team lends its expertise to FCE researchers and graduate students by offering assistance with metadata development, data submissions, individual project database design, writing data management plans, GIS and research graphics.

IT Infrastructure: This year there were significant changes in the information management infrastructure used by FCE LTER. Until May 2021, FCE LTER had free access to Oracle RDBMS through FIU. Oracle's arrangement with FIU changed after that point and it would have cost FCE LTER thousands of dollars per year to continue to use Oracle. The IM Team evaluated open source databases for a suitable replacement. PostgreSQL was selected because it supports materialized views which are needed for the FCE website. FCE also migrated from Windows servers to Linux servers while transitioning from Oracle to PostgreSQL. The FCE information management system's staging and production web servers and PostgreSQL databases, as well as the FCE SFTP server, are currently running on Ubuntu virtual servers housed on FIU's Division of Information Technology's equipment. FCE also has a web server and database on virtual servers housed at the offsite Northwest Florida Regional Data Center (NWRDC) located on the campus of Florida State University in Tallahassee, Florida. If the servers on the FIU campus go down, then the website can be brought up using the servers at the NWRDC.

Other contributions: The FCE IM is a co-PI on the EDI award and works quarter-time for EDI doing education and outreach. She serves as the liaison between the LTER Information Management Committee and EDI. With support from EDI, the FCE IM organized a 1-credit distributed graduate seminar entitled "Research Data Management for Ecologists" that was offered at FIU, University of New Mexico, and University of Wisconsin-Madison in the Spring 2021 semester. Vanderbilt co-led the FIU class in collaboration with Andrea Nocentini, Data Scientist at Everglades National Park and FCE collaborator. The class met once a week, with the first hour dedicated to a speaker and the second hour for an exercise. Experts in areas such as data management plan preparation (Bill Michener, UNM), FAIR data (Shelley Stall, AGU), and Aaron Ellison (data provenance, Harvard) were invited to give presentations during the course, while other topics (e.g., metadata, repositories, team science) were covered by instructors. Seven FIU students, six UNM students, and 19 students from UW-Madison registered for the course. Students learned to write a data management plan, write comprehensive metadata, and clean and archive data in EDI's repository.

The FCE IM is currently the Associate Editor for Data Science for the journal *Ecological Informatics*. She was also the lead Special Editor on a Special Issue in *Ecological Informatics* (Vanderbilt and Gries 2021) entitled: "Integrating long-tail data: How far are we?"

The FCE IM serves as the North American representative on the International LTER's information management committee.

Impact on society beyond science and technology

Benefits to Society

FCE builds partnerships with Federal, State and local agencies and non- government organizations with the efforts of the FIU office in Washington, D.C. to ensure science-based restoration guidance (e.g., Borkhataria et al. 2017; Sklar et al. 2019). We will continue reporting long- term findings to these agencies, including directly to the U.S. Congress through our System-Wide Indicators for Everglades Restoration (Brandt et al. 2018, a process being studied by our *Freshwater Governance* working group (H2c) and indirectly via advising The National Academies Committee on Independent Review of Everglades Restoration Progress (CISRERP 2018). In coordination with our FIU D.C. office, we will visit congressional offices to discuss the progress of Everglades restoration. We are continuing to share our results with high profile and key political figures through PI Gaiser's role on the State of Florida Governor's Blue Green Algae Task Force and Collaborator Mark Rains who was recently named as the State of Florida's Chief Science Officer. In their roles, both Gaiser and Rains will help to ensure that FCE research informs the management of the Florida Coastal Everglades. Globally, we will continue to use science to inform policy, including through our leadership in the International Blue Carbon Science and Policy working group establishing policy guidelines for protecting valuable carbon stored in vegetated coastal ecosystems. By co-developing research with scientists from non-government organizations and government agencies at local to global scales, the FCE epitomizes the process of convergence science in the field of ecology (AC-ERE 2018).

Products

Publications

Book Chapters

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Zhao, J., S.L. Malone, C.L. Staudhammer, G. Starr, H. Hartmann, and S. Oberbauer. 2021. Freshwater wetland plants respond nonlinearly to inundation over a sustained period. American Journal of Botany 108: 1917-1931. DOI: 10.1002/ajb2.1746

Zhao, X., V.H. Rivera-Monroy, L. Farfan, H.O. Briceno, E. Castañeda-Moya, R. Travieso, and E.E. Gaiser. 2021. Tropical cyclones cumulatively control regional carbon fluxes in Everglades mangrove wetlands (Florida, USA). Scientific Reports 11: 13927. DOI: 10.1038/s41598-021-92899-1

In Press

Gaiser, E., J.S. Kominoski, D.M. McKnight, C.A. Bahlai, C. Cheng, S. Record, W. Wollheim, K.R. Christianson, M.R. Downs, T.K. Harms, P.A. Hawman, S.J. Holbrook, A. Kumar, D.R. Mishra, N.P. Molotch, R.B. Primack, A. Rassweiler, R.J. Schmitt, L. Sutter. In revision. Long-term ecological research and the COVID-19 anthropause: A window to understanding social- ecological disturbance. Ecosphere.

Kominoski, J.S., J. Pachón, J. Brock, C. McVoy, S.L. Malone. In press. Understanding drivers of aquatic ecosystem metabolism in freshwater subtropical ridge and slough wetlands. Ecosphere.

Hogan, J.A., E. Castaneda-Moya, L. Lamb-Wotton, T. Troxler, and C. Baraloto. In press. Water levels primarily drive variation in photosynthesis and nutrient use of scrub Red Mangroves in the southeastern Florida Everglades. Tree Physiology.

Patrick, C.J., J.S. Kominoski, W.H. McDowell, B. Branoff, D. Lagomasino, M. Leon, E. Hensel, M. J. S. Hensel, B.A. Strickland, T.M. Aide, A.R. Armitage, M. Campos-Cerqueira, V.M. Congdon, T.A. Crowl, D.J. Devlin, S. Douglas, B.E. Erisman, R.A. Feagin, S.J. Geist, N.S. Hall, A.K. Hardison, M.R. Heithaus, J.A. Hogan*, J.D. Hogan, S. Kinard, J.J. Kiszka, T-C Lin, K. Lu, C.J. Madden, P.A. Montagna, C.S. O'Connell, C.E. Proffitt, B.K. Reese, J.W. Reustle, K.L. Robinson, S.A. Rush, R.O. Santos, A. Schnetzer, D.L. Smee, R.S. Smith, G. Starr, B.A. Stauffer, L.M. Walker, C.A. Weaver, M.S. Wetz, E.R. Whitman, S.S. Wilson, J. Xue, X. Zou. In press. A universal pattern of trade-offs between ecosystem resistance and resilience to tropical cyclones. Science Advances.

Rehage, J.S., R.E. Boucek, R.O. Santos, J.A. Massie, N.M. Viadero, R.J. Rezek. In press. Untangling flow-ecology relationships: effects of seasonal stage variation on common snook aggregation and movement rates in the Everglades. Estuaries and Coasts.

Zhang, B., S. Wdowinski, D., Gann, and S-H Hong. In revision. Spatiotemporal variations of wetland scattering: The role of water depth and vegetation

characteristics in Sentinel-1 SAR dual-polarization amplitude observations. Remote Sensing of Environment.

Conference Papers and Presentations

Abiy, A. 2021. Century-Long Hydroclimate Variability and Teleconnection: Implications for Long Term Freshwater Availability in the Everglades, Southeast Florida. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Ali, N. 2021. Fire Management in the Everglades National Park from 1948-2017. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Anderson, K.J., J. Kominoski, S. Hoffman, A. Nocentini, and M. Zeller. 2021. How does phosphorus limitation differentially affect dissolved organic carbon composition in peat and marl freshwater marshes? Association of the Sciences of Limnology and Oceanography Virtual Meeting, Virtual, June 22, 2021 - June 27, 2021.

Biswas, H., K. Zhang, M.S. Ross, and D. Gann. 2021. Watershed Segmentation of Aerial Photographs for Delineation of Tree Patches in a Mangrove-Marsh Transition Zone. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Breithaupt, J.L. 2021. Organic Carbon Burial Rates increase Following Mangrove Encroachment of Sawgrass Marsh. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Castañeda-Moya, E., V.H. Rivera-Monroy, R.M. Chambers, X. Zhao, L. Lamb-Wotton, A. Gorsky, E.E. Gaiser, T. Troxler, J. Kominoski, and M. Hiatt. 2021. Hurricane-induced P Deposition Effects on Plant-Soil Feedbacks in Karstic-Dominated Mangroves of the Florida Coastal Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Chavez, S. 2021. Observing Changes in the Mangrove Forests of the South Florida Everglades following Hurricane Irma using Remote Sensing Measurements. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Chavez, S., S. Wdowinski, D. Lagomasino, T.E. Fatoyinbo, B. Cook, E. Castañeda-Moya, R.P. Moyer, K. Radabaugh, T. Troxler, and E.E. Gaiser. 2021. Use of remote sensing to determine damage and recovery of mangrove forests in the Everglades following hurricane disturbances. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 13, 2021 - December 17, 2021.

Cordoba, N., and R.M. Price. 2021. Hydrologic Properties of Mangrove and Sawgrass Peat Under Varying Salinity Conditions in Shark River Slough, Everglades, Florida. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 15, 2021.

Eggenberger, C. 2021. Prey Fish Community Dynamics in Two Neighboring, Yet Distinct Coastal Everglades Subestuaries. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Essian, D. 2021. Predicting Effects of Water Management on Breeding Abundance of Three Wading Bird Species. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Fernandez, M., J.C. Trexler, and E. Tate-Boldt. 2021. Aquatic community structure and biomass response to experimental water flow in an oligotrophic wetland. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Fitz, H.C., R. Paudel, Y. Khare, and T. Van Lent. 2021. Landscape Soil Carbon Sequestration Under Scenarios of Climate Change and CERP. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 27, 2021.

Flood, P.J. 2021. Alligator-Engineered Impacts on Consumer Nutrient Dynamics and Isotopic Niche. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Flood, P.J., B.A. Strickland, J. Kline, M.R. Heithaus, and J.C. Trexler. 2021. Alligator-engineered impacts on consumer nutrient dynamics and isotopic niche. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Flower, H.. 2021. Re-Examining Resiliency in the Face of Climate Change. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 22, 2021.

Follstad Shah, J.J., M. Ardon, M. Gessner, A. Lecerf, and J. Kominoski. 2021. Invariant temperature sensitivity of leaf litter breakdown amongst taxonomic groups and streams with different trophic status. Society for Freshwater Science Virtual Meeting, Virtual, May 23, 2021 - May 27, 2021.

