

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

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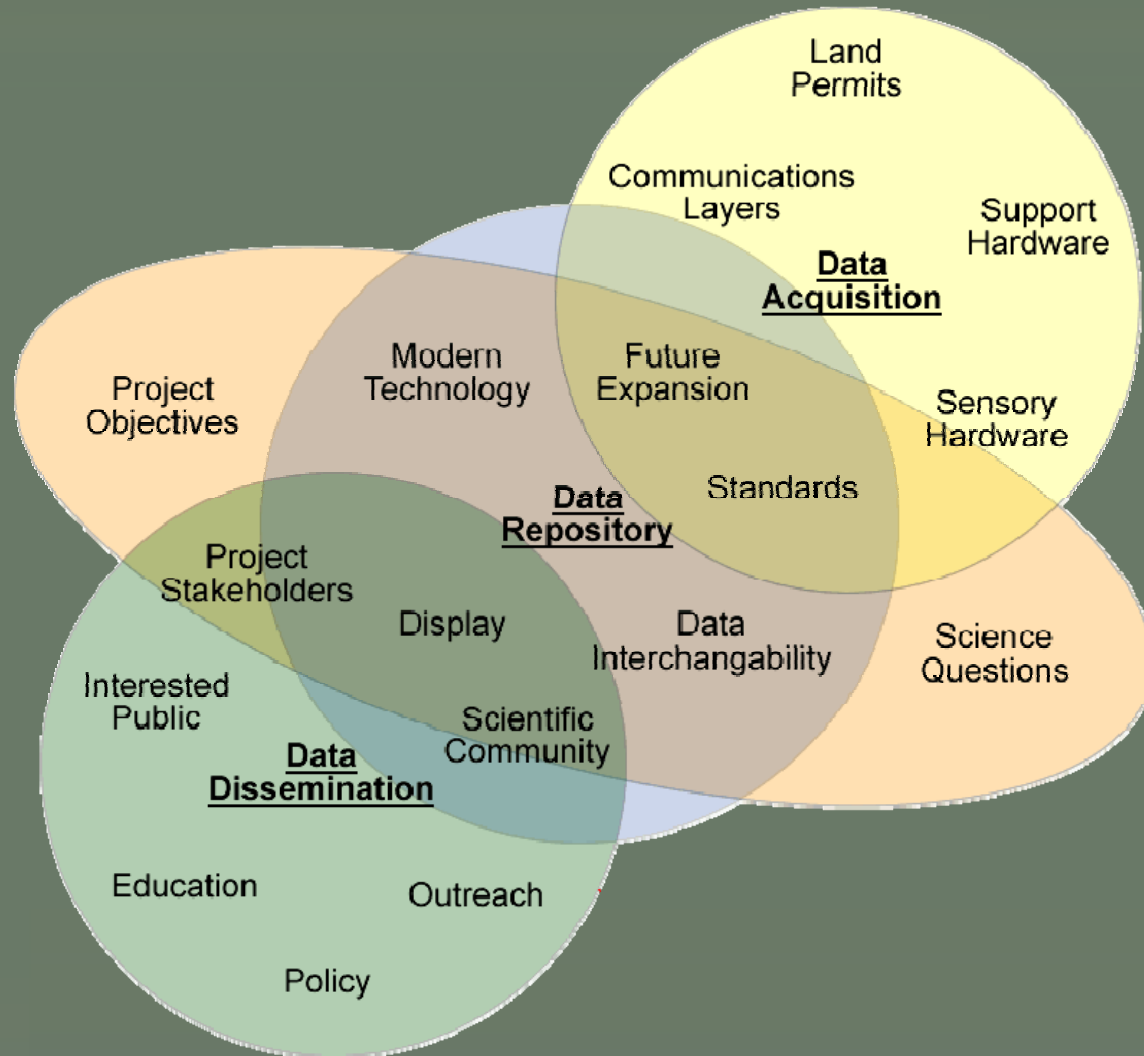
# NSF-EPSCoR: Research Grant

- \$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

# Translated: a broad mission!





# Primary Considerations

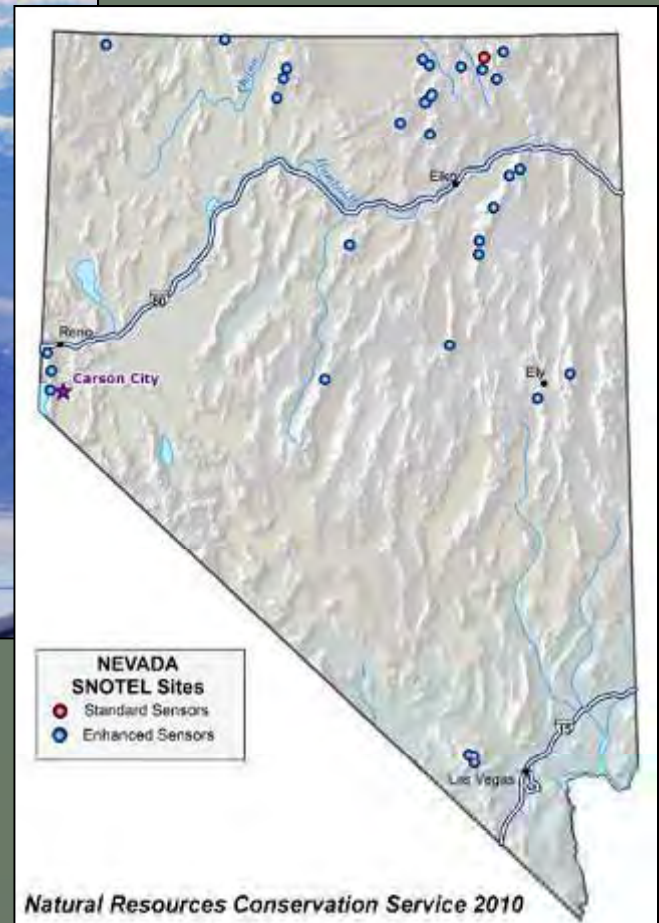
- Compatibility with historical climate data at minimum
  - Sensor deployment
  - Capture intervals
  - Datalogger programming, measurement units
- Robust and independent basic observations with expanded services
  - Discrete power/storage for 1hr Met averages
  - 1min & 10min intervals still have 400+ 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

