



# CENTER FOR SNOW & AVALANCHE STUDIES

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## PRESS RELEASE

For Immediate Release

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RE: Water cycle monitoring in the San Juan Mountains advances modeling and understanding of snow hydrology in the western United States

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For each hour of the last ten years, the Center for Snow and Avalanche Studies has been collecting comprehensive water cycle data from its study area high up in the San Juan Mountains of southwestern Colorado, near Red Mountain Pass. The results of this unique, in-depth mountain system monitoring program have now been published in the scientific journal *Water Resources Research* as "[Mountain system monitoring at Senator Beck Basin, San Juan Mountains, Colorado: A new integrative data source to develop and evaluate models of snow and hydrologic processes.](#)"

The paper's authors believe these newly published data are an important contribution to the small constellation of hydrometeorological datasets. Working with CSAS's Chris Landry and Kim Buck, coauthors Mark Raleigh and Martyn Clark, both with the Hydrometeorological Applications Program of the Research Applications Laboratory at the National Center for Atmospheric Research in Boulder, fine-tuned the "hydrologic forcing data". The team then analyzed the dataset for wind effects on measured precipitation, radiative effects on air temperature measurements, and the like, fully exploring the data's strengths and weaknesses. As perhaps the highest elevation, well-instrumented, purpose-built research watershed in the world, Senator Beck Basin expands the domain of model-ready snow and snow hydrology datasets and provides a new platform for developing improved snowpack and snowmelt runoff forecasting tools.

Further, CSAS's monitoring program at Senator Beck Basin is steadily collecting a valuable climate record where it counts, at the headwaters of major Colorado River tributaries, and within site of the Rio Grande River headwaters. Climate change researchers around the world have recognized mountains as sensitive bellwethers of global and regional change, where system responses are more transparent and perhaps quicker to present than in lower elevation settings. Understanding the complex system interactions governing the seasonal distribution of mountain snowcover, its storage and release of water, and the effects of climate on those processes, are clearly of increasing importance to Colorado water providers.

Water agencies, including the USGS and Bureau of Reclamation have pointed to the need to sustain and expand just the kind of monitoring CSAS is conducting. The USGS, in collaboration with the Army Corps of Engineers, Bureau of Reclamation, and NOAA, recently published a white paper declaring the importance of long-term monitoring for detecting and quantifying impacts of climate change.

The Bureau of Reclamation's recent Colorado River Basin Study implicitly makes the case for the need to monitor how climate change effects on headwater snowpacks are actually playing out. Senator Beck Basin is capturing those data, hour by hour. Senator Beck Basin is also the primary sentry site for CSAS's [Colorado Dust-on-Snow Program](#).

(See attached "Center for Snow Information Sheet" for further details about CSAS.)

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"CSAS is proactively addressing a gap in American monitoring of alpine landscapes. I am personally very excited by CSAS' emergence in this field" **Dr. Jonathan Overpeck**, 2007 IPCC Nobel Laureate

"CSAS provides vital information for understanding the critical issues of our time - issues like water usage, environmental policy, and global warming - all of which have huge implications for the future. Venture is proud to support this research, which will help preserve our mountains for the next generation." **Lisa Branner**, Venture Snowboards

"I support CSAS because Senator Beck Basin is the best study site in North America for high alpine snow research ... CSAS is top-notch!" **Dr. Hans-Peter Marshall**, Geoscientist

"Climate change equals changing snow pack, which affects people, plants and ecosystems. We depend on programs like the CSAS to determine the rate mountain systems are changing." **Dr. Heidi Steltzer**, Alpine & Arctic Ecologist

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## Center for Snow Information Sheet

### Who is CSAS?

The Center for Snow & Avalanche Studies is an independent 501(c)(3) organization that serves the mountain science community and regional resource managers by:

- Hosting & conducting interdisciplinary mountain system research and
- Conducting integrative 24/7/365 mountain system monitoring at the Senator Beck Basin Study Area that captures weather, snowpack, radiation, dust-on-snow, soils, plant community and hydrologic signals of regional climate trends.

### Why is the CSAS's Senator Beck Basin study area important to Colorado?

The 720 acre, alpine Senator Beck Basin Study Area at Red Mountain Pass (SBB) was established by CSAS in 2003 to monitor for and detect climate-driven changes in regional mountain snow systems, and to foster new research on mountain snowpack and snowmelt processes. SBB is an unique asset for the Colorado water management and hydrologic modeling communities faced with year-to-year resource variability and potentially more severe drought episodes.