Gaiser, E.E. 2021. Pulsing dynamics and the development of coastal ecosystems facing sea-level rise. Society of Wetland Scientists Annual Meeting, Virtual, June 8, 2021.

Gaiser, E.E. 2021. Periphyton and vegetation monitoring for the adaptive management of the Upper Taylor Slough (UTS) hydrological changes. Annual meeting of the Upper Taylor Slough Adaptive Management Team, Virtual, May 21, 2021.

Gaiser, E.E. 2021. Plenary: Sea level rise and the future of the Florida Everglades. United States Committee of the International Council on Monuments and Sites. Virtual International Symposium on Preserving World Heritage in a Changing Climate, Virtual, October 28, 2021.

Gaiser, E.E., J.C. Trexler, J. Kline, F. Tobias, and R. Travieso. 2021. Long-term Periphyton Dynamics Reflect Legacy Nutrient Sources and Downstream Biological Spiraling Along the Eastern Boundary of Everglades National Park. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Garcia Barcia, L., M. Borbolla, K.R. Gastrich, V. Hagan, J. Morris, H. Moncrief-Cox, Y. Lorenzo, B.A. Strickland, P. Matich, D.D. Chapman, and M.R. Heithaus. 2021. Growth, habitat use and movement patterns as drivers of mercury and methylmercury tissue concentrations of Bull Sharks. American Elasmobranch Society Conference, Virtual, July 21, 2021.

Gervasi, C.L., J.S. Rehage, R.O. Santos, R. Rezek, W.R. James, R. Boucek, C. Bradshaw, C. Kavanagh, and J.K. Osborne. 2021. Bottom-up conservation: Using stakeholder knowledge to inform conservation priorities for an unregulated and recreationally valued fish species. Annual Meeting of the American Fisheries Society, Baltimore, Maryland, November 9, 2021.

Hong, S.-H., S. Wdowinski, and S.-W. Kim. 2021. Extraction of Absolute Water Level in the Florida Everglades Using TanDEM-X Bistatic Science Phase Observations with a Large Perpendicular Baseline. EGU General Assembly 2021, Virtual, April 19, 2021 - April 30, 2021.

Ishtiaq, K. 2021. Evaluating Peatland Vulnerability to Sea Level Rise and Saltwater Intrusion Using Coupled Simulations of Coastal Transport and Soil-Plant Mechanistic Models in the Florida Coastal Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

James, W.R. 2021. Mapping Energy Flow: E-scapes as a System-level Tool to Evaluate Restoration and Ecosystem Function. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Julian, P. 2021. I’m Calling To You Like A Long Lost Friend: Legacy Phosphorus In Lake Okeechobee. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 22, 2021.

Kleindl, P. 2021. Macrophyte and Microbial Mat Interactions Along Environmental Gradients in the Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Kominoski, J. 2021. Long-term ecological research of coastal biogeochemistry reveals disturbance legacies. International Symposium on Coastal Ecosystems and Global Change, Xiamen University, China, April 16, 2021 - April 19, 2021.

Kominoski, J. 2021. Bridging Towards Restoration: Quantifying How Increases in Freshwater Hydroperiod are Changing the Ecology of Northeast Shark River Slough, Everglades National Park. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Kominoski, J., C.A. Weaver, A.R. Armitage, and S.C. Pennings. 2021. Coastal carbon processing rates increase with mangrove cover following a hurricane in Texas, USA. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Kominoski, J., S.C. Neubauer, R. Bremen, A. Camacho, A. Camacho-Santamans, S.P. Charles, J.A. Cherry, E.E. Gaiser, K. Gedan, A.M. Helton, E. Herbert, K. Ishtiaq, M.L. Kirwan, K.W. Krauss, L. Lamb-Wotton, D. Morant, G.B. Noe, M.J. Osland, T. Troxler, K. Tully, and B.J. Wilson. 2021. Net ecosystem productivity maximized at intermediate salinity increases in diverse coastal wetlands. Association of the Sciences of Limnology and Oceanography Virtual Meeting, Virtual, June 22, 2021 - June 27, 2021.

Lamb-Wotton, L. 2021. Multi-risk Assessment of Saltwater and Drought-related Vulnerability of Coastal Wetlands to Peat Collapse in the Florida Coastal Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 27, 2021.

Lorenz, J.J. 2021. Response of Roseate Spoonbills to Increased Hydroperiods on Preferred Foraging Grounds in Response to Sea Level Rise. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Malone, S.L. 2021. Patterns in Net Ecosystem Exchange across Everglades Wetland Ecosystems. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Malone, S.L., J. Zhao, J. Kominoski, G. Starr, C.L. Staudhammer, P.C. Olivas, and S. Oberbauer. 2021. Integrating Aquatic Metabolism and Net Ecosystem CO_2 Balance in Calcareous Short- and Long- Hydroperiod Subtropical Freshwater Wetlands. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Mannetti, L.M., E. Cook, E.E. Gaiser, M. Garriga, K. Grove, D.M. Iwaniec, J. Kominoski, T. McPhearson, T. Munoz-Erickson, A. Mustafa, T. Troxler, and M.A. Smith. 2021. Transformative approaches to envisioning and modeling sustainable, equitable, and resilient coastal cities. Coastal Estuarine and Research Federation Virtual Meeting, Virtual, November 1, 2021 - November 11, 2021.

Martens-Habbena, W. 2021. Impact of soil nitrogen cycling on agricultural productivity and natural resources in Florida. International Conference on Nitrification and Related Processes, Logan, Utah, July 18, 2021 - July 27, 2021.

Massie, J., R.O. Santos, R. Rezek, N. Viadero, R. Boucek, P.W. Stevens, and J.S. Rehage. 2021. Keeping Up with the Currents: Linking Seasonal Flow Dynamics to Downstream Migrations of Common Snook in the Shark River Estuary, Everglades National Park. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 22, 2021.

Massie, J., R.O. Santos, R. Rezek, W.R. James, N. Viadero, R. Boucek, P.W. Stevens, and J.S. Rehage. 2021. Primed and cued: Linking interannual and seasonal flow dynamics to the spawning migrations of Common Snook in the Florida Everglades. Annual Meeting of the American Fisheries Society, Baltimore, Maryland, November 9, 2021.

Mazzei, V. 2021. Harmful Algal Bloom Dynamics in the Lake Okeechobee System: Preliminary Findings from Monthly Field Monitoring and Experimental Mesocosms. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Mesa, X., D. Gann, J.P. Sah, and M.S. Ross. 2021. Plant Community Change Detection on Tree Islands in ENP from Multi-spectral WorldView 2, G-LiHT LiDAR Data and Historic Aerial Stereo Photography. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Nocentini, A., J. Kominoski, J. O'Brien, and J. Redwine. 2021. Fire causes a stronger release of nutrient limitation in higher than lower phosphorus-limited subtropical wetlands. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Nocentini, A., J. Kominoski, J.P. Sah, and J. Redwine. 2021. Coupling fire and water management to control wetland nutrient cycling during Everglades restoration. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Obeysekera, J. 2021. Past and Projected Climate Trends in South Florida: Progress and Challenges. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 22, 2021.

Oli, J., and S.L. Malone. 2021. Post-fire recovery in the Everglades fire-adapted freshwater wetland ecosystems. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 13, 2021 - December 17, 2021.

Oliver-Cabrera, T., S. Wdowinski, S. Kruse, and T. Robinson. 2021. Using InSAR time series observations to detect sinkhole activity: West-central Florida case study. Bringing Land, Ocean, Atmosphere and Ionosphere data to the Community of Hazard Alerts Meeting, AGU, Virtual, May 26, 2021.

Onwuka, I. 2021. Concentration – Discharge (C-Q) Relationship: A Useful Tool for Quantifying Phosphorus Export Dynamics in Greater Everglades Ecosystem Canals. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Pulido, C. 2021. Variation in Belowground Functional Traits of Plant Species along the Marl Prairie-slough Gradients in the Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Redwine, J., C.J. Saunders, C. Zweig, A. Atkinson, A. Nocentini, D.T. Rudnick, J. Kominoski, and J.P. Sah. 2021. Bridging towards restoration: how expanding adaptive management processes will influence the next decade of ecological conditions in Northeast Shark River Slough. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Rehage, J.S., R.O. Santos, C.R. Kelble, R. Boucek, W.R. James, and R. Rezek. 2021. Everglades Recreation Fisheries and their Underappreciated Relationship to Freshwater Flows: Knowns, Hypotheses, and Key Unknowns. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Rehage, J.S., R.O. Santos, C.R. Kelble, R. Boucek, W.R. James, and R. Rezek. 2021. The importance of animal movement in estuarine connectivity. Coastal and Estuarine Research Federation (CERF) Conference, Virtual, November 1, 2021 - November 11, 2021.

Rezek, R. 2021. Individual Consumer Movement Mediates Food Web Coupling Across a Coastal Ecosystem. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 22, 2021.

Rodemann, J., W.R. James, D. Gann, B. Furman, J.S. Rehage, and R.O. Santos. 2021. Development of a depth-invariant vegetation index for mapping seagrass cover. Coastal and Estuarine Research Federation (CERF) Conference, Virtual, November 1, 2021 - November 11, 2021.

Rodemann, J., W.R. James, R.O. Santos, B. Furman, Z.F. Fratto, V. Bautista, J. Hernandez, N. Viadero, J. Linenfelser, L.A. Lacy, M.O. Hall, C.R. Kelble, C. Kavanagh, and J.S. Rehage. 2021. Impact of Extreme Disturbances on Suspended Sediment in Western Florida Bay: Implications for Seagrass Resilience. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Rodriguez, J., S. Chakrabarti, E. Choi, N. Shehadeh, S. Sierra-Martinez, J. Zhao, and W. Martens-Habbena. 2021. Nutrient-limited enrichments of nitrifiers from soil yield consortia of Nitrosocosmicus-affiliated AOA and Nitrospira-affiliated NOB. World Microbe Forum - American Society of Microbiology and European Societies of Microbiology Joint Virtual Meeting, Virtual, June 20, 2021 - June 24, 2021.

Ross, M.S. 2021. Vegetation-Environment Relationships in Two Coastal Ecogeomorphic Settings on a Transgressive Carbonate Platform. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Sah, J.P. 2021. Incident Light and Flooding Combine to Determine Understory Plant Composition in an Experimental Everglades Tree Island. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Santos, R.O. 2021. Integrating Seascape, Trophic and Movement Ecology to Assess Coastal Ecological Responses in the Context of Freshwater Management. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Shribman, Z. 2021. Predicting blue carbon sequestration with belowground biomass: Model verification in South Florida's mangroves. International Symposium on Coastal Ecosystems and Global Change, Virtual, Xiamen, China, April 16, 2021 - April 19, 2021.

