Mapping Headwater Streams in North Carolina

North Carolina Division of Water Quality
North Carolina State University
North Carolina Department of Transportation
Background

**Problem**: Existing Maps Inaccurate and Inconsistent

Critical to NC Division of Water Quality 401 program and other public agencies and private sector

**Solution**: Make better maps

Take advantage of state-wide LiDAR (Light Detection And Ranging) coverage

Stream Mapping Project began early 2004

(NCDWQ, NCSU, NCDOT)
Approach

• Use LiDAR data acquired from the NC Floodplain Mapping Program to create new topographic maps

• Conduct field identification and mapping of intermittent and perennial streams and their origins in headwater areas

• Conduct spatial analysis using GIS data and field data

• Use field data and other GIS data to create predictive models of streams and origins
What are we trying to predict with spatial models?

• Presence/Absence of stream in a valley
• Stream length
• Flow Duration – ephemeral, intermittent or perennial

What are the influencing factors?
What processes do these factors represent?
How do factors and processes vary spatially?
Methods: Field Data

• Walk streams

• Locate Origins

• Determine flow regime (DWQ Stream ID, 2005)

• GPS origins (sub-meter accuracy)

http://h2o.enr.state.nc.us/ncwetlands/regcert.html
Methods: GIS Data

Create Digital Elevation Models (DEMS)

• Generate Terrain Derivatives

• Acquire existing GIS Data, ex. Soils, geology...

Spatial patterns and analysis

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North Carolina Division of Water Quality
Stream Mapping Field Sites

- 23 watersheds
- 600 + origins
Variables used (or to be used) in Analysis

- Level IV Ecoregion
- Local Slope
- Average Slope
- Contributing Drainage Area
- Local Curvature, profile and plan
- Average Upslope Curvature, profile and plan
- Soils
- Geology
- Land use
- Indices (roughness, stream power...)
General Description

Ephemeral to intermittent 46 %
Intermittent to perennial 36 %
Ephemeral to perennial (all mtns) 14 %
Other, wetlands and modified 8 %

does not include outer coast

First order intermittent stream length

mountains 33 %
piedmont 22 %
inner coast plain 32 %
outer coast plain 56 %

44 origins/1 site

*Data for 21 sites, 542 origins
Average Slope
Int/Per
Within Ecoregion
*Eastern Blue Ridge
Between Ecoregions
*Eastern Blue Ridge
*Rolling Coastal Plain
*Triassic Basin

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Contributing Drainage Area
Int/Per
Within Ecoregion
All except
Eastern Blue Ridge &
Group B-Slate Belt

Between Ecoregions
*Rolling Coastal Plain
*Triassic & Eastern BR
*Slate Belt & N. Outer
Piedmont

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Landscape Process.....

**Trend Plots**

**Average Slope and Contributing Drainage Area against Topographic Relief by Site**

**Range (max-min)**

**Avg Slope ↑ Relief ↑**

**Drainage Area ↓ Relief ↑**

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<table>
<thead>
<tr>
<th></th>
<th>Carolina Slate Belt-A</th>
<th>Carolina Slate Belt-B</th>
<th>Eastern Blue Ridge Foothills</th>
<th>Northern Outer Piedmont</th>
<th>Rolling Coastal Plain</th>
<th>Triassic Basin</th>
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<td>per</td>
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<td>Min</td>
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<td>0.05</td>
<td>2.04</td>
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<tr>
<td>Mean</td>
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<td>23.74</td>
<td><strong>50.86</strong></td>
<td>60.85</td>
<td><strong>5.16</strong></td>
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<tr>
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<td>69.96</td>
<td>68.16</td>
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<td>7.04</td>
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<td>90%</td>
<td>27.39</td>
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<td>187.26</td>
<td><strong>8.16</strong></td>
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<td>322.27</td>
<td>328.28</td>
<td>14.60</td>
<td>15.85</td>
</tr>
</tbody>
</table>

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Silk Hope Study Area
Chatham County, NC

Preliminary model overpredicts total stream length by 19%. Overprediction in 1st order streams.

Legend
- Preliminary modeled streams
- Ground-truthed streams

0 450 900 1,600 Meters