The Great Salt Lake Basin Hydrologic Observatory

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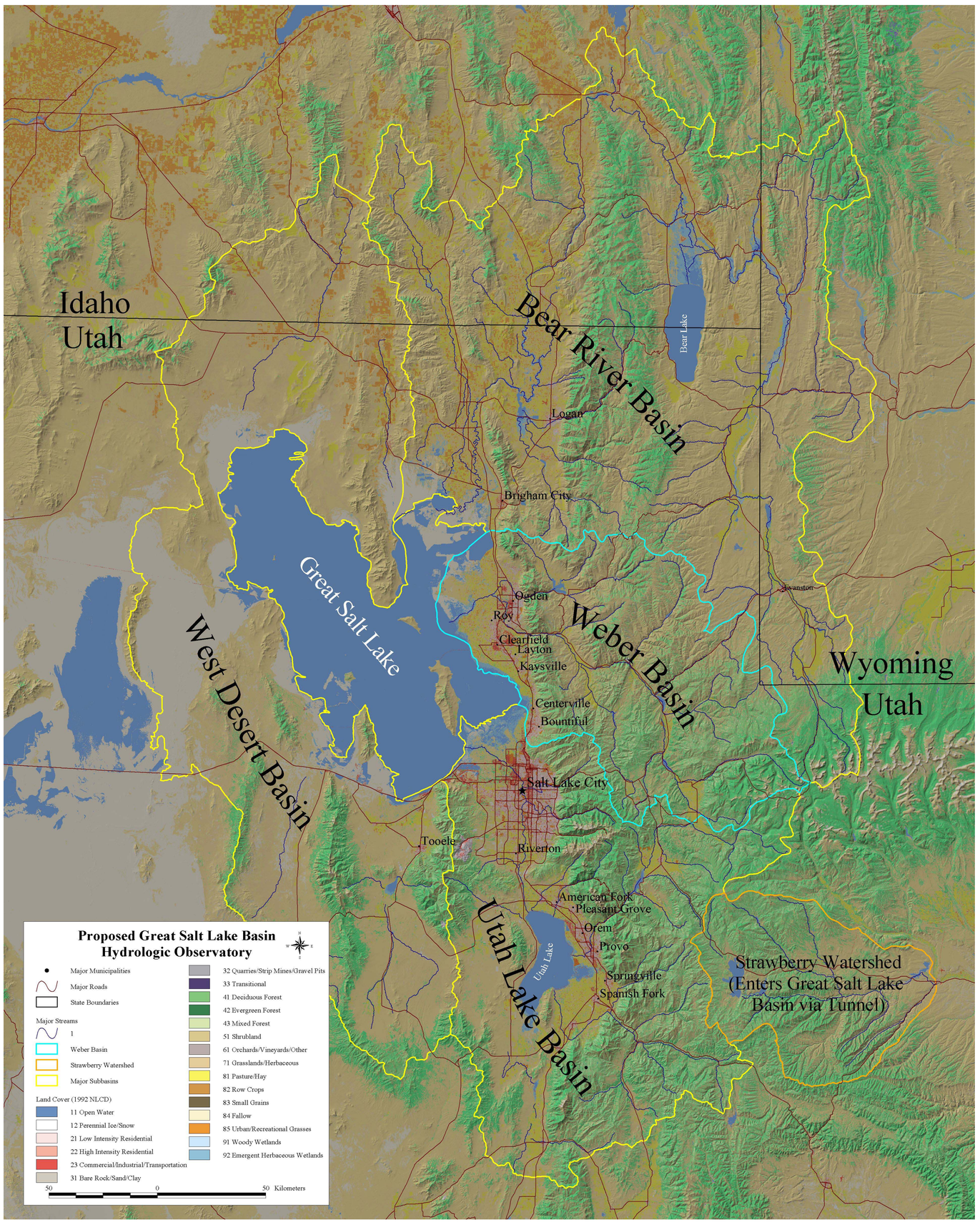
Abstract

Through the Consortium of Universities for the Advancement of Hydrologic Sciences, Inc. (CUAHSI), NSF plans to establish a network of hydrologic observatories. The mountain west is a high priority area for detailed observations because of the sensitivity, uncertainty and vulnerability of mountain systems and rapid human population growth with critical dependence of human and natural ecosystems on mountain water resources. The Great Salt Lake basin serves as a microcosm for much of the western U.S. in that the hydrologic system is driven by snowmelt in the mountains that supplies water to the relatively arid valleys. The region is dominated by nonlinear interactions between snow deposition and loss in the mountains, streamflow and groundwater recharge at high and mid-elevations, and evaporation from the desert floor. A planning group is working on a multi-million dollar long term plan and proposal for the Great Salt Lake Basin Hydrologic Observatory which would include a focus on mountain and snow hydrology. Hydrologic Observatories would be shared national facilities and our planning group welcomes participation and suggestions from the wider community with a stake in mountain and snow hydrology and related fields.

