Desert Research Institute

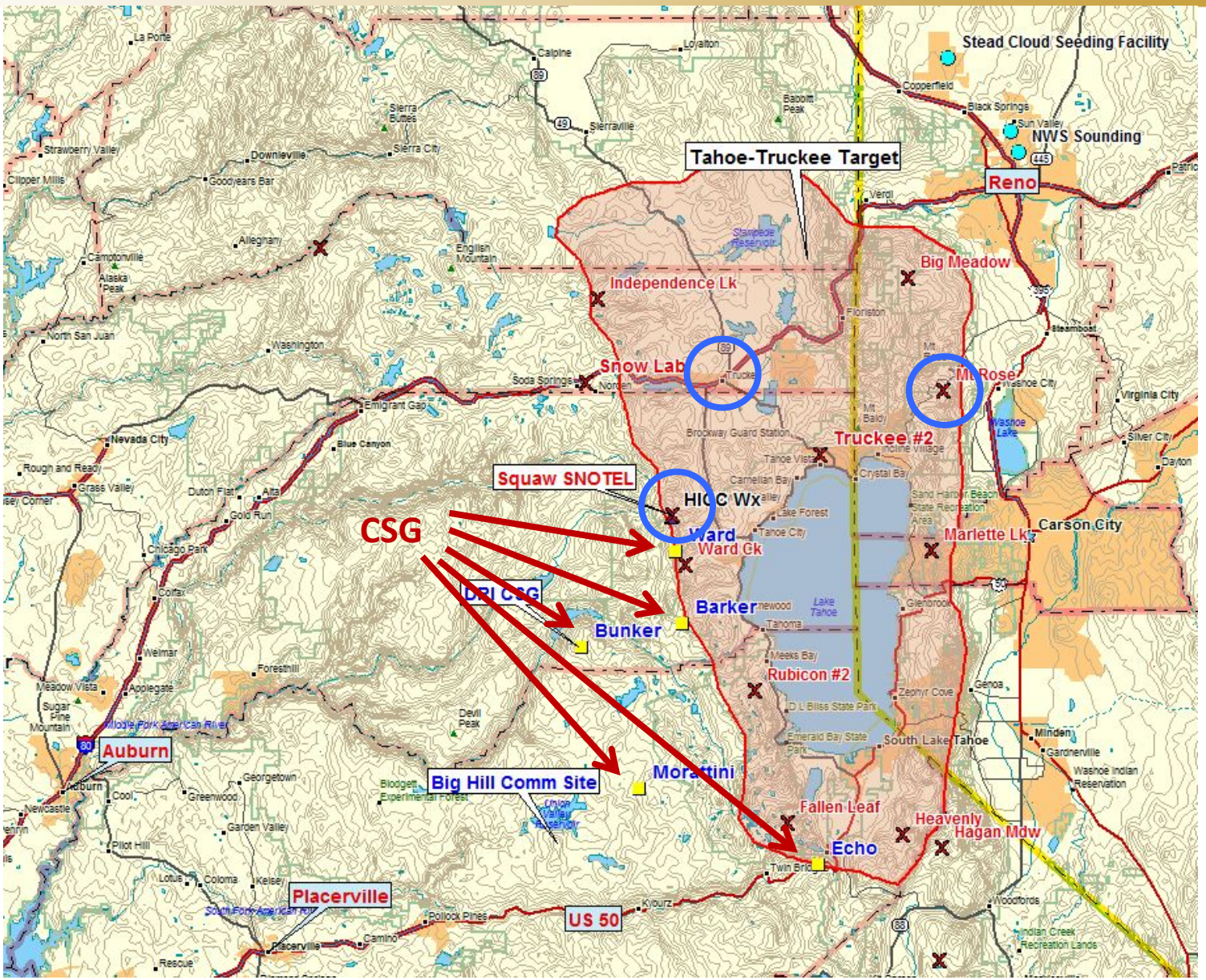
Lake Tahoe/Truckee River Cloud Seeding

Presented by: Frank McDonough – Meteorologist

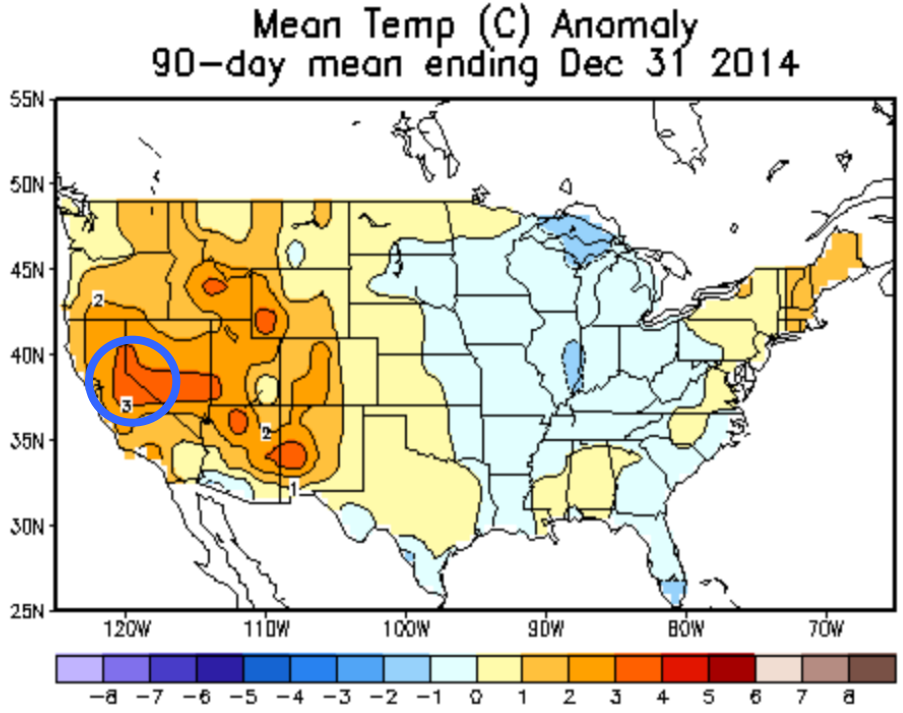
Outline

- Tahoe/Truckee Winter 2014 – 2015 summary
- Cloud seeding – background
- Cloud seeding operations across the West
- Summary: Truckee/Tahoe cloud seeding operations for WY2015
  - Estimated additional precipitation produced by cloud seeding
  - Comparisons to other years
- Operational schedule for remainder of season
- Summary

