The meeting teleconference will begin shortly

Listen to the meeting by using your computer or tablet speakers
or by calling (877) 853 5247 using meeting ID 979 215 700

View the live meeting presentation at https://sbvmwd.zoom.us/j/979215700
PASSCODE: 3802020

Public comments, suggestions or questions regarding technical issues may be emailed to comments@sbvmwd.com

Please use the chat feature in the Zoom toolbar to let the moderator know that you would like to make a comment during the meeting or use the digital "raise hand" function in Zoom.

Please mute your microphone during the meeting to reduce background noise. Click on the microphone icon to unmute your microphone if needed.

Call to Order

Board of Directors Workshop - Resources
Thursday, April 7, 2022

Chairperson – Director Hayes
Vice-Chair – Director Harrison

Introductions

Following the introduction of Directors and District staff, participants may use this time to state their name and agency/affiliation in order to be included in the formal record of attendees.

Public Comment

Any person may address the Board on matters within its jurisdiction.

- *Please use the chat feature on the Zoom toolbar or digitally raise your hand to let the moderator know you would like to make a comment.*

Summary of Previous Meeting (Pg. 2)

Board of Directors' Workshop - Resources - March 3, 2022

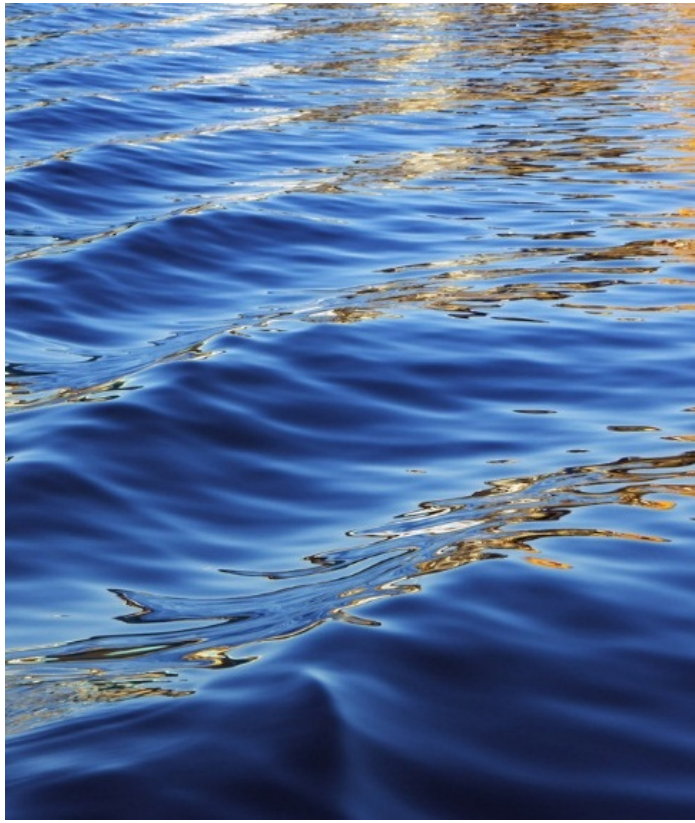
Discussion Item 4.1 (Pg. 9)

Bob Tincher, PE, MS – Chief Water Resources Officer
Adekunle Ojo, MPA – Water Resources Manager

