Northern Great Plains Water Consortium

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Climate Cyclicity and the Economic Vitality of the Northern Great Plains

Compared to past extremes in the climate cycle, the widespread settlement of the Red River Basin of eastern North Dakota and western Minnesota occurred during a period of relative calm. The early settlers, primarily traders and fur trappers, experienced the tail end of our last wet cycle in the early 1800s, and those farmers who lived here in the 1920s and ´30s experienced a drought that was severe enough to ruin livelihoods. Unfortunately, these climatic shifts pale in comparison to those that occurred prior to widespread human settlement of the region.

Background

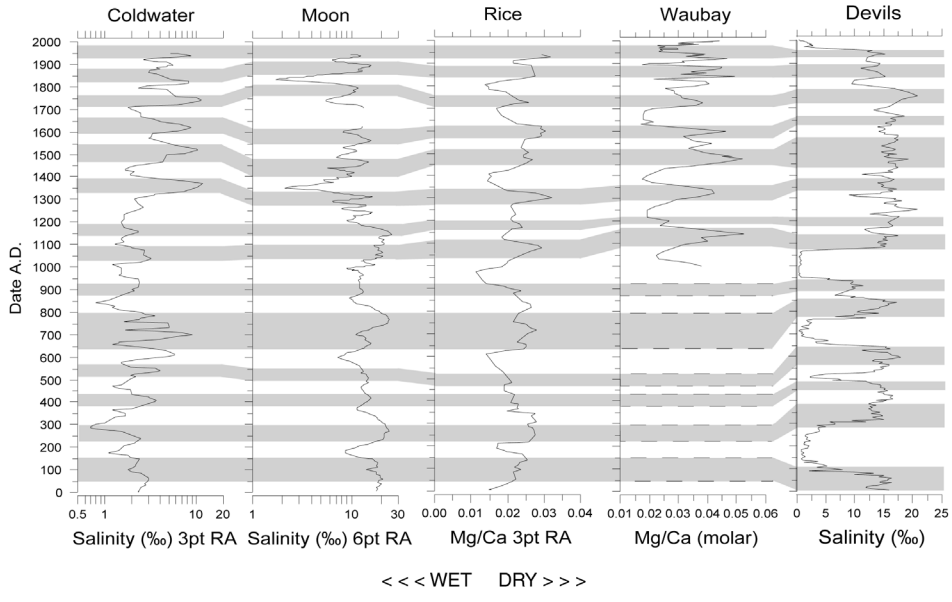
Research conducted by the Energy & Environmental Research Center (EERC) indicates that frequent climatic fluctuations resulting in alternating periods of drought and wet conditions are typical for the northern Great Plains and suggests that the severity and length of extremes exceeded those on modern record (Solc et al., 2005). Laird et al. (1996) conducted paleoclimatic research and found that prior to 1200 A.D., there were 100-yr-long cycles of frequent, extreme droughts that made the Dust Bowl look like a picnic.

This begs the question: how prepared are we to handle the inevitable and extreme climate fluctuations that we will be encountering? If the past 15 years in the Red River Basin is any indication of our readiness for wet conditions, we are sadly unprepared. From the devastating 1997 and 2009 spring floods, to the summer deluges of 2000, 2002, and 2005, to the rapid rise in Devils Lake water levels, the region has been inundated with one record flood event after another. The 1997 flood caused an estimated $5 billion in damage to the Red River Valley (International Joint Commission, 2000), and as of 2008, over $450 million has been spent on building dikes and moving roads, rails, and power lines in the Devils Lake area (U.S. Geological Survey, 2009). While the total damage estimates for the spring of 2009 have yet to be tallied, it is safe to say that hundreds of millions of dollars have been spent to combat flooding in both the Red River Valley and Devils Lake regions in this year alone.