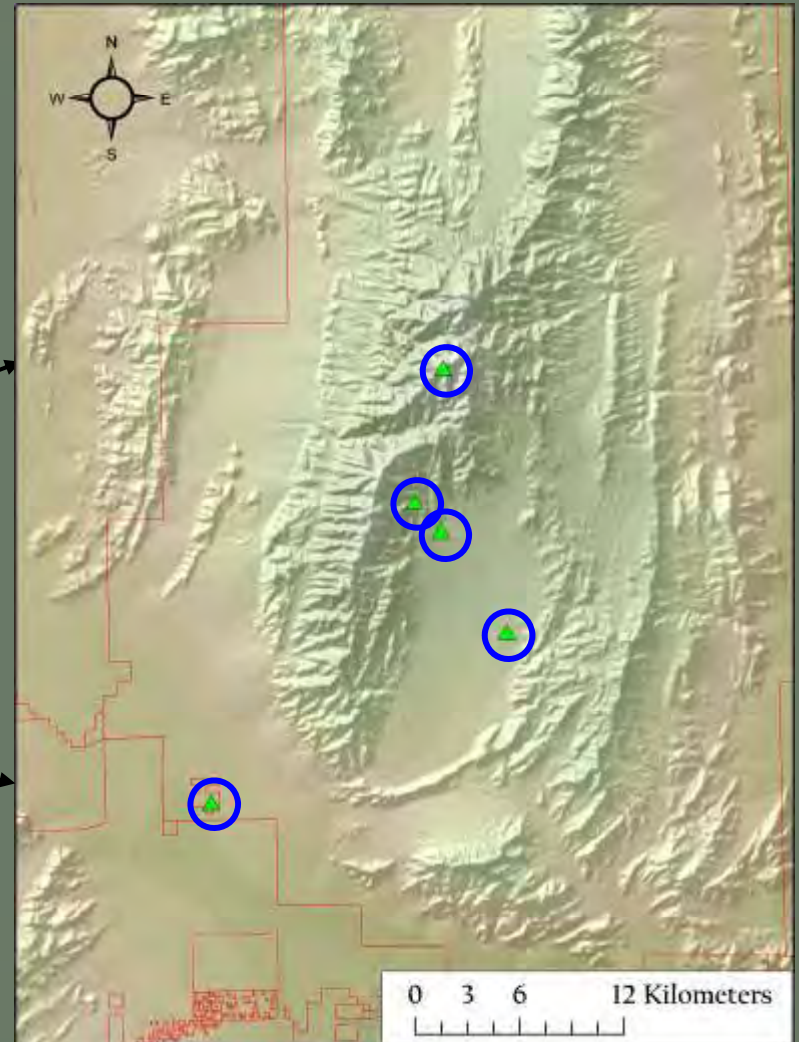
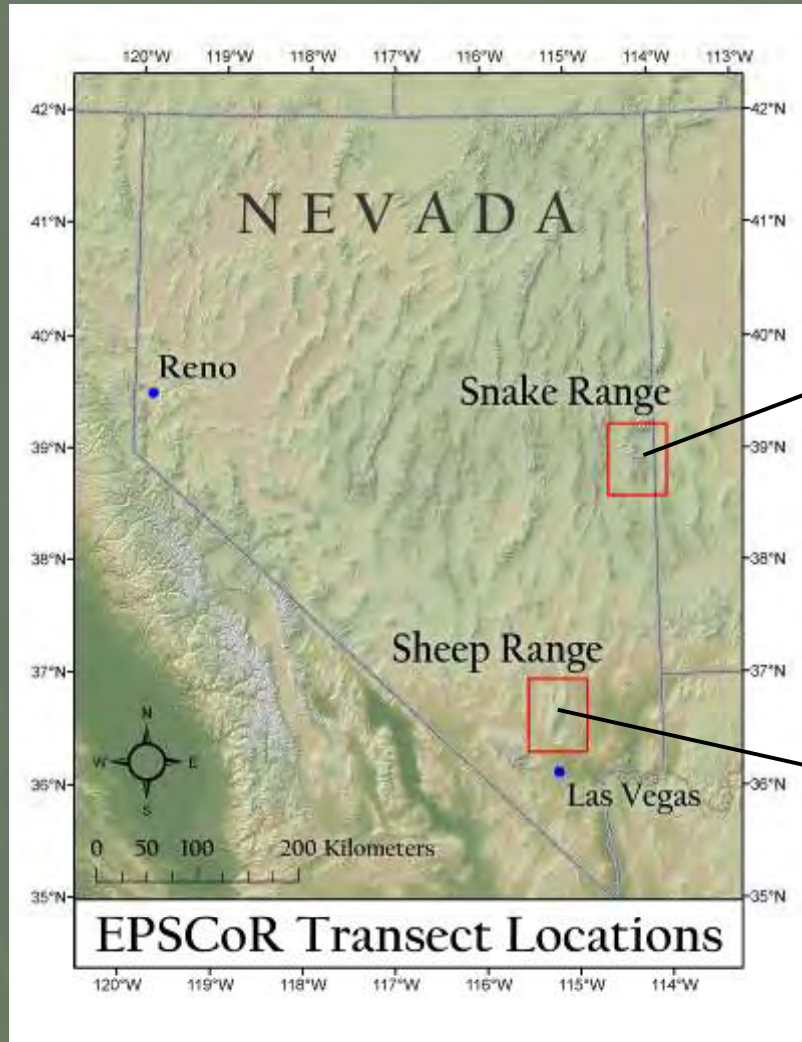
- Snowpack reservoir
- Groundwater recharge
- Basin/Range ecology



