

# Real-time Water Decision Support Services for Droughts

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# Background



During 2011, Texas experienced the most serious drought in its history. Water shortages caused large loss of property and endangered lives. The importance of effective water management is magnified during droughts.

Reference: <http://photoblog.statesman.com/dry-season-the-texas-drought-of-2011>

# Model as a Service (MaaS)

- Migrating environmental models from stand-alone applications to services running in the Cloud through the Web.
- Non-technical users can remotely execute the model and visualize results as a service through a simple Web interface.

# Web Application

RTWDSS v0.2 About

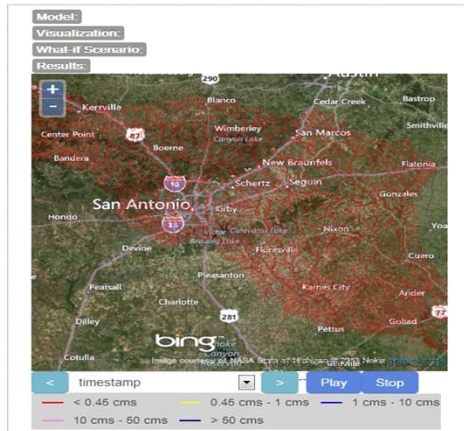
**Real-Time Water Decision Support System v0.2**

This prototype real-time modeling system downloads Noah-MP Land Surface model data, which forecast runoff, soil moisture, evapotranspiration, and water table levels given land surface features. These results are then used by a river model called RAPID to forecast stream flows. Model forecasts are visualized as a Web application for students and decision makers to understand the impacts of drought and flood conditions on streamflows. Users can adjust model parameters to predict the impacts of alternative curtailment scenarios or weather forecasts.

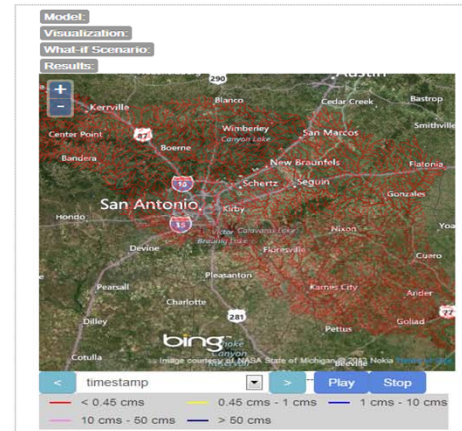
## Executions

+	Model: 2012-10-31 to 2012-11-09	Model: 2012-04-02 to 2012-05-01	Model: 2012-03-13 to 2012-04-10	Model: 2012-04-01 to 2012-04-30	Model: 2012-04-01 to 2012-05-31	Model: 2012-11-01 to 2012-11-10	Model: 2012-11-01 to 2012-11-10
	What-if: Wet	What-if: None	What-if: Wet	What-if: Wet	What-if: None	What-if: Dry	What-if: None
	Viz: 2012-10-31 to 2012-12-09	Viz: 2012-04-02 to 2012-05-01	Viz: 2012-03-13 to 2012-05-10	Viz: 2012-04-01 to 2012-05-30	Viz: 2012-04-01 to 2012-05-31	Viz: 2012-11-01 to 2012-12-10	Viz: 2012-11-01 to 2012-11-10
	Status: FINISHED	Status: FINISHED	Status: FINISHED	Status: FINISHED	Status: FINISHED	Status: FINISHED	Status: FINISHED

