

Integrating Urban Ecological Models

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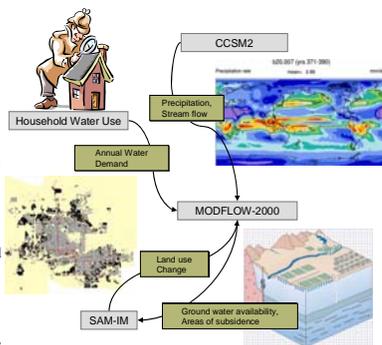
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Model Integration

Long-term decision-making often requires modeling of related environmental systems that fall under the domain of multiple agencies. A major informatics challenge is developing an infrastructure that will facilitate the sharing of models among the diverse members of the urban ecological research community in central Arizona. In this project we build on prior work that established the Southwest Environmental Information Network (SEINet) to 1) establish a multi-agency network of metadata, data, and application services that can be invoked through an open, platform-independent messaging format and 2) enable the creation and execution of scenarios, or workflows, that loosely couple models by "piping" outputs of one process to the input of another – even if the two processes are running in different locations, on different operation systems, or in different languages.

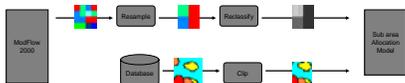
Models

In this project we have defined a use-case workflow that links output from a global climate model (CCSM2) running at National Center for Atmospheric Research to a hydrology model (MODFLOW2000) running at the Arizona Department of Water Resources and then to a land-use change model (SAM-IM) developed by the Maricopa Association of Governments as an ArcView GIS model. In the new Decision Center for a Desert City project (DCDC), a household water use model provides input for Modflow-2000.



Challenges

The models employed in this workflow are located at different institutions, run under different operating environments, and could not be directly coupled without extensive re-programming which would take them out of the research/planning context that produced them. In an approach based on loose-coupling, outputs from one application must often be transformed, transported, and reformatted in order to generate input parameters for a subsequent application in the workflow.



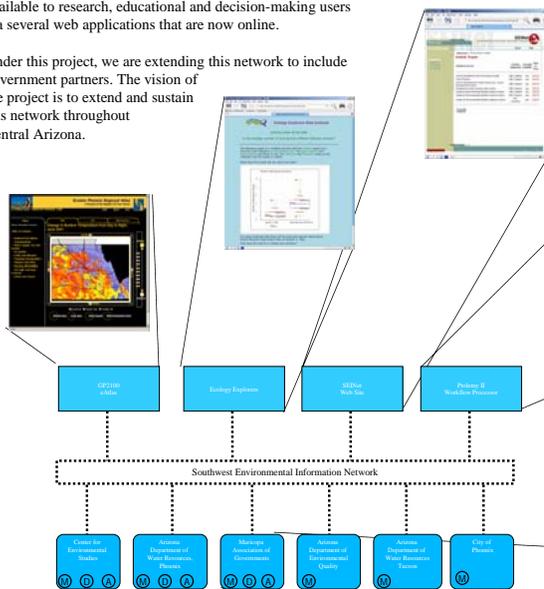
Consider the above detail describing some of the workflow steps through which input to the Subarea Allocation Model –Information manager (SAM-IM) is generated. Modeled data on groundwater storage from MODFLOW 2000 is generated at a 0.5 mile resolution and must be re-sampled to match the 1 Acre resolution of SAM-IM. Values for groundwater storage must then be reclassified to represent estimates of water availability required by SAM-IM. The workflow may include additional data drawn from other sources such as existing land-use which may require other processing such as boundary clipping before input.

Community Integration

Southwest Environmental Information Network

Under prior funding, CES has developed the Southwest Information Network (SEINet as an infrastructure for making distributed environmental data available to research, educational and decision-making users via several web applications that are now online.

Under this project, we are extending this network to include government partners. The vision of the project is to extend and sustain this network throughout Central Arizona.



Contributed Resources

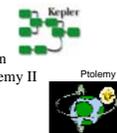
Each of the institutions participating in the network contributes some information resources. All are publishing metadata; those participating in this project are publishing data and applications. The vision of the project is to extend and sustain this network.

- ① **Metadata.** Searchable catalogs of published resources are based on the Ecological Metadata Language (EML). EML is a modular language based on eXtensible Markup Language (XML) and has elements for describing datasets, literature, and software. This project is developing a module for model documentation that will be submitted to the EML working group.
- ② **Data.** Datasets are published to the network either as public or restricted access, depending on the sensitivity, cost recovery, or human-subjects aspects of the data or the activities that produced it.
- ③ **Applications.** Sharing applications such as models enables agencies to construct meta-models that combine resources of other agencies with those developed in house.

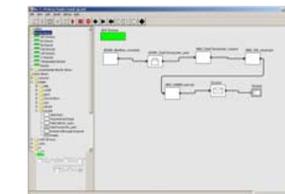
Application Integration

Kepler Project

To develop the tools for scripting and executing the workflow that integrates distributed components, the project is participating in the Kepler project – an open-source collaboration between several projects including two large ITR projects. Kepler uses the Java-based Ptolemy II software to develop a component-oriented workflow modeling environment for ecological, biological, and geological analysis.

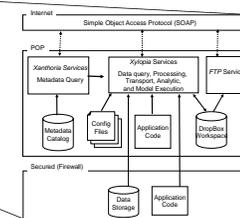


In the example to the right, the conceptual workflow described in the lower left portion of this poster is implemented with a series of actors making remote SOAP calls to web services at ADWR and MAG. The pipes between actors carry XML metadata needed to instruct each service where to find its input data and how to use it.



Point of Presence

Within the network, each participating agency has a Point of Presence (POP) on the grid. A dedicated computer is provided by the project to reside outside the agencies firewall. This server has a suite of web services installed and is configured to replicate certain environmental properties such as local and public drop boxes for inter-POP data exchange and configuration files for mapping local addresses to abstract handles. The Ptolemy II workflow software exchanges messages with these services using SOAP.



Xylogia

Applications are exposed by the POP using Xylogia web services. The Xylogia project was started under previous funding to create a uniform metadata-aware interface to various application functions including data query, calculations, and visualization. In most cases, Xylogia services are wrappers designed to provide a SOAP interface to existing applications, rather than writing entirely new code.

