Building Climate Monitoring Infrastructure in Nevada: Field science meets cyberinfrastructure along high elevational transects

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...and a cast of many more...











#### **NSF-EPSCoR:** Research Grant

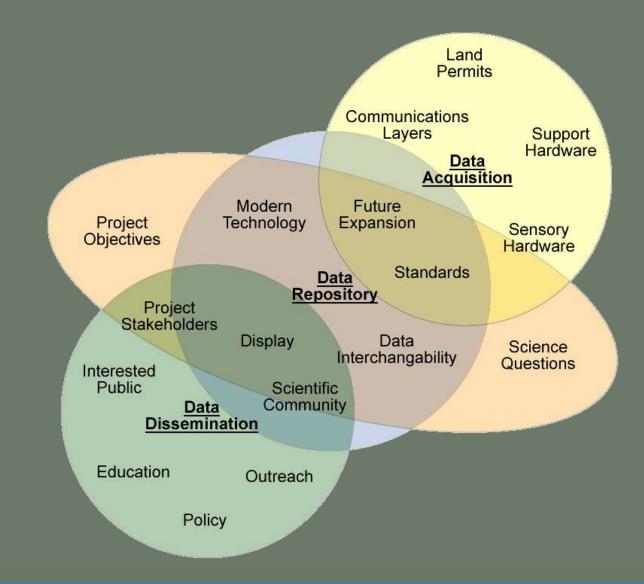
- \$15 million 5-year award (FY 2009 FY 2013)
- Administered by UNR, UNLV, and DRI

"The project will create a statewide interdisciplinary program that will stimulate transformative research, education, and outreach on the effects of regional climate change on ecosystem services (especially water resources) and support use of this knowledge by policy makers and stakeholders."

• Science, education, and outreach infrastructure

 Getting cutting-edge environmental research into Nevada and the Great Basin – not easy!

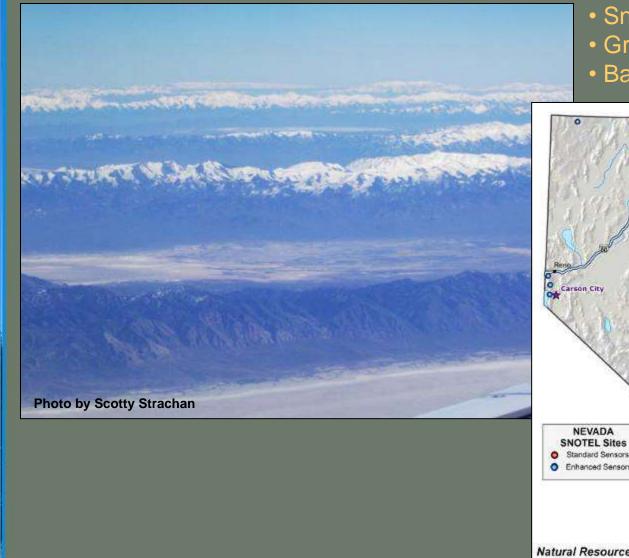
## Translated: a broad mission!



# **Primary Considerations**

- Compatibility with historical climate data at minimum
  - Sensor deployment
  - Capture intervals
  - Datalogger programming, measurement units
- Robust and independent basic observations with expanded services
  - Discrete power/storage for 1hr Met averages
  - 1min & 10min intervals still have 400+ days of local storage
  - Large solar/battery arrays for expanded services
- High speed TCP/IP communications network
  - Supports real-time observation via PTZ cameras
  - Allows transmission of numerous or high-frequency variables
  - Enables 2-way comms for remote troubleshooting and control
  - Attractive to a wide audience of long-term collaborators
- Centralized access and management (Cyberinfrastructure)
  - Supports asset management/tracking system
  - Allows development of hardware management protocols