Smith, M.A., J. Kominoski, E.E. Gaiser, N.B. Grimm, L.E. McPhillips, B.R. Rosenzweig, A. Ruhi, and T. Troxler. 2021. Synchronizing hydrology in urban watersheds: flow-shunt flood-pulse concept. Association of the Sciences of Limnology and Oceanography Virtual Meeting, Virtual, June 22, 2021 - June 27, 2021.

Stansbury, K. 2021. Drivers of Extracellular Polysaccharide Production in a Mat Forming Diatom. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Strickland, N.D., D. Gann, and J.C. Trexler. 2021. Using Spatially Balanced Vegetation Mapping to Improve Aquatic Animal Biomass Estimates. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Strickland, N.D., J.C. Trexler, E.E. Gaiser, and D. Gann. 2021. Using spatially balanced vegetation mapping to improve aquatic animal biomass estimates. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Trexler, J.C. 2021. Experimental and Model-Driven Evaluation of Effects of Restoring Water Flow on Nutrient Transfer from the Basal to the Consumer Portions of Everglades Marsh Food Webs. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 21, 2021.

Vanderbilt, K., C. Gries, P. Hanson, A. Nocentini, and J. Wheeler. 2021. Is a distributed graduate seminar a successful way to share information management expertise with students? American Geophysical Union Annual Meeting, Virtual, December 15, 2021.

Viadero, N. 2021. Between Dry Rock and a Salty Place: Can the Coastal Everglades Support a Freshwater Largemouth Bass Population in the Face of Sea Level Rise? Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Vidales, R. 2021. Red Mangrove Leaf Traits in Variable Coastal Environments of the Southeast Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Wdowinski, S. 2021. Direct and indirect wind impacts on coastal sea level along the US Atlantic and Gulf shorelines. Bringing Land, Ocean, Atmosphere and Ionosphere data to the Community of Hazard Alerts Meeting, AGU, Virtual, May 26, 2021.

Wdowinski, S., H. Liao, and B. Zhang. 2021. A multi-sensor monitoring system of surface water level changes in the Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Wdowinski, S., H. Liao, and B. Zhang. 2021. A multi-sensor monitoring system of surface water level changes in wetlands. EGU General Assembly 2021, Virtual, April 19, 2021 - April 30, 2021.

Yu, Z. 2021. Drivers of Methane Emissions in Freshwater Marshes of the Florida Everglades. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 27, 2021.

Yu, Z., C.L. Staudhammer, G. Starr, S.L. Malone, and S. Oberbauer. 2021. Identifying environmental drivers of methane fluxes in freshwater wetlands of the Florida Everglades. Ecological Society of America Annual Meeting 2021, Virtual, August 2, 2021 - August 6, 2021.

Yu, Z., G. Starr, C.L. Staudhammer, S.L. Malone, and S. Oberbauer. 2021. A comparison of methane fluxes in short- versus long-hydroperiod freshwater marsh in the Florida Everglades. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 13, 2021 - December 17, 2021.

Zhai, L. 2021. Improving Evaluations of Hydrological Drivers of Wetland Plant Distributions Using Temporal Variations in Water Depth. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 20, 2021.

Zhang, B. 2021. Space-based Mapping of the Everglades Mangrove Canopy Height after Hurricane Irma with Multi-sensor Observations and Machine Learning. Greater Everglades Ecosystem Restoration (GEER) Meeting, Virtual, April 28, 2021.

Zhang, B., S. Wdowinski, and H. Liao. 2021. A multi-sensor monitoring system of surface water level changes in wetlands. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 13, 2021 - December 17, 2021.

Zhang, B., S. Wdowinski, C. Lin, S. Chavez, and G. Narasimhan. 2021. Space-based mapping of mangrove canopy height with multi-sensor observations fusion by machine learning technique. American Geophysical Union Annual Meeting, New Orleans, Louisiana, December 13, 2021 - December 17, 2021.

Zhao, J., L. Huang, S. Chakrabarti, J. Cooper, E. Choi, and W. Martens-Habbena. 2021. Nitrogen- and phosphorus-based coexistence and competition of ecotypes in complex soil archaeal nitrifier communities. World Microbe Forum - American Society of Microbiology and European Societies of Microbiology Joint Virtual Meeting, Virtual, June 20, 2021 - June 24, 2021.

Dissertations and Theses

Master's Theses

Emery, Meredith. 2021. Reconstructing cyclical browning from diatom records in a subtropical lake. Master's thesis, Florida International University.

Shribman, Zoe. 2021. Blue carbon in south Florida's mangroves: The role of large roots and necromass. Master's thesis, Louisiana State University.

Stansbury, Kaitlin. 2021. Drivers of extracellular polysaccharide production by a mat-forming diatom. Master's thesis, Florida International University.

Ph.D. Dissertations

Bernardo, Melissa. 2021. Actually-existing resilience: The adaptive actions of Miami's Redland Farmers and potential pathways for transformation. Ph.D. dissertation, Florida International University.

Smith, Matthew. 2021. Quantifying how coastal flooding and stormwater runoff drive spatiotemporal variability in carbon and nutrient processing in urban aquatic ecosystems. Ph.D. dissertation, Florida International University.

Zhao, Xiaochen. 2021. Assessing mangrove wetland structure and function regulated by environmental gradients under climate change and increasing human impacts: A modeling approach. Ph.D. dissertation, Louisiana State University.

Websites

Florida Coastal Everglades LTER Program Website
https://fcelter.fiu.edu/
The Florida Coastal Everglades LTER Program Website provides information about FCE research, data, publications, personnel, education & outreach activities, and the FCE Student Organization.

Coastal Angler Science Team (CAST) Website
http://cast.fiu.edu/
The Coastal Angler Science Team (CAST) Website, created by FCE graduate student Jessica Lee, provides information about how researchers and anglers are working together to collect data on important recreational fish species in Rookery Branch and Tarpon Bay in the Everglades and invites anglers to participate in this project.

Predator Tracker
http://tracking.fiu.edu/
The Predator Tracker website has information about the Predator Tracker application and a link to download the application. Predator Tracker is a stand alone application based on a kiosk at the Museum of Discovery and Science in Ft. Lauderdale. The application allows one to learn how researchers at Florida International University track and study big predators in the Shark River Estuary in Everglades National Park and explore their predator tracking data.

Wading Through Research
http://floridacoastaleverglades.blogspot.com/
A blog created by FCE graduate students which focuses on the experiences of graduate students conducting research in the Everglades.

Other products

Databases
The FCE Information Management System (FCE IMS) contains 181 datasets which are available on the FCE LTER's website (https://fcelter.fiu.edu/data/index.html) and in the EDI Data Repository. Datasets include climate, consumer, primary production, water quality, soils, and microbial data as well as other types of data. A table of FCE LTER data sets in the EDI Data Repository with DOIs for each dataset is included as a supplementary document in the Appendix.

Technologies or Techniques

- Algorithm development for LiDAR data bias correction
- Algorithm development for vegetation change detection across spatial scales

Participants & Other Collaborating Organizations

Participants

Name	Most Senior Project Role
Kominoski, John	PD/PI
Fourqurean, James	Co PD/PI
Gaiser, Evelyn	Co PD/PI
Grove, Kevin	Co PD/PI
Rehage, Jennifer	Co PD/PI
Bhat, Mahadev	Faculty
Boswell, Kevin	Faculty
Burgman, Robert	Faculty
Castaneda, Edward	Faculty
Chambers, Randy	Faculty
Crowl, Todd	Faculty
Dorn, Nathan	Faculty
D’Elia, Marta	Faculty
Gann, Daniel	Faculty
Heithaus, Michael	Faculty
Kiszka, Jeremy	Faculty
Malone, Sparkle	Faculty
Martens-Habbena, Willm	Faculty
Nelson, James	Faculty
Oehm, Nicholas	Faculty
Osburn, Chris	Faculty

Name	Most Senior Project Role
Parkinson, Randy	Faculty
Price, Rene	Faculty
Rezek, Ryan	Faculty
Richards, Jennifer	Faculty
Santos, Rolando	Faculty
Stingl, Uli	Faculty
Trexler, Joel	Faculty
Troxler, Tiffany	Faculty
Wakefield, Stephanie	Faculty
Wdowinski, Shimon	Faculty
Guimarães, Beatriz	K-12 Teacher
Hernandez, Amanda	K-12 Teacher
Pavon, Jose	K-12 Teacher
Simpson, Lacey	K-12 Teacher
Whelan, Cristina	K-12 Teacher
Ishtiaq, Khandkar	Postdoctoral (scholar, fellow or other postdoctoral position)
James, W. Ryan	Postdoctoral (scholar, fellow or other postdoctoral position)
Krause, Johannes	Postdoctoral (scholar, fellow or other postdoctoral position)
Laas, Peeter	Postdoctoral (scholar, fellow or other postdoctoral position)
Solohin, Elena	Postdoctoral (scholar, fellow or other postdoctoral position)
Strickland, Bradley	Postdoctoral (scholar, fellow or other postdoctoral position)

Name	Most Senior Project Role
Zhao, Jun	Postdoctoral (scholar, fellow or other postdoctoral position)
Gastrich, Kirk	Other Professional
Kamener, Gabriel	Other Professional
Rugge, Michael	Other Professional
Standen, Emily	Other Professional
Tobias, Franco	Other Professional
Trabelsi, Shakira	Other Professional
Travieso, Rafael	Other Professional
Wilson, Sara	Other Professional
Bautista, Valentina	Technician
Bremen, Ryan	Technician
Choi, Chang Jae	Technician
Distrubell, Andy	Technician
Dominguez, Gustavo	Technician
Espanol, Ian	Technician
Hoffman, Sophia	Technician
Hornaday, Alex	Technician
Murray, Miranda	Technician
Pezoldt, Austin	Technician
Reinsel, Madeline	Technician
Restrepo, Veronica	Technician
Rizzie, Christopher	Technician
Sarsich, Megan	Technician
Stumpf, Sandro	Technician

