FCE ASM 2012

Climate and Disturbance

Research Activities from 2010 - 2011

• JOPL Special Issue
• Paleoclimate/paleoecolgoical efforts
• SRS tracer study I & II
• NSF MR2 equipment operational, e.g. CRDS
• International efforts (Victor, LSU)
• Planning effort for coring from the Greater Okeechobee region for AMO (with RSMAS & Cal State Fullerton)


AMO, PDO, and Region 5

- Both the AMO and the PDO influence precip.
- AMO & PDO alternate periods of correlation
- Relatively short instrumental record for such observations
  - Stresses the need for paleo-records
Precipitation within the FCE

Moses et al., in press
AMO and Precipitation


Wet Season
AMO, ENSO & PDO

Compared with seasonal precipitation

Moses et al., in press
FCE Annual Precipitation

EDEN NexRad

NOAA gauges

EDEN Mean Annual Precipitation (2002-2006)

NOAA Mean Annual Precipitation (2002-2006)
Merged EDEN & NOAA Precip (2002-2006)
Synthesis of SOM & nutrient accumulation in the Everglades southern coastal ecotone: Implications for hydrologic restoration

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Objectives

• Summarize vertical soil accretion in the southern Everglades region

• Summarize soil OM and nutrient accumulation rates – focus on Taylor River
PART 2: Spatial & Temporal Variation in Soil-OM & Nutrient Accumulation, 1880-2008
Soil-OM & P accumulation & Paleo-Hydrology, 1880-2010

Soil-OM (g m\(^{-2}\) y\(^{-1}\))

Soil-P (g m\(^{-2}\) y\(^{-1}\))

Paleo-salinity
- <15 ppt
- 18-25 ppt
- >25 ppt

Russel Bank \(^1\)
Barnes Sound \(^2\)

Synthesis: Accretion & SOM/Nutrient Accumulation

Accretion | SOM accum. | P accum. | Inferred Mechanisms
--- | --- | --- | ---
↓ | ↓ | ↓ | Soil oxidation, P mineralization
↓ | ↓ | ↓ | Soil oxidation, erosion, P mineralization
↑? | ↑? | ↑↑↑ | GW-P discharge, Increased NPP
↓ | ↓ | ↑↑↑ | GW-P discharge, Marine-P influx, Increased Oxidation

Reduced Freshwater

FW marshes

White Zone

Mangroves (N & Mid)

Mangroves (S)
# Synthesis: Expectations with Hydrologic Restoration

<table>
<thead>
<tr>
<th>Offset SLR (accretion)</th>
<th>Water Quality (P retention)</th>
<th>Inferred Mechanisms</th>
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<tr>
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<td>Low soil oxidation, Low P mineralization</td>
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<td>Low soil oxidation/ Low erosion Low P mineralization</td>
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<td>Less GW-P disch. Lower NPP</td>
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<td>Less GW-P dischg. Low soil oxidation Low P mineralization</td>
</tr>
</tbody>
</table>

**FW marshes**

**White Zone**

**Mangroves (N & Mid)**

**Mangroves (S)**

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*Note: The diagram illustrates the expected outcomes of hydrologic restoration on different ecosystems. The arrows indicate the direction of changes in soil properties and water quality.*
Accumulation Rates at SRS-6

Donny Smoak, Josh Breithaupt (USF)
Vic Engle (ENP/USGS)
Tom Smith (USGS)
and others

Important to know how much C accumulation has occurred
• for carbon flux modeling, long-term
• SL rise
• GW discharge (P)
• NSF WSC
Accumulation Rates at SRS-6

OC & Mass Accumulation

- $^{210}$Pb dating of six cores at SRS-6
- Site mean OC burial rate: $163\pm33$ g m$^{-2}$ yr$^{-1}$; “Wilma” mean OC burial rate is $266\pm58$ (~63% increase)
- OC represents 27% of Mass Burial Rate overall, and 17% of “Wilma” burial rate.
- Site mean sediment accretion rate is $2.8\pm0.5$ mm yr$^{-1}$; (basically matching mean Key West SLR rate)
- Accretion rate in “Wilma” layer is $4.8\pm1.1$, (~71% increase).
- “Wilma” impact noticeable in intervals both pre- & post- 2005
- Mechanisms for increased OC burial rate need clarification:
  - Increased production following the storm? and/or
  - Storm surge resuspension & deposition of previously buried OC?

Sediment Accretion
Core retrieved 160m inland; (~85m southwest of flux tower)

Mean OC burial: 197 g m$^{-2}$ yr$^{-1}$

Mean Sediment Accretion (density corrected): 3.0 mm yr$^{-1}$

Generally increasing trend up-core

Dated depth is 28cm; model age errors are less than 3% for given dates

Sediment being used in diatom analysis of salinity changes in past century (Ania Wachnicka).
Ecosystem Disturbance Assessment

An assessment of natural and human disturbance effects on Mexican ecosystems: current trends and research gaps

Luis E. Calderon-Aguilera, Víctor H. Rivera-Monroy, Luciana Porter-Bolland, Angelina Martínez-Yrízar, Lydia B. Ladah, Miguel Martínez-Ramos,

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DOI 10.1007/s10531-011-0218-6


Objectives,
To assess,
(1) the most important agents of disturbance
(2) the vulnerability of each ecosystem to anthropogenic and natural disturbance, and
(3) the differences in ecosystem disturbance regimes and their resilience.

The constant and widespread presence of human impacts on both terrestrial and aquatic ecosystems is reflected either in reduced area coverage for most systems, or reduced productivity and biodiversity, particularly in the case of fragile ecosystems (e.g., rain forests, coral reefs). In all cases, the interaction between historical human impacts and episodic high intensity natural disturbance (e.g., hurricanes, fires) has triggered a reduction in species diversity and induced significant changes in habitat distribution or species dominance. The lack of monitoring programs assessing before/after effects of major disturbances in Mexico is one of the major limitations to quantifying the commonalities and differences of disturbance effects on ecosystem properties.
Immediate future goals

- JOPL Special Issue – Comes out this year
- SRS tracer study I & II – and potentially WSC
- Move forward with DIC (both concentration and $^{13}$C) at all FCE sites
- Deploy CRDS system at three sites with RSMAS ($pCO_2$ and $^{13}$C)
- Coring key sites, Greater Okeechobee region for AMO (with RSMAS and Fullerton)
- High res. Peoleoclimate/hydrologic reconstructions (SRS, TS and Big Pine Key)
- All of these efforts will transition right into FCE III

Enfield, et al., (2001) - GRL
Future approaches: Deployments above, in and below the ecotone for \( \text{pCO}_2 \)

• New analytical approaches – Picarro iTOC system (NSF award)

• RSMAS has 2 more

\( ^{13}\text{C} \) in air (and in DIC, TOC and DOC)

Can be deployed in the field for \textit{in situ} sampling