A Hydrologic Observatory to measure the Hydrology of the Modern West focused on the interactions between human influences and hydrologic processes



What is a Hydrologic Observatory?

A **principal goal** of CUAHSI is the development of the observational and data systems infrastructure necessary to acquire knowledge sufficient to address large scale hydrologic science problems. The global scale and complexity of hydrologic processes requires an open and integrated community effort.

A **Hydrologic Observatory** (HO) is a large scale (>10,000 km^2) experimental watershed designed to integrate observations of water processes, fluxes and flow paths at an unprecedented scale to provide a richly detailed observational basis for breakthroughs in understanding of the large scale interactions that control the hydrologic cycle.

Why locate a Hydrologic Observatory in the Great Salt Lake Basin?

The **steep topographic, climatic, and land-use gradients** in the Great Salt Lake Basin provide the opportunity to examine hydrologic processes across a wide range of elevations, precipitation values, vegetation, and land uses. The Great Salt Lake Basin has a compactness that is unparalleled in the U.S., and that is more proximal to logistical support than any other comparable location in the U.S. For example, a 30 km transect can span from regional base-level to alpine catchment while remaining within 50 km of major research universities, an international airport, and major government agencies.

Located in one of the **fastest-growing areas** in the United States, the Great Salt Lake Basin provides the opportunity to **observe climate and human-induced land-surface changes affecting water availability, water quality, and water use**.

The Great Salt Lake Basin is tractable as a hydrologic observatory because it is **closed** and **the lake serves as an integrator**. The vast majority of inflow to the lake is contributed by the three major subwatersheds to the east, and characterization of the major fluxes in the basin can be accomplished with high density monitoring to the east of the lake with lower density monitoring to the west.

The Great Salt Lake Basin Hydrologic Observatory development team is highly committed to the concept of openness. It is our hope that researchers from across the United States will involve themselves and even lead aspects of the proposed observatory. Please contact us if you would like to become part of the Great Salt Lake Basin Hydrologic Observatory Team or for more information regarding the Proposed Great Salt Lake Basin Hydrologic Observatory

A Community Research Platform for Mountain Climate Sciences

Hydrologic scientists working together for the greater good in the intermountain region

http://greatsaltlake.utah.edu

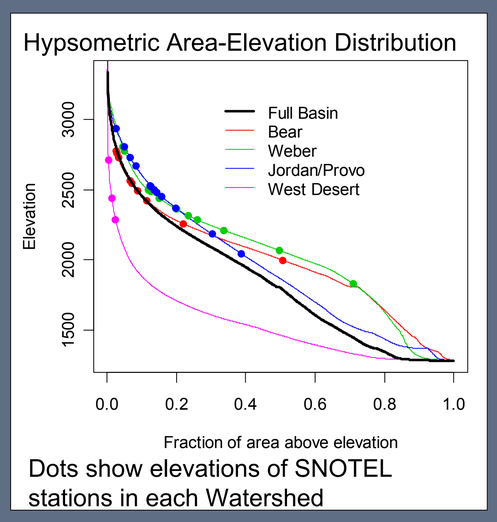
Science Themes

Overarching Questions

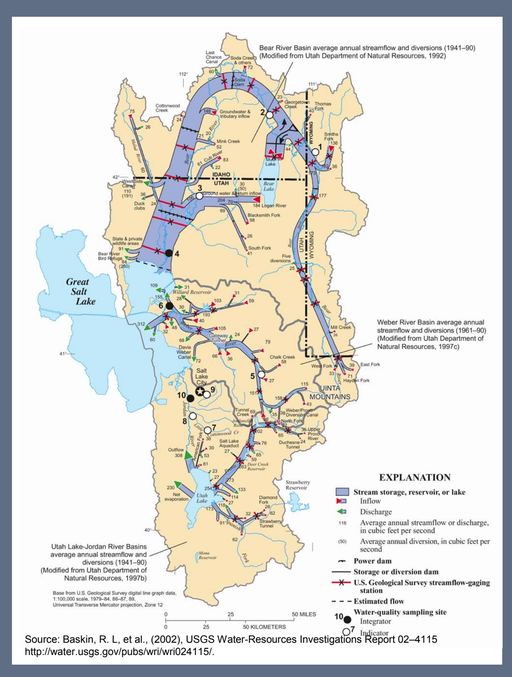
- How do climate variability and human-induced landscape changes affect hydrologic processes, water quality and availability, and aquatic ecosystems over a range of scales?
- What are the resource, social and economic consequences of these changes?