Name	**Most Senior Project Role**
Tytlar, Sara	Technician
Cook, Mark	Staff Scientist (doctoral level)
Dessu, Shimelis	Staff Scientist (doctoral level)
Fitz, Carl	Staff Scientist (doctoral level)
Julian, Paul	Staff Scientist (doctoral level)
Lorenz, Jerry	Staff Scientist (doctoral level)
Van Dam, Bryce	Staff Scientist (doctoral level)
Vanderbilt, Kristin	Staff Scientist (doctoral level)
Anderson, Kenneth	Graduate Student (research assistant)
Bernardo, Melissa	Graduate Student (research assistant)
Biswas, Himadri	Graduate Student (research assistant)
Castillo, Nicholas	Graduate Student (research assistant)
Chavez, Selena	Graduate Student (research assistant)
DeVito, Lauren	Graduate Student (research assistant)
Eggenberger, Cody	Graduate Student (research assistant)
Emery, Meredith	Graduate Student (research assistant)
Flood, Peter	Graduate Student (research assistant)
Garcia, Laura	Graduate Student (research assistant)
Garriga, Marbelys	Graduate Student (research assistant)
Gervasi, Carissa	Graduate Student (research assistant)
Hormiga, Samantha	Graduate Student (research assistant)
Johnson, Katie	Graduate Student (research assistant)
Kleindl, Paige	Graduate Student (research assistant)
Lamb-Wotton, Luke	Graduate Student (research assistant)

Name	**Most Senior Project Role**
Linenfelser, Joshua	Graduate Student (research assistant)
Lopes, Christian	Graduate Student (research assistant)
Massie, Jordan	Graduate Student (research assistant)
Mesa, Ximena	Graduate Student (research assistant)
Montenegro, Kevin	Graduate Student (research assistant)
Moore, Courtney	Graduate Student (research assistant)
Ortiz, Liz	Graduate Student (research assistant)
Paz, Valeria	Graduate Student (research assistant)
Reyes, Jessika	Graduate Student (research assistant)
Rodemann, Jonathan	Graduate Student (research assistant)
Shannon, Thomas	Graduate Student (research assistant)
Shribman, Zoe	Graduate Student (research assistant)
Smith, Matthew	Graduate Student (research assistant)
Stansbury, Kaitlin	Graduate Student (research assistant)
Stingl, Shanna	Graduate Student (research assistant)
Viadero, Natasha	Graduate Student (research assistant)
Vorseth, Chloe	Graduate Student (research assistant)
White, Mackenzie	Graduate Student (research assistant)
Yu, Zhuoran	Graduate Student (research assistant)
Zhang, Boya	Graduate Student (research assistant)
Zhao, Xiaochen	Graduate Student (research assistant)
Alfonos, Keily	Undergraduate Student
Borbola, Michael	Undergraduate Student
Gonzalez Starchek, Maria Gabriela	Undergraduate Student

Name	Most Senior Project Role
Jimenez, Jr., Carlos	Undergraduate Student
Mularo, Evan	Undergraduate Student
Padron, Lauren	Undergraduate Student
Samara, Yamilla	Undergraduate Student
Tucker, Nick	Undergraduate Student
Meija, Valeria	High School Student
Ajavon, Ayi	Research Experience for Undergraduates (REU) Participant
Gonzalez, Lizbeth	Research Experience for Undergraduates (REU) Participant
Hernandez, Myranda	Research Experience for Undergraduates (REU) Participant
Hulting, Katherine	Research Experience for Undergraduates (REU) Participant
Restrepo, Veronica	Research Experience for Undergraduates (REU) Participant

Collaborating Organizations

Coastal Carolina University
Conway, South Carolina

College of William & Mary
Williamsburg, Virginia

The Deering Estate
Miami, Florida

East Carolina University
Greenville, North Carolina

Eckerd College
St. Petersburg, Florida

EcoLandMod, Inc.
Fort Pierce, Florida

Encounters in Excellence, Inc.
Miami, Florida

Everglades Foundation
Palmetto Bay, Florida

Everglades National Park
Homestead, Florida

Florida Gulf Coast University
Fort Myers, Florida

Florida State University
Tallahassee, Florida

Georgia Tech
Atlanta, Georgia

Helmholtz-Zentrum Hereon
Geesthacht, Germany

Louisiana State University
Baton Rouge, Louisiana

NASA Goddard Space Flight Center
Greenbelt, Maryland

National Park Service - South Florida/Caribbean Network Inventory and Monitoring Program
Palmetto Bay, Florida

North Carolina State University
Raleigh, North Carolina

Oklahoma State University
Stillwater, Oklahoma

Sanibel-Captiva Conservation Foundation
Sanibel, Florida

Tulane University
New Orleans, Louisiana

University of Alabama
Tuscaloosa, Alabama

University of Central Florida
Orlando, Florida

University of Hawaii at Manoa
Honolulu, Hawaii

University of South Carolina
Columbia, South Carolina

University of South Florida St. Petersburg
St. Petersburg, Florida

U.S. Geological Survey
Reston, Virginia

Life University
Marietta, Georgia

Miami-Dade County Public Schools
Miami-Dade County, Florida

National Audubon Society - Tavernier Science Center
Tavernier, Florida

National Tropical Botanical Gardens
Coconut Grove, Florida

Oak Ridge National Laboratory
Oak Ridge, Tennessee

The Pennsylvania State University
University Park, Pennsylvania

South Florida Water Management District
West Palm Beach, Florida

UNAVCO
Boulder, Colorado

University of California, Los Angeles
Los Angeles, California

University of Florida
Gainesville, Florida

University of Louisiana at Lafayette
Lafayette, Louisiana

University of South Florida
Tampa, Florida

University of Wisconsin
Madison, Wisconsin

Appendix: FCE LTER Data Packages in the EDI Repository

DOI	Authors	Title
https://doi.org/10.6073/pasta/705982cd2283522fd897664bbd65aef2		NOAA Daily Surface Meteorologic Data at NCDC Everglades Station (ID-082850)(FCE LTER), South Florida from February 1924 to 2017
https://doi.org/10.6073/pasta/7fed0a47b285b6be06030fa4108e56aa		NOAA Daily Surface Meteorologic Data at NCDC Flamingo Ranger Station (ID-083020) (FCE), South Florida from January 1951 to Present
https://doi.org/10.6073/pasta/e73196a56cbee37148761f83c94aacf2		NOAA Daily Surface Meteorologic Data at NCDC Miami International Airport Station (ID-085663)(FCE LTER), South Florida from January 1948 to Present
https://doi.org/10.6073/pasta/19d4d4031f389ea62faa65c0f0f7342f		NOAA Daily Surface Meteorologic Data at NCDC Royal Palm Ranger Station (ID-087760)(FCE LTER), South Florida from May 1949 to Present
https://doi.org/10.6073/pasta/dd507279ead6dab518823bdcafec8071		NOAA Daily Surface Meteorologic Data at NCDC Tavernier Station (ID-088841)(FCE), South Florida from June 1936 to May 2009

DOI	Authors	Title
https://doi.org/10.6073/pasta/84f68e11230e6c6fce1c38eb07e5280f	Briceno, Henry	Surface Water Quality Monitoring Data collected in South Florida Coastal Waters (FCE LTER) from June 1989 to Present
https://doi.org/10.6073/pasta/6532ed318ab4a75edf0820f7bb2ba53d	Briceno, Henry	Microbial Sampling from Shark River Slough and Taylor Slough, Everglades National Park, South Florida, USA (FCE LTER) from January 2001 to Present
https://doi.org/10.6073/pasta/0fb149ced55edb32c282deb234caab56	Heithaus, Michael; Matich, Philip; Rosenblatt, Adam	Large consumer isotope values, Shark River Slough, Everglades National Park (FCE LTER), May 2005 to Present
https://doi.org/10.6073/pasta/79e8ef59e5b93b2ff59321e0a93118ae	Heithaus, Michael; Matich, Philip; Rosenblatt, Adam	Temperatures,salinities, and dissolved oxygen levels in the Shark River Slough, Everglades National Park (FCE LTER) , from May 2005 to May 2014
https://doi.org/10.6073/pasta/f501b0b23aee50119f8973d1e416a9d4		NOAA Monthly Mean Sea Level Summary Data for the Key West, Florida, Water Level Station (FCE) (NOAA/NOS Co-OPS ID 8724580) from 01-Jan-1913 to Present
https://doi.org/10.6073/pasta/b07ae4ab29f525b7a9924382904e581b	Gaiser, Evelyn; Scinto, Leonard	Biogeochemical data collected from Northeast Shark Slough, Everglades National Park (FCE LTER) from September 2006 to September 2008

DOI	Authors	Title
https://doi.org/10.6073/pasta/9e929b1d4c7ab02e3afd12652391f3a3	Anderson, William	Pond Cypress C-111 Basin, Everglades (FCE), South Florida Dendroisotope Data from 1970 to 2000
https://doi.org/10.6073/pasta/354b4b6ac638551cc947a9e83e17805d	Trexler, Joel	Consumer Stocks: Fish, Vegetation, and other Non-physical Data from Everglades National Park (FCE), South Florida from February 2000 to April 2005
https://doi.org/10.6073/pasta/bc7e38fe4b8f5f976f1adb9e6395a8f8	Trexler, Joel	Consumer Stocks: Physical Data from Everglades National Park (FCE), South Florida from February 1996 to April 2008
https://doi.org/10.6073/pasta/b0e2ae3fb140447717b8dd9fdc3f4ac5	Trexler, Joel	Consumer Stocks: Fish Biomass from Everglades National Park (FCE), South Florida from February 2000 to April 2005
https://doi.org/10.6073/pasta/4c6f16f6825cc77204ef76f21e86b75a	Trexler, Joel	Consumer Stocks: Fish Biomass from Everglades National Park (FCE), South Florida from February 1996 to March 2000
https://doi.org/10.6073/pasta/7ff817fdf10aac0ad84a64acd6ca1c95	Trexler, Joel	Consumer Stocks: Wet weights from Everglades National Park (FCE), South Florida from March 2003 to April 2008