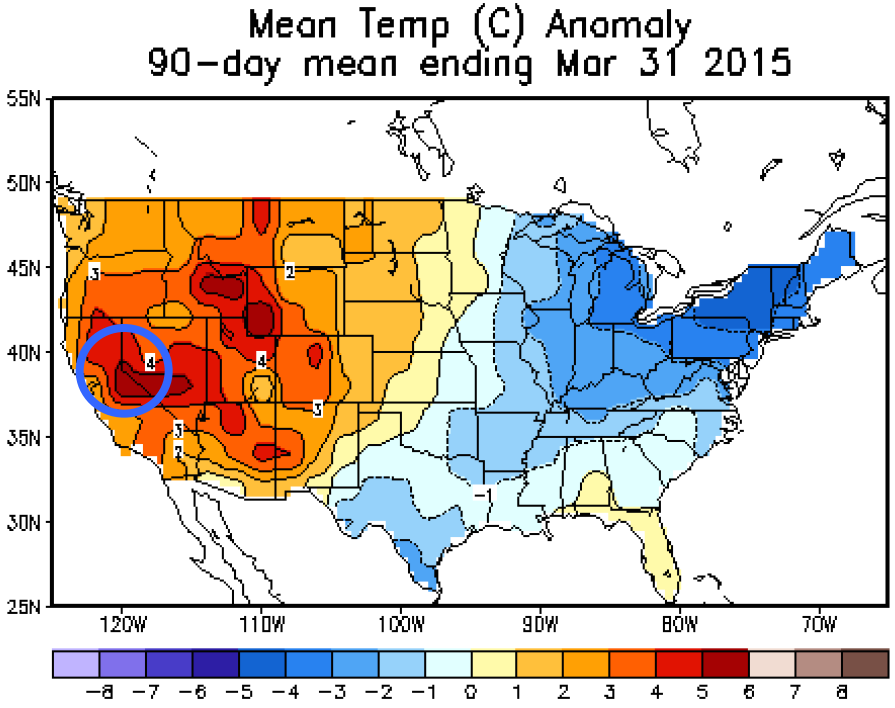
Tahoe/Truckee seeding network



Water Year 2015: Temperatures



Oct – Dec 2014: Average temperatures
6° F above normal

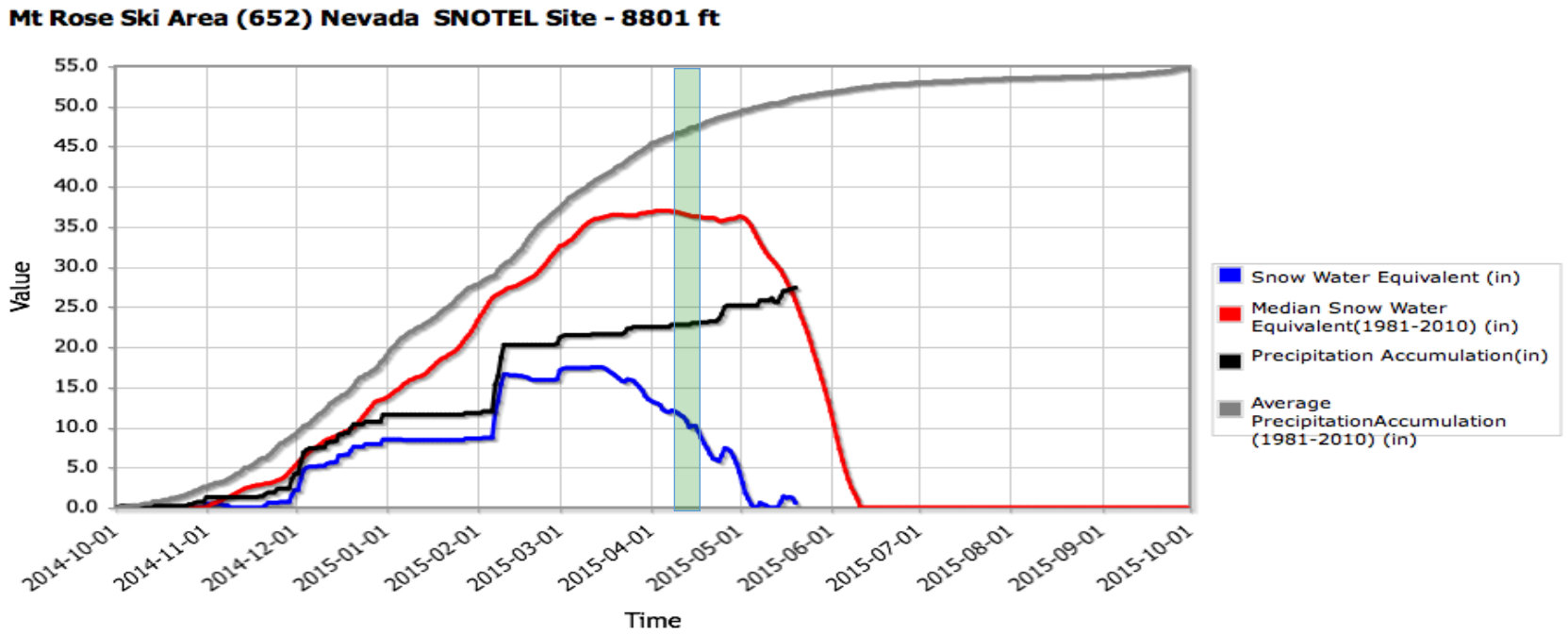


Jan – Mar 2015: Average temperatures
10° F above normal

Warmest winter on record for Truckee Watershed

Mt Rose Ski Area (8801') – Carson R.