Complex Terrain

How does complex terrain affect the spatial patterns and dynamics of hydrologic processes? How well can we quantify the spatial and temporal fluxes, storages and flow paths of water in all its phases (vapor, ice/snow and liquid) in complex terrain?



Dots show elevations of SNOTEL stations in each Watershed

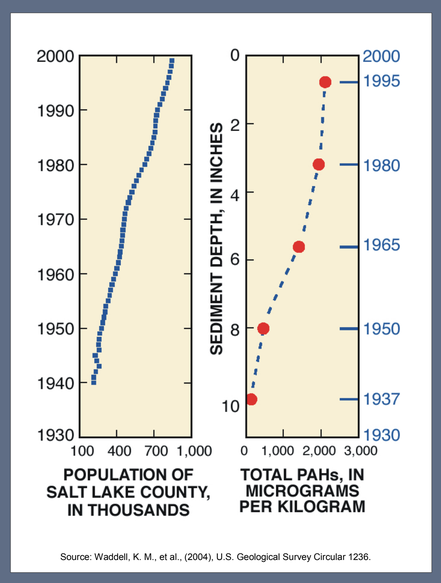


Source: Baskin, R. L, et al., (2002), USGS Water-Resources Investigations Report 02–4115 http://water.usgs.gov/pubs/wri/wri024115/.

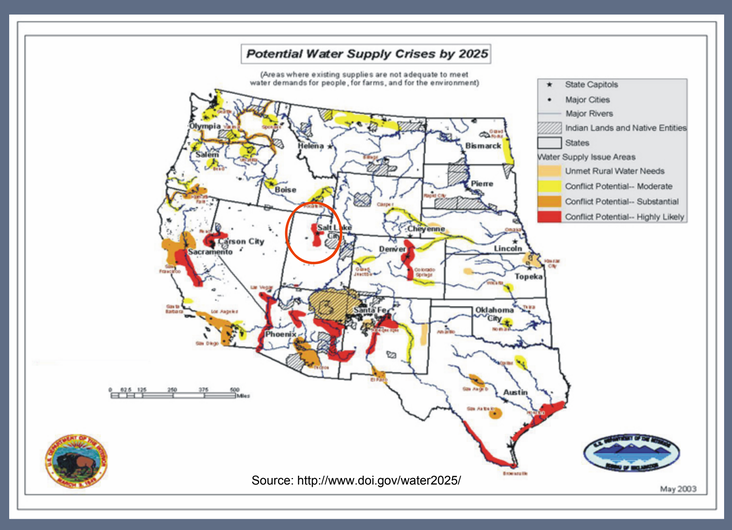
The Great Salt Lake acts as a collector and integrator of hydrologic signals from the surrounding basin providing the opportunity to investigate fundamental hydrologic processes at scales that have been previously unexplored. Lake sediments in closed basin lakes extend our knowledge of hydrologic processes and water quality

Water and Mass Balance Closure

The terminal Great Salt Lake Basin presents a unique opportunity to close the water, solute and sediment balances that is rarely possible in a watershed of a size sufficient for the study of land surface-atmosphere interactions.



Source: Waddell, K. M., et al., (2004), U.S. Geological Survey Circular 1236.