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https://doi.org/10.6073/pasta/cb1409728ddb1d071a405f9afc0d9309	Price, Rene	Rainfall Stable Isotopes collected at Florida International University-MMC (FCE LTER), Miami Florida, from October 2007 to Present
https://doi.org/10.6073/pasta/8b6e429fb37dbeaeaa22f962af725a42	Boyer, Joseph; Dailey, Susan	Overnight Shark River Surveys from Shark River Slough, Everglades National Park (FCE), South Florida from October 2001 to March 2002
https://doi.org/10.6073/pasta/269b52cfc1e30e4aaf6fa0dfb29b2407	Gaiser, Evelyn; Childers, Daniel	Water Quality Data (Porewater) from the Shark River Slough, Everglades National Park (FCE LTER), from January 2001 to Present
https://doi.org/10.6073/pasta/57ec1ea96f7b5830396c392cada58028	Gaiser, Evelyn; Childers, Daniel	Sawgrass Above and Below Ground Total Nitrogen and Total Carbon from the Shark River Slough, Everglades National Park (FCE LTER), from September 2002 to Present
https://doi.org/10.6073/pasta/a8e93b56115178781b4fab946d857b09	Gaiser, Evelyn; Childers, Daniel	Sawgrass Above and Below Ground Total Phosphorus from the Shark River Slough, Everglades National Park (FCE LTER), from September 2002 to Present
https://doi.org/10.6073/pasta/c0e834e8e1bf4050db6a9967ec99b4b7	Gaiser, Evelyn; Childers, Daniel	Water Quality Data (Extensive) from the Shark River Slough, Everglades National Park (FCE LTER), from October 2000 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/b1728f184e37a74107da707f26da749e	Gaiser, Evelyn; Childers, Daniel	Water Quality Data (Grab Samples) from the Shark River Slough, Everglades National Park (FCE LTER), from May 2001 to Present
https://doi.org/10.6073/pasta/c72b8eaeb519914fdba14fa4bfbb0228	Troxler, Tiffany	Water Quality Data (Extensive) from the Taylor Slough, Everglades National Park (FCE LTER), from April 1996 to Present
https://doi.org/10.6073/pasta/b024b21f2d0da5e4fab07ca403d06d90	Troxler, Tiffany; Childers, Daniel	Water Quality Data (Grab Samples) from the Taylor Slough, Everglades National Park (FCE LTER), from May 2001 to Present
https://doi.org/10.6073/pasta/986977091d9ff18aac52ea1c4886e64b	Troxler, Tiffany; Childers, Daniel	Water Quality Data (Extensive) from the Taylor Slough, just outside Everglades National Park (FCE), from August 1998 to December 2006
https://doi.org/10.6073/pasta/cd96927a753e84af3d9d2a07b02fa322	Troxler, Tiffany; Childers, Daniel	Water Quality Data (Grab Samples) from the Taylor Slough, just outside Everglades National Park (FCE), for August 1998 to November 2006
https://doi.org/10.6073/pasta/1c4f9019e3dc4306b17a067f455430ad	Troxler, Tiffany; Childers, Daniel	Water Quality Data (Porewater) from the Taylor Slough, just outside Everglades National Park (FCE), from August 1998 to October 2006
https://doi.org/10.6073/pasta/c142808f3d583c826e7b1f0c123a8cb9	Troxler, Tiffany	Water Quality Data (Extensive) from the Taylor Slough, Everglades National Park (FCE LTER), South Florida from July 1999 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/03561dc06de5538d50e5fbd6ccb2c025	Troxler, Tiffany	Water Quality Data (Grab Samples) from the Taylor Slough, Everglades National Park (FCE), South Florida from September 1999 to Present
https://doi.org/10.6073/pasta/d4e923e473d693cce2a896d82348e112	Troxler, Tiffany; Childers, Daniel	Water Quality Data (Porewater) from the Taylor Slough, Everglades National Park (FCE), South Florida from September 1999 to December 2006
https://doi.org/10.6073/pasta/efe73edf89298dbdf92af812e7f0070e	Troxler, Tiffany; Childers, Daniel	Sawgrass Above and Below Ground Total Phosphorus from the Taylor Slough, Everglades National Park (FCE LTER), South Florida for March 2002 to Present
https://doi.org/10.6073/pasta/53e28bcee44aeda5c0dc960c86236b56	Troxler, Tiffany; Childers, Daniel	Sawgrass Above and Below Ground Total Nitrogen and Total Carbon from the Taylor Slough, Everglades National Park (FCE LTER), South Florida for March 2002 to Present
https://doi.org/10.6073/pasta/800da15e45d294c5d32ea601cbeb3622	Gaiser, Evelyn; Childers, Daniel	Sawgrass above ground biomass from the Shark River Slough, Everglades National Park (FCE LTER), South Florida from November 2000 to Present
https://doi.org/10.6073/pasta/e6640b978d38e54d88f2231ebc7db92d	Troxler, Tiffany; Childers, Daniel	Sawgrass above ground biomass from the Taylor Slough, just outside Everglades National Park (FCE), South Florida from October 1997 to December 2006

DOI	Authors	Title
https://doi.org/10.6073/pasta/94e39a09293f0d518e7f2763e353afa3	Troxler, Tiffany; Childers, Daniel	Sawgrass above ground biomass from the Taylor Slough, Everglades National Park (FCE LTER), South Florida from August 1999 to Present
https://doi.org/10.6073/pasta/6cd7783c4871eaf3527ab177deacd035	Troxler, Tiffany; Childers, Daniel	Periphyton Net Primary Productivity and Respiration Rates from the Taylor Slough, just outside Everglades National Park (FCE), South Florida from December 1998 to December 2004
https://doi.org/10.6073/pasta/903576c777c0b7dc6bf87cd86f9fbc05	Troxler, Tiffany; Childers, Daniel	Soil Physical Data from the Shark River Slough, Everglades National Park (FCE), from November 2000 to January 2007
https://doi.org/10.6073/pasta/81e0fc75f420c948340b17715a4d78a5	Troxler, Tiffany; Childers, Daniel	Soil Physical Data from the Taylor Slough, just outside Everglades National Park (FCE), from October 1998 to October 2006
https://doi.org/10.6073/pasta/ac54452865f50d6ca972a4c196522e4f	Troxler, Tiffany; Childers, Daniel	Soil Physical Data from the Taylor Slough, within Everglades National Park (FCE), from September 1999 to November 2006
https://doi.org/10.6073/pasta/6040a745baed01378e215c8070d0126d	Troxler, Tiffany; Childers, Daniel	Soil Characteristic and Nutrient Data from the Taylor Slough, within Everglades National Park (FCE), from March 2002 to April 2004

DOI	Authors	Title
https://doi.org/10.6073/pasta/1aac7210c2f0cd431f272e57851b010a	Price, Rene; Childers, Daniel	Precipitation from the Shark River Slough, Everglades National Park (FCE LTER), South Florida from November 2000 to Present
https://doi.org/10.6073/pasta/3193b02e99a16f874ef3e1b63ca295e2	Troxler, Tiffany; Childers, Daniel	Water Levels from the Taylor Slough, Everglades National Park (FCE LTER), South Florida from April 1996 to 2012
https://doi.org/10.6073/pasta/ee33480b08eb2bbfd283852efe2b614c	Childers, Daniel; Price, Rene	Water Levels from the Shark River Slough, Everglades National Park (FCE LTER), South Florida from October 2000 to Present
https://doi.org/10.6073/pasta/6581a4898452afd4bc1f6665b44aeb4f	Troxler, Tiffany; Childers, Daniel	Precipitation from the Taylor Slough, just outside Everglades National Park (FCE), South Florida from August 2000 to December 2006
https://doi.org/10.6073/pasta/2bb421d19f71704ed7476ca128bacb72	Troxler, Tiffany; Childers, Daniel	Water Levels from the Taylor Slough, just outside the Everglades National Park (FCE), South Florida from October 1997 to December 2006
https://doi.org/10.6073/pasta/9014da3b5b4170d95b7b427cf818887e	Troxler, Tiffany; Childers, Daniel	Precipitation from the Taylor Slough, Everglades National Park (FCE LTER), South Florida from July 2000 to Present
https://doi.org/10.6073/pasta/637e2c1db863fe950bafad48beb81cd1	Troxler, Tiffany; Childers, Daniel	Water Levels from the Taylor Slough, Everglades National Park (FCE LTER), South Florida from August 1999 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/b244a3eb610cdfb419088f2ebab00d34	Jaffe, Rudolf	Monthly monitoring of Fluorescence, UV, Humic and non-Humic Carbon, Carbohydrates, and DOC for Shark River Slough, Taylor Slough, and Florida Bay, Everglades National Park (FCE LTER) for January 2002 to August 2004
https://doi.org/10.6073/pasta/6d2e26bc8c8cd2322981d22a095ab968	Jaffe, Rudolf	Examination of protein-like fluorophores in chromophoric dissolved organic matter (CDOM) in a wetland and coastal environment for the wet and dry seasons of the years 2002 and 2003 (FCE)
https://doi.org/10.6073/pasta/1bb7981116c89e6f414964b0a113b294	Jaffe, Rudolf	Monthly monitoring fluorescence data for Florida Bay, Ten Thousand Islands, and Whitewater Bay, in southwest coast of Everglades National Park (FCE) for February 2001 to December 2002
https://doi.org/10.6073/pasta/22916d1d52d8a756020b8c7537b1bd87	Jaffe, Rudolf	Quantitative and qualitative aspects of dissolved organic carbon leached from plant biomass in Taylor Slough, Shark River and Florida Bay (FCE) for samples collected in July 2004
https://doi.org/10.6073/pasta/76696c297746734756f827ec748eb20f	Jaffe, Rudolf	Chemical characteristics of dissolved organic matter in an oligotrophic subtropical wetland/estuary ecosystem, Everglades National Park (FCE), South Florida from December 2001 to January 2002