## Case 1

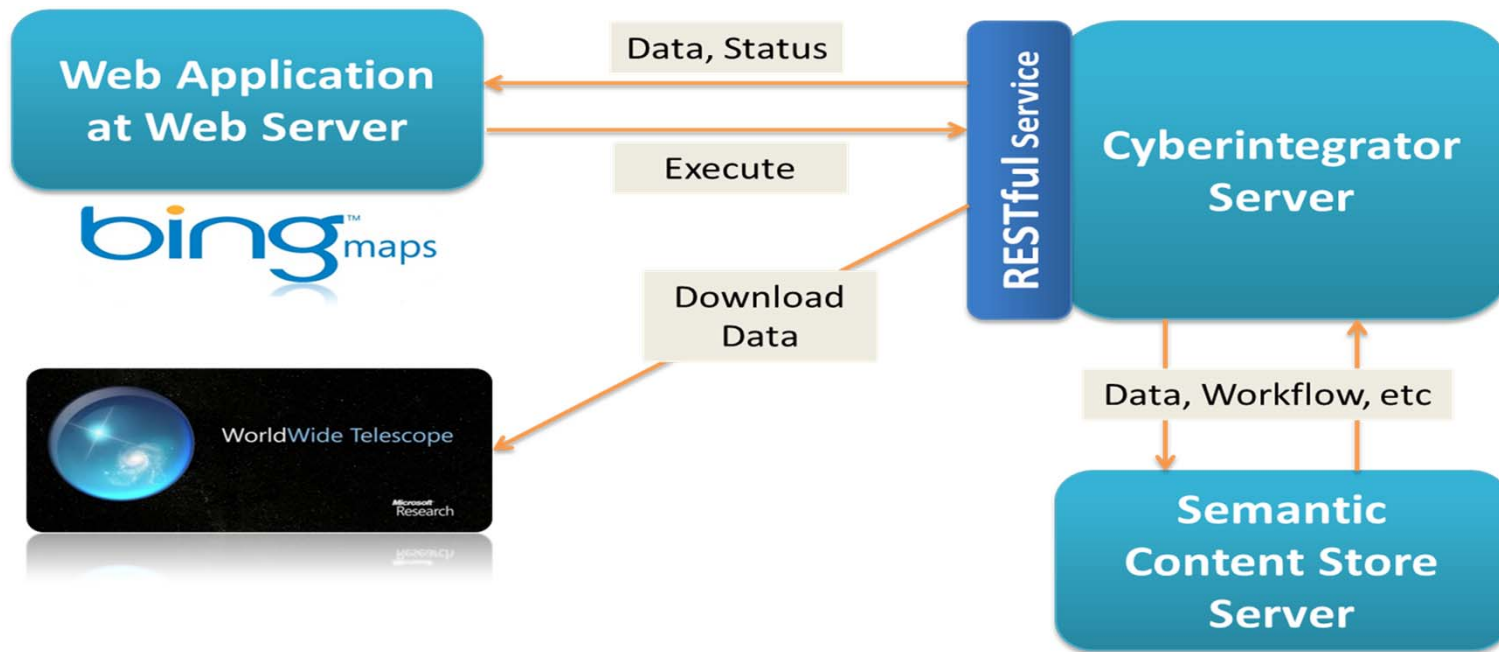


## Case 2

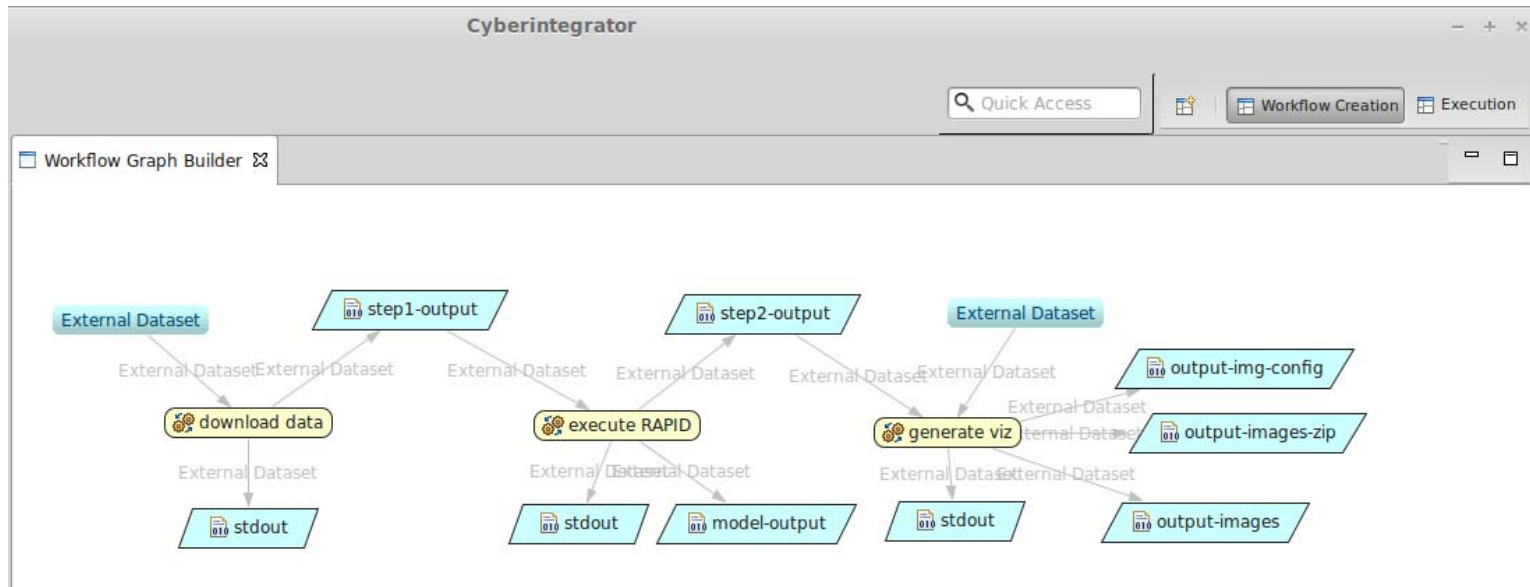


Collaboration with Center for Research in Water Resources, Texas Commission on Environmental Quality (TCEQ)  
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# Real-Time Modeling Service Architecture



# Cyberintegrator Workflow



- Download NLDAS data
- Execute RAPID model
- Generate visualization (images) of the model results

