Earth Science
Applied Sciences

Averting Drought Shortages in the Colorado River:

Transitioning Long-Range, Data-Infused Scenario Modeling to the Central Arizona Project

Project Overview

The NASA Applied Sciences program is supporting research to improve the long-range scenario planning capabilities at the Central Arizona Water Conservation District (CAWCD) to inform decision-making for the Colorado River. CAWCD is a water conservation district that operates, maintains and plans deliveries for the Central Arizona Project (CAP), an aqueduct system that transports Colorado River water delivered to 80% of Arizona's population in three counties, including 10 Native American tribes, 17 irrigation districts, and is vital to the economic health of Arizona.

Project Highlights:

- *Uses a large number of NASA datasets for parameterizing, forcing and evaluating a regional model of the Colorado River.*
- *Provides a detailed view of the projected hydrologic changes to climate and land use scenarios relevant to decision making in subbasins of the Colorado River.*
- *Involves basin stakeholders who form part of the drought planning process in the Colorado River and represent major state agencies.*

The goal of this collaborative research is to construct data-infused long-range modeling scenarios that represent future hydrologic conditions in the Colorado River with respect to climate change forcing, land cover change, and their combination. The project team partners with a range of basin stakeholders to build trust and incorporate feedback into the alternative futures.

Scenario Modeling of the Colorado River

Regional simulations in the Colorado River are achieved through recent improvements to the Variable Infiltration Capacity (VIC) model. Statistically downscaled projections of temperature and precipitation from 8 General Circulation Models and two emissions scenarios are used to force VIC until 2099. Land cover change due to urban expansion and impacts on natural ecosystems are incorporated at projected times in the future. Highly-resolved modeling with detailed datasets allows inspecting changes at scales ranging from individual counties up to large river systems in the Colorado River. A focus is being placed on the sub-basin hydrologic response and its underlying causes.

How NASA satellites are helping scenario modeling of the Colorado River

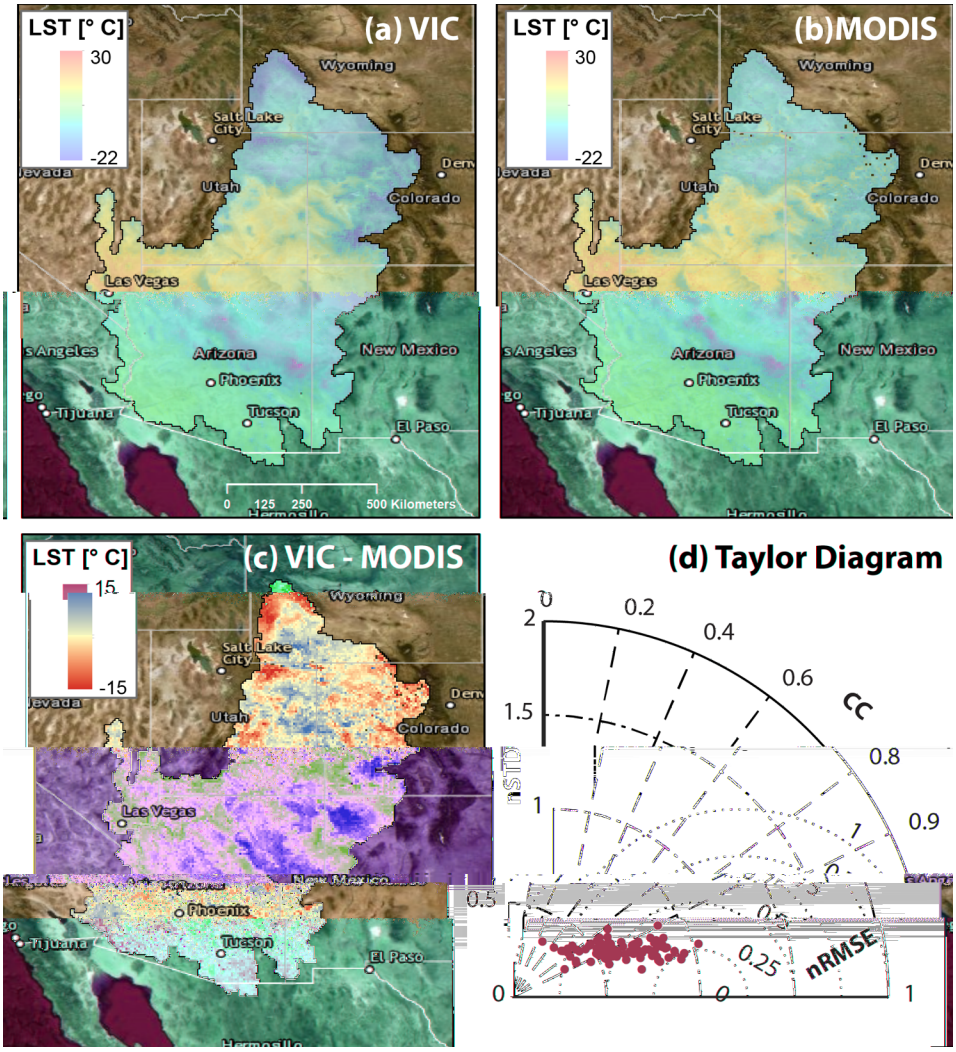
Arizona State University and CAWCD are working closely to ensure that NASA products add value to the modeling activities. These products are a key part of the VIC model evaluation in a historical period. Input from basin stakeholders is sought on the NASA products and evaluation metrics most relevant to their operations and to inform the model output visualization.

Arizona State University

CAP CENTRAL ARIZONA PROJECT

Model comparisons to remotely-sensed land surface variables

The project partners are utilizing the strengths of satellite data to test the spatial distribution of key modeling states in the Colorado River. Obtaining the correct patterns in basin snow cover and water equivalent are important for winter simulations that lead to spring runoff. Similarly, land surface temperature provides insight into the surface energy balance for all seasons. We are applying spatial metrics for the comparison of NASA products, such as those from the Moderate Resolution Imaging Spectroradiometer (MODIS), and simulated variables of the same type from VIC at the satellite overpass time. Similar efforts will be conducted with SMAP.



Comparison of land surface temperature (LST) during December through February 2011 from (a) VIC model and (b) MODIS, and their difference (c) VIC minus MODIS (same overpass time, averaged over period). (d) Taylor Diagram shows the model evaluation relative to MODIS in terms of the correlation coefficient (CC), normalized spatial standard deviation (nSTD) and normalized Root Mean Squared Error (RMSE). Each symbol represents the comparison of basin-scale maps for different days in the period of Dec. - Feb. 2011.