I, Clavdivs

From Antiquity to the BBC
I, VVorms
Integrated Water Resource Modeling System
IWRMS

A System of

Integrated Modeling for Water Resource Management
King County Department of Natural Resources & Parks

- Science, Monitoring and Data Management group responsible for evaluating existing County practices and providing science input to County policy making
- Needs “integrated” modeling capability to support scientific investigations and planning efforts
Project Goals

- Integrate disparate set of computational models (land use, watershed, lake, river, and estuary) to model water quantity and quality in Puget Sound region.

- Develop integrated suite of tools – from problem conception, through modeling, to visualization/communication – to support the needs of modelers, water quality planners, and natural resource management.

- Flexible/extensible – not all models identified at this time.
PNNL Goals

• Provide flexible, extensible *capability* for model integration and its application to King County/DNRP’s problems

• Develop a robust solution that can
  – be applied in other geographic domains
  – Integrate models other than watershed/lake/river
  – Integrate tools other than scientific models
  – Enable users to integrate models/tools without programmer involvement

• Use this effort as model for other jurisdictions/organizations with similar needs
Requirements Gathering

- Personal Interviews
- Focus Groups
- Technology Demonstration Workshop
- Initial Requirements
- Requirements Prioritization
- Resource Assessment
- System Requirements
Requirements Analysis

- Wide and varied needs to support a variety of model usage scenarios
- Building on top of PNNL’s Framework for Risk Analysis of Multimedia Environments System (FRAMES) would best meet County needs with available funding
- Incorporate 3rd-party commercial off-the-shelf software where feasible
  - Data analysis & visualization
  - Distributed computing
- Use participatory design process since many potential users didn’t have clear picture of their needs.
IWRMS Computing Architecture

External Data Sources
- FTP
- HTML
- Databases
- XML

Internal Data Sources
- GIS
- Data Warehouse
- Databases
- Files

Distributed Multi-User Role-Based Model Integration Framework

Data Management
- Data Harvester
- Repository Tools

Central Repository

Modeling / Applications
- Model Connection Framework
- Analysis / Visualization Tool Integration
- Model Integration / Execution Wizard
- Study Manager

Distributed Computing

Users
- Planner
- Modeler
- Manager
- System Admin.
Model Connection Framework

- Facilitates seamless transfer of information between the variety of models and data sources
- FRAMES is the basis for our MCF
  - Previously developed by PNNL (nearly a decade of research and development)
  - Allows for plug-and-play interchangeability of modelling simulation elements
- Currently extending FRAMES to support collaboration among multiple, simultaneous users
Model Integration Wizard

New concept that simplifies the task of integrating a new model into the framework with existing frameworks.

- Special software programs must be written to make a model conform to framework data specifications.

Our solution:

- Employs graphical tools
- Visually maps data from model-specific formats to framework specifications.
### Data Harvester Manager d3k076

<table>
<thead>
<tr>
<th>Name</th>
<th>Frequency</th>
<th>Status</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lk Washington 1A</td>
<td>Daily</td>
<td>Completed</td>
<td>Water quality in Lk Wash. based on current projected land use growth.</td>
</tr>
<tr>
<td>Lk Washington 23A</td>
<td>Monthly</td>
<td>In Progress</td>
<td>Water quality in Lk Wash.</td>
</tr>
<tr>
<td>Sammamish River</td>
<td>Once</td>
<td>Failed</td>
<td>Effects of temperature on salmon.</td>
</tr>
</tbody>
</table>

The Data Harvester provides tools that allow for easy incorporation of varying formats (visual tools).
Distributed Computing

Provides a mechanism to allow computing resources on a network to be utilized for modeling.

- Economies of scale:
  - As more computing resources are added to the network, they increase the computing resources of the framework.

- Modeling simulations contain multiple independent execution tasks:
  - Can be executed in parallel (at the same time on different computing resources)
  - Drastically reduces time to get results (as opposed to running execution tasks serially on one computer).

- Provides support for models that execute on varying platforms (Windows, Unix, Linux).

UPS
3TB Disk Array
Compute Nodes
Dell SC1425
Computing Node 1
Dell SC1425
Computing Node 2
Dell SC1425
Computing Node 3
Dell SC1425
Computing Node 4
Project Status

- Demonstrations of initial system functionality in July 2004 and January 2005
- Currently focused on subsystem integration
- Viz/Analysis tool integration to start in Spring ‘05
- “beta” release expected in July 2005
- Initial system delivery scheduled for December 2005
Expected Results

- Greater speed in producing usable information from existing data
- Ability to use data in new ways...to answer questions that couldn’t be answered before
- Ability to inform water resource sampling programs