Modeling and Visualization Software for Ecological Planning and Restoration

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- Joined U.S. Geological Survey (USGS) in 2009
- Louisiana & Florida
- Advanced Applications team
- Desktop applications using Eclipse Rich Client Platform (RCP)
Overview

- Joint Ecosystem Modeling (JEM)
- Restoration in Florida
- Planning in coastal Louisiana
- Eclipse RCP & p2 role
- Ecological Modeling Applications & Successes
- Takeaways
Florida Everglades Restoration

Complex, large-scale, and ongoing effort to return compartmentalized wetland to more natural wetland ecosystem.

Over two decades of work, vast amounts of biological, hydrologic, and modeling data decades in time scale, billions of dollars in scope and projects.

To promote collaboration, the Everglades ecological modeling community:

- adopted NetCDF for modeling and visualization
- established the Comprehensive Everglades Restoration Plan (CERP)

NetCDF Metadata Conventions

http://bioscience.oxfordjournals.org/content/45/Supplement_1/S66
http://link.springer.com/article/10.1007%2Fs10021%9500006
http://link.springer.com/article/10.1007%2Fs10980-010-9478-x
Joint Ecosystem Modeling

- Promote data sharing and standards
- Pair scientists with application developers
- Create ecological modeling and decision-support software
- Informed use of monitoring and modeling data for Greater Everglades restoration
...A Trip Down Memory Lane
Technological needs back in 2008...

<table>
<thead>
<tr>
<th>Capability</th>
<th>Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Write once”, multi-OS</td>
<td>Java</td>
</tr>
<tr>
<td>“Native” UI</td>
<td>Eclipse RCP &amp; SWT</td>
</tr>
<tr>
<td>User Applications (no admin)</td>
<td></td>
</tr>
<tr>
<td>Distribution of Applications</td>
<td>HTTP File Server</td>
</tr>
<tr>
<td>Update Facility</td>
<td>Update Manager(?) p2</td>
</tr>
<tr>
<td>Mix-and-match Software Modules</td>
<td>OSGI</td>
</tr>
<tr>
<td>Geospatial Data &amp; Manipulation</td>
<td>UCAR NetCDF (JEM community using this); GeoTools</td>
</tr>
<tr>
<td>3D Earth Model, Overlay Layers</td>
<td>NASA WorldWind (AWT)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Enter: EverVIEW Slice & Dice

- Wizard-based RCP app
- Bundled spatial libraries for NetCDF manipulation
- Update Manager (not p2)
EverVIEW Slice & Dice

- Temporal, spatial (bbox, shapefile), and value subsetting
- Table viewer & CSV export
- Large data files → whittled down (geographic region, timeframe)
- CSV analyzed in spreadsheet
EverVIEW Slice & Dice: p2 to the Rescue!

- Update Manager had problems
- p2 matures in time for Slice & Dice release
- Useful resource: wiki.eclipse.org!

Equinox p2 cures Eclipse plug-in headaches

This article explores the new features of Equinox p2, which debuted in Eclipse V3.4. It looks at the pitfalls of the update manager user interface (UI) that was available in earlier versions of Eclipse and shows how the Equinox p2 framework is an improvement. Specifically, it shows how to use the new features in the Equinox p2 framework to install Eclipse and its plug-ins.

Plug-in installation problems prior to Eclipse V3.4

Before Eclipse V3.4, installing Eclipse plug-ins was cumbersome. In fact, it was complex enough that only advanced users installed new plug-ins. There were two methods of installing plug-ins: manual download and graphical user interface (GUI).
EverVIEW Data Viewer

- Multi-tabbed (globe, table, charts)
  - How to use AWT controls with SWT?
- Multi-sectioned (1-4), synchronized views
  - Displaying sections for single-globe & multi-globe views?
EverVIEW Data Viewer