# 1. Define Workflow Steps

**Command Line Wizard**

**Setup command line tool**  
External tool command line with options.

Executable:  ...

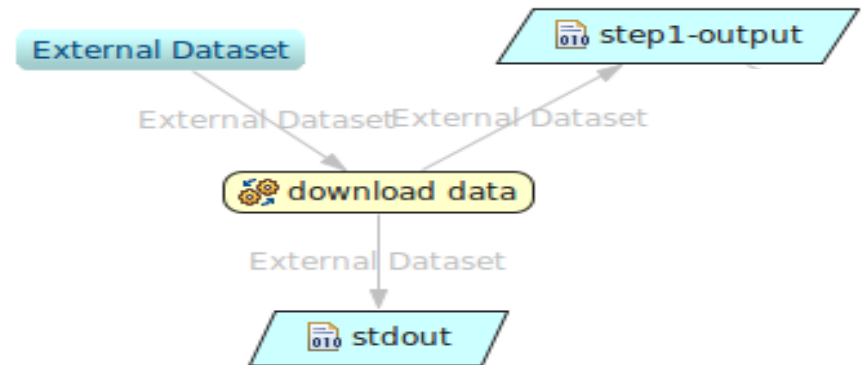
Capture stdout?   also stderr?

Capture stderr?

Options:

file(in:step1_input.zip[not passed])	Add Value
start-year[NUMBER] = 2012	Add Parameter
start-day[NUMBER] = 1	Add Data
end-year[NUMBER] = 2012	Edit
end-day[NUMBER] = 1	Delete
file(out:input_RAPID_workflow.zip)	Up
	Down

