**Title**: Evaluating the Robustness of California Infrastructure Investment Partnerships to Paleo-Informed Hydroclimatic Variability

**Agency & Grant**: National Science Foundation Graduate Research Fellowship, DGE-1650441

**Project Lead and Institution**: Rohini Gupta; Cornell University

**Research Objectives**: California is characterized by immense hydroclimatic variability which leads to cycles of severe droughts and floods that are intensifying in a changing climate. This variability poses difficulties for water systems planning and management in the region. In May 2021, California Governor Gavin Newsom announced a $5.1 billion package for “immediate drought response and long-term water resilience investments”. The plan recommends improving water infrastructure and developing flexible methods for water sharing especially targeted towards managing drought. This research employs a high-resolution water resources simulation model, the California Food-Energy-Water System (CALFEWS)1, to assess infrastructure investments in the expansion of the Friant-Kern Canal and/or a jointly managed groundwater bank. The proposed research will clarify how well candidate investments improve water deliveries to stakeholders while also clarifying the viability of funding them through partnerships across water districts in the southern Central Valley region. We evaluate the robustness of 100 different optimal configurations of water district partnerships under alternative plausible future conditions characterized by differing climates, changing agricultural/municipal demands and imposed regulatory requirements. The climate ensembles are developed from a 600-year paleo (tree-ring) based reconstruction of regional weather patterns2. We generate multiple ensembles of daily, 600-year streamflow traces and create climate-change informed traces for each of the model’s inflow points. Thus, we can explore how the cost of the partnerships and the water gains provided by the infrastructure investments change in new hydroclimate scenarios that embody a large extent of natural variability in the climate system, including past megadrought and megaflood dynamics that have been more severe and longer than what has been observed in the modern record. **Resource Needs**: The proposed project requires ACCESS computing resources due to the high resolution of the CALFEWS model, both in terms of the daily time scale and representation of individual stakeholders. This project will also feature the longest input scenarios that CALFEWS has ever been run with. The 1,500,000 Discover ACCESS credits equates to approximately 84,000 units on Stampede2 which is the preferred resource because of prior successful run configurations of CALFEWS on this resource. We also have prior successful parallel scaling tests that can inform the computational needs of the current experiment. Under a maximum complexity configuration of CALFEWS (one that includes both options to fund canal expansion and invest in a joint groundwater bank), a simulation that runs a 64-member ensemble of 600-year traces will take ~400 minutes (6.7 hours; ~20 minutes per 30-year sequence) to run on an SKX compute node. This long simulation can be segmented through checkpointing into smaller segmented simulations to make sure RAM limits are not exceeded (e.g., the maximum RAM of 4GB per core on the SKX node). The 100 partnership configurations will be evaluated in 120 plausible futures, each characterized by the 64, 600-year traces of hydrology and additional uncertainties. Thus, we will run a total of 100\*120=12,000 total simulations, each taking ~6.7 hours, which leads to 80,400 node hours (~80,400 SUs on a normal partition). We will use 48-node jobs, where 6 simulations can be run at once on each node. Thus, we can run 48\*6= 288 simulations simultaneously. This leads to: 12,000/288= 42 batched jobs. The 2TB of storage on the home directory and additional storage on the scratch directory will be able to accommodate the storage of the inflow scenarios. Storage of output scenarios is minimal (about 4000 kB per simulation = 0.048 TB) which will be transferred in batches back to our local storage.