Water Science from the U.S. Geological Survey in Support of Park Management

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The U.S. Geological Survey's (USGS) Water Resources Division has a long history of collaboration with the National Park Service (NPS) to provide water science and data to help manage parks.

Streamgaging in parks

One area of frequent collaboration is streamgaging. The USGS operates about 545 streamgages in national parks. Usually the stage and streamflow data are sent by satellite radio telemetry to receiving stations, from which the near-real-time data are disseminated via the internet (http://water.usgs.gov/waterwatch/). The data are used for a variety of purposes, related to public safety, water supply, resource management, design of facilities, water rights, recreation, education, and climate-change monitoring.

In recent decades tight budgets in both agencies have led to a decline in the number of streamgages in parks, even while the protected acreage has been increasing. In 1970 there was one streamgage for every 62,000 acres of NPS land; in 2006 there was one streamgage for every 154,000 acres. A 2007 NPS survey identified 423 sites where existing streamgages were threatened with a loss of funding, discontinued streamgages need to be reinstalled, or a new streamgage was needed. In order to pursue some potential funding sources, both within and outside the federal government, to improve this situation, the list will soon be revisited with the help of NPS inventory and monitoring networks and regions. Special emphasis will be placed on streamgages that could be useful in monitoring the effects of climate change.

Many parks are realizing the potential for streamgages and their data to enhance the park's interpretive program, and are working with the USGS to put visitors and web users in touch with the information.

Interpretive water studies

In addition to streamgaging, the USGS also frequently collaborates with the NPS on interpretive hydrologic studies. Many excellent examples were featured in other presentations in this conference [this volume]. A few additional recent examples include:

- Evaluation of the regional flow characteristics of the Death Valley regional flow system in Nevada and California. In collaboration with the NPS and other agencies, the USGS has developed a three-dimensional, steady-state and transient ground-water flow model to help answer questions about boundaries of sub-regional and local flow systems, regional flow paths and fluxes, locations and rates of ground-water discharge, and impacts of human activities on the flow system.
- Connections among basin-fill aquifers, carbonate-rock aquifers, and surface-water

resources in southern Snake Valley, Nevada, near Great Basin National Park. NPS and USGS are working to improve understanding of hydrologic systems that sustain numerous water-dependent ecosystems on federal lands in Snake Valley, Nevada. Understanding these connections is important because proposed projects to pump and export ground water from Spring and Snake Valleys in Nevada may result in unintended capture of water currently supplying springs, streams, wetlands, limestone caves, and other biologically sensitive areas.

- Flood frequency and water stages for Potomac and Shenandoah Rivers, Harpers Ferry National Historical Park, West Virginia. Harpers Ferry, situated at the confluence of these two rivers, has historically been affected by flooding from both rivers. Either river may contribute individually to flooding, or the combination of flows may be the source of flooding. The prediction of corresponding water-surface elevations at Harpers Ferry is complex because of differences in rainfall distribution across the two regions and the timing of the peaks on both rivers.
- Influence of local recharge on water quality in Hot Springs National Park, Arkansas. The hot springs of Hot Springs National Park consist of a mixture of water from two recharge components: a primary hot-water component and a secondary cold-water component. Urbanization in the area near the hot springs has increased the potential for degradation of the quality of surface-water runoff and locally derived ground-water recharge to the hot springs. Comparison of analyses of samples collected during base-flow conditions from the springs in 2000 and during a storm event in 2001, with the results from earlier studies dating back to the late 1800s, indicates that little change in major, minor, and trace constituent chemistry has occurred, and that the water continues to be of excellent quality.

Information about USGS water programs, contacts, data, projects, and publications of interest to the NPS may be found on an internal NPS web site at www1.nrintra.nps.gov/wrd/USGS.NPS/.

Regionally downscaled climate-change and hydrologic projections for national parks

A web site supported by the U.S. Bureau of Reclamation, Lawrence Livermore National Laboratory, and Santa Clara University (http://gdo-dcp.ucllnl.org/downscaled_cmip3_projections/#Welcome) provides convenient access to an archive of regionally downscaled projections of temperature and precipitation for any area of interest within the conterminous United States. The geographic resolution of these projections is 1/8 by 1/8 degree of latitude or longitude. It is a relatively straightforward process to average the results of sixteen different climate-change models to project, within error limits, monthly temperature and precipitation for any national park for the next century, under up to three future carbon-emission scenarios. Furthermore, the USGS has recently published a monthly water-balance model (McCabe and Markstrom 2007), which can be applied to the results of the climate-change projections to provide estimates of future trends in a suite of hydrologic parameters such as evapotranspiration (based on the Thornthwaite equation), soil moisture, snowpack storage,

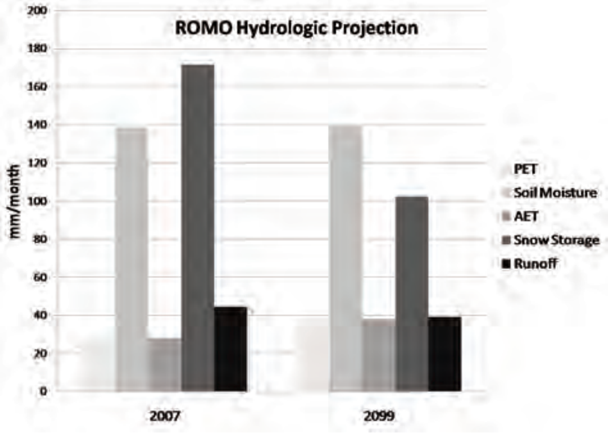

Figure 1. Projected changes in selected hydrologic parameters in Rocky Mountain National Park, Colorado, for the end of the century. Based on the average of 16 regionally downscaled climate change projections for the moderate A1B future carbon-emission scenario, and on projections from the USGS monthly water-balance model by McCabe and Markstrom.

and runoff, again within error limits. This model was used in conjunction with the regionally downscaled climate-change projection to project hydrologic changes for a part of Rocky Mountain National Park in Colorado. The results (Figure 1) showed that by the end of this century, even though precipitation is projected to increase slightly over the next century, the projected increase in temperature, and hence evapotranspiration, is expected to result in a decrease in runoff of about ten percent. The warmer temperatures are also expected to reduce snowpack storage by about forty percent, and to shift the onset of spring snowmelt about a month earlier.

Reference

McCabe, G.J., and S.L. Markstrom. 2007.
USGS Open-File Rep. 2007-1088. On-line at http:// pubs.usgs.gov/of/2007/1088.