DOI	Authors	Title
https://doi.org/10.6073/pasta/07272b339cff887abca38b8676789a56	Jaffe, Rudolf	Physical and microbial processing of dissolved organic nitrogen (DON) (Salinity Experiment) along an oligotrophic marsh/mangrove/estuary ecotone (Taylor Slough and Florida Bay) for August 2003 in Everglades National Park (FCE), South Florida, USA
https://doi.org/10.6073/pasta/da883a9edecd3c2a2be661531b16a780	Jaffe, Rudolf	Physical and microbial processing of dissolved organic nitrogen (DON) (Photodegradation Experiment) along an oligotrophic marsh/mangrove/estuary ecotone (Taylor Slough and Florida Bay) for August 2003 in Everglades National Park (FCE), South Florida, USA
https://doi.org/10.6073/pasta/cc9f23891b8bb977eaf5d7eb6f76005f	Jaffe, Rudolf	Characterization of dissloved organic nitrogen in an oligotrophic subtropical coastal ecosystem (Taylor Slough and Shark River Slough) for December 2001 in Everglades National Park (FCE), South Florida, USA
https://doi.org/10.6073/pasta/88a8b327f77f9818fc48751e90f4d2cb	Gaiser, Evelyn	Periphyton Productivity from the Shark River Slough and Taylor Slough, Everglades National Park (FCE LTER), from October 2001 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/df0df1868e303a71e58ec7b29fcf8b29	Gaiser, Evelyn	Macrophyte count data collected from Northeast Shark Slough, Everglades National Park (FCE LTER) from September 2006 to September 2008
https://doi.org/10.6073/pasta/e7898d1958661abfec2910d778cb2991	Gaiser, Evelyn	Periphyton data collected from Northeast Shark Slough, Everglades National Park (FCE LTER) from September 2006 to September 2008
https://doi.org/10.6073/pasta/e963f515578c8f33e3cc3d3bd548f234	Gaiser, Evelyn	Periphyton Accumulation Rates from Shark River Slough, Taylor Slough and Florida Bay, Everglades National Park (FCE LTER) from January 2001 to Present
https://doi.org/10.6073/pasta/eba5dc4882541be7696a1f59c1b62c64	Gaiser, Evelyn	Periphyton Biomass Accumulation from the Shark River and Taylor Sloughs, Everglades National Park (FCE LTER), from January 2003 to Present
https://doi.org/10.6073/pasta/e49e256a8b8d4842b68894721107ab16	Collado-Vides, Ligia	Macroalgae Production in Florida Bay (FCE), South Florida from May 2007 to Present
https://doi.org/10.6073/pasta/7ec8a89997863f2864b98e62b6535bde	Twilley, Robert; Rivera-Monroy, Victor; Castaneda, Edward	Mangrove Forest Growth from the Shark River Slough, Everglades National Park (FCE), South Florida from January 1995 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/b159b26b251d40494258f3d4430f4dfc	Troxler, Tiffany; Childers, Daniel	Soil Characteristics and Nutrient Data from the Shark River Slough, within Everglades National Park (FCE), from March 2003 to March 2004
https://doi.org/10.6073/pasta/542c044a50f7081beb454d1314fddff2	Castaneda, Edward; Rivera-Monroy, Victor; Twilley, Robert	Mangrove Soil Chemistry Shark River Slough and Taylor Slough, Everglades National Park (FCE), from December 2000 to May 23, 2002
https://doi.org/10.6073/pasta/f0e13c236606c1ed6efe5618e3eee8c0	Frankovich, Thomas	Florida Bay Physical Data, Everglades National Park (FCE), South Florida from January 2001 to February 2002
https://doi.org/10.6073/pasta/5a01d59e5f7d73bd1f7baee2c71af765	Gaiser, Evelyn	Environmental data from FCE LTER Caribbean Karstic Region (CKR) study in Yucatan, Belize and Jamaica during Years 2006, 2007 and 2008
https://doi.org/10.6073/pasta/7b0e0c1a9a93965c79fd66bd4bbae46d	McIvor, Carole	Global Climate Change Impacts on the Vegetation and Fauna of Mangrove Forested Ecosystems in Florida (FCE): Nekton Portion from March 2000 to April 2004
https://doi.org/10.6073/pasta/52ed83a4d3148a02c8642e6f18d45659	Lorenz, Jerry	Physical Hydrologic Data for the National Audubon Society's 16 Research Sites in coastal mangrove transition zone of southern Florida from November 2000 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/c40d320f5d15fdd36a65ef7a2ef93f17	Smith, Ned	Evaporation Estimates for Long Key C-MAN Weather Station, Florida Bay (FCE) from July 1998 to May 2004
https://doi.org/10.6073/pasta/43f9e2156680db7372e8ad4db497eb0d	Saunders, Colin	Physical Characteristics and Stratigraphy of Deep Soil Sediments from Shark River Slough, Everglades National Park (FCE) from 2005 and 2006
https://doi.org/10.6073/pasta/c0cb8ff0f150e429674ecf0db15bedc5	Saunders, Colin	Radiometric Characteristics of Soil Sediments from Shark River Slough, Everglades National Park (FCE) from 2005 and 2006
https://doi.org/10.6073/pasta/e8f697869b4be3ac9c0cecff377d94d8	Saunders, Colin	Macrofossil Characteristics of Soil from Shark River Slough, Everglades National Park (FCE) from July 2003 to February 2006
https://doi.org/10.6073/pasta/2bcdb06ad4018aac1783c25701fa086b	Saunders, Colin	Isotopic Variation of Soil Macrofossils from Shark River Slough, Everglades National Park (FCE) in December 2004
https://doi.org/10.6073/pasta/8660289b8c1e9f2ca01ee503f0d9ecda	Chambers, Randy; Russell, Timothy; Gorsky, Adrianna	Physical and Chemical Characteristics of Soil Sediments from the Shark River Slough and Taylor Slough, Everglades National Park (FCE LTER) from August 2004 to Present

DOI	Authors	Title
https://doi.org/10.6073/pasta/536f61d4f0383101fc618ea51ae83d6b	Fourqurean, James	Florida Bay Nutrient Data, Everglades National Park (FCE), South Florida from August 2008 to Present
https://doi.org/10.6073/pasta/80bdd9313e1b82967389cef66cc087eb	Fourqurean, James	Florida Bay Braun Blanquet, Everglades National Park (FCE), South Florida from October 2000 to Present
https://doi.org/10.6073/pasta/ff606f863b711d4d9ce5d279f2fa3b56	Fourqurean, James	Florida Bay Productivity Data, Everglades National Park (FCE), South Florida from September 2000 to Present
https://doi.org/10.6073/pasta/8313969490ed0d91f8769b2853621fff	Fourqurean, James	Florida Bay Stable Isotope Data Everglades National Park (FCE LTER), South Florida from January 2005 to Present
https://doi.org/10.6073/pasta/37e73f234bc9756ada9192b3ee6ebd86	Fourqurean, James	Florida Bay Physical Data, Everglades National Park (FCE), South Florida from September 2000 to Present
https://doi.org/10.6073/pasta/45c042a44df4060b1766631dd2070851	Fourqurean, James	Florida Bay Seagrass Canopy Temperature Data, Everglades National Park (FCE), South Florida from September 2000 to Present
https://doi.org/10.6073/pasta/846912ffee551f31a886a24efb3064bb	Barr, Jordan; Fuentes, Jose; Engel, Vic; Zieman, Joseph	Flux measurements from the SRS-6 Tower, Shark River Slough, Everglades National Park (FCE LTER), South Florida from October 2006 to 2014

DOI	Authors	Title
https://doi.org/10.6073/pasta/f2dea22c72b4ba72fed419f15cbabb60	Price, Rene	Water flow velocity data, Shark River Slough (SRS) near Black Hammock island, Everglades National Park (FCE LTER), South Florida from October 2003 to August 2005
https://doi.org/10.6073/pasta/f0a076ef1cdb35abafab8b0b61fde59f	Price, Rene	Water flow velocity data, Shark River Slough (SRS) near Chekika tree island, Everglades National Park (FCE LTER) from January 2006 to Present
https://doi.org/10.6073/pasta/18c744af8da6cbfb986ff2a2fb20eded	Price, Rene	Water flow velocity data, Shark River Slough (SRS) near Frog City, south of US 41, Everglades National Park (FCE LTER) from October 2006 to July 2009
https://doi.org/10.6073/pasta/bdc327b2f493cfd4f51e3820fcbe4a0c	Price, Rene	Water flow velocity data, Shark River Slough (SRS) near Gumbo Limbo Island, Everglades National Park (FCE) from October 2003 to Present
https://doi.org/10.6073/pasta/fbb12ce7f9595d2b9c6ec6011b9236e1	Price, Rene	Water flow velocity data, Shark River Slough (SRS) near Satinleaf Island, Everglades National Park (FCE LTER) from July 2003 to December 2005
https://doi.org/10.6073/pasta/06938136601cdd81eb37837b7ea4b5fb	Price, Rene	Non-continuous TS/Ph7b Weather Tower Data, Everglades National Park (FCE LTER), South Florida from May 2008 to 2017

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https://doi.org/10.6073/pasta/d5a224eed0f1bec5b69ce963493d9af1	Price, Rene	Non-continous meteorological data from Butternut Key Weather Tower, Florida Bay, Everglades National Park (FCE LTER), April 2001 through August 2013
https://doi.org/10.6073/pasta/2b42a17496155b8a7ce2191ae90e193b	Price, Rene	Groundwater and surface water phosphorus concentrations, Everglades National Park (FCE), South Florida for June, July, August and November 2003
https://doi.org/10.6073/pasta/274fb25dec72d09d8226f147cdfbecb1	Rosenblatt, Adam	Water Temperature measured at Shark River, Everglades National Park (FCE) from October 2007 to August 2008
https://doi.org/10.6073/pasta/d5f7c45539c24870c37a4e05689ba9f2	Rosenblatt, Adam	Water Temperature, Salinity and other physical measurements taken at Shark River, Everglades National Park (FCE LTER) from February 2010 to March 2014
https://doi.org/10.6073/pasta/a50dd41d188c25bc122deee65c2c73a9	Rosenblatt, Adam	Water Temperature measured at Shark River, Everglades National Park (FCE) from July 2007 to June 2011
https://doi.org/10.6073/pasta/7682f3f1180f6048716b39531328a0b4	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Radiation measurements at Key Largo Ranger Station, South Florida (FCE) for July 2001

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https://doi.org/10.6073/pasta/d0950d21f1ba78c9e91ae08d867174be	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Meteorological measurements at Key Largo Ranger Station, South Florida (FCE) for July 2001 to August 2001
https://doi.org/10.6073/pasta/7390d5ffed6b06f0b881a8942a53e880	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Mangrove leaf physiological response to local climate at Key Largo, Watson River Chickee, Taylor Slough, and Little Rabbit Key, South Florida (FCE) from July 2001 to August 2001
https://doi.org/10.6073/pasta/6a3a958ec35ea159a935be9ceb214fe8	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Rubisco limited photosynthesis rates of Red mangrove leaves at Key Largo, Watson River Chickee, Taylor Slough, and Little Rabbit Key, South Florida (FCE) from July 2001 to August 2001
https://doi.org/10.6073/pasta/d6bea805dbfa2dca53bfd60735de1af8	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Light limited carboxylation rates of Red mangrove leaves at Key Largo, Watson River Chickee, Taylor Slough, and Little Rabbit Key, South Florida (FCE) from July 2001 to August 2001
https://doi.org/10.6073/pasta/aec87311dc582fde9adf4a11a198e0aa	Barr, Jordan; Fuentes, Jose; Zieman, Joseph	Flux measurements from the SRS-6 Tower, Shark River Slough, Everglades National Park, South Florida (FCE) from January 2004 to August 2005
https://doi.org/10.6073/pasta/e9498a3ecfd1d497c6b4c266901c9d4b	Frankovich, Thomas	Gastropod Biomass and Densities found at Rabbit Key Basin, Florida Bay (FCE) from March 2000 to April 2001

