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Framework for a U.S. Geological Survey Hydrologic Climate-Response Program in Maine

The seasonal water cycle in Maine has been shown to be sensitive to changes in air temperature during the last century. A hydrologic climate-response program would improve understanding of the future effects of climate change in the State.

Introduction

It is important to monitor hydrologic systems in the United States that could change dramatically over the short term as a result of climate change. Many ecological effects of climate change can be understood only if hydrologic data networks are in place. Because of its humid, temperate climate and its substantial annual snowpack, Maine's seasonal water cycle is sensitive to air temperature changes (Hodgkins and others, 2003). Monitoring of relevant hydrologic data would provide important baseline information against which future climate change can be measured.

A series of recent investigations by the U.S. Geological Survey (USGS) has documented changes in several components of the water cycle, including earlier snowmelt runoff in Maine during the last 30 to 40 years (Hodgkins and others, 2003), earlier lake- and river-ice breakups (Hodgkins and others, 2002; Hodgkins and others, 2005), and a denser and thinner late-winter snowpack (Hodgkins and Dudley, 2006). Snowmelt runoff timing was measured as the date, each year, by which half of the total winter-spring streamflow passed a streamflow-gaging station. Historical snowmelt runoff timing for the Piscataquis River in central Maine is shown in figure 1 as an example.

Results of climate projections input to hydrologic models indicate that hydrologic trends, such as earlier spring snowmelt runoff, are expected to continue into the future (Hayhoe and others, 2007). These trends could affect species at the southern edge of their range in Maine, such as Atlantic salmon and Canada lynx, and may also affect availability of water for human use. This fact sheet describes the framework of a hydrologic climate-response program that would improve understanding of the effects of future climate change in Maine.

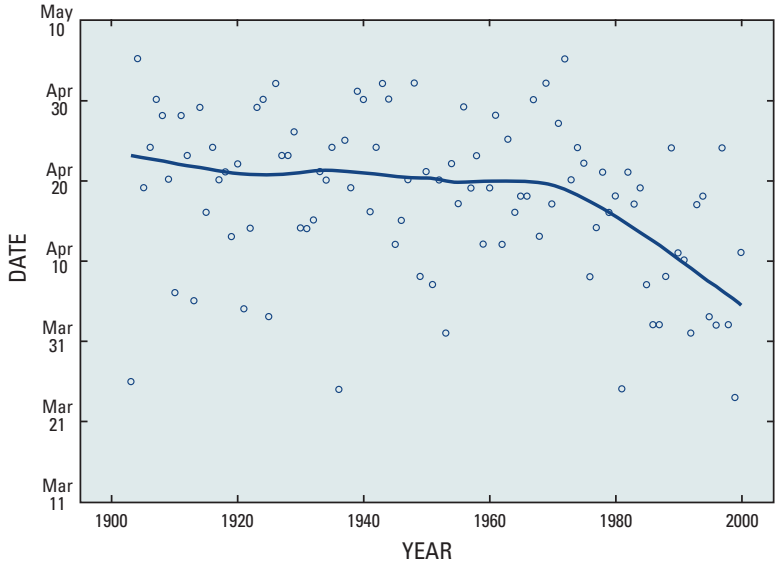

Figure 1. Annual snowmelt runoff timing for the Piscataquis River in central Maine, 1903-2000.

Program Design

The framework of a USGS hydrologic climate-response program in Maine would consist of four major parts (Hodgkins and others, 2009): (1) identifying homogeneous climate-response regions; (2) identifying hydrologic components and key variables of those components that would be included in a hydrologic climate-response data network (for example, streamflow has been identified as a primary component, with a key variable of streamflow being the timing of snowmelt runoff); (3) regularly updating historical trends of hydrologic-network variables; and (4) selecting basins for process-based studies.

Maine would be divided into seven climate-response regions that follow major river-basin boundaries and have relatively homogeneous climates. A map of the climate-response regions and

streamflow-gaging stations with long-term data that would be appropriate for inclusion in a climate-response data network are shown in figure 2.

Components to be included in the hydrologic climate-response network would have at least one key variable for which extensive historical data are available at multiple sites. The components proposed for inclusion are streamflow, lake ice, river ice, snowpack, and groundwater. The proposed key variables of the hydrologic climate-response network are expected to be responsive to climate change in the next few decades. These variables are also important for human water use and (or) ecosystem function.

Key hydrologic variables within each climate-response region would be analyzed periodically to maintain up-to-date analyses of year-to-year variability, decadal variability, and longer term trends. One basin in each climate-response region would be identified for process-based hydrologic and ecological studies. The hydrologic climate-response program for Maine would provide early warning of changes in the seasonal water cycle of Maine and increase understanding of the effects of changes on humans and ecosystems.

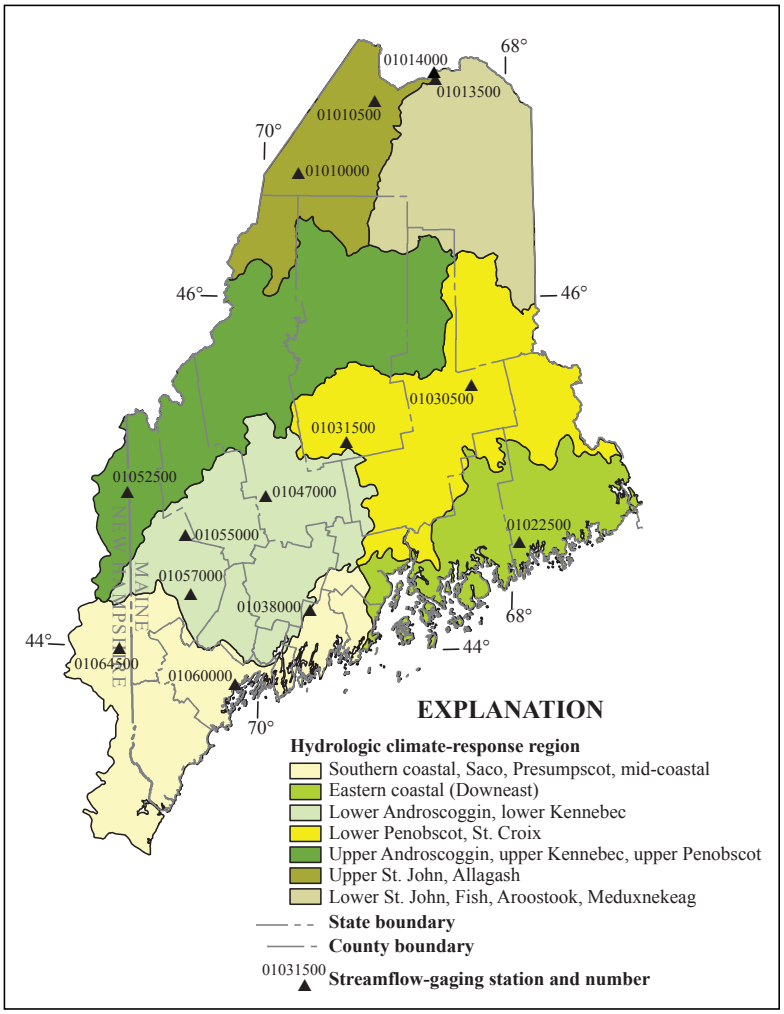

Figure 2. Location of climate-response regions and streamflow-gaging stations with long-term data that would be appropriate for inclusion in a hydrologic climate-response program in Maine.

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