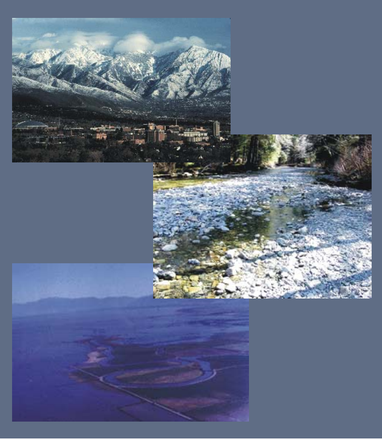
Source: http://www.doi.gov/water2025/

Sustainability and Human Dynamics

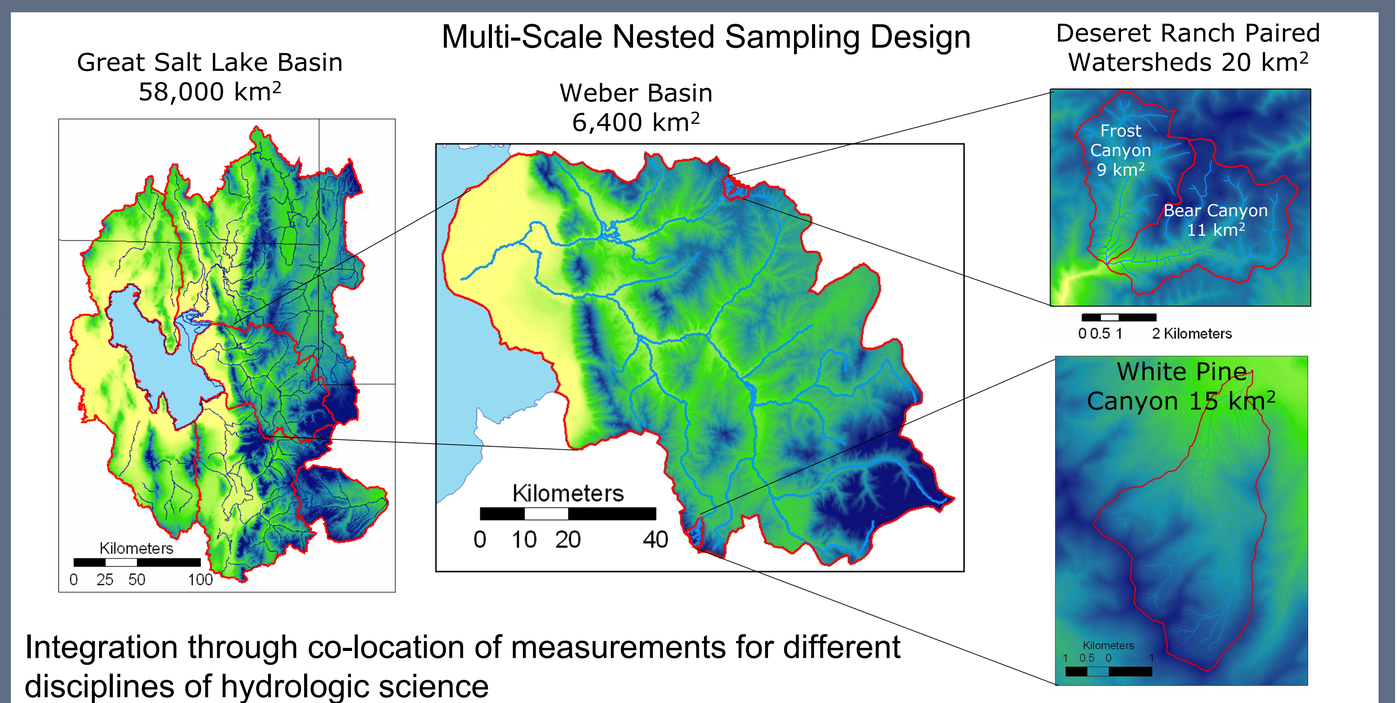
How do hydrologic fluxes, flow paths, and residence times change in response to land use change and development that is prevalent in much of the western U.S.

Fragile Mountain and arid Ecosystems

How are aquatic and terrestrial species and resources related to topography and geology, and how will these systems respond to changes in the magnitude and timing of seasonal hydrologic processes

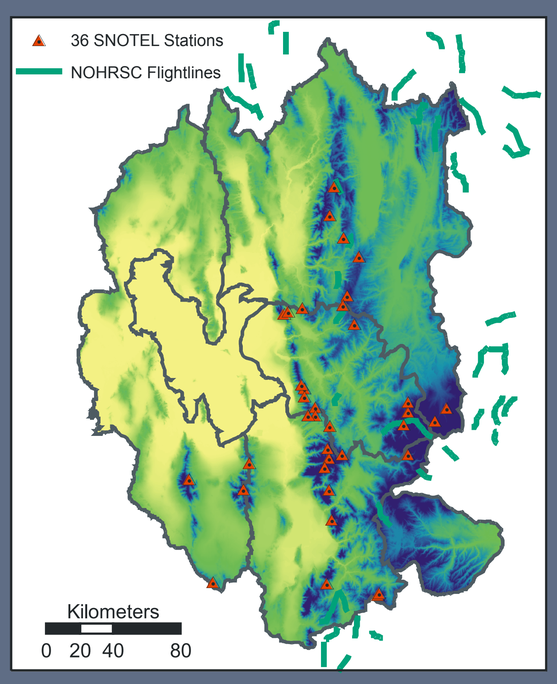


Measurement Approach



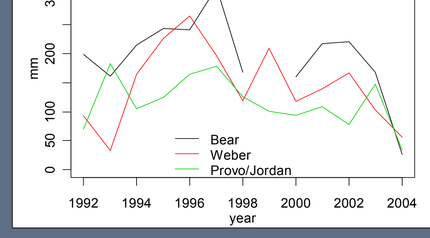
Integration through co-location of measurements for different disciplines of hydrologic science