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https://doi.org/10.6073/pasta/2bf2a1f1d9c7904b12b137ba58956203	Frankovich, Thomas	Seagrass Epiphyte Accumulation for Florida Bay, South Florida (FCE) from December 2000 to September 2001
https://doi.org/10.6073/pasta/0d88f0cd8f29d6f227e19050bde91896	Frankovich, Thomas	Mean Seagrass Epiphyte Accumulation for Florida Bay, South Florida (FCE) from December 2000 to September 2001
https://doi.org/10.6073/pasta/5aadc198730a74b48ae27b6c1e11f3a8	Frankovich, Thomas	Seagrass Epiphyte Accumulation: Epiphyte Loads on Thalassia testudinum in Rabbit Key Basin, Florida Bay (FCE) from March 2000 to April 2001
https://doi.org/10.6073/pasta/bf798892c1105cb3a157f7132165c732	Frankovich, Thomas	Thalassia leaf morphology and productivity measurements from arbitrary plots located in a Thalassia seagrass meadow in Rabbit Key Basin, Florida Bay (FCE) from March 2000 to April 2001
https://doi.org/10.6073/pasta/393fd3bbbd5a520e5cf372483113f2ce	Frankovich, Thomas	Florida Bay, South Florida (FCE) Seagrass Epiphyte Light Transmission from December 2000 to February 2002
https://doi.org/10.6073/pasta/6b1a16e33753fdd17053c94d3e69c044	Troxler, Tiffany; Childers, Daniel	Periphyton Net Primary Productivity and Respiration Rates from the Taylor Slough, just outside Everglades National Park, South Florida (FCE) from December 1998 to August 2002

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https://doi.org/10.6073/pasta/84241f5358c01c8dacd832b42d3fc736	Gaiser, Evelyn	Diatom Species Abundance Data from LTER Caribbean Karstic Region (CKR) study (FCE) in Yucatan, Belize and Jamaica during 2006, 2007, 2008
https://doi.org/10.6073/pasta/f3a6a99aa7dacb1d338cf2d6d1698482	Gaiser, Evelyn	Periphyton data from LTER Caribbean Karstic Region (CKR) study in Yucatan, Belize and Jamaica (FCE) during 2006, 2007, 2008
https://doi.org/10.6073/pasta/b4200968cd7c84d47fd59a3d271e11b8	Cardona-Olarte, Pablo; Rivera-Monroy, Victor; Twilley, Robert	Greenhouse experiment (FCE) in April and August 2001: Responses of neotropical mangrove saplings to the combined effect of hydroperiod and salinity/Biomass
https://doi.org/10.6073/pasta/c559309bdc4b90e325b1e8772e1de60a	Cardona-Olarte, Pablo; Rivera-Monroy, Victor; Twilley, Robert	Greenhouse mixed culture experiment from August 2002 to April 2003 (FCE): Evaluate the effect of salinity and hydroperiod on interspecific mangrove seedlings growth rate (mixed culture) / Morphometric variables
https://doi.org/10.6073/pasta/435f4c70788b8199849b43c5445d3367	Mead, Ralph	Bulk Parameters for Soils/Sediments from the Shark River Slough and Taylor Slough, Everglades National Park (FCE), from October 2000 to January 2001
https://doi.org/10.6073/pasta/58459b0ae2531cbd516536a35735f83e	Rehage, Jennifer	Seasonal Electrofishing Data from Rookery Branch and Tarpon Bay, Everglades National Park (FCE) from November 2004 to Present

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https://doi.org/10.6073/pasta/91d7c7dd18e2580c7b1523c562db8021	Rehage, Jennifer	Minnowtrap Data from Rookery Branch and the North, Watson, and Roberts Rivers National Park (FCE) from November 2004 to April 2008
https://doi.org/10.6073/pasta/4eda63d153f0859a70c4398c3762be9e	Gaiser, Evelyn; Trexler, Joel	Fish and consumer data collected from Northeast Shark Slough, Everglades National Park (FCE) from September 2006 to September 2008
https://doi.org/10.6073/pasta/04a8792fed9ceed4237bd3273a97e8f8	Heithaus, Michael; Matich, Philip	Bull shark catches, water temperatures, salinities, and dissolved oxygen levels in the Shark River Slough, Everglades National Park (FCE) , from May 2005 to May 2009
https://doi.org/10.6073/pasta/961afc6d60089b0a11628abf89bae713	Castaneda, Edward; Rivera-Monroy, Victor	Water Levels from the Shark River and Taylor River Slough mangrove sites, Everglades National Park (FCE), South Florida from May 2001 to Present
https://doi.org/10.6073/pasta/1506f26afff3056d8b2a7738e2f6253e	Castaneda, Edward; Rivera-Monroy, Victor	Abiotic monitoring of physical characteristics in porewaters and surface waters of mangrove forests from the Shark River Slough and Taylor Slough, Everglades National Park (FCE LTER), South Florida from December 2000 to Present

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https://doi.org/10.6073/pasta/beb355c2f21efc3653f888709cf49637	McIvor, Carole	Global Climate Change Impacts on the Vegetation and Fauna of Mangrove Forested Ecosystems in Florida (FCE): Nekton Mass from March 2000 to April 2004
https://doi.org/10.6073/pasta/b7cc9644dbe22e6f3e869a6e8b2277bc	Castaneda, Edward; Rivera-Monroy, Victor; Twilley, Robert	Monitoring of nutrient and sulfide concentrations in porewaters of mangrove forests from the Shark River Slough and Taylor Slough, Everglades National Park (FCE LTER), South Florida from December 2000 to Present
https://doi.org/10.6073/pasta/73c32ad91eddd1843338e4081754d41e	Lorenz, Jerry	Standard Lengths and Mean Weights for Prey-base Fishes from Taylor River and Joe Bay Sites, Everglades National Park (FCE), South Florida from January 2000 to April 2004
https://doi.org/10.6073/pasta/56a7c2c88e4e20dc8c2b0100c3de9a1d	Rains, Mark	Subsurface Water Temperatures taken in Shark River Slough and Taylor Slough, Everglades National Park, South Florida (FCE) from May 2010 to Present
https://doi.org/10.6073/pasta/3938d3bb664d57584afc749c6a768f31	Jaffe, Rudolf	Monthly monitoring fluorescence data for Shark River Slough and Taylor Slough, Everglades National Park (FCE) for October 2004 to February 2014

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https://doi.org/10.6073/pasta/f8b5c0585e41ab48f07faf79c380043c	Heithaus, Michael; Matich, Philip	Large shark catches (Drumline), water temperatures, salinities, dissolved oxygen levels, and stable isotope values in the Shark River Slough, Everglades National Park (FCE LTER) from May 2009 to May 2011
https://doi.org/10.6073/pasta/81f980e956de95e603bfc367232d9fcd	Heithaus, Michael; Matich, Philip	Shark catches (longline), water temperatures, salinities, and dissolved oxygen levels, and stable isotope values in the Shark River Slough, Everglades National Park (FCE LTER) from May 2005 to Present
https://doi.org/10.6073/pasta/1d696e0668ed238469adeaed24dd7bc1	Onsted, Jeff	FCE Redlands 1994 Land Use, Miami-Dade County, South Florida
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https://doi.org/10.6073/pasta/b1c64a9c7c616829ace724de8d41785b	Onsted, Jeff	FCE Redlands 2001 Land Use, Miami-Dade County, South Florida
https://doi.org/10.6073/pasta/f0c0fcaaca44b472112745262c372628	Onsted, Jeff	FCE Redlands 2008 Slope Mosaic, Miami-Dade County, South Florida
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https://doi.org/10.6073/pasta/e7856aad78610c7c365cf620f47a5ef5	Onsted, Jeff	FCE Redlands 1994 Land Use, Miami-Dade County, South Florida
https://doi.org/10.6073/pasta/29ed91e46b4a898129f8b03c3500abbd	Heithaus, Michael; Nowicki, Robert	Percent cover, species richness, and canopy height data of seagrass communities in Shark Bay, Western Australia, with accompanying abiotic data, from October 2012 to July 2013
https://doi.org/10.6073/pasta/3eed6e46081423861d71e6d6a6ee3194	Heithaus, Michael; Nowicki, Robert	Fish community data obtained from Antillean-Z fish trap deployment in the Eastern Gulf of Shark Bay, Australia from June 2013 to August 2013
https://doi.org/10.6073/pasta/b4c39439f21d56d0c87b00c59073cf89	Heithaus, Michael; Thomson, Jordan	Capture data for sharks caught in standardized drumline fishing in Shark Bay, Western Australia, with accompanying abiotic data, from February 2008 to July 2014.
https://doi.org/10.6073/pasta/225c82aa5925cee430a8c7a6a44e8d85	Heithaus, Michael; Thomson, Jordan	Capture data for sharks caught in standardized drumline fishing in Shark Bay, Western Australia, with accompanying abiotic data, from January 2012 to April 2014.

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https://doi.org/10.6073/pasta/e91ff5368ab0dfc412678170f8a0d1a6	Heithaus, Michael; Nowicki, Robert	Count data of air-breathing fauna from visual transect surveys including water temperature, time, sea and weather conditions in Shark Bay Marine Park, Western Australia from February 2008 to July 2014
https://doi.org/10.6073/pasta/7696e20214fbf84f25d664ff7dc8050c	Heithaus, Michael; Thomson, Jordan	Marine turtles captured during haphazard at-sea surveys in Shark Bay, Australia from February 2008 to December 2013
https://doi.org/10.6073/pasta/299262fa63c46ead98210cb5ea0bcac2	Heithaus, Michael; Bessey, Cindy	Stationary camera observations, set, and environmental data from Shark Bay Marine Park, Western Australia from July 2011 to June 2012
https://doi.org/10.6073/pasta/b7742d3e0a93696342708d98590b9db1	Heithaus, Michael; Bessey, Cindy	Fish trap catch, set, and environmental data from Shark Bay Marine Park, Western Australia from May 2010 to July 2012
https://doi.org/10.6073/pasta/eb094c43ecd8c2c99bbeda0605f67fd3	Castaneda, Edward; Rivera-Monroy, Victor; Twilley, Robert	Mangrove Litterfall from the Shark River Slough and Taylor Slough, Everglades National Park (FCE), South Florida from January 2001 to Present
https://doi.org/10.6073/pasta/dd9da92e48b2506cc0c2a352a5cbea8f	Anderson, William	DIC and DOC 13C tracer data from Shark River Slough and Harney River (FCE), Everglades, South Florida in November 2011