Photo by Scotty Strachan



# Nevada Monitoring Transects



# Snake Range West Transect

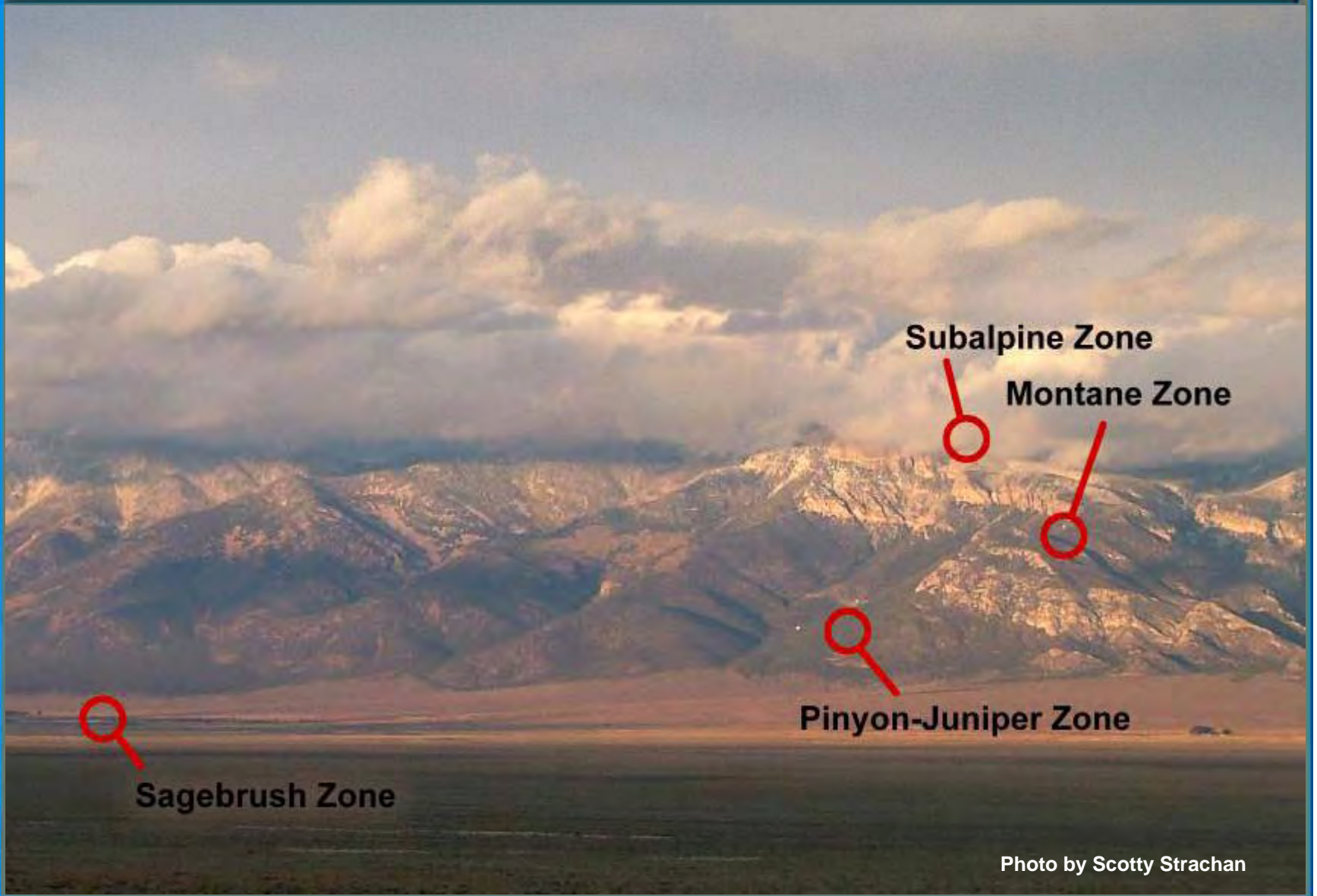
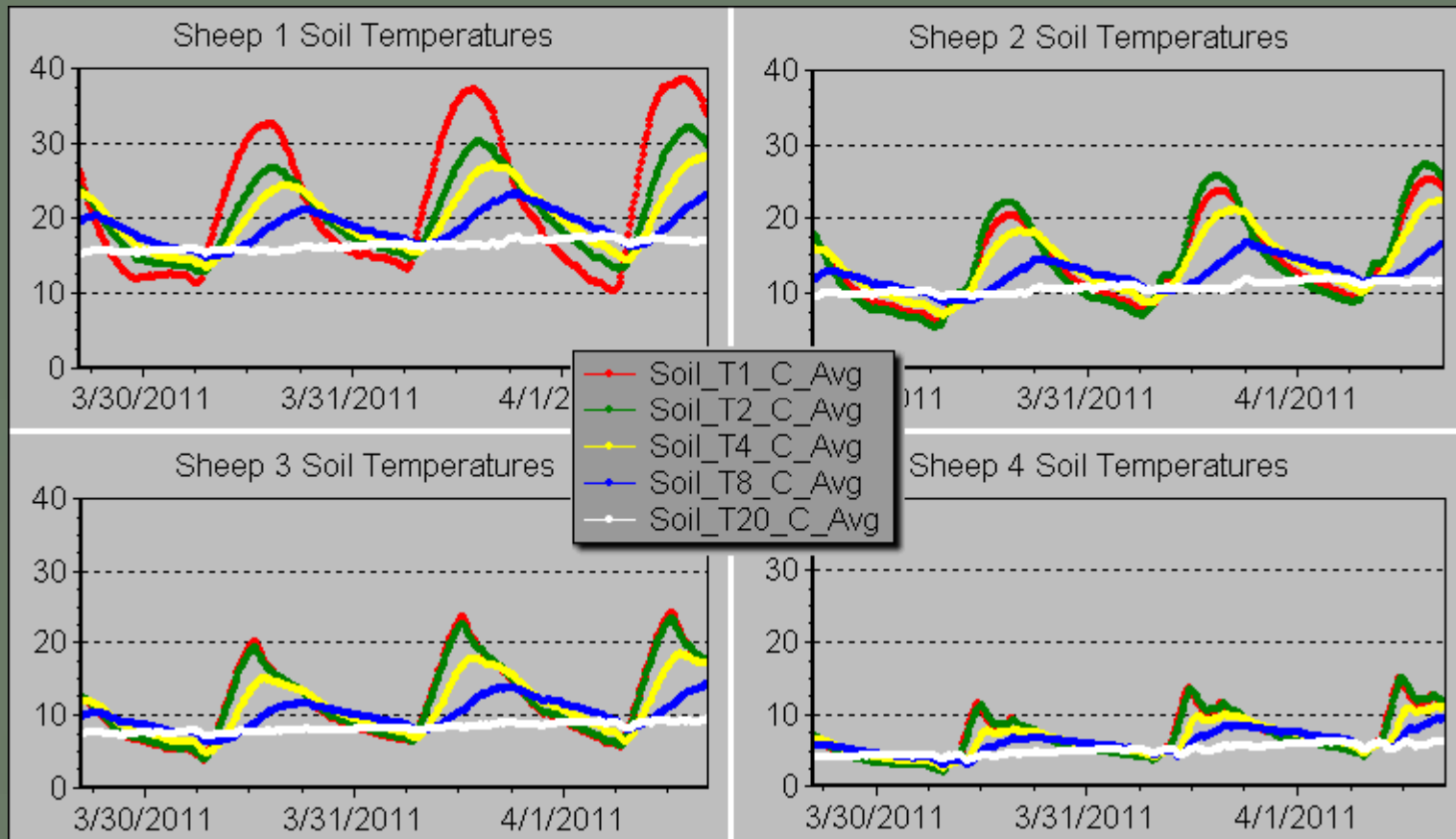