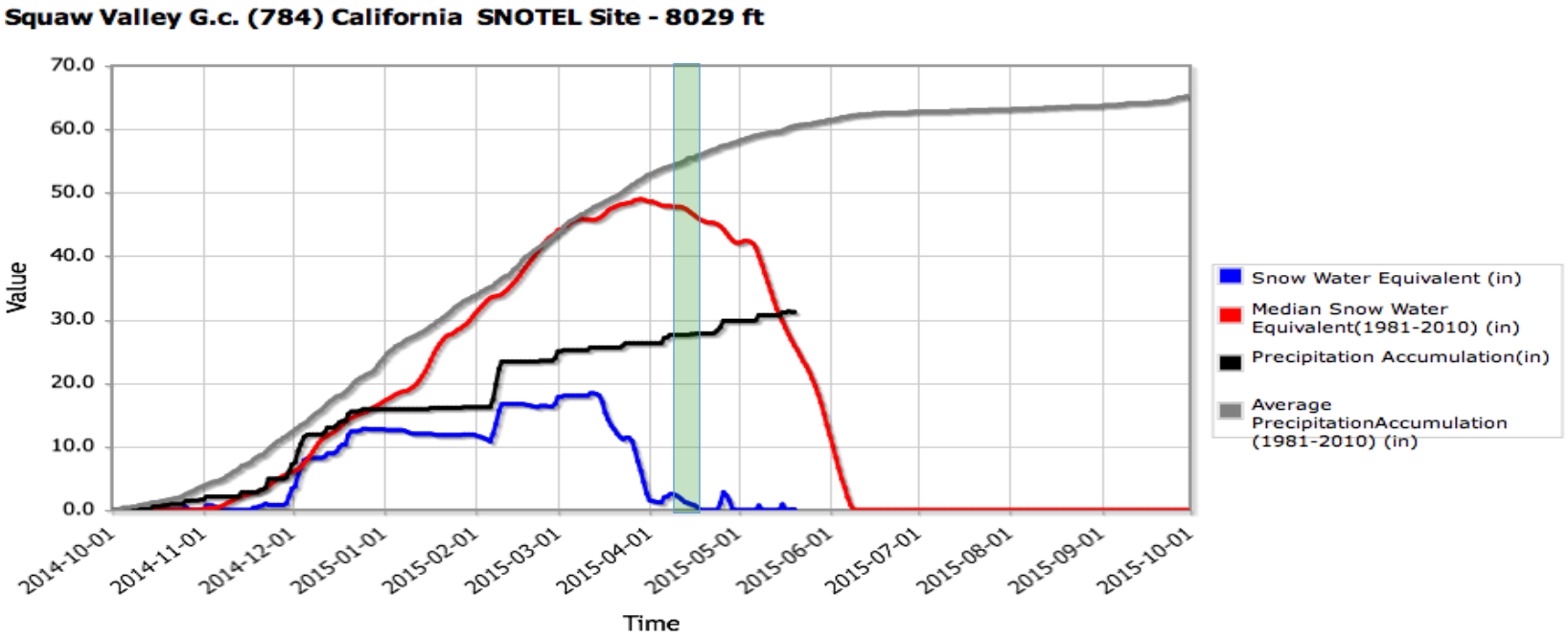
Winter Precipitation



- Mid – April snapshot:
- Total precipitation (rain and snow): 22.8" / 47.3" (48%)
- Snow water equivalent: 10" / 36.4" (27.4%)

