2009 Florida Coastal Everglades
3RD Year Review
Theme 3: Hydrologic drivers as related to the position of the seawater mixing zone

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HYDROLOGY GROUP
CONCEPTUAL MODEL

Fresh water head levels
Seawater levels
rainfall
climate
management

Water Table
Solute-P
Brackish Mixing Zone
Seawater Intrusion
Ocean

Florida Coastal Everglades
Long Term Ecological Research
Annual Rainfall (cm) as deviation from the 30-yr mean

Royal Palm

MIA
51 tropical and subtropical storms affected Florida between 2000 and 2008
Hydrology and Climate

Graphs showing the number of storms affecting Florida and the temperatures and precipitation in Miami International Airport from 1961 to 1990.
FLOWs beneath Tamiami Trail into Shark Slough

2000 – 2006 total flows: ~10M acre-ft
Annual Taylor Slough Bridge Flows

2000 – 2006 total flows: ~175K acre-ft
CENTRAL QUESTIONS

1. How will changing hydrologic conditions (upstream water flow or sea level rise) affect the position of the brackish mixing zone and alter geochemical conditions in the ecotone? (Addressed in the first 3 years)

2. How will changing freshwater inflows or sea level rise affect water residence times in the oligohaline ecotones of Taylor and Shark River Sloughs? (Will be addressed in the next 3 years)
Position of seawater mixing zone is monitored with groundwater wells
11 Sites Sampled In Sept. 2007

Groundwater Wells < 7m deep

- 5 Salinity contour in June – Aug 2003
- 5 Salinity contour in Sept. 2007
SRS-4
Water depth and Groundwater Salinity

Smith and Anderson, USGS, provisional data
SRS-4/ SH-2

I need to update this graph
11 Sites Sampled In Sept. 2007

Groundwater Wells < 7m deep

Salinity contour in June – Aug 2003

Salinity contour in Sept. 2007
Western Coastline of ENP
Sept. 2007

\[ y = -0.74x + 103.57 \]
\[ R^2 = 0.02 \]

\[ \text{Total N (µM)} \]

Salinity (psu)

Surface Water  
Groundwater  
Linear (Groundwater)

Gulf of Mexico

(Boyer et al. 1999)
Western Coastline of ENP
Sept. 2007

\[ y = 0.20x + 0.04 \]
\[ R^2 = 0.72 \]

Total P (µM)

salinity (psu)

Surface Water
Groundwater

(Boyer et al. 1999)
Gulf of Mexico
In the brackish groundwater zone, calcium carbonate mineral dissolution is responsible for the release of P at lower salinities, while at higher salinities, bicarbonate ions in the intruding seawater exchange with phosphate ions adsorbed onto the limestone bedrock. The high P in the brackish groundwater is then transported upward toward the roots of the overlying mangroves.
In Shark Slough, the groundwater TP in the underlying limestone bedrock (GW) is higher than observed in Peat groundwater (PW) and higher still than the surface water (SW). The high TP in the groundwater may be retained in the peat before it discharges to the surface water. TP concentrations measured in Taylor Slough groundwater in the bedrock (GW) and peat (PW) are lower than those observed in Shark Slough and similar to those observed in Taylor Slough surface water (SW).
Position of the Mangrove Ecotone (left figure) is similar to the landward extent of the seawater mixing zone in the underlying groundwater, as defined by the 5 psu salinity contour line (right-hand figure), suggesting a connection between extent of the mangroves and the underlying groundwater chemistry.
FCE Hydrology in ISSE Context

**Socio-cultural-economic Template**

**HUMAN BEHAVIOR**
- Ecosystem restoration
- Land governance
- Water use policies
- Urban-development boundary

**HUMAN OUTCOMES**
- Land use change
- Demography trends
- Societal vulnerability
- Human health

**PULSES**
- Increased storm activity
- Short-term water mgmt

**PRESSES**
- Sea-level rise, wet climate cycles, sustained reduced fw flows

**Geophysical Template**

**SYSTEM STRUCTURE**
- Water levels
- Ecotone Salinity
- Belowground Nutrients

**SYSTEM FUNCTION**
- Surface Discharge
- Groundwater discharge
- Surface P transport
- Groundwater P transport

**SYSTEM SERVICES**
- C sequestration
- Flood protection
- Saltwater intrusion to aquifer