Photo by Scotty Strachan

# Data Across the Gradient

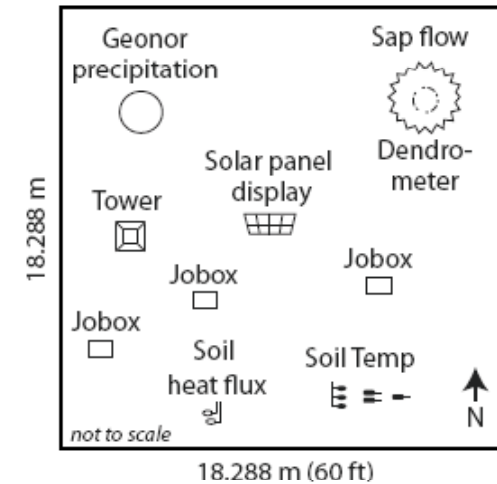
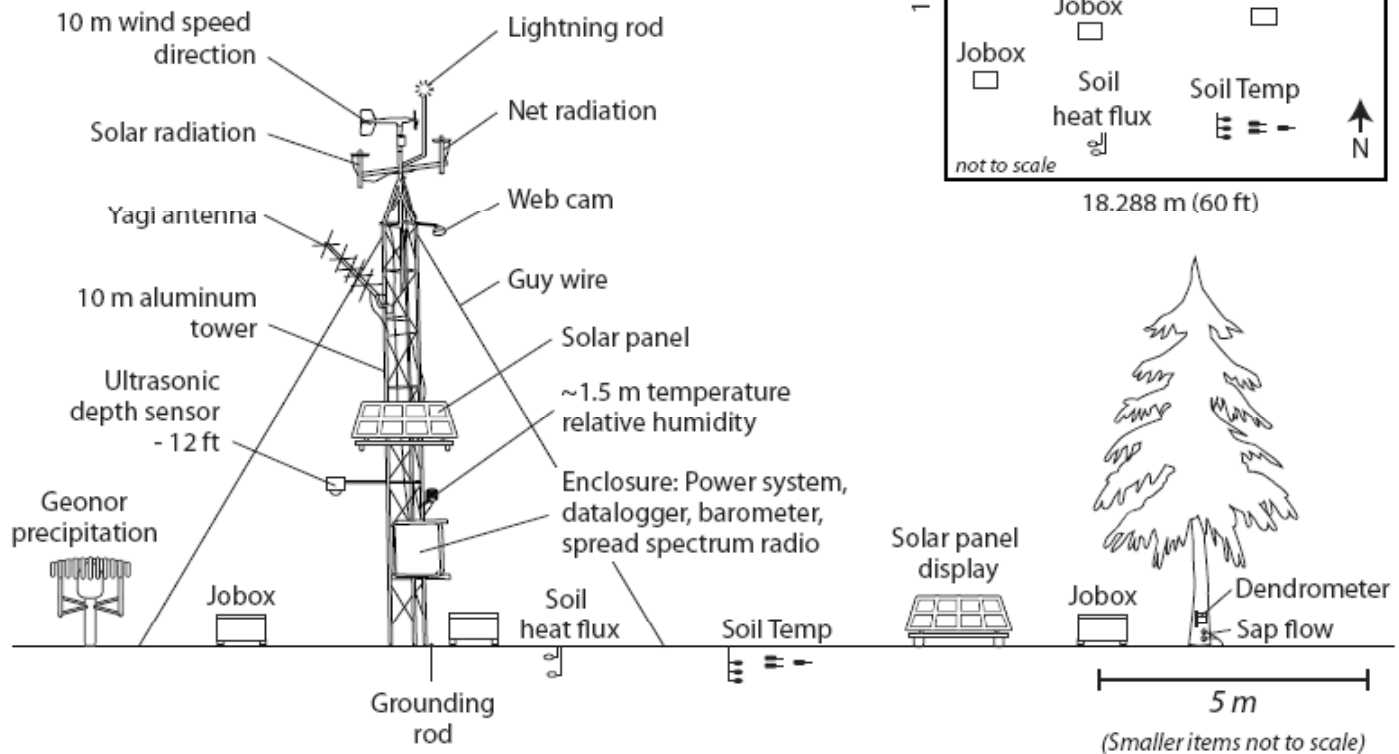




