Studying Sea Level Rise and Coastal Forests with Dendrochronology

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What we know

• Tidal forested freshwater wetland response to sea level rise
  • Very little
  • Ecotonal position makes them sensitive to sea level rise (Whigham et al. 2009)
  • Forest communities being converted to marsh (Craft et al. 2009)
  • Tree stress can cause changes in the net N and P mineralization, thus impacting eutrophication (Noe et al. 2013)
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Agriculture
Residential
Forested
Wetland
Deciduous
Forest

Why Should We Care?

Introduction
Dendrochronology
Methods
Preliminary Results
Next Steps

St. Jones River
Wetland
Residential
Agriculture
Forested Wetland
Deciduous Forest
Research Questions

1. Can we use dendrochronology and coastal forests as a proxy for sea level rise?
2. Can we learn about coastal forest response to sea level rise?
3. Can we learn about storm frequency and marsh inundation from the tree ring record?

*very few studies with tree rings in these communities
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Annual Tree Rings (cross-section view)
Variation in Ring Width Due to Environmental Conditions
Visual Inspection and Dot Dating

Introduction

Dendrochronology

Methods

Preliminary Results

Next Steps
Skeleton Plots

the narrower the ring, the longer the line!

http://www.ltrr.arizona.edu/skeletonplot/plotting.htm
Measuring Rings (.001mm)

- False and Missing Rings
TRE-RING WIDTH

Rapid growth when tree is young

Measured ring widths (mm)

Ring width INDICES
(with fast, early “growth trend” removed, i.e. filtered out)
The MASTER CHRONOLOGY is based on previously measured and dated tree rings from the same area and includes a master skeleton plot AND tree-ring width measurements (indices).
Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar
(Juniperus virginia)

1. Master chronology 1 (below 1 ft contour)
2. Master chronology 2 (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records
Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar (*Juniperus virginia*)

1. Master chronology 1 (below 1ft contour)
2. Master chronology 2 (inundated with 1.0 m rise)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records
Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar (Juniperus virginia)

1. Master chronology 1 (inundated with 0.5 m rise)
2. Master chronology 2 (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records
Our Project

Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar (*Juniperus virginia*)

1. Master chronology 1 (inundated with 0.5 m rise)
2. Master chronology 2 (between 1 ft and 2 ft contour)
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5. Compare to storm records
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Study Site: St. Jones Reserve
Study Species: Eastern Red Cedar (*Juniperus virginia*)

1. Master chronology 1 (inundated with 0.5 m rise)
2. Master chronology 2 (between 1 ft and 2 ft contour)
3. Difference chronology
4. Compare to tide gauge
5. Compare to storm records
Work Completed

• Collected duplicate cores from a minimum of 20 trees for both chronologies
• Glued and sanded all cores
• Dot dated and created a master skeleton plot for master chronology 1
• Measured all rings for master chronology 1
• In the quality control process for master chronology 1
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Preliminary Results

Time Span: 84 years (1932-2015)
Time Span with more than 2 series: 73 years (1943-2015)
Number of Series: 27
Rings measured: 1,175
Series intercorrelation 0.190
Average mean sensitivity .379
Problems to be addressed: 31
Preliminary Results

Tree Ring Widths

<table>
<thead>
<tr>
<th>Year</th>
<th>Ring Width (mm)</th>
</tr>
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<tbody>
<tr>
<td>1930</td>
<td>2.5</td>
</tr>
<tr>
<td>1940</td>
<td>2.0</td>
</tr>
<tr>
<td>1950</td>
<td>1.5</td>
</tr>
<tr>
<td>1960</td>
<td>1.0</td>
</tr>
<tr>
<td>1970</td>
<td>1.5</td>
</tr>
<tr>
<td>1980</td>
<td>2.0</td>
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<td>1990</td>
<td>2.5</td>
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<tr>
<td>2000</td>
<td>2.0</td>
</tr>
<tr>
<td>2010</td>
<td>1.5</td>
</tr>
<tr>
<td>2020</td>
<td>1.0</td>
</tr>
</tbody>
</table>
Next Steps

1. Clean up and de-trend master chronology 1
2. Build master chronology 2
3. Create difference chronology
4. Complete statistical analysis
References and Questions