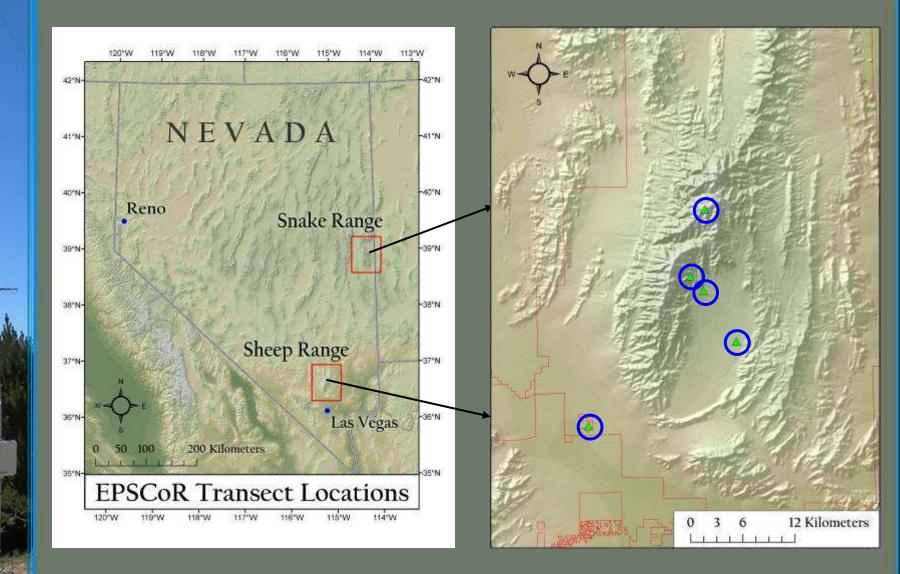
#### Importance of Elevation in Nevada



- Snowpack reservoir
- Groundwater recharge
- Basin/Range ecology



## Nevada Monitoring Transects



## Snake Range West Transect

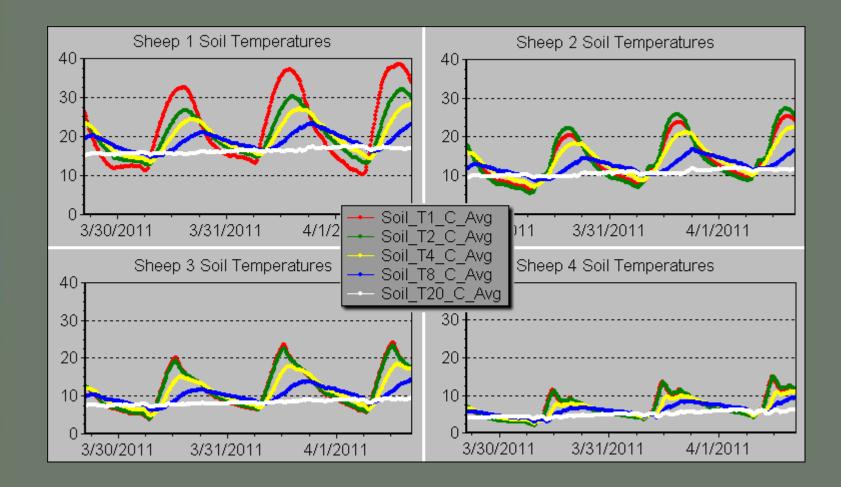
Sagebrush Zone

Subalpine Zone Montane Zone

**Pinyon-Juniper Zone** 

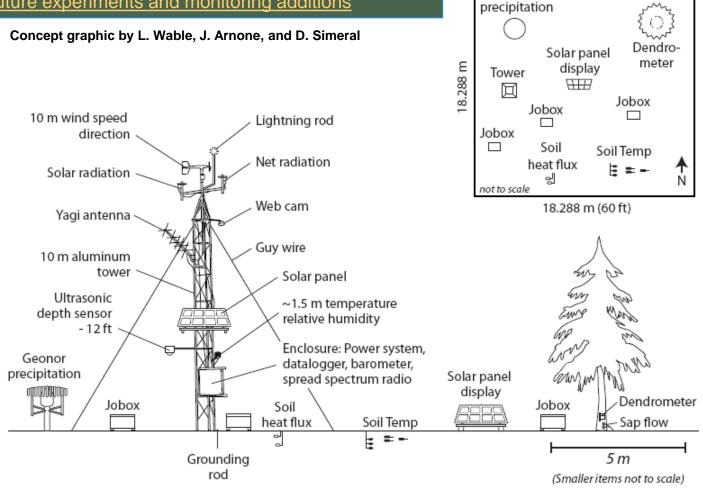
