Center for Regional Climate Studies (CRCS) Whitepaper

Background: The goal of the Center for Regional Climate Studies (CRCS) is to develop and apply integrated methods for assessing and predicting climate variation impacts on regional hydrological systems and agricultural production. Following this main theme, six research areas were identified that include:

1. Analysis of regional climate variations and data uncertainty
2. Prediction of hydrological changes for extreme conditions
3. Integration of hydrologic modeling across regional and local scales
4. Assessment of crop productivity response to climate and hydrological variations
5. Prediction of agricultural autonomous adaptation in response to changing climate and crop productivity
6. Exploration of feedback mechanisms between environment and land use changes.

Research Team: As a cross- and trans-disciplinary research cluster, the research team is made of researchers / faculty members from around 10 disciplines which include: Atmospheric Science, Agribusiness and Applied Economics, Chemical Engineering, Biology, Geology and Soils, Civil and Environmental Engineering, Computer Science, Counseling Psychology, and Earth System Science and Policy.

Current research emphases/expertise: The group has focused our studies in four main areas: weather and climate, hydrological processes, agriculture and economy, and air and water quality.

(1) Weather and Climate

Ground-based, remote sensed as well as model-based data have been analyzed for weather and climate related applications over the NGP region. Climate related applications included regional climate variations and the impact of large scale dynamics on regional climate. Weather related applications include the study of properties ranging from temperature, to precipitation, to extreme weather events such as blizzards (Fig. 1) and severe storms. This information has then been used to understand impacts on the hydrological and agricultural communities.

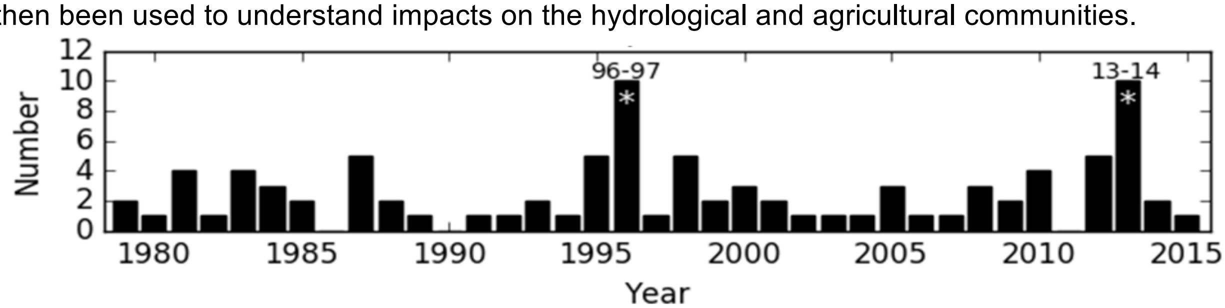

Figure 1: Annual number of blizzards within the Red River Valley from 1979-2015.

(2) Hydrological Processes

An integrated hydrological model has been developed with advanced multi-scale modeling capabilities that simulates regional hydrological processes at ranging in scale from local water bodies to entire watersheds. In-depth studies have also been conducted to evaluate the Devils

Lake flooding potential under current and future climate scenarios with the combined use of hydrological, economical and climate model data (Fig. 2). In addition, large scale hydrologic modeling has been conducted for the Red River basin and all of North Dakota (Fig. 4).

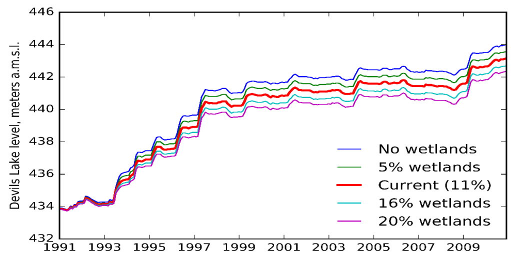

Figure 2: Predicted water levels of Devils Lake in 4 hypothetical wetland coverage scenarios.

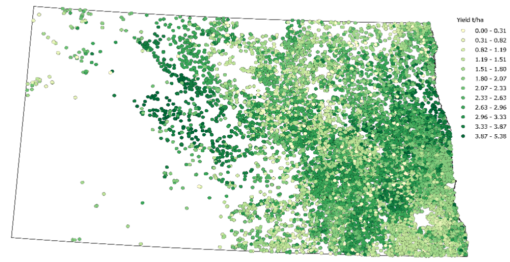

Figure 3: Simulated soybean yields for North Dakota in 2014.

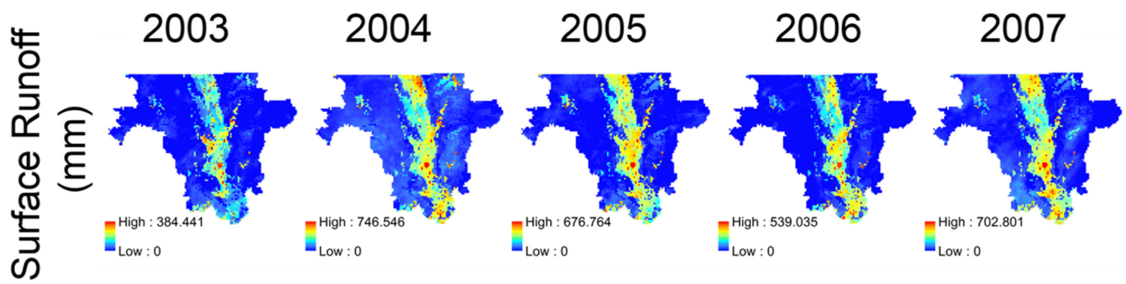

Figure 4: Simulated annual runoff for the Red River basin from a hydrological model.

(3) Agriculture and Economy

Regional agricultural activities have been studied using crop models. Agricultural acreage response functions have also been developed for crops such as corn and wheat. Linking with weather and climate data, the group has studied crop yields under current and future climate scenarios (Fig. 3). In addition, by coupling an economical model with a crop model, the group is in the position to study the impact of human factors (such as market, policy) on crop yields and soil health. This coupling provides the potential to improve future predictions of these properties.

(4) Air and Water Quality

The group has developed expertise in air quality analysis and monitoring. The group has also developed modeling capability for estimating water quality associated with Devils Lake including properties such as sulfate concentration (Fig. 5).

<u>Other expertise and data the group offers</u>

Regional-based hydrological, soil health, and biological data are being measured for selected regions. Farmer level surveys have been collected for studying the linkages between farm level activities and climate and economic variables.

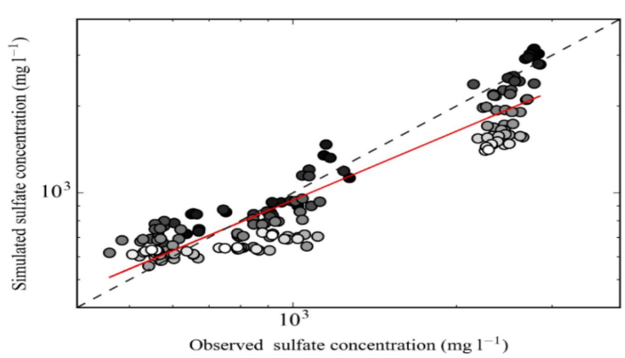

Figure 5: Comparison of simulated and observed sulfate concentrations from 2008 to 2014.

Webpage: https://und-crcs.org/