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Wednesday, March 28
3:30 PM – 5:00 PM
SESSION 38: Climate Change 2 - Hydrologic Forecasting

Projecting Continental U.S. Water Stress Based on Global Datasets - Esther Parish, Oak Ridge National Laboratory, Oak Ridge, TN (co-authors: Evan Kodra, Karsten Steinhauser, Auroop Ganguly)

Human populations are profoundly affected by water stress, or the lack of sufficient per capita available freshwater. Water stress can result from overuse of available freshwater resources or from a reduction in the amount of available water due to decreases in rainfall and stored water supplies. Analyzing the interrelationship between human populations and water availability is complicated by the uncertainties associated with climate change projections and population projections. We present a simple methodology developed to integrate disparate climate and population data sources and develop first-order per capita water availability projections at the global scale. Simulations from the coupled land-ocean-atmosphere Community Climate System Model version 3 (CCSM3) forced with a range of hypothetical greenhouse gas emissions scenarios are used to project grid-based changes in precipitation minus evapotranspiration as proxies for changes in runoff, or fresh water supply. Population growth changes according to several Intergovernmental Panel on Climate Change (IPCC) storylines are used as proxies for changes in fresh water demand by 2025, 2050 and 2100. These freshwater supply and demand projections are then combined to yield estimates of per capita water availability aggregated by watershed and political unit. Results suggest that important insights might be extracted from the use of the process developed here, notably including the identification of the globe's most vulnerable regions in need of more detailed analysis and the relative importance of population growth versus climate change in in altering future freshwater supplies. However, these are only exemplary insights and, as such, could be considered hypotheses that should be rigorously tested with multiple climate models, multiple observational climate datasets, and more comprehensive population change storylines.

A Web-Based Tool for Estimating Climate Change Induced Shifts in Storm Intensity and Frequency - Stephen Bourne, Atkins, Smyrna, GA (co-authors: Kelly Brumbelow, Leslie Gowdish, Tom Singleton)

Across the globe, the effects of a changing climate are being felt. More intense storms are coming more frequently in some places, while longer droughts plague others. To truly understand the impact of changing climate, we must understand how it plays out in day-to-day life. What does a shift in temperature of 1 deg. C. or an extra inch of annual rainfall really mean to farmers, homeowners, sunbathers, and indeed all users of water resources? Traditionally, hydrologic analysis uses models of water flowing through watersheds to answer these questions. The models are typically at short time steps of an hour or less to truly capture the peaks in rainfall and subsequent river flows - peaks that can put the public in danger during floods, or bring fertility to farmland. Building an understanding of how storms events will change as a result of changing climate is therefore crucial for effective and safe water resources management. Yet, few easily accessible and user friendly tools exist for estimating climate change induced shifts in storm intensity and frequency. In fact, few tools exist for even accessing general circulation model (GCM) results - the models which are typically used to estimate climate change impact. Moreover, methodologies for using GCM results to forecast storm intensity and frequency shift have yet to mature, resulting in a lack of forecasting tools that can be readily accessed. In this presentation, we will present a new web- and map- based tool for forecasting 15-min to hourly time step storm timelines from 2010-2060. The tool implements a new forecasting method that synthesizes the forecast by using historic storms measured at gages as building blocks. Based on GCM-projected shifts in monthly rainfall and temperature, the method assigns a forecasted number of storms to each future month and adjusts their total volume to match the projected monthly total. The end result is a high frequency storm forecast that can be used for understanding the impact of climate change on hydrology, water quality, and indeed all rainfall-dependent factors. Results to date will be presented.

Assessing Alaska North Slope Lake Water Balance under Climate Change: Implications for Future Energy Exploration - Kelly Brumbelow, Texas A&M University, College Station, TX (co-authors: Stephen Bourne, William Schnabel, Walter McDonald)

Lakes on the North Slope of Alaska are used for water supply for building of ice roads and pads during the wintertime energy exploration season. Ongoing climate change may affect the water balance of these lakes and result in diminished water resources to support oil and gas development as well as preserve environmental integrity. The North Slope Decision Support System (NSDSS) combines GIS databases and analytical functions with future climate scenarios and hydrologic modeling. This integrated system can be used to assess potential changes to lake water balance. These changes can then be compared against water needs under future energy development scenarios to identify potential conflicts and needs for adaptive management of water resources. This paper will present the hydrologic modeling, integration of GIS tools, and case studies of specific North Slope lakes. The unique context of North Slope energy and environmental management will be further described to illustrate challenges for water management in the region and the role of GIS and decision support tools.