Squaw Precipitation (8029') - Crest

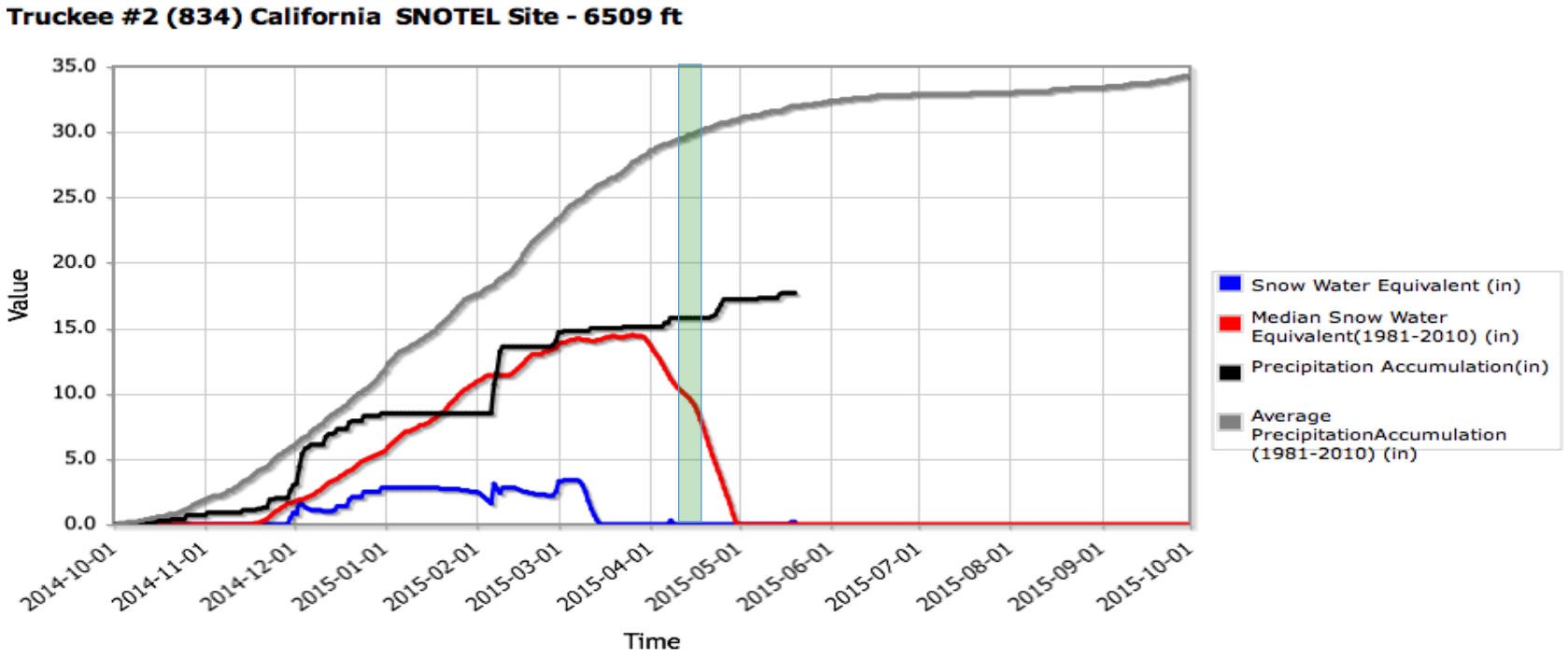
Winter Precipitation



- Mid April snapshot:
- Total precipitation (rain and snow): 27.5" / 55.0" (50%)
- Snow water equivalent: 1.1" / 47.5" (2.3%)

Truckee Precipitation (6509') –Truckee R

Winter Precipitation

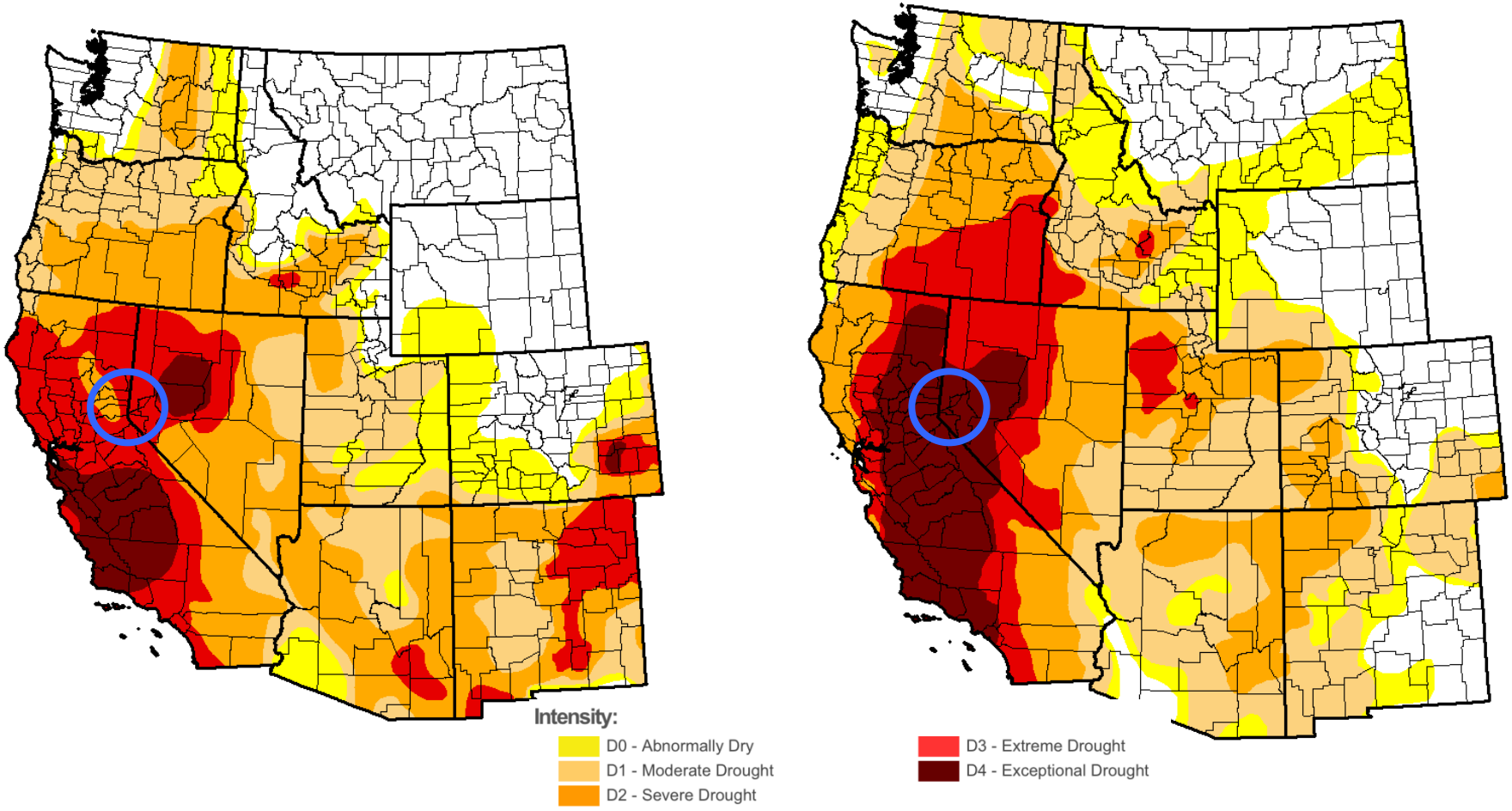


- Mid April snapshot:
- Total precipitation (rain and snow): 15.7" / 29.8" (53%)
- Snow water equivalent: 0" / 9.9" (0%)

