Development of a Real-time Coastal Drought Index

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Coastal Drought

- Effects on:
  - Tidal marsh
  - Shellfisheries
  - Vibrio pathogen transport
- Largest stressor – salinity
**Question** – Can a drought index be developed for the coast?
Can Salinity be Used as a Drought Index Variable?

Pee Dee River

Waccamaw River

Riverine Flow

Freshwater

Saltwater

Tidal forcing
1) Mean water level
2) Tidal range
Long-term Salinity Data

Waccamaw River at Hagley Landing (02110815)
Long period of record
1989 to present
Daily mean salinity
~8,000 data point
Flow, Salinity, and Drought Index
Index Development Approach

1. Signal process salinity times series to extract drought information,
2. Create “coastal drought” salinity time-series,
3. Compute frequency distribution, and
4. Use frequency distribution to set drought thresholds
Index Development Approach

- Computed frequency distribution of CDI values
- Pick threshold values from distribution
Issues to Address

- Concern for “wet” conditions
- Time scales between the CDI and ecological response variables
Standardized Precipitation Index (SPI)

- Similarity of SPI and cumulative Z-scores
- Normalize precipitation with probability distribution
- Index values are standard deviation from the median
- Index for dry and wet conditions
- SPIs comparable for different locations
Benefits of computing a **Standardize Salinity Index**

- Compute for multiple time periods
  - 1-month, 3-month, 6-months, etc.
  - Difference time periods used for different drought response variable
- Index for fresher and saltier conditions
- Real-time computation of SSI
- Challenges
  - Limited number of long-term sites
  - Missing record – estimating data gaps
Monthly values

Negative SSIs – saltier conditions
Positive SSIs- fresher conditions

Now with “negative” drought values
Transform SSI values into Drought Declarations

<table>
<thead>
<tr>
<th>Declaration</th>
<th>Description</th>
<th>CDI Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>W4</td>
<td>Exceptional wet</td>
<td>2</td>
</tr>
<tr>
<td>W3</td>
<td>Extreme Wet</td>
<td>1.6</td>
</tr>
<tr>
<td>W2</td>
<td>Severe Wet</td>
<td>1.3</td>
</tr>
<tr>
<td>W1</td>
<td>Moderate Wet</td>
<td>0.8</td>
</tr>
<tr>
<td>W0</td>
<td>Abnormally Wet</td>
<td>0.5</td>
</tr>
<tr>
<td>N0</td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td>D0</td>
<td>Abnormally Dry</td>
<td>-0.5</td>
</tr>
<tr>
<td>D1</td>
<td>Moderate Drought</td>
<td>-0.8</td>
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</tr>
</tbody>
</table>

Positive SSIs – fresher conditions
Negative SSIs – saltier conditions
Coastal Drought Declarations
Regional Comparison

Is the CDI a site specific index or can it be used to regional comparisons?
Comparison with Drought Monitor Maps

5/15/2001

10/18/2007

5/22/2012
Florida Bay Application

USGS Coastal Gradients Network

Comparison of Joe Bay CDI with Drought Monitor maps
Dark water events in Southern Florida

Size of the 2011 event much smaller than the one 10 years earlier
Summary

- CDI can be used for drought and wet conditions
- Not a site specific CDI
- May be able to use different periods of salinity record
- Can be used to regional comparison
- The multiple CDI-interval can tie it to various drought response variables
- Based on established SPI computation that readily understood and used in the drought community
Questions?

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