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https://doi.org/10.6073/pasta/58414574e57fd558d71cfab0952c0dc1	Rehage, Jennifer	Common snook (Centropomus undecimalis) movements within the Shark River estuary (FCE), Everglades National Park, South Florida from February 2012 to Present
https://doi.org/10.6073/pasta/bb567fd4066fa2866419a1a200a89c92	Rehage, Jennifer	Trophic transfer of Everglades marsh consumer biomass to Everglades Estuaries (FCE), Everglades National Park, South Florida from December 2010 to Present
https://doi.org/10.6073/pasta/19cf88ce1278d8aec2bf776de13f4ff4	Harrison, Elizabeth; Trexler, Joel	Cichlasoma urophthalmus microsatellite fragment size collected from the Florida Everglades (FCE) and Central America from June 2010 to March 2013
https://doi.org/10.6073/pasta/4a07f10ec6a08e78279a506423f22305	Harrison, Elizabeth; Trexler, Joel	Cichlasoma urophthalmus cytochrome b sequences collected from the Florida Everglades (FCE) and Central America from January 2012 to May 2014
https://doi.org/10.6073/pasta/fa74b6fd049af01379f50d9693552d55	Chambers, Randy; Russell, Timothy; Hatch, Rosemary; Katsaros, Dean; Gorsky, Adrianna	Percentage of Carbon and Nitrogen of Soil Sediments from the Shark River Slough, Taylor Slough and Florida Bay within Everglades National Park (FCE LTER) from August 2008 to Present

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https://doi.org/10.6073/pasta/4ad1a469ff103d2e8f0c3971f703ec16	Fourqurean, James; Howard, Jason	Cross Bank Benthic Aboveground Biomass, Everglades National Park (FCE LTER), South Florida from 1983 to 2014
https://doi.org/10.6073/pasta/3a9bb697bbb8295bffdf6031ff1ae644	Fourqurean, James; Howard, Jason	Cross Bank Sediment Characteristics, Everglades National Park (FCE LTER), South Florida from 2014
https://doi.org/10.6073/pasta/756edd5f40dbf69ca478d8c48f6ee6ba	Price, Rene	Monthly water balance data for southern Taylor Slough Watershed (FCE LTER) from January 2001 to December 2011
https://doi.org/10.6073/pasta/e84cc609ffbc63bb45bd484810e6746b	Jaffe, Rudolf; Pisani, Oliva	Biomarker assessment of spatial and temporal changes in the composition of flocculent material (floc) in the subtropical wetland of the Florida Coastal Everglades (FCE) from May 2007 to December 2009
https://doi.org/10.6073/pasta/e355a9f1d3c1e5ad4e5764a9c24b02c3	Kominoski, John; Gaiser, Evelyn	Mangrove soil phosphorus addition experiment from June 2013 to August 2013 at the mangrove peat soil mesocosms (FCE), Key Largo, Florida - Nutrients in Porewater, Soil and Roots
https://doi.org/10.6073/pasta/96f4fc41e721f657219429c64b01f0e4	Kominoski, John; Gaiser, Evelyn	Mangrove soil phosphorus addition experiment from July 2013 to August 2013 at the mangrove peat soil mesocosms (FCE), Key Largo, Florida - Nutrients in Surface Water and Aboveground Biomass

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https://doi.org/10.6073/pasta/02cf0405c4f560746a5e5275ef6e225b	Regier, Peter; JaffÃ©, Rudolf	Fluxes of dissolved organic carbon from the Shark River Slough, Everglades National Park (FCE), South Florida from May 2001 to September 2014
https://doi.org/10.6073/pasta/7ed04d64d07a7dd7a4694615df8211a6	Gaiser, Evelyn	Periphyton and Associated Environmental Data From the Comprehensive Everglades Restoration Plan (CERP) Study from February 2005 to November 2014 (FCE)
https://doi.org/10.6073/pasta/a9dca89331d33221c59a6aa0ae96278a	Gaiser, Evelyn	Relative Abundance Diatom Data from Periphyton Samples Collected from the Greater Everglades, Florida USA from September 2005 to November 2014
https://doi.org/10.6073/pasta/6e16b97781030e670fd94221ac812f5d	Gaiser, Evelyn	Relative Abundance of Soft Algae From theComprehensive Everglades Restoration Plan (CERP) Study (FCE) from February 2005 to November 2014
https://doi.org/10.6073/pasta/1755e84862607d90e33bcefe6ce997e2	Coronado, Carlos A; Sklar, Fred	Sediment Elevation Change (Feldspar Marker Horizon Method) from Northeastern Florida Bay (FCE) from 1996 to Present
https://doi.org/10.6073/pasta/0edc80f91191e66eea6b4b0ebd407a0d	Coronado, Carlos A; Sklar, Fred	Sediment Elevation Change (SET Method) from Northeastern Florida Bay (FCE) from 1996 to Present

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https://doi.org/10.6073/pasta/70cdfca241ed9dffefdb7b3608d20ef1	Trexler, Joel; Sanchez, Jessica	Periphyton Nutritonal Data across the freshwater Everglades (FCE): June 2016-Feb 2017
https://doi.org/10.6073/pasta/4e6dc2b1aab5c02c224a27c2eaff2e82	Mazzei, Viviana; Gaiser, Evelyn	Periphyton, hydrological and environmental data in a coastal freshwater wetland (FCE), Florida Everglades National Park, USA (2014-2015)
https://doi.org/10.6073/pasta/05944589bc8b526ead9b1df50797e00a	Yoder, Landon; Roy Chowdhury, Rinku	Institutional Dimensions of Restoring Everglades Water Quality - Social Capital Analysis (FCE), Florida Everglades Agricultural Area from September 2014 to July 2015
https://doi.org/10.6073/pasta/94d1f65d4c822af1150bc9e7694e59d1	Yoder, Landon; Roy Chowdhury, Rinku	Institutional Dimensions of Restoring Everglades Water Quality -Interview Notes (FCE), September 2014-July 2015
https://doi.org/10.6073/pasta/f66a58d857b76740e03c3c48da16cc73	Sarker, Shishir	Water, Soil, Floc, Plant Total Phosphorus, Total Carbon, and Bulk Density data (FCE) from Everglades Protection Area (EPA) from 2004 to 2016
https://doi.org/10.6073/pasta/adc510f0d772128a19c545cc6c8a7df1	Wilson, Benjamin; Troxler, Tiffany	Nutrient data from the Peat Collapse-Saltwater Intrusion Field Experiment from brackish and freshwater sites within Everglades National Park, Florida (FCE LTER), collected from October 2014 to September 2016

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https://doi.org/10.6073/pasta/0412d0e992558af65cf22110ef8f0e1b	Wilson, Benjamin; Troxler, Tiffany	Leaf nutrient and root biomass data from the Peat Collapse-Saltwater Intrusion Field Experiment within Everglades National Park (FCE), collected from October 2014 to September 2016
https://doi.org/10.6073/pasta/6a18d0ec3a960a82b6989c18f01205b2	Wilson, Benjamin; Troxler, Tiffany	Biomass data from the Peat Collapse-Saltwater Intrusion Field Experiment within Everglades National Park (FCE), collected from October 2014 to September 2016
https://doi.org/10.6073/pasta/54104d869d122b20b4bcfa3cf8acad1c	Wilson, Benjamin; Troxler, Tiffany	Modeled flux data from the Peat Collapse-Saltwater Intrusion Field Experiment within Everglades National Park (FCE), collected from October 2014 to September 2016
https://doi.org/10.6073/pasta/a84048bfa2552499fad8d80f313db008	Wilson, Benjamin; Troxler, Tiffany	Flux data from the Peat Collapse-Saltwater Intrusion Field Experiment within Everglades National Park, collected from October 2014 to September 2016
https://doi.org/10.6073/pasta/56ed2fa499366b43e43ac794fcaa52c6	Rizzie, Chris; Nocentini, Andrea; Sarker, Shishir; Kominoski, John; Gaiser, Evelyn; Scinto, Leonard	Biogeochemical data collected from Northeast Shark River Slough, Everglades National Park, Florida from September 2006 to present

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https://doi.org/10.6073/pasta/a269722318964f74cb5cabf87f0d3fb3	Lee, Dong Yoon; Wilson, Ben J.; Servais, Shelby; Mazzei, Viviana; Kominoski, John	The Salinity and phosphorus mesocosm experiment in freshwater sawgrass wetlands: Determining the trajectory and capacity of freshwater wetland ecosystems to recover carbon losses from saltwater intrusion (FCE LTER), Florida, USA from 2015 to 2018
https://doi.org/10.6073/pasta/2eb6663175051c21427304e75d0840fb	Castaneda, Edward; Rivera-Monroy, Victor	Sediment and nutrient deposition and plant-soil phosphorus interactions associated with Hurricane Irma (2017) in mangroves of the Florida Coastal Everglades (FCE LTER), Florida
https://doi.org/10.6073/pasta/45cfe2505580cedf88a82f8911bdd741	Howard, Jason L; Fourqurean, James W	Organic and inorganic data for soil cores from Brazil and Florida Bay seagrasses to support Howard et al 2018, CO_2 released by carbonate sediment production in some coastal areas may offset the benefits of seagrass â€œBlue Carbonâ€ storage, Limnology and Oceanography, DOI: 10.1002/lno.10621
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https://doi.org/10.6073/pasta/27f6332609eb1ef6d398c7855855f2e3	Hogan, James A; Castaneda, Edward; Lamb-Wotton, Lukas	FCE LTER Taylor Slough/Panhandle-7 Site Scrub Red Mangrove (Rhizophora mangle) Leaf Gas Exchange Data, Florida, USA from January-December 2019
https://doi.org/10.6073/pasta/27afcea3bab0adc058457705506248f8	Kominoski, John	Saltwater Coastal Carbon Flux Synthesis
https://doi.org/10.6073/pasta/4097433552819a3c6958b5dbd0b8ef86	Kominoski, John Stephen	Freshwater Subtropical Ridge and Slough Wetland Metabolism, South Florida, USA: 2014-2016
https://doi.org/10.6073/pasta/b202c11db7c64943f6b4ed9f8c17fb25	Nocentini, Andrea; Kominoski, John S	Biogeochemical data collected in the eastern marl prairies of the Everglades (Florida, USA) before and after fire, between the years 2018 and 2021
https://doi.org/10.6073/pasta/d1abed5732fe4f4b086e092fb85bf431	Kominoski, John Stephen	Monthly monitoring fluorescence data for Shark River Slough and Taylor Slough, Everglades National Park, Florida, USA (FCE LTER) for 2012 to Present