Photo by Scotty Strachan

#### Data Across the Gradient



#### **Basic Station Concept**

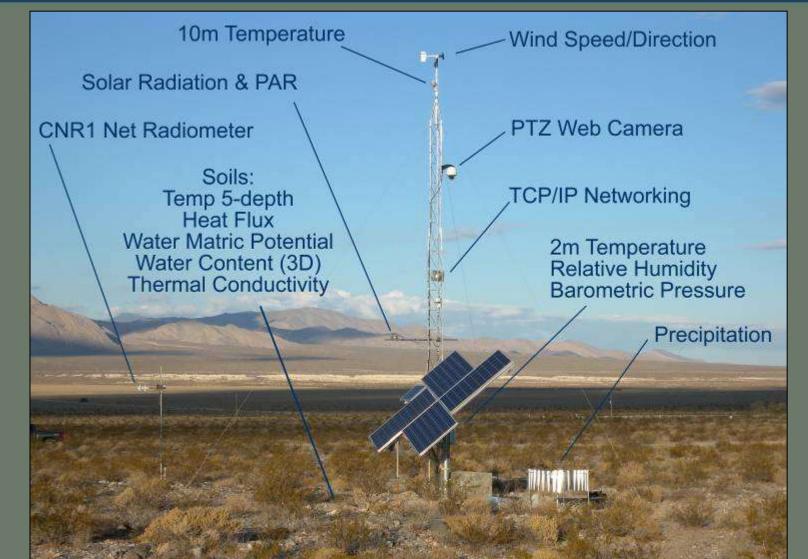
- Baseline atmospheric, ecological, and hydrological monitoring
- Provide power generation and communications capability
- Plan for future experiments and monitoring additions



