California Energy Commission
Public Interest Energy Research (PIER) Program
ENVIRONMENTAL AREA RESEARCH

Monitoring Groundwater Recharge In the Sierra Nevada Mountains For Impact On Hydrologic Resources

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Fact Sheet

The Issue

Snowmelt is a significant source of replenishing groundwater resources in the western United States. In addition, this groundwater recharge process is typically a major contributor to streamflow. Climate warming during the past 50 years has resulted in decreased snowfall and faster snowmelt in California's Sierra Nevada mountain range.

Reductions in snowpack and increased melt rates may reduce the ground infiltration of meltwater and groundwater recharge, which may affect surface water resources. In addition to being a source for municipal water supply and agricultural irrigation, water is an important component in California's generation of electricity—especially in hydroelectric generation, but also as a coolant in coal-, oil-, and gas-fired power plants.

The potential impact of climate change on groundwater recharge is difficult to estimate, largely because the recharge rate is difficult to measure, especially at the basin or catchment level. Although mountains are important sources of groundwater recharge, some promising methods for monitoring recharge, which have only been used in basins or valleys, are untested in mountain settings.

To understand future water availability, long-term monitoring of water recharge in mountains where snowpack accumulates is needed for relating changes in climate to changes in recharge. For successful long-term monitoring of mountain recharge, a broader, more robust set of monitoring methods is needed.

Bear Creek Spire in California's Sierra Nevada mountains.
Source: Wikipedia

Project Description

This research will test various methods of examining groundwater recharge processes in mountain settings. Using a field site at Sagehen Creek in the Sierra Nevada, investigators will:

- Investigate the potential for using long-term, repeated dating of groundwater using natural tracers (including chlorofluorocarbons, sulfur hexafluoride, and tritium/helium-3) as an indicator of changing recharge conditions.

- Determine the possibility of using high resolution gravity mapping (microgravity monitoring) to estimate catchment-scale recharge in mountain settings.
- Estimate the contribution of snowmelt to groundwater recharge by using naturally occurring stable isotopes of hydrogen and oxygen in precipitation, snowmelt, and groundwater. New designs of precipitation and soil water collectors for characterizing stable isotope compositions will be tested.
- Determine the portion of streamflow derived from the snowpack of the previous winter by developing and implementing methods using the naturally occurring sulfur isotope 35S, which can be used as a chemical tracer.
- Archive all data collected for inclusion in any future long-term monitoring projects at the site.

PIER Program Objectives and Anticipated Benefits for California

Because California's energy supply depends upon water, understanding potential changes in the state water supply as the climate changes is essential to planning for future energy needs. Given that a warming climate could increase energy demand, related impacts on the water supply must be considered to maintain a viable energy supply for California.

Water is a vital resource needed for all aspects of day-to-day living such as consumption, sanitation, agriculture, manufacturing, and energy production. Greater knowledge of the potential impacts of climate change on mountain snowmelt and groundwater recharge will help water planners ensure a sustainable water supply for California's future.

Project Specifics

Agreement Number: PIR-08-010
Recipient: Desert Research Institute, Division of Hydrologic Sciences
Application: Statewide
Amount: $400,000
Co-funding: $13,000 from U.S. Geological Survey; $900 from Desert Research Institute
Term: March 2009 to September 2012

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