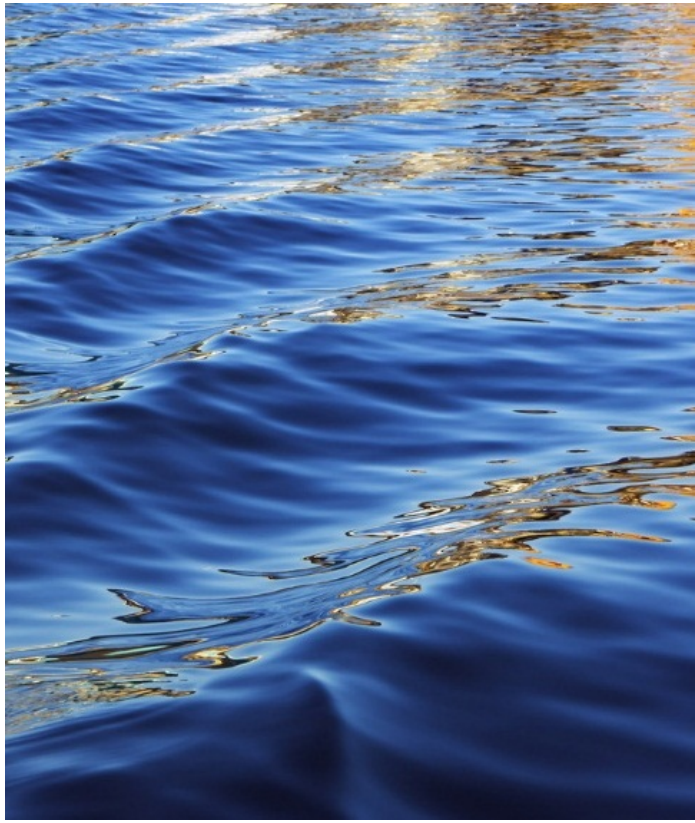
Staff Update on Cloud Seeding

Staff Recommendation
Receive and File

Staff Update on Cloud Seeding



Summary of Previous Report from Staff



Total **Projected** Increases

Ground Only Seeding

Target Area	Seasonal Precip. Increase (inches)	Percent Increase	Avg. Natural Streamflow (AF)	Streamflow Increase (AF)	Percent Increase
NW	0.41	3.5%	25,000	2,043	8.2%
NE	0.49	4.1%	65,000	4,330	6.7%
SW	0.59	3.7%	5,000	447	9.0%
SE	0.49	4.5%	10,000	1,373	13.7%
	TOTAL w/ Ground Only		**105,000**	**8,193**	**7.8%**

With Aerial Support in the NE Target

Target Area	Seasonal Precip. Increase (inches)	Percent Increase	Avg. Natural Streamflow (AF)	Streamflow Increase (AF)	Percent Increase
NW	0.41	3.5%	25,000	2,043	8.2%
NE	0.89	7.3%	65,000	7,772	12.0%
SW	0.59	3.7%	5,000	447	9.0%
SE	0.49	4.5%	10,000	1,373	13.7%
	TOTAL		**105,000**	**11,635**	**11.1%**

$44/AF ($22/AF with grant funds, 7,800 AF)

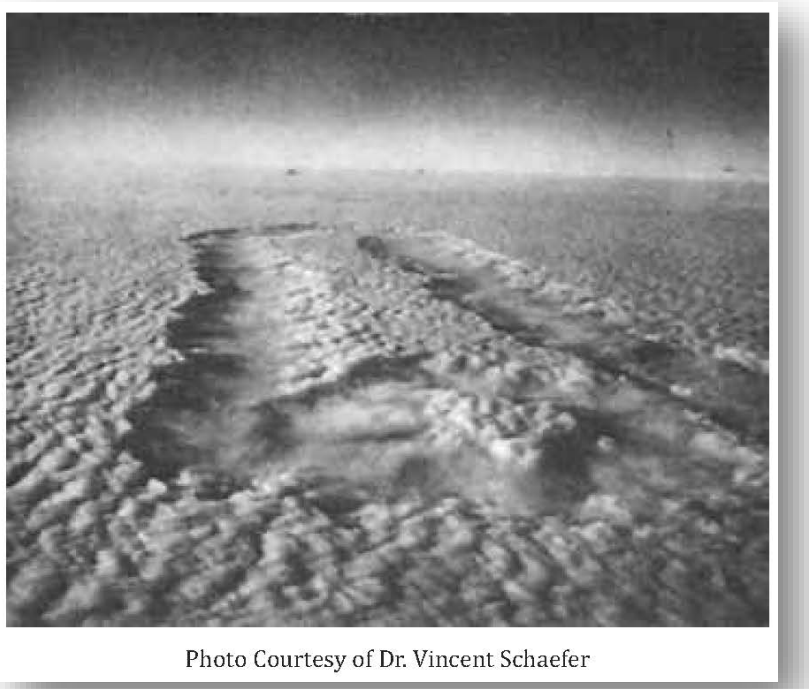


Photo Courtesy of Dr. Vincent Schaefer

Cloud seeding works but there is no way to directly measure how much water you will actually receive for your money

