

Accurate measurement and modeling of the snowpack energy balance are critical to understanding the terrestrial water cycle. Most of the water resources in the western US come from snowmelt, yet statistical runoff models that rely on the historical record are becoming less reliable because of a changing climate. For physically based snow melt models that do not depend on past conditions, ground based measurements of the energy balance components are imperative for verification. For this purpose, the US Army Corps of Engineers Cold Regions Research and Engineering Laboratory (CRREL) and the University of California, Santa Barbara (UCSB) established the “CUES” snow study site (CRREL/UCSB Energy Site, <https://www.snow.ucsb.edu/>) at 2940 m elevation on Mammoth Mountain, California...Snow measurements began near the current CUES site for ski area operations in 1969. In the 1970s, researchers began taking scientific measurements. Today, CUES benefits from year round gondola access and a fiber optic internet connection. Data loggers and computers automatically record and store over 100 measurements from more than 50 instruments each minute. CUES is one of only five high altitude mountain sites in the Western US where a full suite of energy balance components are measured. In addition to measuring snow on the ground at multiple locations, extensive radiometric and meteorological measurements are recorded. Some of the more novel measurements include scans by an automated terrestrial LiDAR, passive and active microwave imaging of snow stratigraphy, microscopic imaging of snow grains, snowflake imaging with a multi-angle camera, fluxes from upward and downward looking radiometers, snow water equivalent (SWE) from different types of snow pillows, snowmelt from lysimeters, and concentration of impurities in the snowpack...

excerpt from: Bair, E.H., Dozier, J., Colee, M. and Claffey, K. (2015) CUES - A Study Site for Measuring Snowpack Energy Balance in the Sierra Nevada. *Frontiers in Geoscience* 3, doi: [10.3389/feart.2015.00058](https://doi.org/10.3389/feart.2015.00058). [pdf]

