Application of HYMAN Model to evaluate water and salt budgets in Shark River Estuary

Cheng-Feng Tsai¹
Robert R. Twilley²
Clinton S. Willson¹
Victor H. Rivera-Monroy²

¹Department of Civil and Environmental Engineering
²Department of Oceanography and Coastal Sciences
Louisiana State University
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1. The Importance of Coastal Wetlands

- Reduce storm surge and saltwater intrusion
- Support food chain
- Provide wildlife habitats
- Improve water quality
- Maintain a near-sea-level elevation
- Protect coastal community

(Patrick 1994; Day et al. 1995; Kadlec 1995; Nepf 1999; Mitsch and Gosselink 2000; Day et al. 2007; Melesse et al. 2007; Spalding and Hester 2007)
2. The Everglades

Source: http://fcelter.fiu.edu/
3. The Water Flow in the Everglades

Historic Flow

Current Flow

The Plan (CERP) Flow

Source: www.evergladesplan.org
4. Central Question

How changes in hydrology at the landscape level will influence the water and salt budgets in Shark River Estuary?

(Twilley and Rivera-Monroy 2005)
### 5. Study Sites and Monitoring Stations

<table>
<thead>
<tr>
<th>Site</th>
<th>Latitude (N)</th>
<th>Longitude (W)</th>
<th>Availability</th>
<th>Agency</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS4</td>
<td>25° 24.5859'</td>
<td>80° 57.8586'</td>
<td>Channel water depth, Forest water depth, Topography, Pore water salinity, Sediment accretion rate</td>
<td>FCE</td>
</tr>
<tr>
<td>SRS5</td>
<td>25° 22.6214'</td>
<td>81° 1.9408'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SRS6</td>
<td>25° 21.8778'</td>
<td>81° 4.6768'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENP_TE</td>
<td>25° 24.4926'</td>
<td>80° 57.8604'</td>
<td>Precipitation, Temperature</td>
<td>ENP</td>
</tr>
<tr>
<td>ENP_GI</td>
<td>25° 22.5870'</td>
<td>81° 1.7724'</td>
<td>Channel salinity</td>
<td></td>
</tr>
<tr>
<td>ENP_SR</td>
<td>25° 21.1098'</td>
<td>81° 5.9814'</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Map of study sites and monitoring stations]

6. Conceptual Model of HYMAN

(Twilley 1982)
### 7. Input Parameters

#### HYDROLOGY INFORMATION
- **Initial Water Level (cm):** 80
- **Seepage (cm/day):** 4.1
- **Ground Surface Above msl (cm):** 80
- **Full Bankstage (cm):** 8
- **% of Rainfall Reaching Forest Floor:** 0.95
- **Threshold (m):** 1.07
- **Sea Level Rising Rate (cm/100 years):** 0.002

#### SALINITY INFORMATION
- **Initial Salt in Pore Water (water level × initial salinity):** 0.097
- **Initial Salinity in Pore Water:** 0.0012125
- **Specific Yield for Above Ground:** 0.9
- **Specific Yield for Under Ground:** 0.065
- **Index for Salt Export by Tide:** 0.0003
- **Index for Salt Export by Rainfall Runoff:** 2.0
- **Accretion Rate:** 0.006

▲: constants
■: daily variables
8. Pore water measurements

Plot 1

Plot 2

SRS4

SRS5

SRS6

Plot 2

Plot 1

Shark River

Shark River

Shark River
9. Results and Discussions
Precipitation in SRS6
Pore water salinity of SRS5

Year 2003

Year 2004

Year 2005

Pore water salinity (ppt)
Precipitation in SRS5

The graph illustrates the monthly rainfall in SRS5 from 2003 to 2005. The blue line represents the simulated rainfall, and the red line represents the observed rainfall. The graph shows a significant variation in rainfall throughout the years, with peaks in some months and troughs in others. The inset image provides a geographical context for the SRS5 location.
Tidal salinity in SRS5

[Graph showing tidal salinity over years 2003 to 2005 with observed and simulated data.]
Precipitation in SRS4

The graph shows monthly precipitation data for SRS4 from 2003 to 2005. The data is represented by lines with markers and error bars indicating the observed values. The simulated data is shown with a dotted line. The precipitation peaks are observed in May for all years, with slight variations in magnitude.
Tidal salinity in SRS4
10. Conclusions

- The modified HYMAN model can reasonably match the pore water salinity observation trends in these three mangrove forest sites.
- The simulated pore water salinity at each site is consistent with its distance to the estuary mouth.
- Topography (e.g. bankstage) is the most critical factor to calibrate the HYMAN model.
- Precipitation determines the timing of the pore water salinity peak in the forest.
11. Future Study

- Measure actual surface runoff
- Determine groundwater recharge/discharge influence
- Test upstream freshwater schemes
- Run global climate change/sea level rise impacts
Questions?