Integrated hydrological, power system and economic modeling of climate impacts on electricity demand and cost

Objective

Impacts of climate related water stress and temperature changes can cascade through energy systems, though models have yet to capture this compounding of effects. Here, we employ a coupled water-power-economy model to capture these important interactions in a study of the exceedance of water temperature thresholds for power generation in the Western U.S.

Approach

We build on previous efforts by quantifying the potential economic losses from a set of climate forcing scenarios, applying a multisector dynamic modeling framework that integrates a hydrological model, a detailed power system model with high spatial and temporal resolution, and a state-level economy-wide model of the U.S.

Impact

We find that not all reductions in reserve electricity generation capacity result in impacts, and that when they occur, intermittent interruptions in electricity supply at critical times of the day, week, and year account for much of the economic impacts. Lastly, we find that impacts may be in different locations from the original water stress.

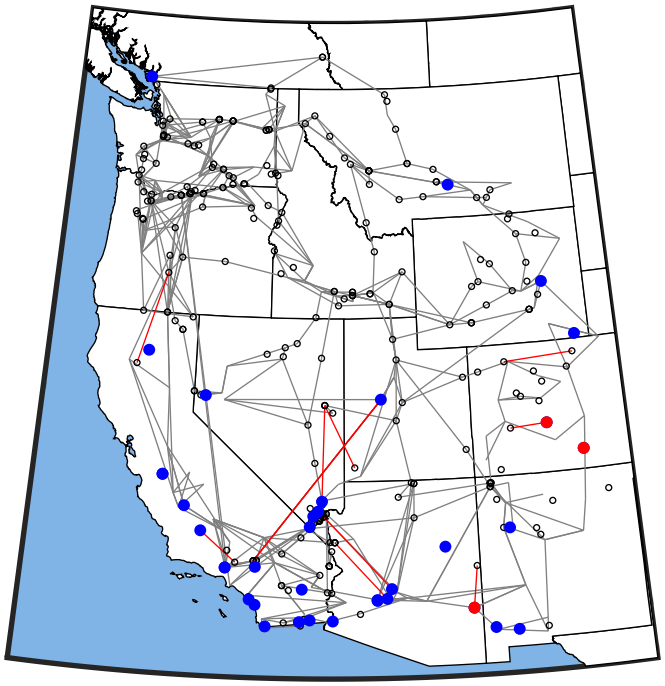

Figure: Geographic distribution of impacts (GFDL, 2097, week 29). Blue circles indicate the geographic locations of generators that are unavailable for at least one day of this week because of the water temperature restrictions, red lines indicate the transmission lines that experience congestion, and red circles indicate geographic locations that exhibit unmet electricity demand

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