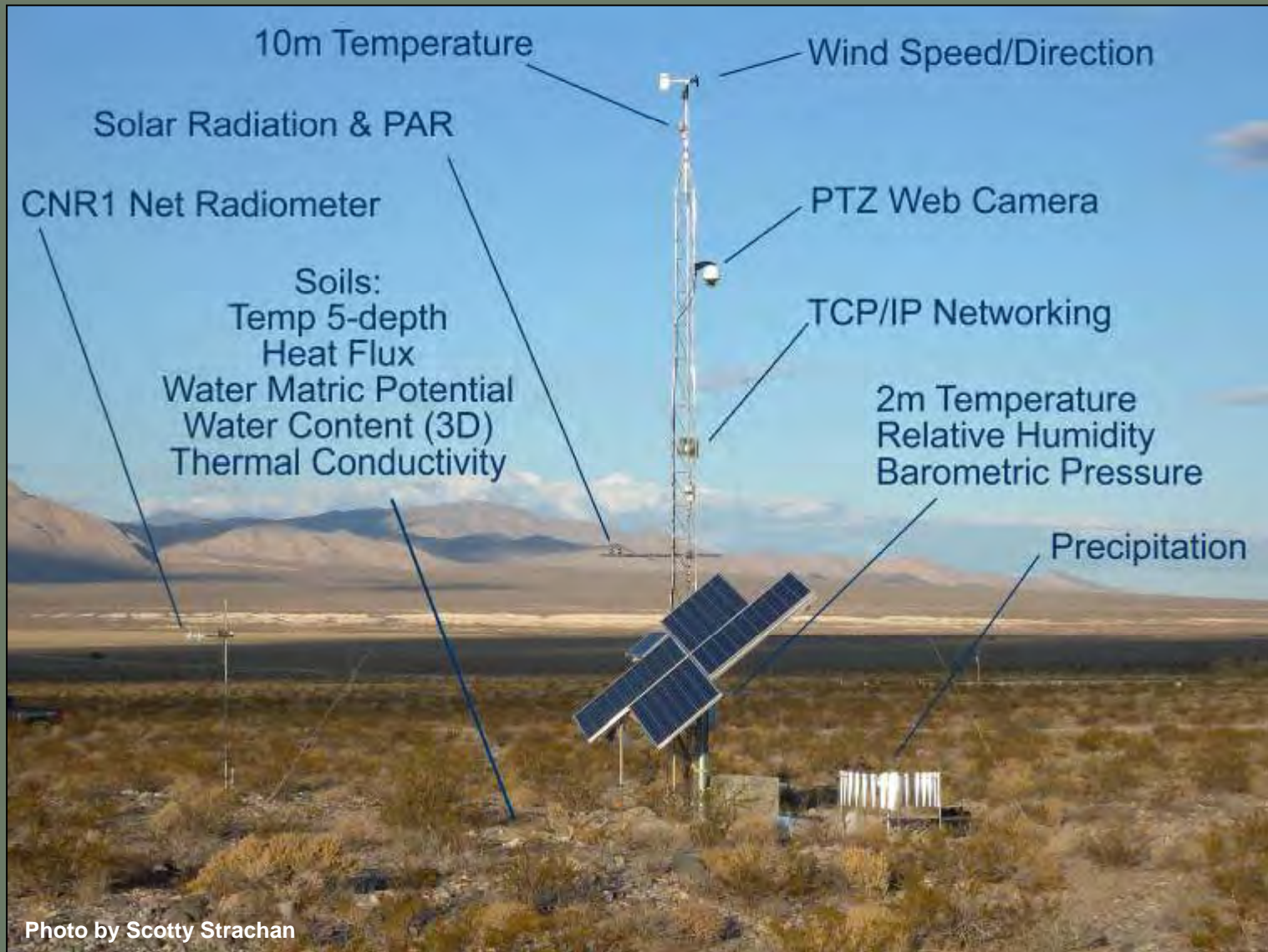
# Basic Station Concept

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

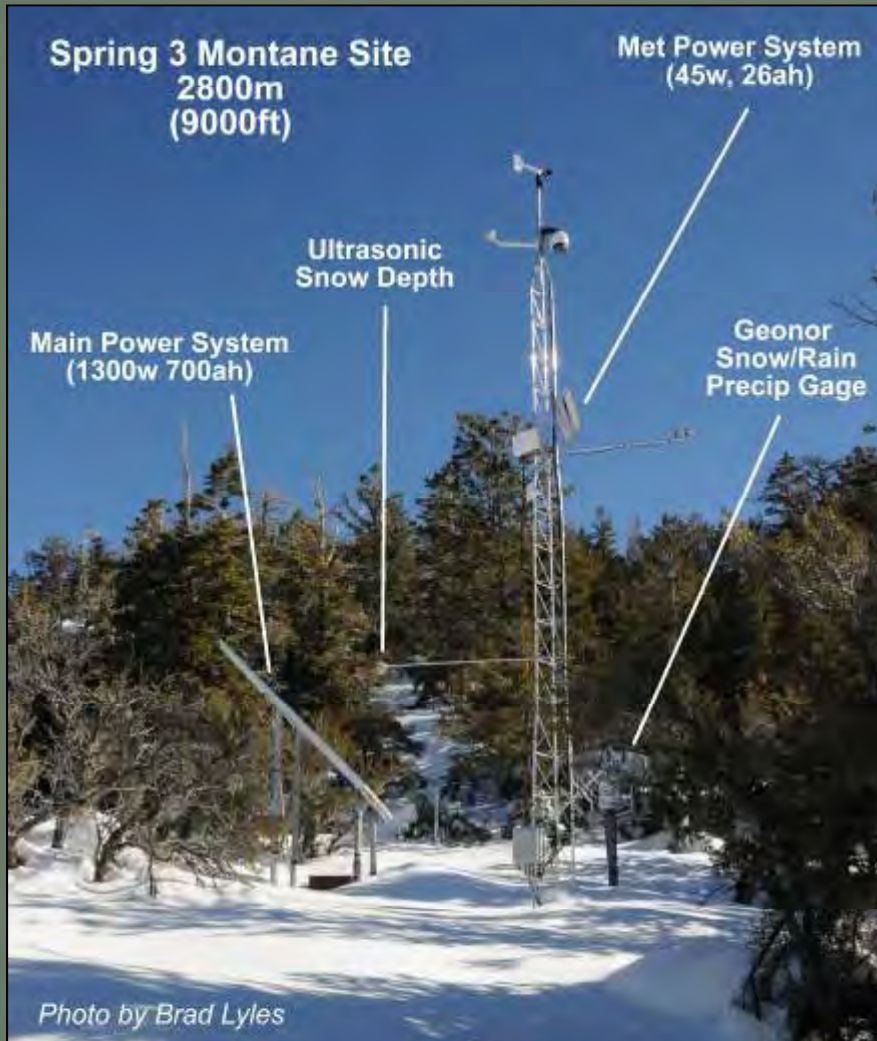
Concept graphic by L. Wable, J. Arnone, and D. Simeral