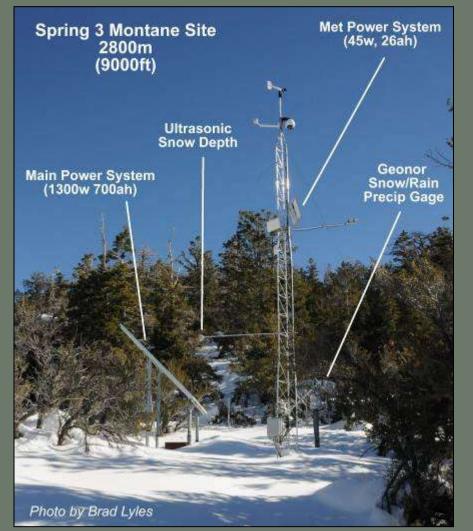
Sap flow

Geonor

#### **Basic Station Implementation**



#### **Basic Station Implementation**





Webcam Photos, 4-07-2011, 11am local



# Equipment



## **Geonor Precipitation Gage**



## **Equipment Enclosures**

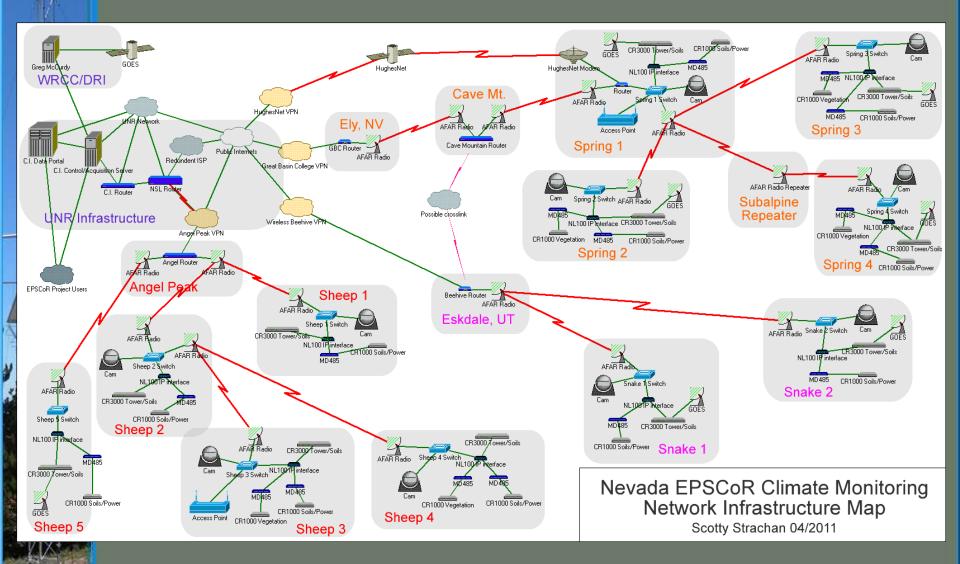


# Communications

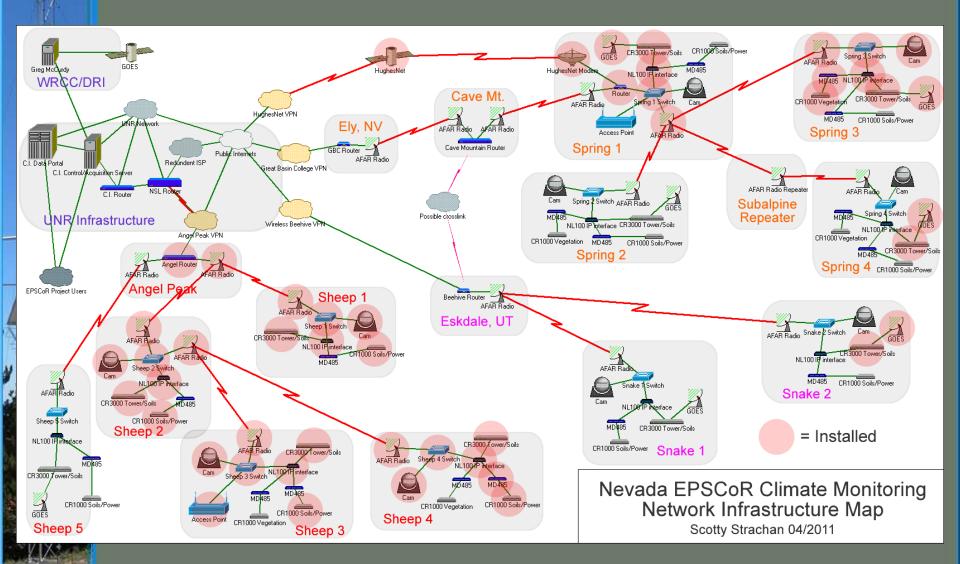
- Full TCP/IP (Transmission Control Protocol / Internet Protocol) networking
- Managed subnets from the UNR campus
- AFAR Communications, Inc. field radios (11Mbps long range 2.4ghz)
- Mikrotik VPN routers w/mini-PCI AP card capability