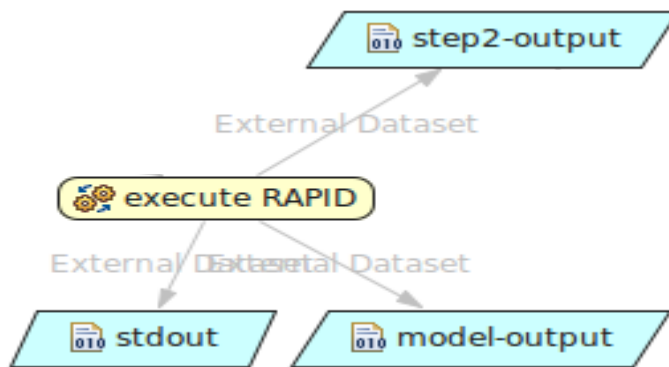
< Back   Next >   Cancel   Finish



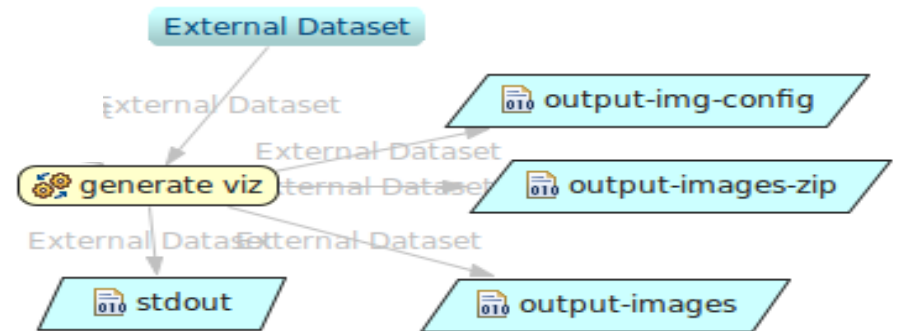
Download NLDAS data

# 1. Define Workflow Steps

- Define other steps the same way



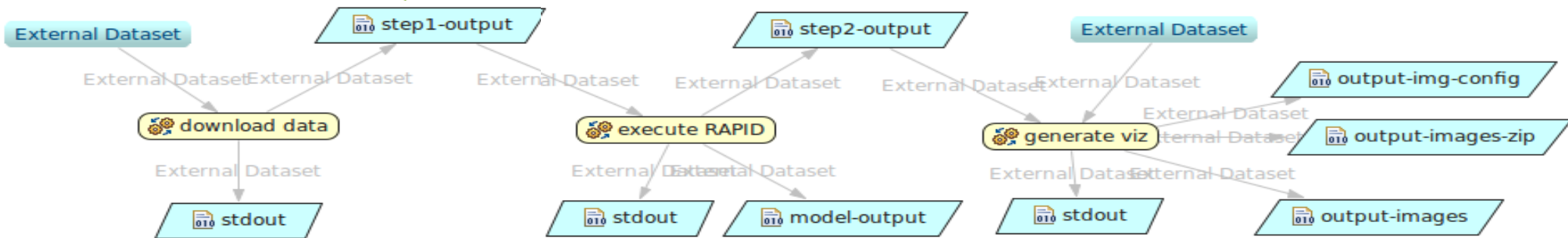
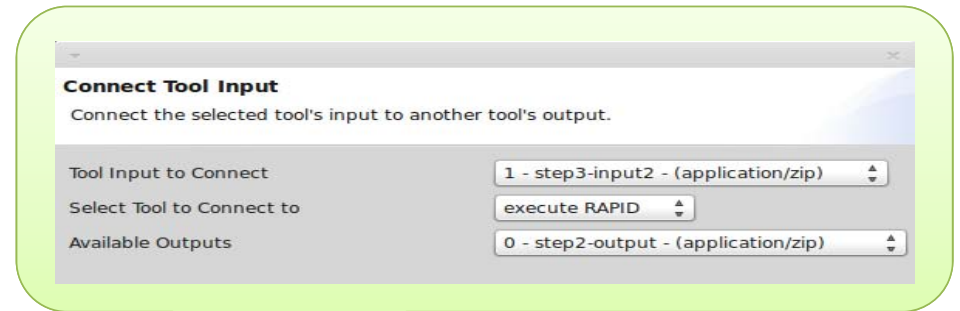
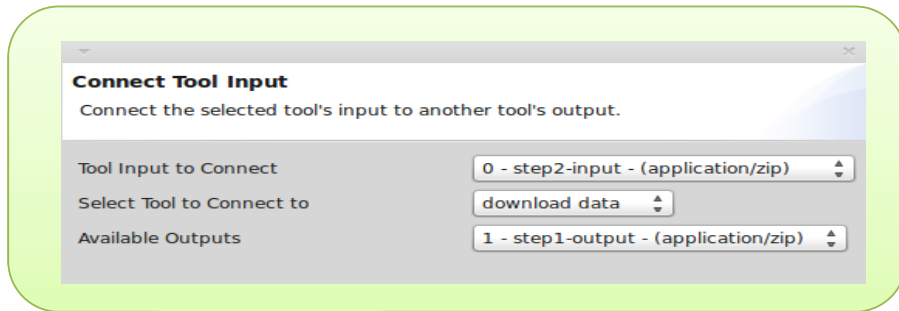
Execute RAPID model



