GIS and RS Analysis of Flood Risk Areas Abutting Étang Saumâtre, Haiti

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Haiti, located on the Caribbean island of Hispaniola, is the poorest country in the western hemisphere and the second poorest in the world.

Haiti is affected by global drivers of natural and anthropogenic origins.

Since 2004, increased incidence and intensity of tropical storms has resulted in a 20.6% lake level rise of Étang Saumâtre, Haiti’s largest lake.

Landsat imagery and topography are analyzed to assess lake expansion and to locate areas most at risk for flooding.
Region of Study

• Latitude 18° 39’ 30”; 18° 28’ 40”; longitude 72° 4’ 0”; 71° 53’ 0”
• The lake is ~ 26 km long and ~10 km wide with an area of 140 km²

• Topography consists of mountainous terrain to north and south
• Located in Hispaniola Rift Valley - an east/west trending depression
• West of and intersecting border with the Dominican Republic
• Uplifted marine strata - limestone bedrock and weathered basalt
• 2010 earthquake - east/west movement along the fault of 30 cm
• Arid micro climate in Rift Valley
• Burn wood for fuel
• Sand and gravel mining
• Ill-defined and insecure property rights
Expansion Etang Saumatre 1984-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Area sq km</th>
<th>% change</th>
<th>Cumulative % change</th>
<th>Perimeter km</th>
</tr>
</thead>
<tbody>
<tr>
<td>1984</td>
<td>116.178</td>
<td>NA</td>
<td>NA</td>
<td>73.749</td>
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<tr>
<td>1992</td>
<td>116.581</td>
<td>0.346</td>
<td>0.346</td>
<td>73.269</td>
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<td>2000</td>
<td>120.639</td>
<td>3.480</td>
<td>3.839</td>
<td>73.384</td>
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<td>2011</td>
<td>136.374</td>
<td>13.043</td>
<td>17.383</td>
<td>77.819</td>
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<td>2014</td>
<td>140.115</td>
<td>2.740</td>
<td>20.603</td>
<td>84.045</td>
</tr>
</tbody>
</table>
Approach

- Contours 0-20
- Deforested slopes
- Slope angle – grade by angle
- Proximity to lake
- Define land use/land cover
- Rank areas
- Define areas most at risk
Locating Areas Most at Risk

Deforestation

• **NDVI** - values between -1 and 1, values 0.5 indicating dense vegetation
• ArcGIS Spatial Analyst (map algebra & raster calculator) and Landsat TM
• NDVI is calculated from bands 3 & 4 (Band 3 = red; Band 4 = near infra-red)
• NDVI formula: \[ \text{NDVI} = \frac{\text{NIR} - R}{\text{NIR} + R} \]

Land Use/Land Cover

• ArcGIS Image Analysis and Landsat TM
• Land cover derived from composite of 7 layers
• Color symbology “saved” composite is changed to: Red = 3; Green = 2; Blue = 1
• Categories of signatures for this analysis are: agriculture; urban; forest; water; dry river bed
• Determined from onsite/ground trothing of land cover during field research in Haiti - November 2013 and June, 2014
Results

• Cul de Sac region west/northwest is enduring the greatest expansion
• West expansion in the rift valley is toward Port au Prince
• PAP is at sea level -subject to sea level rise - only 20 meter topographic difference ES to Port au Prince
• No impoundment to stop or impede water flow
• In the future, it appears water will be encroaching on the Cul de Sac plain from both the west and the east
• Eastern shoreline expanding to southeast in the rift valley
• Southeast expansion on both sides of Haiti 8
• south east/east expanding into Dominican Republic.