Tools for Transboundary Water Resources Management

• Database Development
• Basin Modeling
• Modeling Management Scenarios
• Information Sources
• Participant’s Experience in Transboundary Information and Modeling

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Acknowledgement: Carlos Patino-Gomez, IMTA

Physical Assessment of Transboundary Basins

• Develop Basin-Wide, Multi-National Tools
  – Database
  – Model to Evaluate Scenarios
• Develop Scenarios
  – Stakeholder Driven
  – Improved Water Management Opportunities
• Evaluate Scenarios
  – Physical Feasibility
  – Economic and Institutional Feasibility
• Generate Recommendations
  – Water Management Improvement Options
GIS Database (Geodatabase) Design

Data Model Based on Inventory

Relationships between objects linked by tracing path of water movement

Hydrologic Information System

Analysis, Modeling, Decision Making

Time series data

Arc Hydro Geodatabase

Geospatial data
Arc Hydro Framework

Arc Hydro Data Model: A Geodatabase containing a GIS representation of a Hydrological information System under a case-specific database design

Arc Hydro framework

Personal Geodatabase

Feature Dataset

Hydro Edge Hydro Junction Watershed Network Relation

Rio Grande Basin

228,000 km² (Mexico) + 327,000 km² (US) = 555,000 km² (Total)
Regionalization for Large Basins

- Rio Grande DEM (30mx30m)
  - Basin > 500 million cells
- Too many cells to process
- Break it down
  - Regions < 50 million cells

Preprocess: Raster

Buffered DEM → Burn the Streams → Flow Direction Grid → Fill the sinks
Arc – Hydro Tools

Terrain Preprocessing

Regionalization (cont.)

- Delineate each sub-basin
- Define streams
- Establish connectivity
- Assemble into full basin

*Rio Conchos Sub-basin*
Bi-national Water Information System

2115 Monitoring Points
- Water Quantity
- Water Quality
- Climate

5.26 million time-series records associated with the monitoring points

Time Series in the Geodatabase

Over 5,000,000 time series records today
What if I Don’t Have the DEM for My Region?

- Shuttle Radar Topographic Mission (SRTM)
- A joint project between NASA and NGA
- Flown aboard on February 11-22, 2000 by NASA
- 1 arc second (30 m resolution) for US
- 3 arc second (90 m resolution) Global coverage of 60° N and 56° S latitude

2 radar data sets were collected at the same time separated by 60 m, main antenna and the outboard antenna.

Knowing distance between the two antennas and the differences in the reflected radar wave signals, accurate elevation of the Earth's surface can be calculated.
Existing Data - Shapefiles

- Streams
  Old 1km resolution

- Waterbodies
  Old 1km resolution

SRTM Output

- Horn of Africa DEM
- Ethiopia DEM
Blue Nile Basin

- Greater part of flow of Main Nile (~60%)
- Limited information about its hydrology, especially in upper basin in Ethiopia
- Length ~ 1800m, Area ~ 3000 km²
- Source of some contention in East Africa
- Need accurate hydrographic description

Other Hydro-Regions of Ethiopia

- Blue Nile
- Rift Valley
- South West
- South Central
Results and Validation

Drainage area comparison on the Mexican side of the Rio Grande/Bravo basin

<table>
<thead>
<tr>
<th>Gage Name</th>
<th>CRWR Total Drainage Area on the Mexican side (SqKm)</th>
<th>Total drainage areas by CNA/IMTA (SqKm)</th>
<th>Difference (%) between values from CRWR and CNA/IMTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>24-A Rio Conchos basin, Cosala</td>
<td>75,576.64</td>
<td>75,442</td>
<td>0.48</td>
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<tr>
<td>24-B Presa Amatitlán - Collage - Uraga Station from ISWC, Huautla de Jiménez</td>
<td>404,292.36</td>
<td>103,933</td>
<td>-63.33</td>
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<td>24-D Rio Bravo marsh basin</td>
<td>123,387.08</td>
<td>122,865</td>
<td>-0.41</td>
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<tr>
<td>24-C ro Salado and Salinas basin, Gage Station from TECO below Falcon Dam (CMN05)</td>
<td>185,591.00</td>
<td>184,320</td>
<td>-0.69</td>
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<tr>
<td>TECO Municipal return down to Miguel Aleman City below Rio Alamos in the 24-E de Alamos basin</td>
<td>190,151.92</td>
<td>189,253</td>
<td>-0.48</td>
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<tr>
<td>GAGE #24-24 on San Juan River</td>
<td>221,572.52</td>
<td>221,252</td>
<td>0.14</td>
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<tr>
<td>TBW04/LGA Gage station below Brownsville, Texas, Close to the outlet of the 24 G Brajo Bravo basin</td>
<td>228,281.99</td>
<td>231,841</td>
<td>2.78</td>
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Results and validation (continued)

Drainage area comparison in the Rio Grande/Bravo basin

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<th>Gage Name</th>
<th>CRWR Total Drainage Area of the Rio Grande Basin (SqKm)</th>
<th>Total Drainage Area of the Rio Grande Basin (SqKm) from TECO</th>
<th>Difference (%) CRWR vs TECO</th>
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<tr>
<td>1. Rio Del Pico</td>
<td>22,694.36</td>
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