# Basic Station Implementation



# Basic Station Implementation



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



# Equipment



Photo by Scotty Strachan

# Geonor Precipitation Gage



Photo by Scotty Strachan

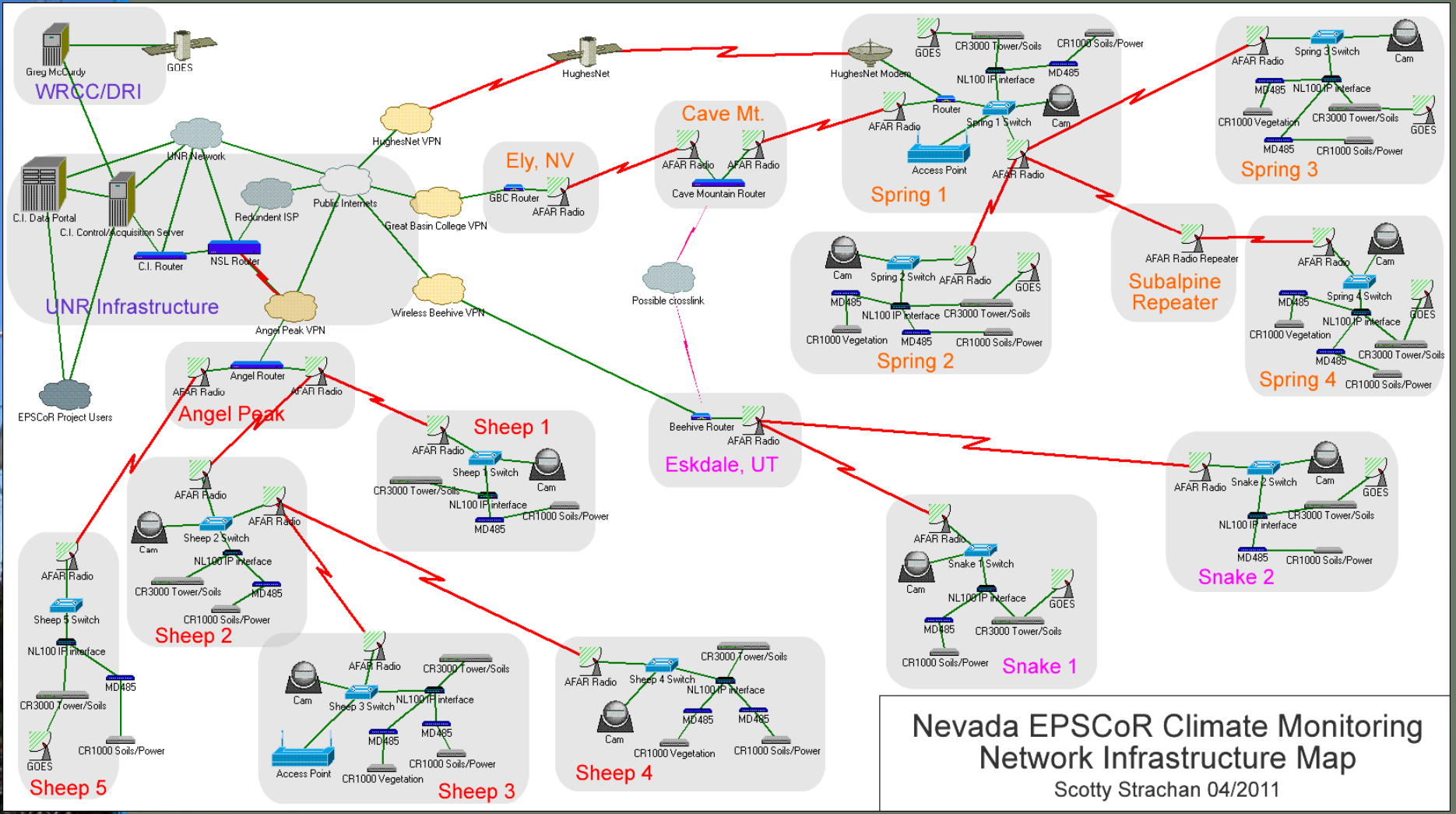
# Equipment Enclosures



Photos by Scotty Strachan

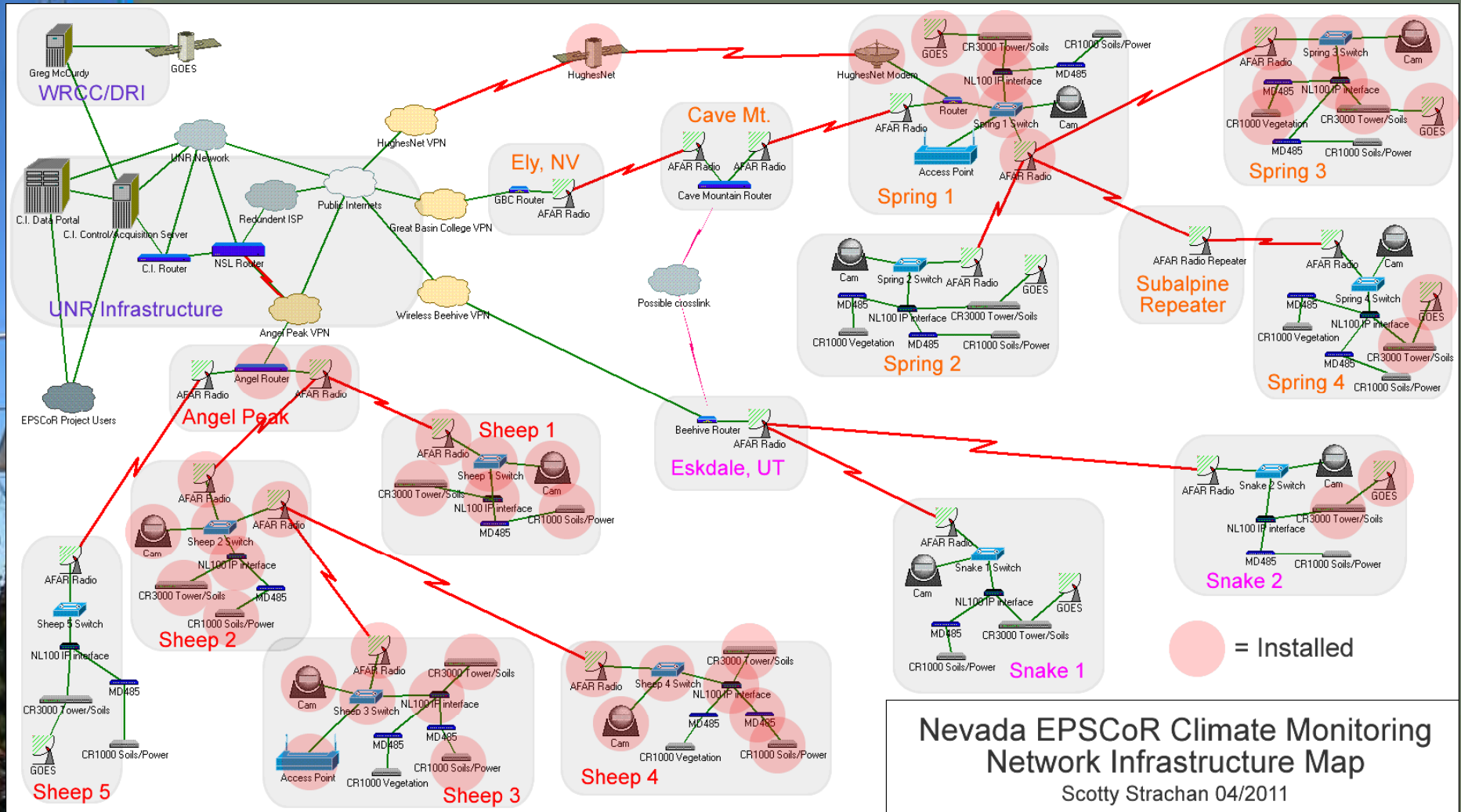


# Networking Infrastructure Plan



Nevada EPSCoR Climate Monitoring Network Infrastructure Map  
 Scotty Strachan 04/2011

# Networking Infrastructure Installed



Nevada EPSCoR Climate Monitoring Network Infrastructure Map

Scotty Strachan 04/2011



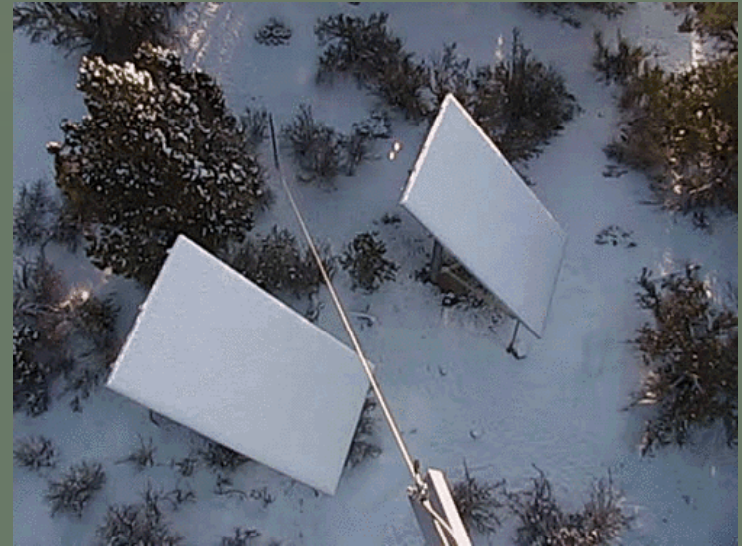
# Cameras



# Cameras: Seasonal Conditions



# Cameras: Daily Conditions



# Live Control

Network Map	Line State	Avg Err %	Coll State	Last Data Coll	Next Data Coll	Vals Last Coll	Vals to Coll
Sheep1 NL100 IPPort_1	off line	0%					
Sheep1 PakBusPort_1	off line	0%					
Sheep1 #1 CR3000	off line	0%	normal	4/7/2011 2:10:04 ...	4/7/2011 2:20:00 ...	2312	2312
Sheep1 NL100 IPPort_2	off line	0%					
Sheep1 PakBusPort_2	off line	4.25%					
Sheep1 #2 CR1000	off line	0%	normal	4/7/2011 2:10:11 ...	4/7/2011 2:20:00 ...	2383	2383
Sheep2 NL100 IPPort_1	off line	0%					
Sheep2 PakBusPort_1	off line	0%					
Sheep2 #1 CR3000	off line	0%	normal	4/7/2011 2:10:04 ...	4/7/2011 2:20:00 ...	2312	2312
Sheep2 NL100 IPPort_2	off line	0%					
Sheep2 PakBusPort_2	off line	3.69%					
Sheep2 #2 CR1000	off line	0%	normal	4/7/2011 2:10:14 ...	4/7/2011 2:20:00 ...	2383	2383
Sheep3 NL100 IPPort_1	off line	0%					
Sheep3 PakBusPort_1	off line	0%					
