PERMANENT FORUM OF BINATIONAL WATERS

SCIENCE TALK ***Sustainable Water through integrated modeling (SWIM): A platform for exploring water futures with a binational perspective.***

March 10, 2022

Brief Summary

The SWIM Team:

Natalia Villanueva Rosales, Associate Professor, Computer Science, University of Texas at El Paso, Principal Investigator for SWIM;
Josiah Heyman, Director of the Center for Inter-American and Border Studies, Professor, Sociology and Anthropology, University of Texas at El Paso;
Deana Pennington, Associate Dean, College of Science Professor, Department of Earth, Environmental and Resource Sciences, University of Texas at El Paso;
Luis A Garnica Chavira, Research Associate CyberShare Center of Excellence, University of Texas at El Paso;
Katalina Salas, PhD student Environmental Science and Engineering University of Texas at El Paso.

"Why SWIM?" The challenge is one of engaging stakeholders – how can we give people something they can work with via participatory modeling? Especially in the border environment. Scientific tools can have a steep learning curve requiring coding skills, but SWIM is available in both English and Spanish with comparable metrics in a unified interactive and interoperable platform. SWIM uses disparate data sources from both countries and comes with ready-made models.

SWIM implements a human-technology framework that integrates participatory modeling (PM) with semantics (SEM) and information technology (IT) in a three-prong approach. SEM focuses on the use and meaning of data about data; PM on people working together to create and use models as stakeholders; the IT component makes all these things useful to support water sustainability. There is a graphical web-based user interface with Metric and English units and SWIM uses data collected across the border, SWIM additionally includes multiple application programming interfaces (APIs) available in the form of web services.

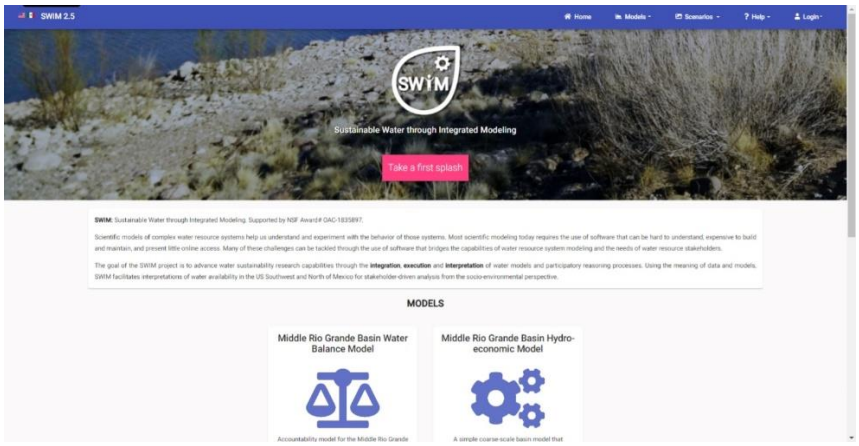
SWIM currently has two models but is not limited to only two; it can accommodate others. The model study area comprises the Rio Grande from the gauging station at San Marcial, NM to the gauging station at Fort Quitman, TX. Within this study area the two models can be considered as "bucket models." The reservoirs and aquifers are the buckets and the river connecting them can be considered as a "leaky pipe." Both models simulate the hydrologic processes in the

model area beginning with inflow at San Marcial that is calculated from projected flows derived from the Colorado headwaters above San Marcial. This generates a rich array of model data that can be selected and used for scenario analysis. It is possible to model different climates, management policies and even technology applied to water management in SWIM in this region. SWIM is not so much about predicting a specific future as about understanding how these elements work together under different conditions.

The Water Balance Model is a spreadsheet-based scientifically validated model. The Hydro Economic Model is more complex and combines crop prices with overall optimization features. A lot can be done with SWIM with many options but to make it easy, the SWIM Team has developed a portfolio of "canned scenarios" for fast answers to common questions. Once familiar with these, users can develop their own model scenarios and work collaboratively among stakeholders to explore a future we all want to live in.