Photo Courtesy of Dr. Vincent Schaefer

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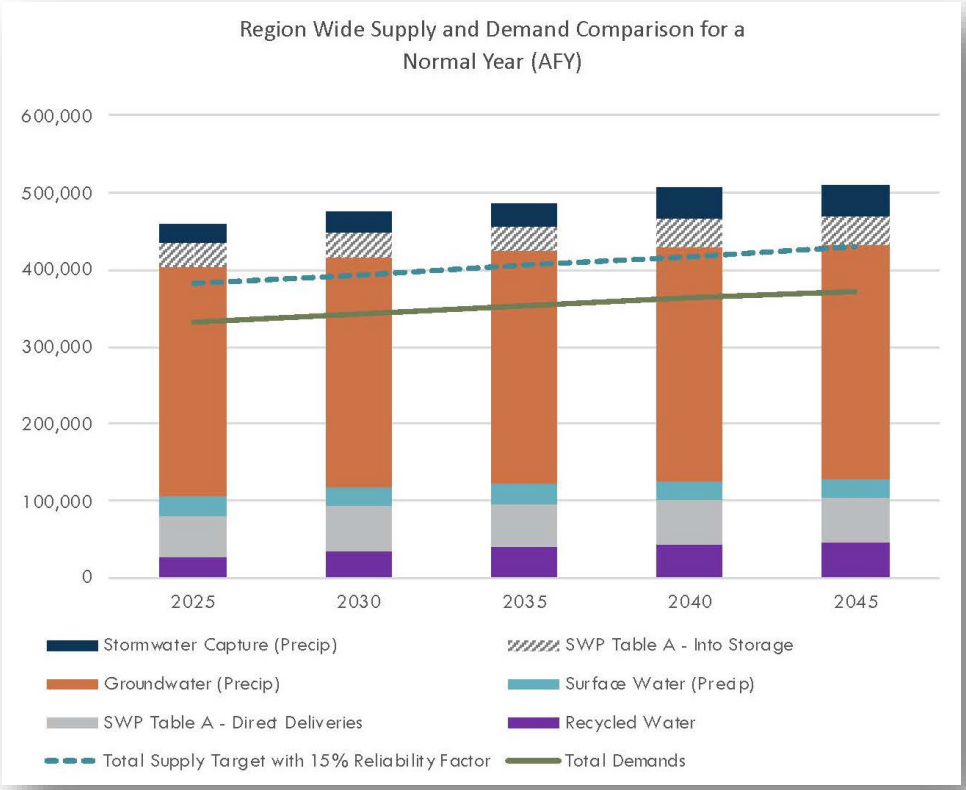
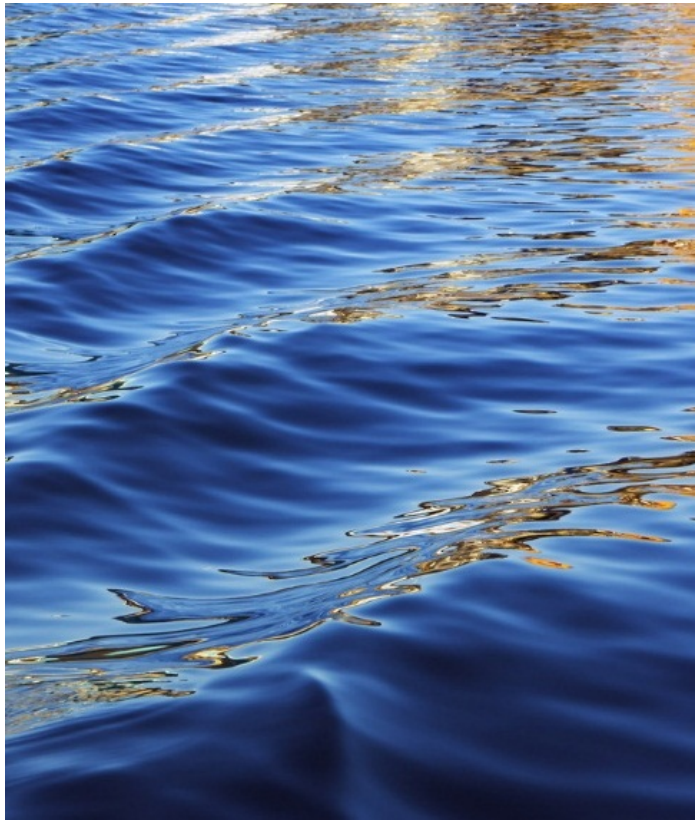


New Information Since Staff's Last Report



Other Projects (provided by SAWPA)