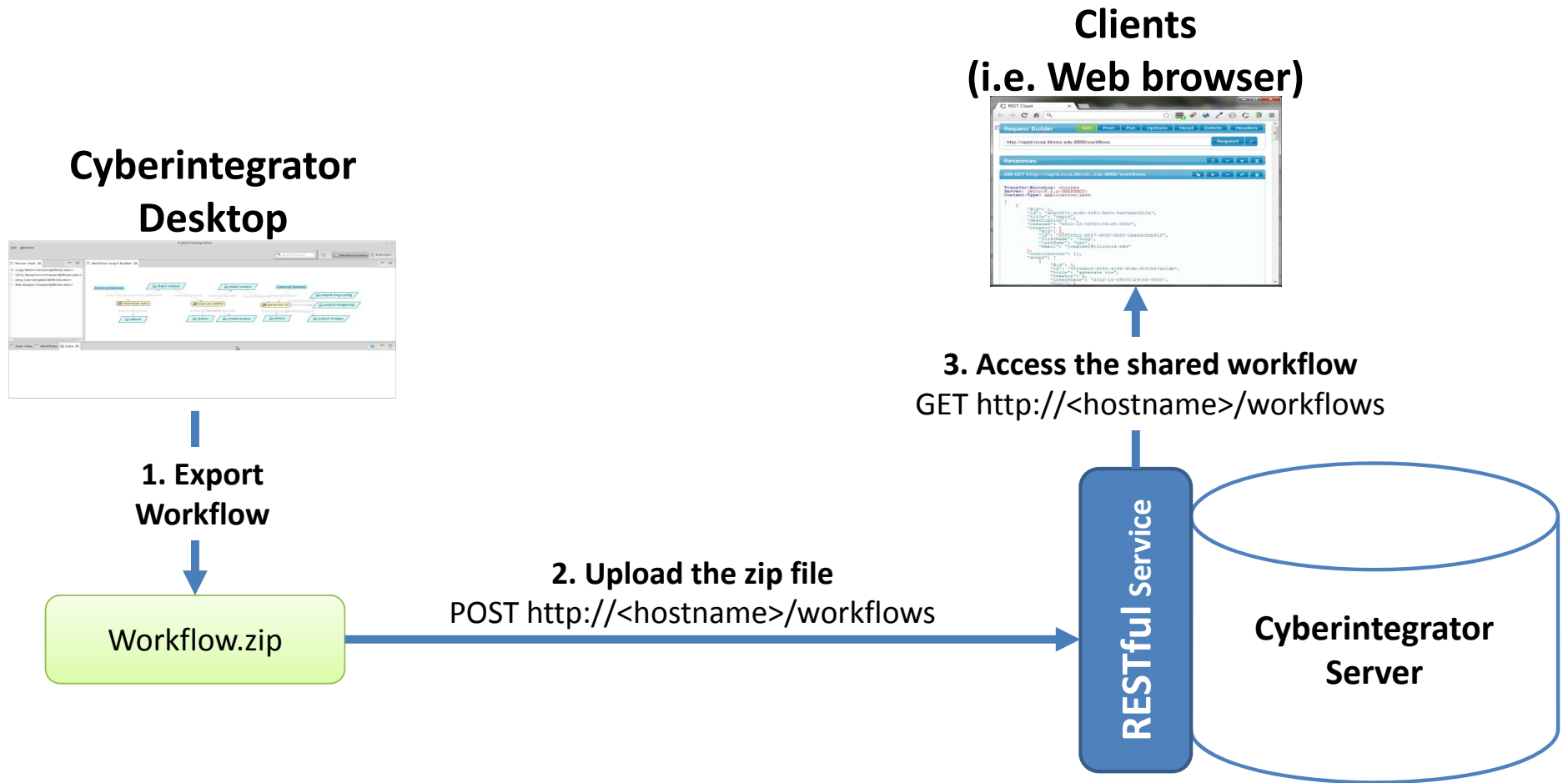
Generate visualization



## 2. Connect Steps: Outputs to Inputs



# 3. Sharing the Workflow as a Service



# Future Work

- Add more real-time data sources and assimilate into land-atmosphere and river flow models to achieve real-time water modeling system.
- Develop the optimization model to provide curtailment hours of each water user for decision makers from TCEQ during droughts.
- Link the workflow system of the optimization model with the RAPID model system to provide real-time water decision support services.

# Acknowledgments

- Microsoft Research provided technical assistance and funding for this work
- David Maidment, Cedric David, Ahmad Tavakoly, and Fernando Salas collaborated in defining requirements and RAPID implementation
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