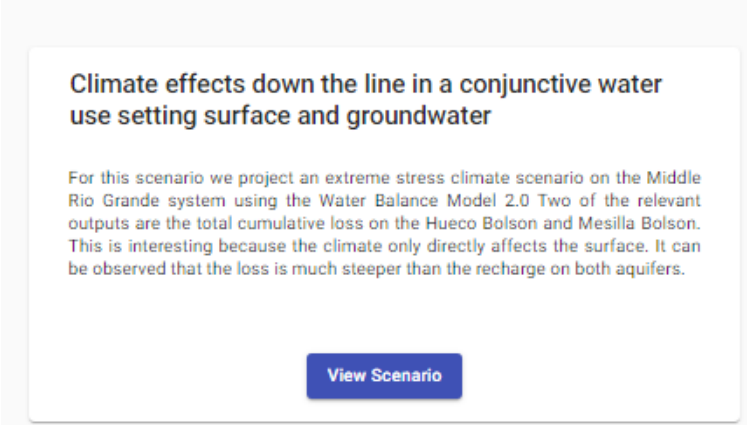
The overall SWIM workflow is to: 1) select a scenario; 2) run the model; 3) view and analyze the results. The Team presented a canned scenario slide that illustrated conjunctive water use showing the relation between ground water in the Hueco and Mesilla Bolsons and input at San Marcial. Since year-to-year outputs can be highly variable, the model shows baseline data as an overall benchmark by which to compare the more variable outputs. The example showed modeled inflow at San Marcial for a given extreme stress climate scenario and its resulting output summaries as cumulative aquifer storage and recharge.

There was an actual example of this canned model scenario in SWIM – *Take the First Splash* – a good way to get a handle on the overall water system.



The example (below) was presented to show an extreme stress climate scenario in the Water Balance Model. This canned scenario shows the power of the integrated model because it

traces the logic from choice of climate scenario to the snowpack, the melt, uses, diversions, etc., and the amount of water in the river as it impacts aquifer water levels.



The point is that, if there is insufficient surface water flow for downstream use, the water is pumped from the groundwater supply. Hence the term, "conjunctive water use." In response to a question about what climate scenario we are now in, it was pointed out that it is the upstream climate more than local precipitation that determines the effects seen locally and the model comprehends this. The scenario's dashboard summarized the impact on Elephant Butte water levels and drawdown/recharge tradeoffs within the bolsons.

A detailed demonstration of the extreme climate stress scenario was also presented. The entire model demonstration is available in the YouTube video of the meeting in English and Español.

There was an audience question about whether SWIM was validated against other well-known models, e.g., USGS models. The response was that SWIM is validated against actual historical data 1950 to 2015 and that it correlated very well. The main driver of the Water Balance Model is data from the Bureau of Reclamation.

The computer services and architecture for SWIM are available and are open source. It is possible to use SWIM to develop models for other regions given the availability of data and effort. The Team would be excited to see someone take advantage of this feature. All the SWIM code and infrastructure should be available by mid-year.

A custom scenario was also presented in SWIM using a wet climate scenario and modifying input data to project into the future by a model run, including the type of stakeholder who is using the model. Running a complete model rather than a canned scenario yields much more output information including a cross-compare feature that enables side-by-side comparison of multiple model scenarios.

Currently SWIM does not have the capability for users to upload their own data. There is an export feature that enables downloading SWIM data.

Stakeholders currently using SWIM include cities, activists, farmers (less so), scientists, students, and water managers.

What's next for SWIM are features that include narrative context of model outputs, integration to the National Infrastructure, a SWIM Knowledgebase, and more user engagement. The Team can be contacted at SWIM@utep.edu

About SWIM. Sustainable Water through Integrated Modeling. Supported by NSF Award# OAC-1835897. From the SWIM website (SWIM 2.5 (utep.edu) the goal of the SWIM project is to advance water sustainability research capabilities through the integration, execution and interpretation of water models and participatory reasoning processes. Using the meaning of data and models, SWIM facilitates interpretations of water availability in the US Southwest and North of Mexico for stakeholder-driven analysis from the socio-environmental perspective.