CORRELATION OF TEMPERATURE AND SNOW WATER EQUIVALENCY IN THE SIERRA NEVADA

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ABSTRACT

Much of the world's resources, such as fresh water in the form of snow are decreasing, as is evident in the Sierra Nevada. This can be attributed to many factors but, most importantly, the continual rise of global temperatures. Nine NRCS (Natural Resources Conservation Service) snow telemetry (SNOTEL) sites were studied in a geographic range from Lake Tahoe to Mono Lake in order to identify a correlation between temperature and snow water equivalency (SWE). GIS results suggest a direct relationship of temperature to SWE. Mountain communities are the stewards of these vital areas and combined with support from the state of California, have an obligation to preserve and protect these areas from anthropogenic abuses. If nothing is done to reduce the human causes of global warming trends, what once was known as the Snowy Mountain range, may soon be exhausted of its valuable snowpack.

PRESENTATION EXTRACTS

Slide 4: References regarding climate change effects on snow cover

- Johnson, Fohl and Dozier : Climate Change and the Sierra Nevada Snowpack
  - "Continually increasing temperature could have a devastating result on annual snowpack and could possibly decrease [it] as much as 30% -70%."
- Mote and Hamlet : Anthropogenic Climate Change and Snow in the Pacific Northwest
  - "With only modest changes of precipitation projected by the climate models, snow water equivalent at almost every location are projected to decrease."
- Seth: Southwest Snow Hydrology
  - "Winter precipitation, snow water equivalency and spring runoff variation in the west are all related to climate patterns."
- Union of Concerned Scientists: California's Environment Threatened By Global Warming
  - "Our models predict 5-6° F increase in temperature by the year 2050 that would dramatically decrease snowpack in the Sierra Nevada."

Slide 5: California is dependent on snow: water supply, agricultural production (the 27.2 billion dollar agricultural industry used over 80% of California's water in 2000), and recreation

Slide 6: National Resource Conservation Service (NRCS) collects data from hundreds of automated SNOTEL (SNOw TELemetry) sites to facilitate water supply forecasting in the western U.S.

- A normal SNOTEL station consists of snow pillows, a precipitation gauge, and a temperature sensor.
- Snow Water Equivalency (SWE) is calculated by weighing snow on pillow sensors.
- Meteor burst technique allows for information to be communicated between remote locations up to 1,200 miles apart.
- Information signals are bounced off billions of small sand-sized meteorites as they enter the atmosphere.

Slide 7: Water Supply Forecasting:

- SNOTEL sites are used to predict the amount of water held in reserve for downstream requirements.
- Regional water districts depend on melt water from the mountain basins to replenish lakes and reservoirs.

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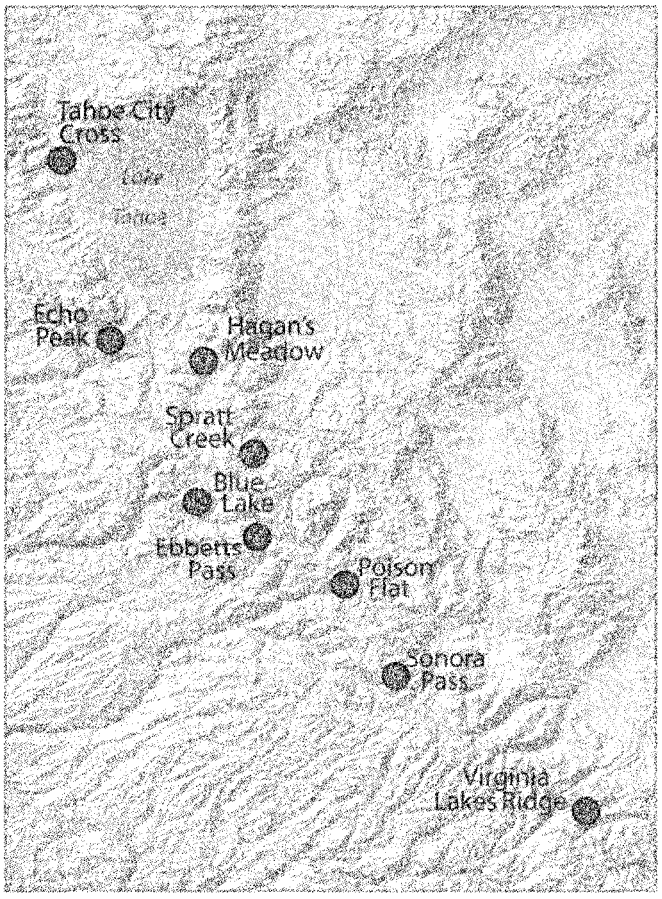
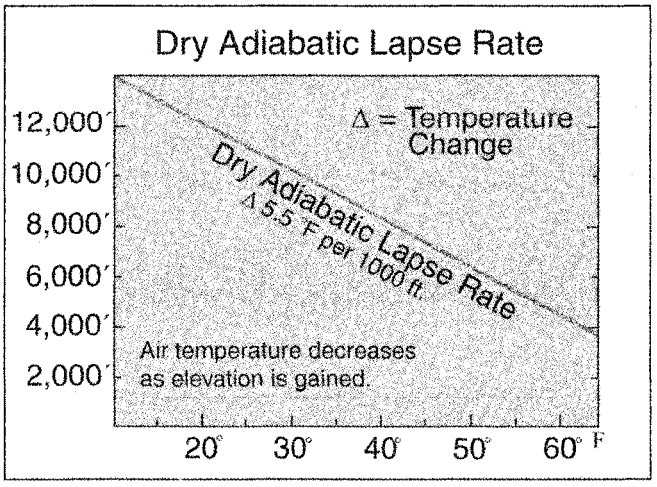
Slide 8: Nine SNOTEL study sites were selected:

- The sites were in a geographic region between Lake Tahoe and Mono Lake.
- Key precipitation months of February, March, April and May were utilized for the study.
- Fourteen-years of Snow Water Equivalency and temperature data were organized for entry into a GIS package.

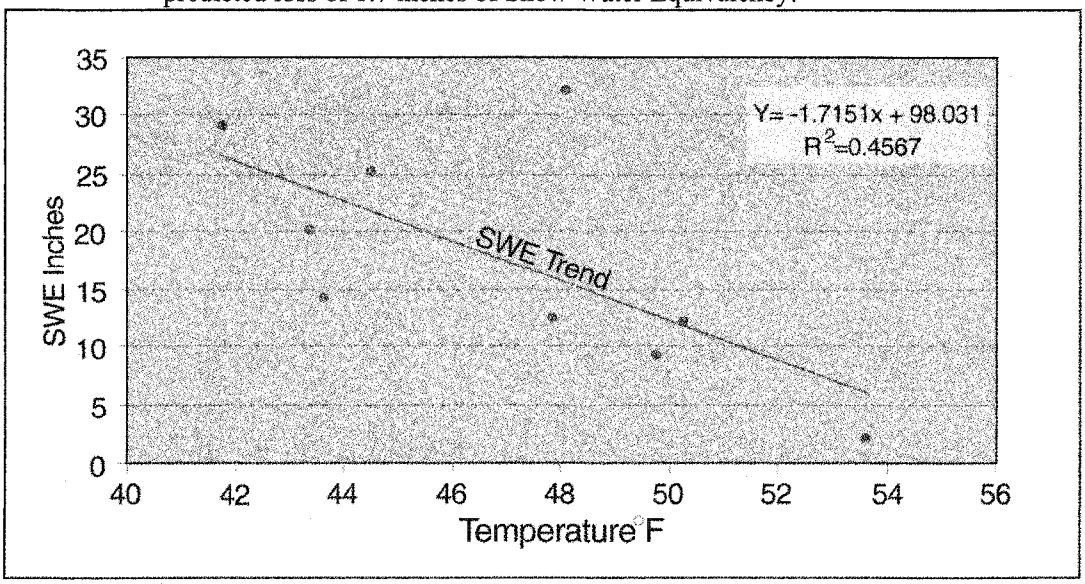


Slide 9: The dry adiabatic lapse rate was used to adjust temperatures from a low elevation station to the SNOTEL sites.



Slide 15: A comparison of the twenty-nine year average to the fourteen-year study period showed an average temperature increase of 3.5°F and an average in Snow Water Equivalency decrease of 0.3 inches.

Slide 16: Using 1990-2003 Temperature vs. SWE for 9 SNOTEL Sites, for every 1°F rise in temperature, there is a predicted loss of 1.7 inches of Snow Water Equivalency.



Slide 17: National Oceanic Atmospheric Administration records of temperature show a 0.39 F increase for the whole state of California over the last two decades (www.nodc.noaa.gov). Scientists suggest that mountain temperatures will change faster then the rest of the state and these increases will likely mean winter precipitation will fall as rain rather than snow.

Slide 18: By 2050, mean snowline is predicted to rise from 6,000 ft to 8,000 ft, and that change will reduce snow water equivalency across the Sierra Nevada and may cause lower elevation SNOTEL sites to be completely bare for the whole winter.

Slide 21: The citizens and government of California can be proactive by supporting international treaties to mitigate causes of global warming. At the state level, it is vital to pass recently proposed emission standards as well as funding alternative energy research.

Slide 22: Mountain communities, more specifically, have a unique responsibility to the rest of the state for preserving watersheds vital to California's future. Without action agriculture, reservoirs, and alpine recreation will be threatened. This study adds to the growing body of evidence that suggest immediate actions be taken. The consequences of losing the Sierra snowpack would far exceed the cost of resolving the causes of climate change today.