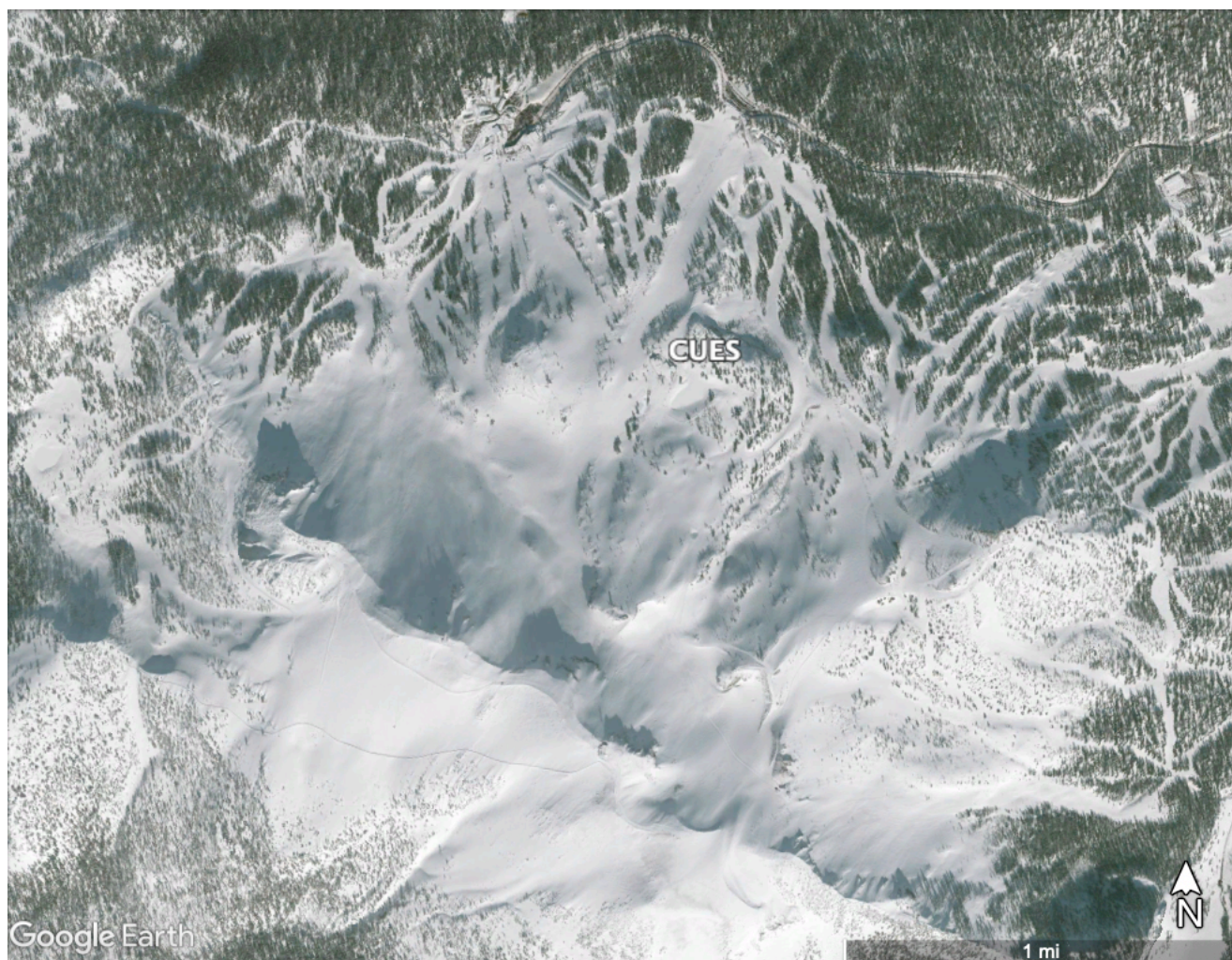
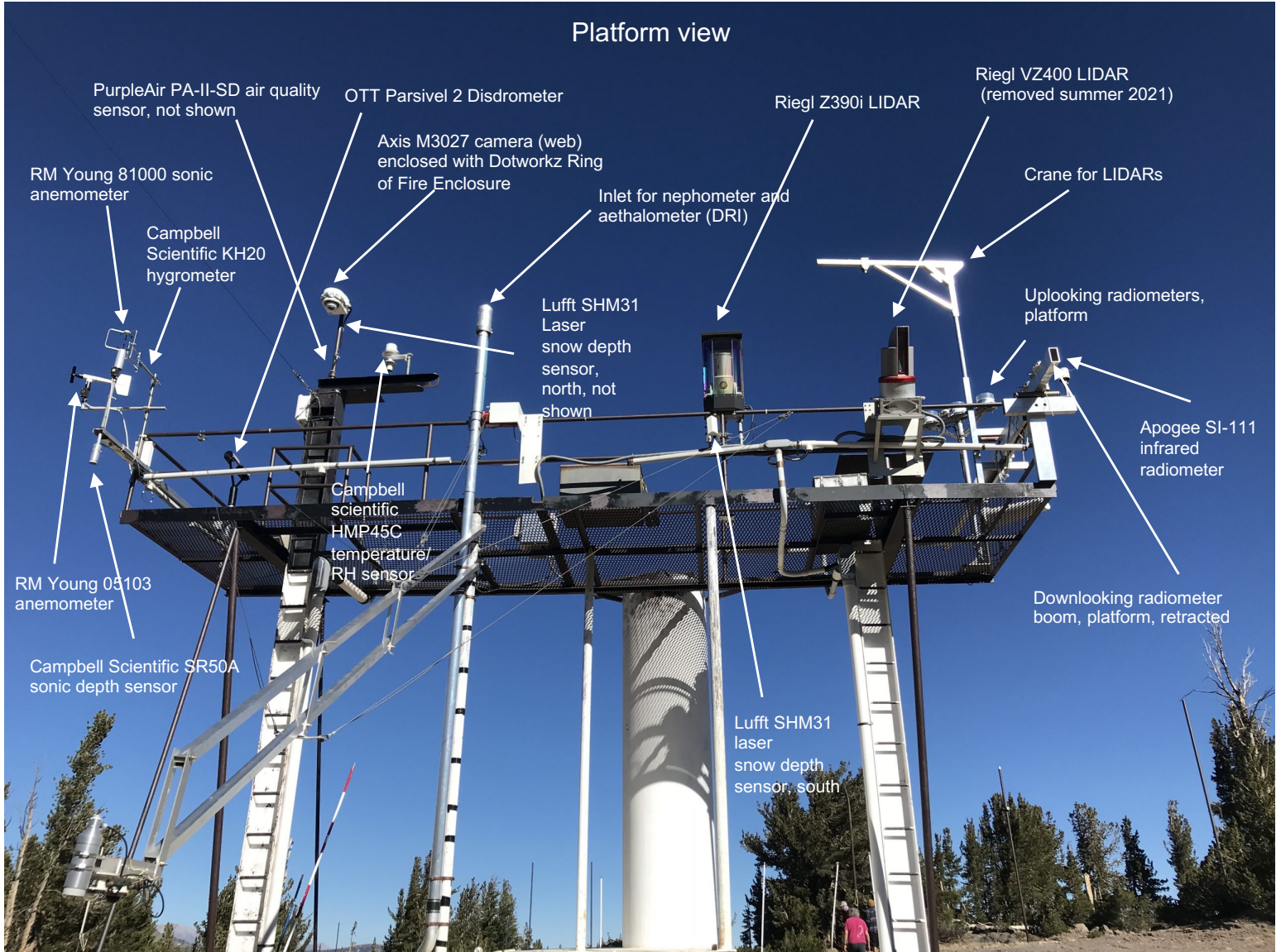
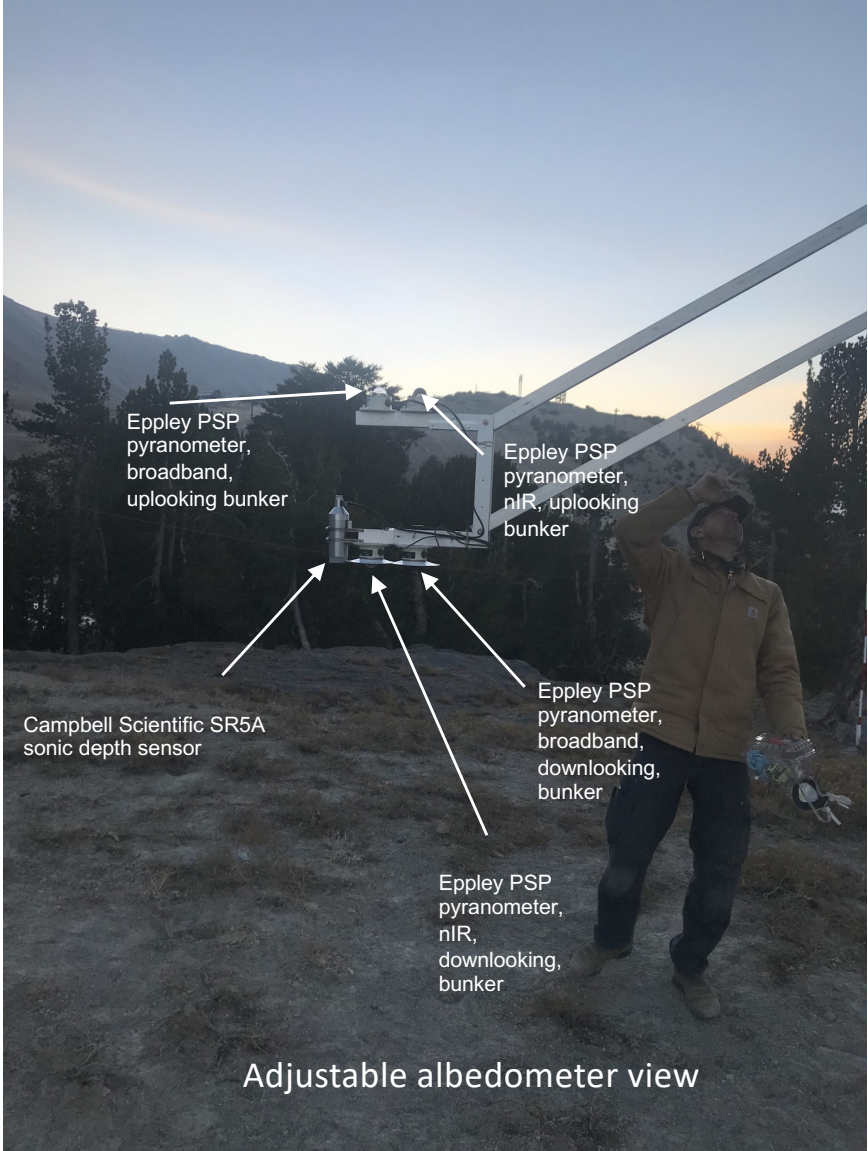


Figure: Mammoth Mountain and CUES in winter. Imagery © DigitalGlobe NextView License

## Platform view





Eppley PSP  
pyranometer,  
broadband,  
uplooking bunker

Eppley PSP  
pyranometer,  
nIR, uplooking  
bunker

Campbell Scientific SR5A  
sonic depth sensor

Eppley PSP  
pyranometer,  
broadband,  
downlooking,  
bunker

Eppley PSP  
pyranometer,  
nIR,  
downlooking,  
bunker

Adjustable albedometer view

North view



Delta-T ST  
105 soil  
moisture  
probe, north

Lysimeter  
pans, north

Delta-T PR 2 soil  
temperature  
probe, north, not  
shown

Delta-T PR2 soil  
temperature  
probe, center, not  
shown

South view



Delta-T ST  
105 soil  
moisture  
probe, south,  
not shown  
Delta-T PR2  
soil  
temperature  
probe, south,  
not shown

## Uplinking radiometer view

Eppley PSP  
pyranometer,  
nIR, uplooking  
platform

Delta-T SPN1  
sunshine  
pyranometer

Eppley PSP  
pyranometer,  
broadband,  
uplooking  
platform

Eppley PIR  
pyrgeometer