Estimates

Case Study	Name	Location	Year	Increase in Precip	Increase in Runoff	Validation Approach
1	Colorado River Basin Augmentation (Central Colorado Mountains River Basins Program)	Central Colorado	WY 2020-2021	9.3%	107,000 AF	Target and Control and Randomized Seeding
2	Santa Barbara County Water Agency	Huasno-Alamo	1981-2014	9%	--	Target and Control
		Santa Ynez	1981-2014	19%-21%	--	
3	Seeded & Natural Orographic Wintertime clouds: the Idaho Experiment (SNOWIE)	Payette	2003-2020	11.2%	271,000 AF	Target and Control with Doppler Radar
		Boise	2003-2020	12.1%	217,000 AF	
		Wood	2003-2020	10.2%	68,000 AF	
4	Wyoming Weather Modification Pilot Program	Wyoming	2005-2014	5%-15%	0.4%-3.7% increase	Randomized cross over with target and control
5	Australia Snowy Precipitation Enhancement Research Project (SPERP)	Entire area	2004-2015	7%	--	Randomized
		Target area	2004-2015	14%	--	
6	Utah Division of Water Resources	Statewide	24-43 years	7%	--	Target and Control
		Statewide	2019-2020	8%	--	

SNOW PACK AUGMENTATION IN THE
SAN BERNARDINO MOUNTAINS

WATER YEARS

1976-77

AND

1977-78

by
Norm Caouette

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

G Louis Fletcher
District Engineer

Grist

Can cloud seeding help quench the thirst of the US West?

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Quantifying snowfall from orographic cloud seeding

Katja Friedrich[a,1], Kyoko Ikeda[b], Sarah A. Tessendorf[b], Jeffrey R. French[c], Robert M. Rauber[d], Bart Geerts[c], Lulin Xue[b], Roy M. Rasmussen[b], Derek R. Blestrud[e], Melvin L. Kunkel[e], Nicholas Dawson[e], and Shaun Parkinson[e]

[a]Department of Atmospheric and Oceanic Sciences, University of Colorado Boulder, Boulder, CO 80309; [b]Research Applications Laboratory, National Center for Atmospheric Research, Boulder, CO 80307; [c]Department of Atmospheric Science, University of Wyoming, Laramie, WY 82071; [d]Department of Atmospheric Sciences, University of Illinois at Urbana–Champaign, Urbana, IL 61820; and [e]Cloud Seeding Group, Idaho Power Company, Boise, ID 83702

Edited by John H. Seinfeld, California Institute of Technology, Pasadena, CA, and approved January 30, 2020 (received for review October 2, 2019)

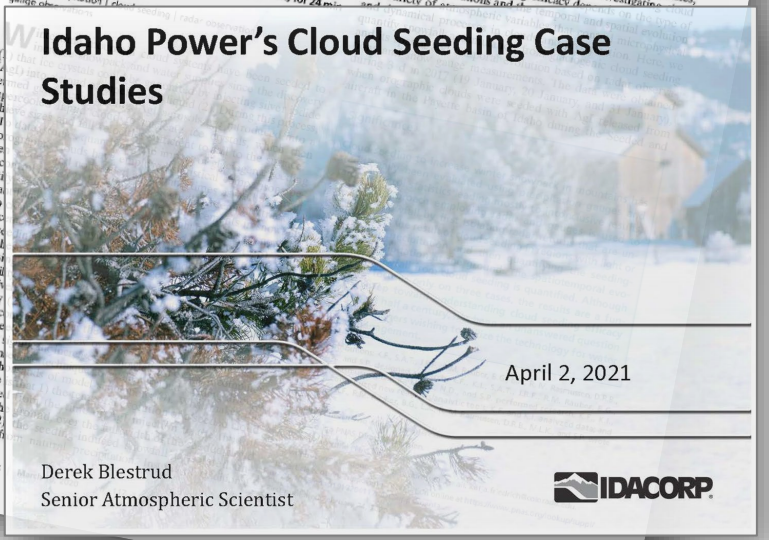
Climate change and population growth have increased demand for water in arid regions. For over half a century, cloud seeding has been evaluated as a technology to increase water supply; statistical approaches have compared seeded to nonseeded events through precipitation gauge analyses. Here, a physically based approach to quantify snowfall from cloud seeding in mountain cloud systems is presented. Areas of precipitation unambiguously attributed to cloud seeding are isolated from natural precipitation (<1 mm h^{-1}). Spatial and temporal evolution of precipitation generated by cloud seeding is then quantified using radar observations and snow gauge measurements. This study uses the approach of combining radar technology and precipitation gauge measurements to quantify the spatial and temporal evolution of snowfall generated from glaciogenic cloud seeding of winter mountain cloud systems and its spatial and temporal evolution. The results represent a critical step toward quantifying cloud seeding impact. For the cases presented, precipitation gauges measured increases between 0.05 and 0.3 mm as precipitation generated by cloud seeding passed over the instruments. The total amount of water generated by cloud seeding ranged from 1.2×10^5 m^3 (100 ac ft) for 20 min of cloud seeding to 3.4×10^5 m^3 (275 ac ft) for 24 min (196 ac ft) for 86 min of seeding to 2.4×10^5 m^3 of cloud seeding.

