ND EPSCoR - Center for Regional Climate Studies

Improved Macro-scale Hydrologic Modeling and Applications in Cold Climate Regions

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What is the outcome or accomplishment?

A macro-scale grid-based hydrologic model has been developed to understand and analyze variations in various hydrologic processes. Its flexible gridded modeling structure makes it easier to couple large-scale satellite-based climatic datasets and land use models to address various climate- and agriculture-related water resource issues in the region.

What is the impact?

With improved modeling of snowpack and snowmelt – unique hydrologic processes in cold climate regions, the prediction of snowmelt-induced floods are improved, further mitigating the related hazard. In addition, improved hydrotopographic modeling for depression-dominated regions helps address issues associated with prairie wetland ecosystems, useful for decision makers and ND farmers.

What explanation/background does the lay reader need to understand the significance of this outcome?

Many macro-scale hydrologic models do not provide detailed, physically-based simulations of the dynamics of snowmelt and frozen soils in cold climate regions, limiting the ability to precisely predict spring floods. This modeling study looked at two river basins. The Red River of the North Basin (RRB), has had numerous floods, significantly affecting agriculture, prairie ecosystems and communities. The record-breaking snowfall and subsequent flood of 2009 cost an estimated $55 million (NOAA's Water Resource Services, 2009).

The Missouri River Basin (MRB), features diverse hydroclimatic and agricultural characteristics along the 2,500 km river. In analyzing hydrologic processes, the sharp elevation drop of nearly 1,000 meters from northwest to southeast translates to variations in accumulated snowpack and subsequent snowmelt. The improved macro-scale snowmelt model also accounts for sub-daily temperature variations. The application of the new method to the MRB demonstrated improved representation of the snowmelt dynamics compared to traditional methods.