Drought Status

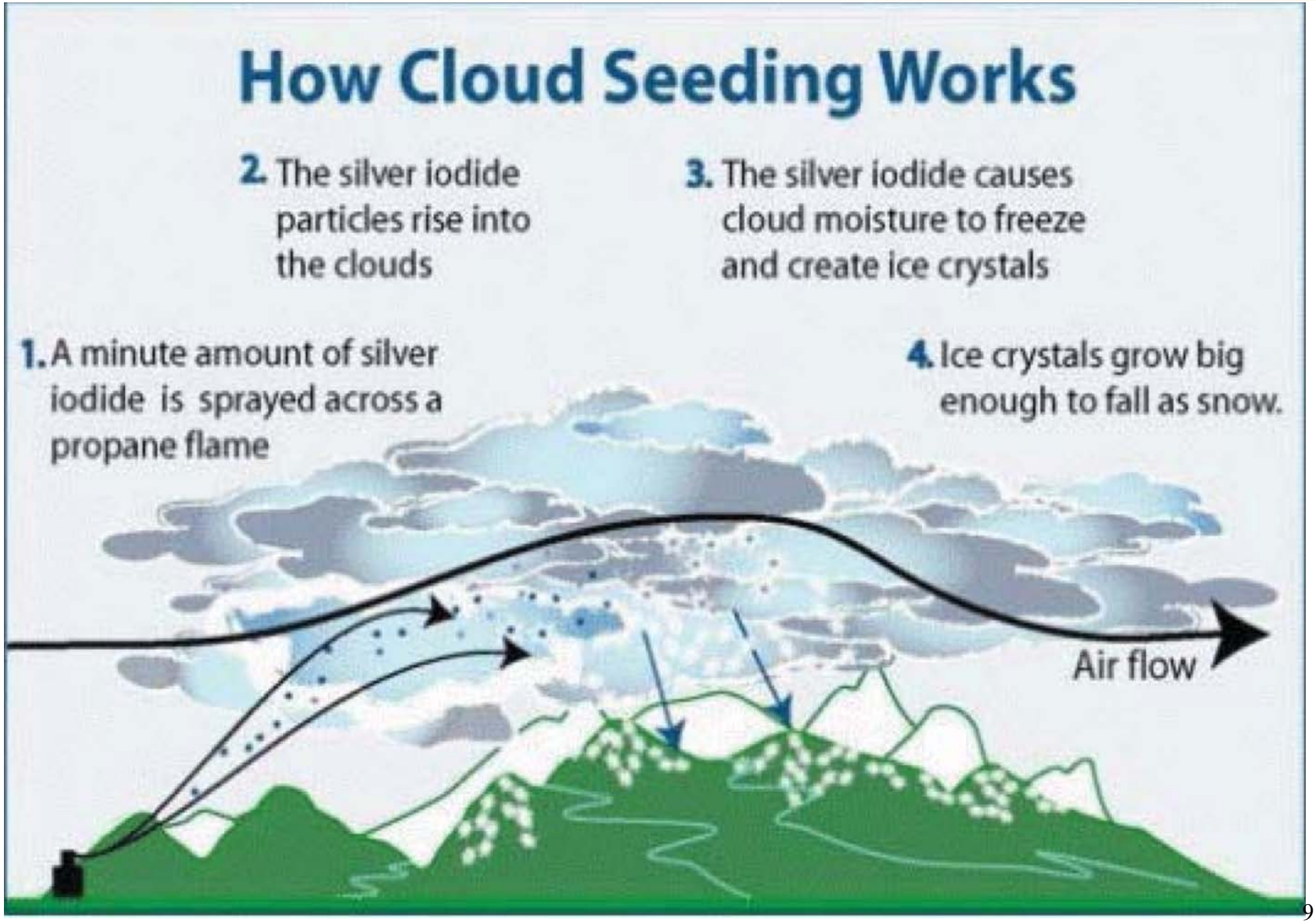
April 8, 2014

May 12, 2015

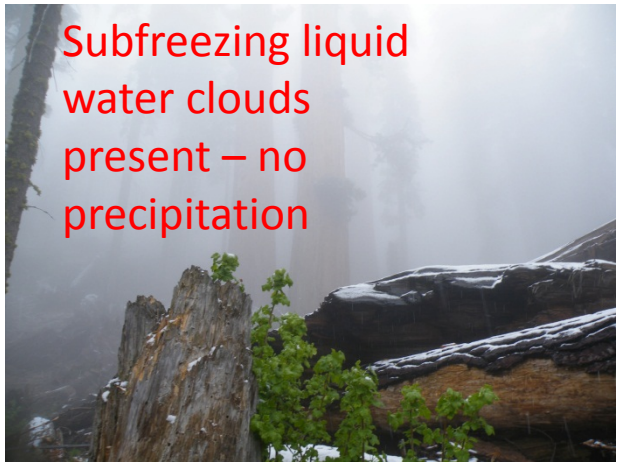


D3 to D4-Exceptional Drought: Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies.

Background


How Cloud Seeding Works
2. The silver iodide particles rise into the clouds
3. The silver iodide causes cloud moisture to freeze and create ice crystals
1. A minute amount of silver iodide is sprayed across a propane flame
4. Ice crystals grow big enough to fall as snow.
Air flow

