WaTER Center Research - CLIMATE CHANGE

Water is indispensable for nearly all human activities, including drinking, bathing, and growing food. The UN Millennium Development Goals include the extension of access to safe drinking water and sanitation/hygiene, the latter of which entails the need for adequate quantities of clean water. Climate change affects freshwater quantity and quality with respect to both mean states (water availability) and variability (floods and droughts). Significant changes in either water use or the hydrological cycle (affecting water supply and floods) require adaptation, especially in those communities most vulnerable and directly dependent upon local water resources. When one source of drinking water dries up or becomes contaminated by flooding, another less desirable source of water must be utilized. Research at the WaTER Center includes robust numerical modeling that utilizes remote sensing (radar and satellite imaging), climate system models, water balance models, and historical weather data to predict droughts, flooding and regional water availability.

Figure 1 shows the interconnectedness of many variables, including population, climate, water demand, and the freshwater hydrologic cycle. Any change in one of these systems will induce a change in the other.

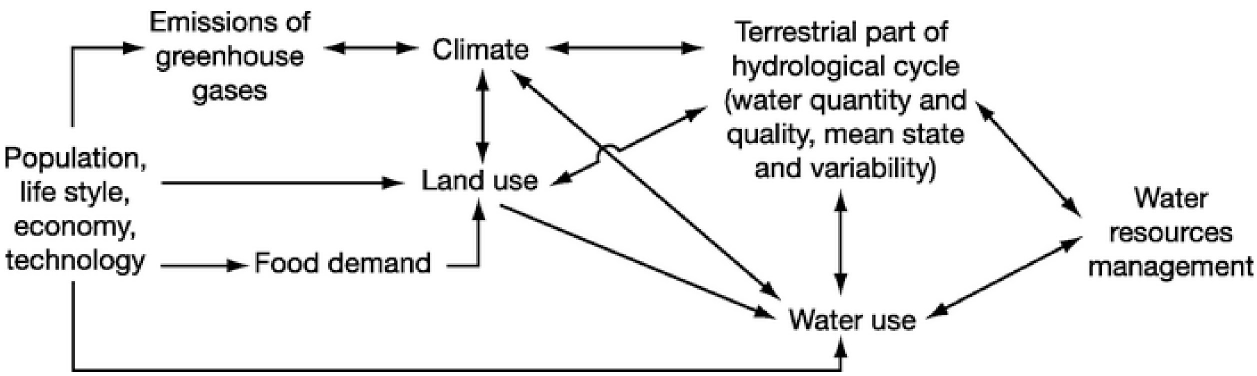

Figure 1. Impact of human activities on freshwater resources and their management, with climate change being only one of multiple pressures. (Source: IPCC, *Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability*).

Consequently, best practices for water and sanitation strategies in response to climate change begin with quantifying the hydrological storages and flows and assessing community vulnerability. As part of a NOAA-funded program, WaTER Center personnel have developed the Integrated Climate-Hydrology-Water Continuum Framework (C-H-W) for the U.S. Southern Great Plains, which the WaTER Center intends to adapt and extend to Ethiopia and Pakistan. Two main components of the framework are: 1) the Regional Atmospheric Modeling System (RAMS 6.0) for dynamically downscaling the IPCC's Global Climate Model (GCM) ensemble predictions; 2) the land surface Variable Infiltration Capacity (VIC) model, driven by downscaled climate forcing data, for hydrologic modeling. The C-H-W has led to an improved understanding of the impact of climate change on water availability, droughts, and climate-sensitive adaptation strategies. This research is capable of addressing the frequency of climate extremes based on projections by the IPCC's Next Generation of Earth System Models (IPCC, 2007). Finally, the VIC will simulate water resource variability and extremes into the future for targeted short, medium, and long-term time lines (e.g., 2020-2050-2100) under different climate change scenarios and socioeconomic development trajectories.

Researchers have used the VIC model to quantitatively measure hydrologic run-off response for a given watershed using historical data sets that span decades, and separate the impacts of climate change and human activities. As more data becomes available in developing countries, this model can be further applied in ways that will inform adaptation efforts in these areas.

A second component of the WaTER Center's hydrologic modeling is to use remote sensing to predict water-related disasters (e.g. floods), which strongly influence agriculture, public health, and household sanitation (Figure 2). In related NASA and USAID-funded work, we have been working with an African Partner, the Regional Centre for Mapping of Resources for Development (RCMRD), over the last four years to implement the distributed high-resolution Coupled Routing and Excess Storage (CREST) hydrological model over the East Africa region.

This real-time system has been benchmarked by historical data records and generates a full spectrum of hydrological states and fluxes.

The results of this modeling are being used to address likely scenarios in Pakistan and Ethiopia. For example, the projection of a drier climate might lead to water conservation strategies, drilling of wells for irrigation, or the move from water-intensive to water-efficient agriculture. The prediction of a wetter climate might lead to design of flood-control measures, or terracing of sloped lands.

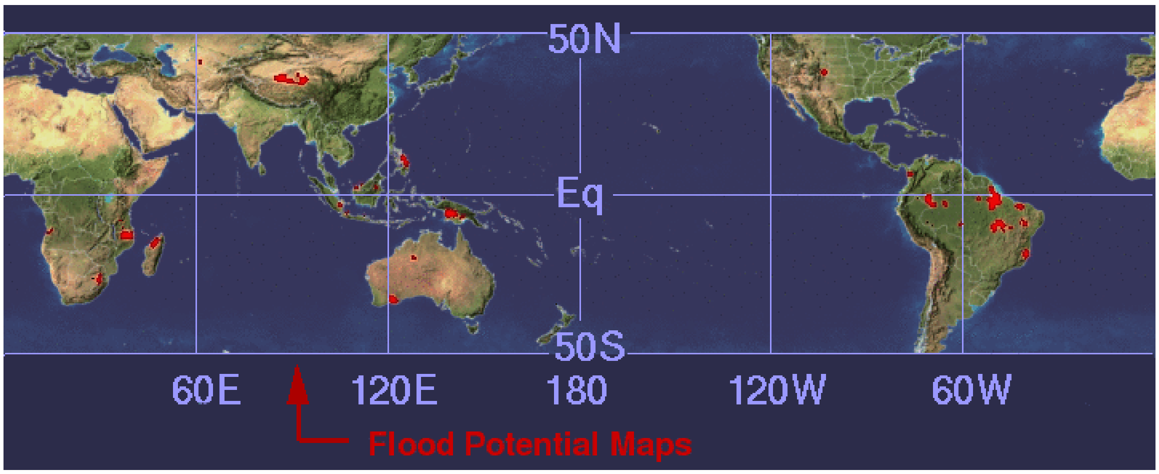

Figure 2. Flood potential across the globe using satellite rainfall estimation.

For more information, visit the research page for Dr. Yang Hong:

http://hydro.ou.edu/
and
http://eos.ou.edu