### Why is our location critical to understanding the Colorado snow system?

Senator Beck Basin (SBB) is located in a critically wet and cold portion of the Colorado River Basin, as identified in the recent Basin Study. SBB's alpine location in the western San Juan Mountains, the first major mountain system downwind of the desert Southwest and Colorado Plateau, is well situated to enable monitoring of regional warming, drought, changes in precipitation phase, and other water yield-affecting processes such as dust-on-snow and spruce/fir forest conditions.

### What is Mountain System Monitoring?

Climate change researchers around the world have recognized mountains as a sensitive bellwether of global and regional change, where 'system responses' are more transparent and perhaps quicker to present than in lower elevation settings. Understanding the complex system interactions governing the seasonal distribution of mountain snowcover, its storage and release of water, and the effects of climate on those processes, are clearly of increasing importance to Colorado water providers.

**What is the CSAS Annual Budget?** CSAS has bootstrapped its first decade on subsistence funding of up to \$140,000/year. To ensure continuous operation of Senator Beck Basin, sustain our Mountain System Monitoring program, and to continue to host research, CSAS needs to grow its budget to \$200,000 per year. CSAS seeks the majority of its funding from stakeholder agencies and organizations.

### Where to find more information?

Senator Beck Basin, including maps and photos: [snowstudies.org/sbbsa1.html](http://snowstudies.org/sbbsa1.html)

Mountain System Monitoring Program: [snowstudies.org/msm1](http://snowstudies.org/msm1)

Complete datasets by Water Year: [snowstudies.org/data1.html](http://snowstudies.org/data1.html)

Graphical representations of data: [snowstudies.org/summary\\_graphs.html](http://snowstudies.org/summary_graphs.html)

Scholarly publications & presentations: [snowstudies.org/pubs1.html](http://snowstudies.org/pubs1.html)

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### **How else is CSAS relevant to Colorado River Basin ?**

SBB is the primary sentinel site for the CSAS's Colorado Dust-on-Snow program. SBB data are providing a platform for hydrologic model development and testing by an NCAR team, led by Dr. Martyn Clark, for application in the CBRFC Community Hydrologic Prediction System (CHPS). Numerous studies in the Colorado River Basin have identified the need for improved monitoring for climate change in the system. SBB data are critical to ongoing research on the impacts of mountain system warming. SBB also provides validation of remote sensing characterizations of catchment scale mountain system behaviors. Data from the alpine SBB area, and the study area facilities themselves, complement other data sets and research venues, such as the high desert USFS Reynolds Creek Experimental Watershed.

### **What are the CSAS science products?**

Senator Beck Basin data constitute the foundation for the science that CSAS conducts and for the research we host and support. SBB datasets are published, in several formats, after each water year and are of particular use by modelers. CSAS also posts 'real-time' data from each of the four SBB study plots. Graphical products are produced monthly and seasonally. CSAS commissions analyses of its Mountain System Monitoring data. CSAS's Colorado Dust-on-Snow program posts updates throughout the year. Finally, peer-reviewed scholarly publications by researchers using SBB facilities and/or data have and will continue to contribute to increased knowledge across a wide range of mountain science domains, including snow and mountain hydrology.

### **What research relies on Senator Beck Basin?**

CSAS hosts field studies at SBB and provides SBB data to academic and agency research groups focused on snow and mountain hydrology. Research teams are currently investigating new technologies for snowpack SWE monitoring (Boise State Univ., Army CRREL), improving snowmelt models (NCAR, Boise State, USFS Reynolds Creek), developing remote sensing algorithms for snowmelt forcing by dust (JPL/UCLA, Western Water Assessment), exploring long-wave radiation effects on mountain system warming (Columbia, Rutgers), and modeling snowcover distribution and atmospheric river events (NCAR, NOAA). New hydrologic and climate related research starting in summer 2013 includes a spruce beetle team from Colo. State Univ., and an SBB soils survey by NCAR's Hydrometeorological Applications Group.

### **What measurements are made at Senator Beck Basin?**

Four arrays of continuously operated infrastructure, including a stream gauging station, have been developed by CSAS at SBB. Year-round automated measurements are complemented by other manual measurements in routine time series. SBB data include:

- Weather: precipitation, wind, air temperature, relative humidity, pressure
- Snowpack: depth of snow cover, SWE (manual), snow temperatures, snow profiles, snow albedo
- Radiation: direct broadband solar radiation, direct near-infrared/shortwave-infrared (NIR/SWIR) solar radiation, diffuse broadband solar radiation at solar noon, downwelling thermal radiation, reflected broadband shortwave radiation, reflected NIR/SWIR radiation, and infrared snow surface temperature
- Dust-on-snow (at SBB): event logs, event wind roses, event sampling and analyses for mass and chemistry
- Soils: heat flux, temperature, volumetric water content
- Plant community: species, diversity, change over time
- Hydrology: stream stage, discharge, water temperature, electrical conductivity