Background



Create ice crystals through seeding

Crystals grow in presence of tiny subfreezing drops

Crystals grow into large crystals which fall as snow and add to snowpack

Snow melts into runoff

DRI cloud seeding

Sited at locations that maximize seeding effectiveness

Remote 24/7 operations by expert cloud seeding meteorologists

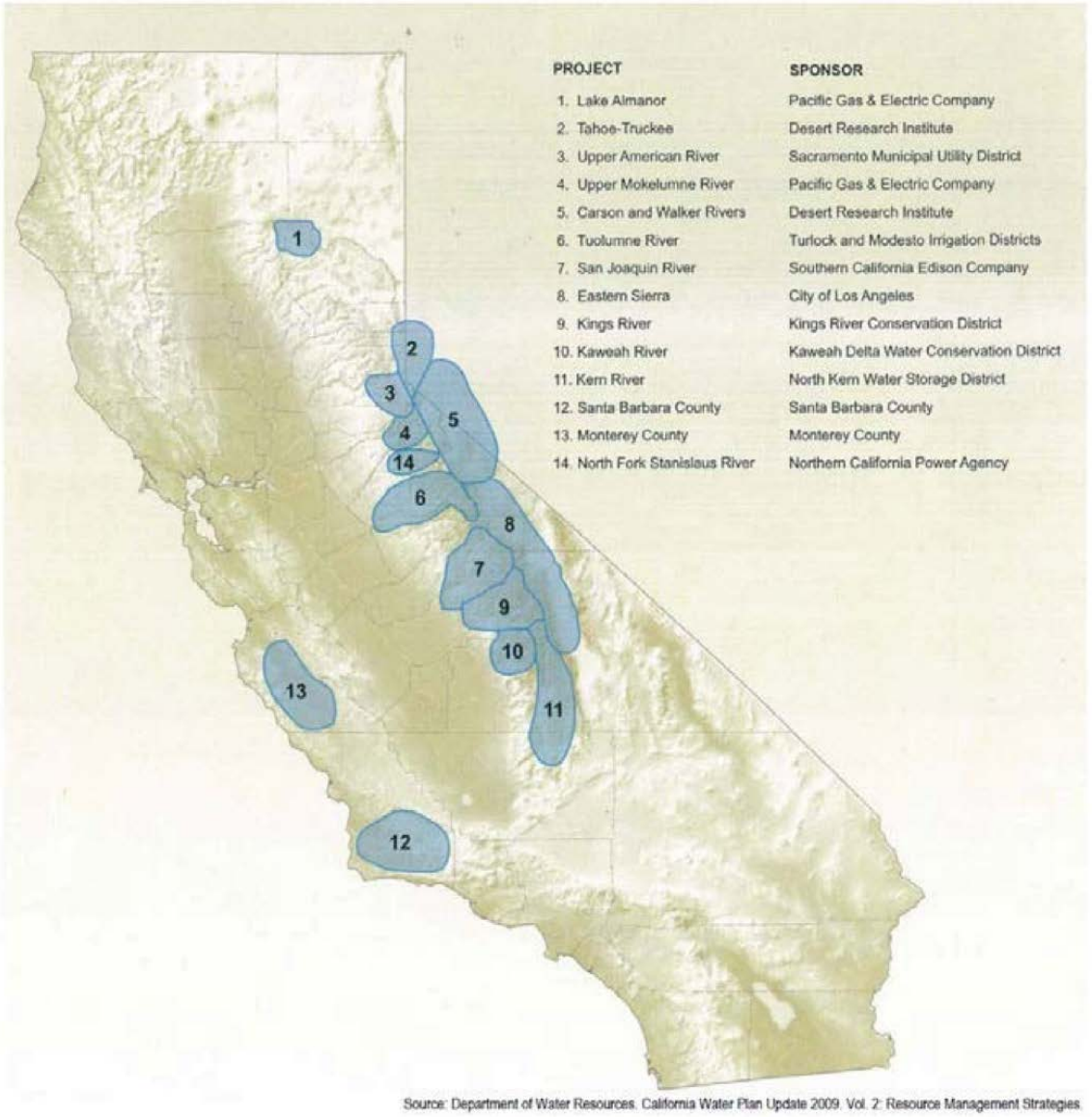
Generators and communications equipment are reliable and serviced by experienced technicians

CA/NV cloud seeding projects

West Coast operational cloud seeding projects over the past 20 years.

Currently active in 11 to 14 watersheds

Aircraft and ground-based



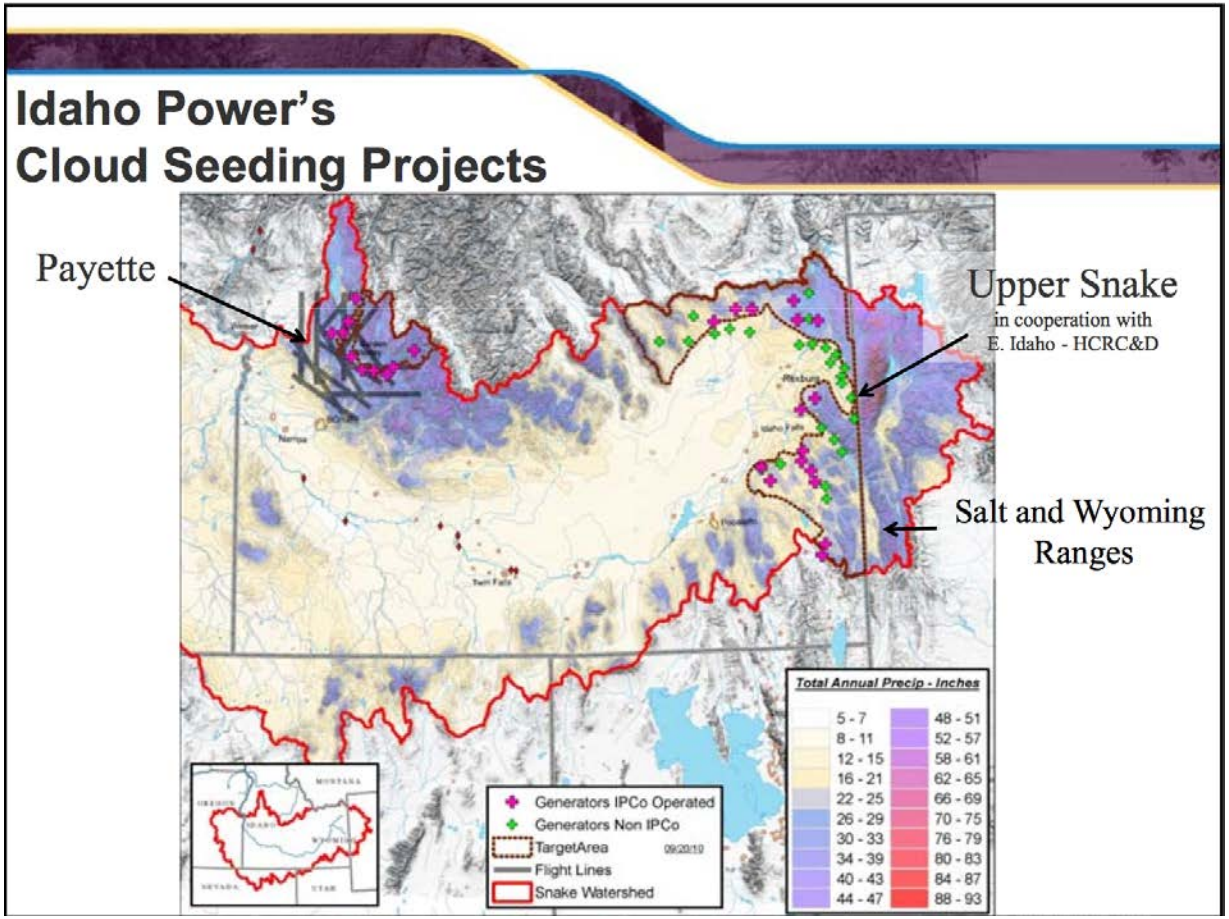
Source: Department of Water Resources. California Water Plan Update 2009. Vol. 2: Resource Management Strategies.