- Users SEE their data
  - SWT_AWT bridge for NASA WorldWind panel
- Users can COMPARE data side-by-side
  - Perspective layouts & placeholder folders for dynamic view part placement
  - Model-View-Presenter: synchronization across sections
Foundation leads to Ecomodels

- RCP
- P2
- Work with PIs to build models
  - Alligator
  - Amphibian
  - Applesnail
  - Vegetation
  - Birds
Alligator Production Suitability Model

### Name
- Habitat Area
- Tree Island Height
- Sum Alligator Holes
- Percent Edge Habitat
- Breeding Potential
- Courtship and Mating
- Nest Building
- Nest Flooding
- Habitat Suitability
- BP Wet/Dry
- CM Depth
- NB Depth
- NF Depth Max

### Description
- Suitability for area of habitat within the grid cell.
- Average height of tree island ground surface above marsh surface.
- Number of alligator holes in the grid cell.
- Proportion of edge habitat in the grid cell.
- Suitability for breeding potential.
- Suitability for courtship and mating.
- Suitability for nest building.
- Probability of flooding during egg incubation.
- Overall alligator production suitability.
- Proportion of days during breeding when too wet or dry.
- Average water depth during courtship and mating.
- Average water depth during nest building.
- Max water depth during egg incubation.

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http://www.cloudacus.com/simglades/alligator.php
Amphibian Model

[Amphibian Model screenshot]

[Model Run Parameters]

[Species Richness Output]

The state of these check boxes determines which HJ values are written to the output file. Checked values will be written, unchecked will not be written. NOTE: this has no bearing on which values are calculated.

Native
- Chorus Frog
- Cricket Frog
- Eastern Narrowmouth Frog
- Green Tree Frog
- Leopard Frog
- Little Grass Frog
- Oak Frog
- Pig Frog
- Southern Frog
- Squared Tree Frog

Invasive
- Cuban Frog
- Greenhouse Frog

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http://jem.gov
https://www.flickr.com/photos/19731486@N07/4629817110

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Applesnail Model (EverSnail)

Initial Condition Parameters

- Initial Snail Population (Snails Per Cell): 160000
- Initial snail age (days): 240

Flooded Condition Survival Parameters

- For size <= 6mm, survival = 1.0 - (0.0130 / days)
- For 6mm < size <= 10mm, survival = 1.0 - (0.0130 / days)
- For 10mm < size <= 16mm, survival = 1.0 - (0.0130 / days)

Dry Condition Survival Parameters

- For size <= 6mm, survival = 1.0 - (0.0240 / days)
- For 6mm < size <= 10mm, survival = 1.0 - (0.0160 / days)
- For 10mm < size <= 16mm, survival = 1.0 - (0.0110 / days)

Growth Parameters

- Snail minimum size (mm): 3
- Snail maximum size (mm): 50
- Snail growth factor (K growth): 0.10

Reproduction Parameters

- Reproduce at depths: 10 cm to 90 cm
- Reproduction stops air temperature: 17.0 deg C
- Stop smoothness (K temp): -1.0
- Egg limit: 25000 per Hectare

Reproduction Date Parameters

- Nov 15 - Jan 14, Factor = 0.0
- Jan 15 - Mar 31, Factor = 1.0
- Apr 1 - Jun 30, Factor = 1.0
- Jul 1 - Nov 14, Factor = 0.3

Output timestep (days): 1

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http://jem.gov
http://www.jaxshells.org/hald.htm

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Everglades Vegetation Model (ELVeS)

