SAND2018-8578C

# How Model Coupling Influences the Perceived Vulnerabilities of Connected Energy-Water Systems

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There is growing need to understand the vulnerability of coupled infrastructure systems to an uncertain and evolving future. Coupled models are commonly used to explore such issues, but little attention is paid to the sensitivity of results to characteristics of the modeling framework. To explore this issue three different coupled modeling systems were used to explore potential impacts of changing climatic and socioeconomic conditions in the San Juan River Basin (SJRB), a major tributary to the Colorado River. All three modeling platforms were forced by statistically downscaled climate data from three global climate models (emission scenario RCP 8.5) while the Variable Infiltration Capacity (VIC) hydrologic model was used to simulate resultant tributary flows. RiverWare was then used to simulate the routing of tributary flows through the SJRB water infrastructure system. The three modeling platforms differed in the resolution of the RiverWare model and its coupling to other models:

1) A standalone low resolution RiverWare model;
2) High resolution RiverWare model coupled to StateCU/StateMod that simulate priority administration in Colorado upstream of the RiverWare model; and,
3) Same as #2 but with additional coupling between RiverWare and an Agent Based Model that simulates irrigators' response to changing conditions.

These coupled model platforms vary in terms of their spatial resolution, accounting of priority administration, exogenous vs. endogenous treatment of water use, infrastructure operations and representation of system dynamics. Results across the three modeling platforms and thee climate models are compared in terms of impacts to both local (i.e., water deliveries, reservoir storage and environmental flows) and non-local (i.e., interbasin transfers and downstream flows to Lake Powell) metrics. Finally, an electric dispatch production-cost model (PLEXOS), was used to evaluate how water shortages to local power plants influence behavior of the broader western electric grid. These comparisons provide insight into how model fidelity and model coupling influence the perceived vulnerability of connected water-energy systems to a range of uncertain future conditions.

*Sandia National Laboratories is a multimission laboratory managed and operated by National Technology and Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA-0003525.*