Sheep3 #1 CR3000	off line	0%	normal	4/7/2011 2:10:05 ...	4/7/2011 2:20:00 ...	2312	2312
Sheep3 NL100 IPPort_2	off line	0%					
Sheep3 PakBusPort_2	off line	0%					
Sheep3 #2 CR1000	off line	0%	normal	4/7/2011 2:10:09 ...	4/7/2011 2:20:00 ...	2364	2364
Sheep4 NL100 IPPort_1	off line	0%					
Sheep4 PakBusPort_1	off line	0%					
Sheep4 #1 CR3000	off line	0.11%	normal	4/7/2011 2:10:05 ...	4/7/2011 2:20:00 ...	2356	2356
Sheep4 NL100 IPPort_2	off line	0%					
Sheep4 PakBusPort_2	off line	6.28%					
Sheep4 #2 CR1000	off line	0%	normal	4/7/2011 2:10:13 ...	4/7/2011 2:20:00 ...	2383	2383
Spring1 NL100 IPPort_1	off line	0%					
PakBusPort	off line	0%					
Spring1 #1 CR3000	off line	0%	normal	4/7/2011 2:10:32 ...	4/7/2011 2:20:00 ...	2448	2448
Spring3 NL100 IPPort_1	off line	0%					
Spring3 PakBusPort_1	off line	0%					
Spring3 #1 CR1000	off line	0%	normal	4/7/2011 2:10:22 ...	4/7/2011 2:20:00 ...	1564	1564
Spring3 NL100 IPPort_2	off line	0%					
Spring3 PakBusPort_2	off line	0%					
Spring3 #2 CR3000	off line	0%	normal	4/7/2011 2:10:23 ...	4/7/2011 2:20:00 ...	1659	1659

Free space: 16,954,048,512 bytes / 15.8 GB  
Server Time: 2:13:26 PM  
Pause Schedule  
Network View  
Views...

# Live Control



Sheep 3 Cam 1 Sheep Range site 3, cam 1

40x  
Tele

Zoom

1x  
Wide

Controls available    Preset   

A live video feed from a camera labeled 'Sheep 3 Cam 1'. The view shows a wide landscape with a dense forest of green trees and a small structure with solar panels in the foreground. In the distance, a tall metal tower is visible against a cloudy sky. The interface includes zoom controls (40x Tele to 1x Wide) and a 'Snap' button.