<table>
<thead>
<tr>
<th>Community</th>
<th>Data Layer</th>
<th>Location</th>
<th>Scale</th>
<th>Shape</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattail</td>
<td>meanAnnualDepth</td>
<td>197.46</td>
<td>200.0</td>
<td>10.17</td>
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<tr>
<td>Spikerush</td>
<td>meanAnnualDepth</td>
<td>237.0</td>
<td>350.0</td>
<td>8.0</td>
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<tr>
<td>FloatingEmergentMarsh</td>
<td>meanAnnualDepth</td>
<td>225.0</td>
<td>250.0</td>
<td>5.0</td>
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<tr>
<td>MixedMarlWetPrairie</td>
<td>meanAnnualDepth</td>
<td>47.46</td>
<td>33350.0</td>
<td>-104.3</td>
</tr>
<tr>
<td>OpenMarsh</td>
<td>meanAnnualDepth</td>
<td>27.46</td>
<td>100.0</td>
<td>10.17</td>
</tr>
<tr>
<td>MuhlenbergiWetPrairie</td>
<td>meanAnnualDepth</td>
<td>150.0</td>
<td>300.0</td>
<td>3.0</td>
</tr>
<tr>
<td>OpenWater</td>
<td>meanAnnualDepth</td>
<td>187.46</td>
<td>200.0</td>
<td>10.17</td>
</tr>
</tbody>
</table>

http://jem.gov
http://www.cloudacus.com/simglades/ELVeS.php
Wading Birds Model

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http://jem.gov
http://www.cloudacus.com/simglades/ELVeS.php
http://dx.plos.org/10.1371/journal.pone.0128182

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Why so many models?

- Help inform Greater Everglades decision-makers
  - Scenario A or B?
  - Impact?
  - Species affected? To what degree?
- Success/failure of restoration efforts
- Help provide a backstop when funding for field collection or monitoring is lean
La. Coastal Protection & Restoration
Louisiana’s Comprehensive Master Plan for a Sustainable Coast

- Data deluge (déjà vu!)
- Coastwide modeling effort, 50-year time horizon
- Respond to land loss
  - Protection measures
  - Restoration efforts
- Scenarios for possible outcomes
  - Which projects?
  - What impacts?

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U.S. Geological Survey

http://coastal.la.gov/a-common-vision/2012-coastal-master-plan/
- EverVIEW Data Viewer:
  - Compare Everglades data
  - NetCDF format
  - Not geographically limited

- La. Master Plan: “connected models”, no standards
  - ASCII Grid
  - GeoTIFF
  - Shapefile
  - ASCII timeseries + Shapefile
  - NetCDF
  - Custom ASCII
  - Etc.
Coastal Louisiana Models – Data Converter

Solution:

- Converter for modeling data to NetCDF
- EverVIEW Data Viewer now used for QA/QC
- Package logic for custom and non-NetCDF formats
- Incrementally deliver updates via p2?
EverVIEW Data Viewer: Extensions

- **Goal**
  - Third party contribution
  - Clean and separate internals
  - Manipulation and conversion **tools**
  - “branded”, custom **environments**

- Start small, get something working
- Use plug-ins & features as p2 installable units
Difference Tool Extension
Quantitative representation of change between scenarios
Transect Tool Extension
Compare values along transect lines
Extensions for Custom Environments

- Look & feel driven by collaborator and communication needs
- Highlight specific datasets
- Package custom functionality
- Leverage existing EverVIEW codebase
Climate Envelope Extension
Present/absence of critical species under IPCC climate scenarios

http://crocdoc.ifas.ufl.edu/projects/climateenvelopemodeling/
EDEN Data Viewer
Visualize Everglades hydrology, elevation, and days since dry metrics

PFLCC Scenarios Viewer
Peninsular Florida climate change scenarios, conservation priorities, and population trends

EverVIEW Data Viewer: Extensions

- **Stumbling blocks**
  - Tight coupling (API dependencies)
  - How to package EverVIEW Core to allow third party development?
- **Successes**
  - Able to leverage EverVIEW as a “platform”
  - Met partner/community needs
Takeaways

- Design intentions vs. “on-the-ground” implementation
- **Good** documentation is key
- Stability & reliability of Eclipse platform
- Fulfill decision-making needs in Louisiana, Florida
Thank You!

- Questions?
- Comments?
- Please evaluate the session!
Evaluate the Sessions

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-1  0  +1