Idaho Cloud Seeding

$1 million/ year

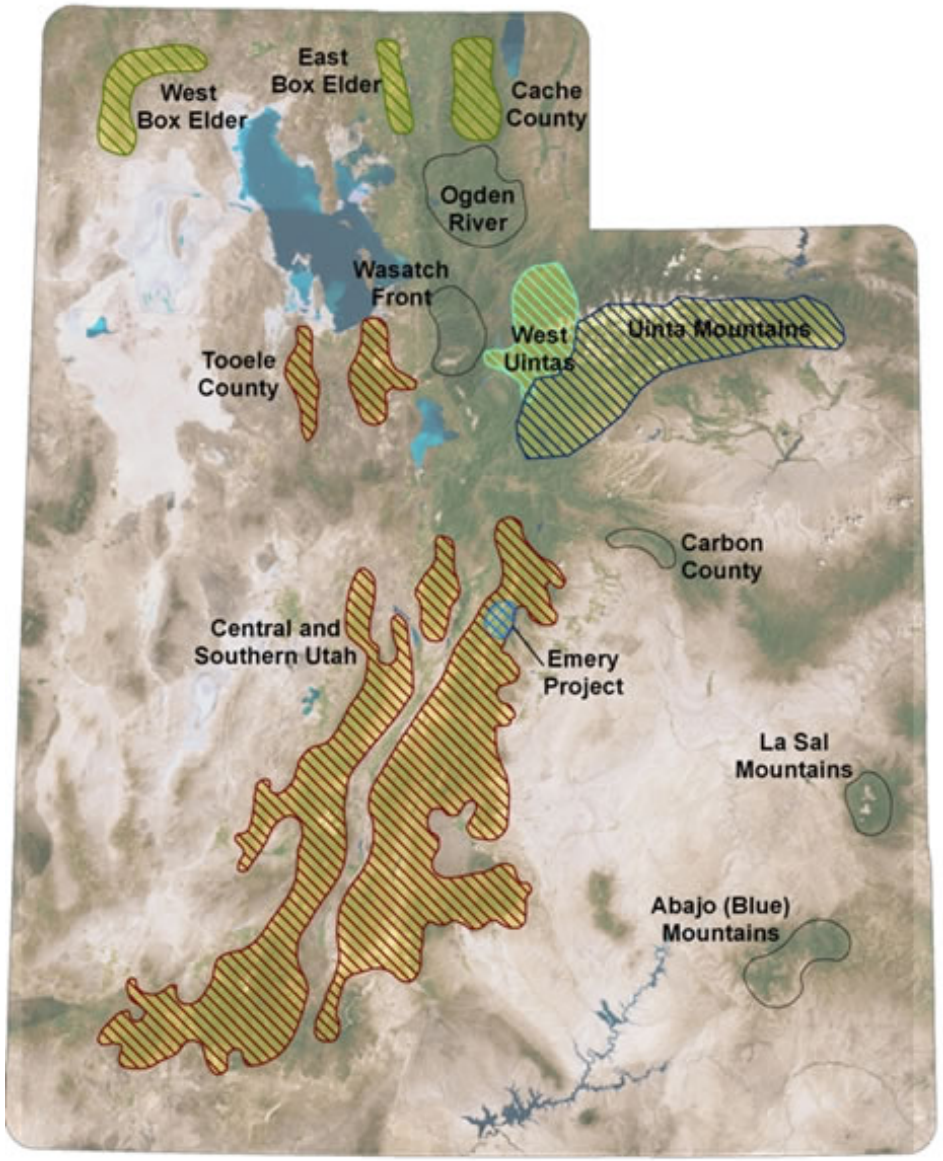
Aircraft cloud seeding warmer winter storms

Ground-based and aircraft cloud seeding for colder storms



Utah cloud seeding projects

Most of the higher terrain in the state is targeted.



Is cloud seeding effective?