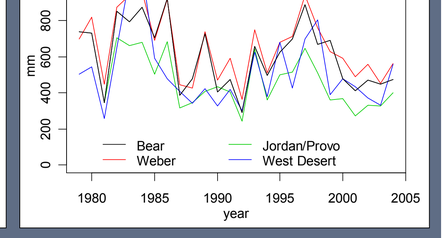
Snow and Mountain Processes

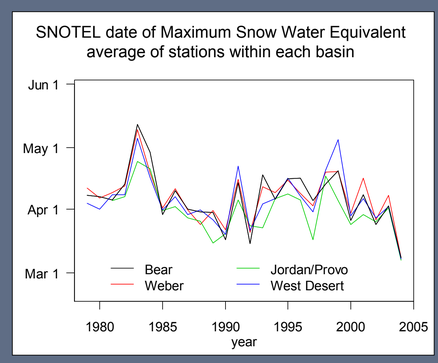


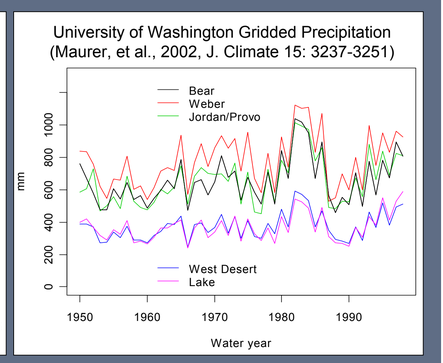
Examples of some of the planned additional measurement infrastructure

- SNOTEL Upgrades to provide soil moisture, solar radiation, Soil temperature, relative humidity, wind speed and direction.
- Flux towers to measure above and below canopy ET fluxes
- Tunable diode laser absorption spectrometer to measure stable oxygen isotope content of atmospheric water vapor to allow tracking of the components of the vapor flux.
- Continuous streamflow and water quality stations
- Spread-Spectrum communications network

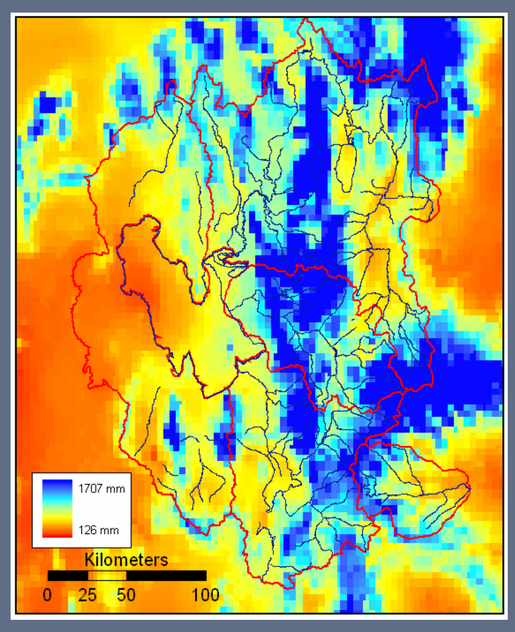




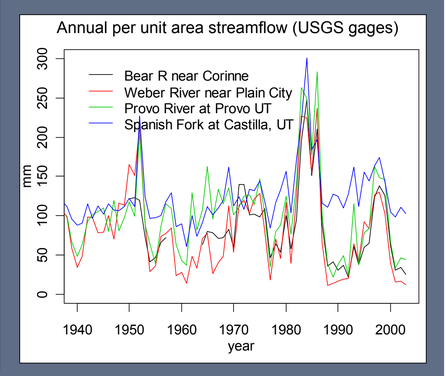




1970-2000 PRISM Annual Precipitation



1970-2000	PRISM Precip (mm)	Unit Runoff (mm)
Bear	563	93
Weber	679	90
West Desert	351	-
Strawberry	484	-
Jordan	540	127
Salt Lake	308	-
Total	493	



Nonlinear Dynamics and Mountain Front Processes

How does the aggregate water balance reflect the integrated effect of nonlinear dynamic interactions among runoff, vegetation, mountain block groundwater, urbanization and water use?