Sheep 4 Cam 1 Sheep Range site 4, camera 1

40x  
Tele

Zoom

1x  
Wide

In control    Southeast   

A live video feed from a camera labeled 'Sheep 4 Cam 1'. The view is a close-up of a large, green pine tree in the foreground. In the background, a landscape with smaller trees and distant hills is visible under a bright sky. The interface includes zoom controls (40x Tele to 1x Wide) and a 'Snap' button.

# 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

### Project P.I.'s:

**Gayle Dana, Nick Lancaster, Scott Mensing, Tom Piechota**

### Ecology & Water Components Leadership:

**Franco Biondi, Lynn Fenstermaker, Sergiu Dascalu, Dale Devitt, Jay Arnone, Laurel Saito, Michael Young, Fred Harris, Brett Riddle**

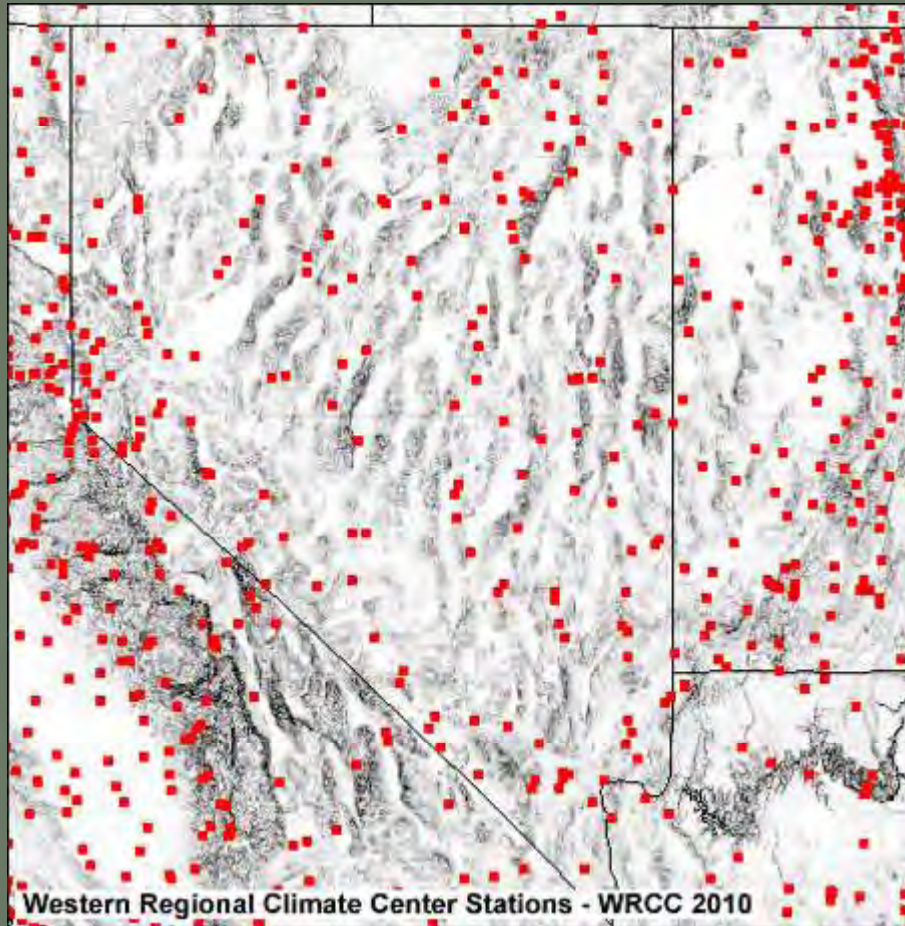
### **Significant Transect Personnel and Assistants:**

**David Charlet, Richard Jasoni, AJ Wolff, Charlie Strachan, John Healey, Mike Hay, Carolyn Rosner, Dave Simeral, Britt Johnson, Amanda Wagner, Jasmine Vittori, Evan Lawley, Kerensa Kruse, Mackenzie Kilpatrick, Kurt Solander**

Slide design and any random humor may be blamed on Dr. David Holt from MSU



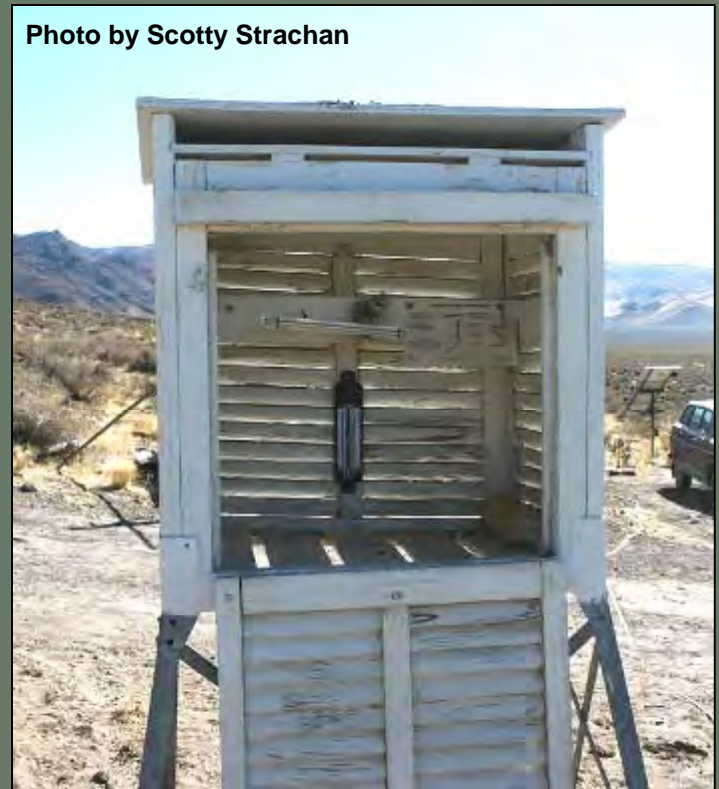
# Nevada & The Great Basin



## Limited climate observations

- Few stations
- Valley locations
- Sporadic time coverage
- Mostly temperature & precip

Photo by Scotty Strachan





# Spring Valley: Sage (5,900')



# Spring Valley: Montane (9,200')



# Spring Valley: Subalpine (11,000')