Cloud seeding can increase snowfall by up to 15% (peer reviewed scientific publications)

- Climax Experiments Colorado (central Colorado Mountains) (Mielke et al. 1981; Grant 1986)

- Bridger Range Experiments (15%) (southwestern Montana) (Super and Heimbach 1983)

- Snowy Precipitation Enhancement Research Project (14%) (Snowy Mountains, Australia) (Manton et al. 2011)

- Wyoming Weather Modification Pilot Project (5 to 15%) (Medicine Bow/Sierra Madre, WY) $15M, 10 years (Breed et al. 2014)

Cloud Seeding Truckee/Tahoe WY 2015

Summary of season to date

- 19 events year to date

Nov 2014 – 4 events
Dec 2014 - 6 events
Jan 2015 - 1 event
Feb 2015 - 2 events
Mar 2015 - 2 events
Apr 2015 - 4 events

-Total Generator hours – 590 gen-hours

-Initial estimate of increase in snow water equivalent (SWE) ~9,000 acre-feet

Cloud Seeding Truckee/Tahoe WY 2015

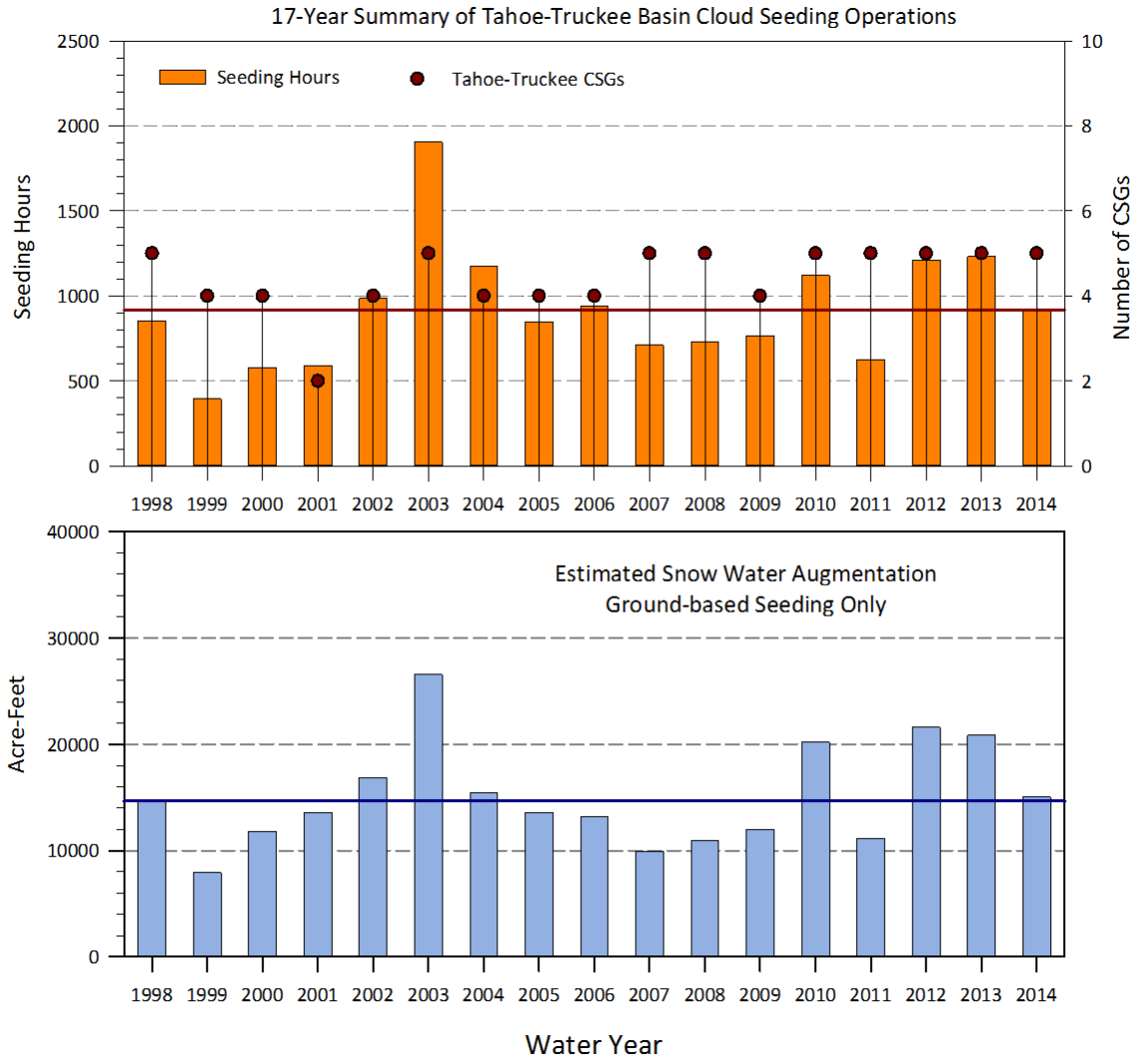
WY 2015 compared to previous years

Mean generator hours
Historic: 917 gen-hours
WY2015: 590 gen-hours

Mean seeding water augmentation
Historic: 14,600 acre-feet
WY2015: ~9,000 acre-feet*

Median cost per acre-ft.
Historic: < $20

*9,000 acre-ft. is enough water for 21,000 Truckee Meadows households.



Cloud Seeding Truckee/Tahoe WY 2015

Operational Plans for remainder of Season

- Completed operations June 1, 2015

- Remove the Barker Pass generators per USFS permit.

- Summarize seasonal results, compute final snowfall augmentation estimates

- Prepare and deliver final seasonal report.

Cloud Seeding Truckee/Tahoe WY 2015

Summary

- Very warm and dry winter overall

- All seedable storms were seeded

- Equipment worked well when needed

- Estimated 9000 acre-feet (3 billion gallons) of water added to snow pack

- Several big storms (Pineapple express) were too warm to cloud seed from ground using AgI
    - Aircraft
    - Liquid Propane

Thank You !

Any questions/comments?

Extra slides

Silver Iodide (AgI)
-Insoluble in water (remains a solid at high and low temperatures)
-No molecular charge
-Less than 1 oz released per hour by DRI generators – dispersed over 35 sq. miles
-Not bioavailable (is not biologically available to the ecosystem)
-The amounts found in the seeded snow < 10 pts trillion (10/1000000000000) (Huggins 2015)
-No detectable in runoff or water bodies even after 50 years of cloud seeding (Mokelumne; Stone 2006)