Proper Planning Requires Climatic Context

While many conventional flood mitigation measures have been implemented to help deal with these excess water problems, one has to question the efficacy of flood mitigation projects with engineering designs based on relatively recent (past 100 to 150 years) climatic data that may not be representative of "normal" conditions in the region. For example, geologic data collected by Bluemle (1991) suggest that the water levels in Devils Lake were high enough to spill into Stump Lake and into the Sheyenne River at least once in the past 1800 years. Early maps of the region, compiled by explorers and fur trappers who relied on the waterways of the region for transport, sometimes show a connection between Devils Lake and the tributaries of the Red River during the record wet period of the 1820s and ´30s (Keating, 1825). A paper written by William Rannie (in press) summarizes historical accounts that document the exceptionally wet summers that occurred in the Red River Basin and surrounding region during two primary intervals: 1824–1834 and 1849–1861. Summertime storms during these periods were so frequent and intense that many areas experienced widespread crop failure and perpetual flooding of waterways.

While science has proven that Devils Lake overflowed into the Sheyenne River in the not-too-distant past, many are still reluctant to believe that the levels could get that high again. Similarly, after the 1997 flood, many residents of the region believed that we would not experience another



The pattern of climate cyclicity in the region for the past 2000 years, as inferred from salinity and magnesium/calcium ratio data for several lakes located in North Dakota and northeastern South Dakota. Shifts to the left indicate wetter conditions and shifts to the right indicate drier conditions. Data derived from Solc et al. (2005), Fritz et al. (2000), and Shapley et al. (2005).

A map developed from the 1823 expedition to the region by Stephen Long that shows a connection between Devils Lake and two tributaries of the Red River (Finley and Vance, 1825). While there are inaccuracies in the map, the suggested connection is intriguing and likely reflects the wetter conditions that existed in the first half of the 19th century.

flood of that magnitude for at least the next 100 years. Unfortunately, Devils Lake water levels continue to rise, and Sheyenne/Red River Valley residents were just inundated with a flood that exceeded the 1997 magnitude in many locations.

We have already demonstrated that we are grossly underprepared to deal with floods that are moderate in size compared to those that have plagued our region in the past. Imagine how devastated the region would be if we were to experience a truly large flood or, scarier yet, a drought much larger in magnitude and duration than that of the 1920s and ´30s. While it is inherent in human nature to ignore the lessons of past history and assume that we will be spared from further catastrophe, the economic and social viability of this region is dependent on innovative flood and drought mitigation solutions that provide true security from extreme events. While it is economically infeasible to prepare for the absolute worst flood and drought scenarios, we are currently grossly underprepared to deal with even the moderate climate shifts experienced by the region in the past 2000 years.

Interested in Joining?

The EERC is actively seeking additional members to complement DOE funding and to help direct the program's efforts. The NGPWC is currently engaged in Phase I of the program, wherein future program efforts and demonstration projects will be selected and prioritized. Phase II of the effort, scheduled to begin in 2010, will focus on demonstrating the water minimization and beneficial reuse strategies and technologies prioritized in Phase I.

Solutions

Through the Northern Great Plains Water Consortium (NGPWC), the EERC is evaluating and demonstrating water management options to help ensure the economic and social vitality of the upper Midwest, even during climate extremes. For example, the Waffle® flood mitigation concept evaluated by the EERC would provide security against floods much larger than 1997 and 2009 and provide landowners with a means of recharging groundwater and increasing soil moisture on their farmland during especially dry years. The EERC is also evaluating innovative options for treatment and reuse of nontraditional water sources, such as wastewater treatment plant effluent, saline groundwater, and water produced from oil and gas operations. These unconventional water resources are largely ignored in our current paradigm where clean supplies of water are inexpensive and relatively abundant; however, as population grows and competition for water supplies increases, the demand for water will continue to rise. Developing strategies to harvest these unconventional resources could mean the difference between catastrophe and moderate inconvenience in the event of a multidecadal drought.

We need solutions that build resiliency into our flood and drought mitigation plans, not solely options where the protection is limited by the size of a dike, the height of a road, or the diameter of a pipe designed to import water from one region to another. Through the NGPWC, the EERC will continue to develop innovative water management options to help ensure our preparedness for future climate extremes.

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