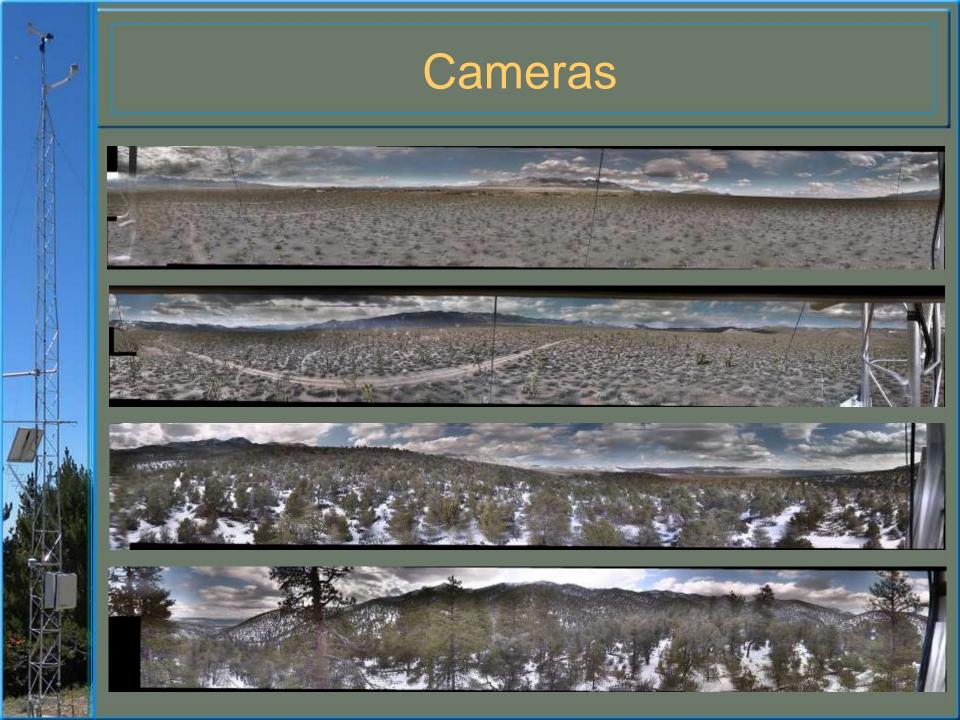


## Networking Infrastructure Plan



## Networking Infrastructure Installed





#### **Cameras: Seasonal Conditions**



## **Cameras: Daily Conditions**









## Cameras: Equipment Monitoring



Snowpole

Scale

Taken Live 4/16/11 11:20am

Pacific

Rain Gage orifice





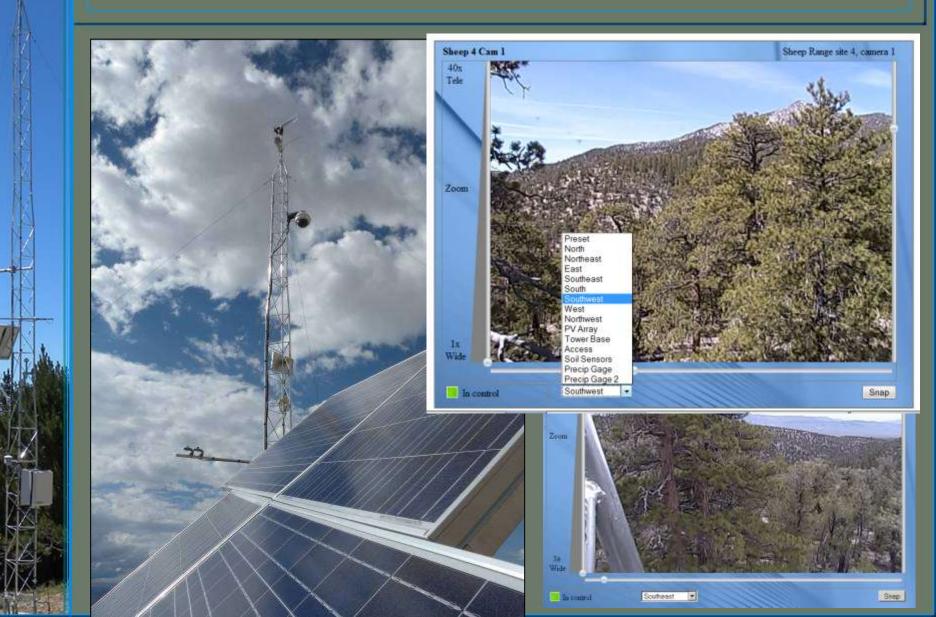


## Live Control

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N	E-KeySheep1PakBusPort_1	off line	0%					
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#### Live Control



#### **Questions?**

#### Acknowledgements

Transect Partners & Landowners:

- Nevada Seismological Laboratory
- Long Now Foundation
- Great Basin College, Ely Campus
- Nevada Land Conservancy
- U.S. Fish and Wildlife Service
- Bureau of Land Management

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Slide design and any random humor may be blamed on Dr. David Holt with the Society for MSU