clouds | precipitation | cl…

gauge ob…

5190–5195 | PNAS

Idaho Power's Cloud Seeding Case Studies



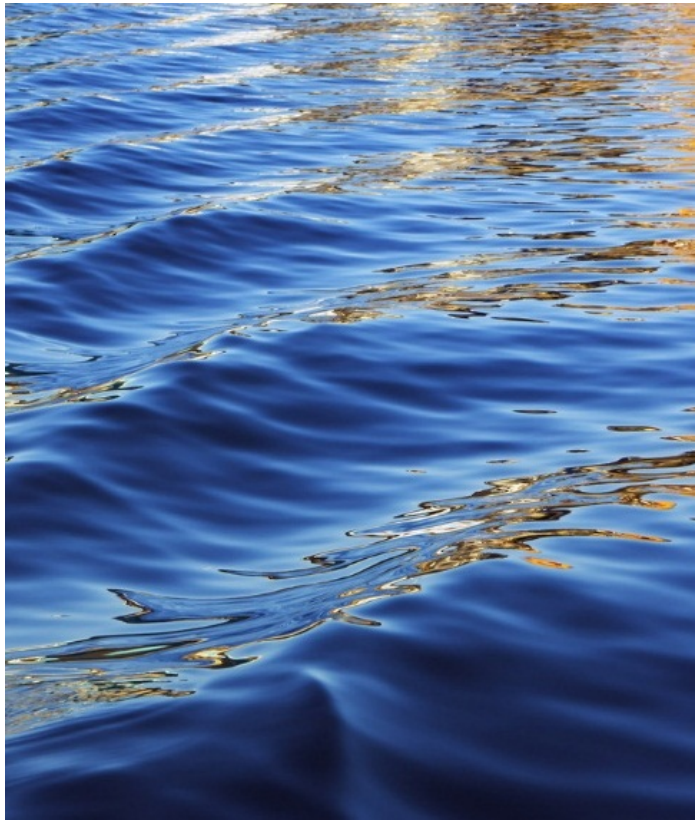
April 2, 2021

Derek Blestrud
Senior Atmospheric Scientist

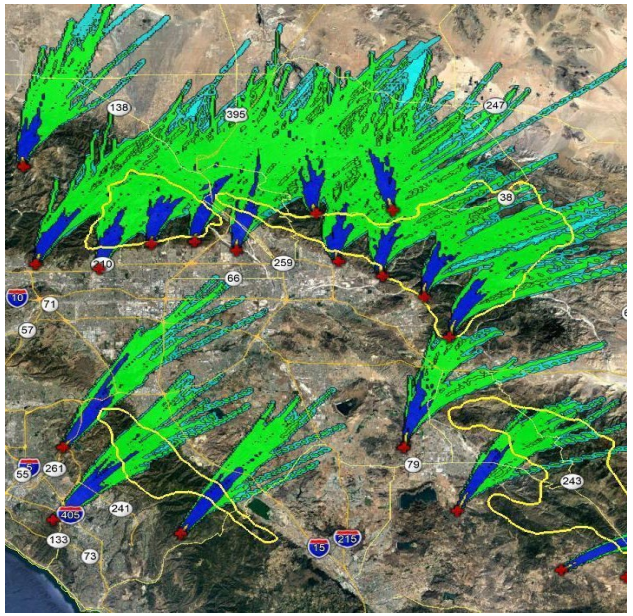
IDACORP

www.pnas.org/cgi/doi/10.1073/pnas.1917204117

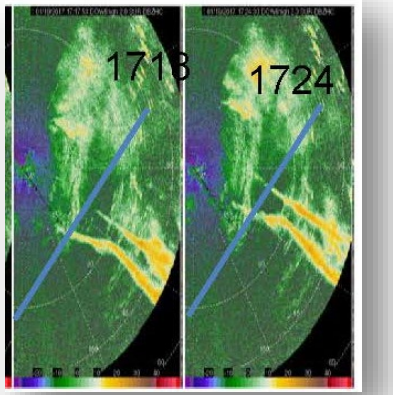
Challenges and Opportunities that May be Addressed in a Pilot Scale Project



Ground Based



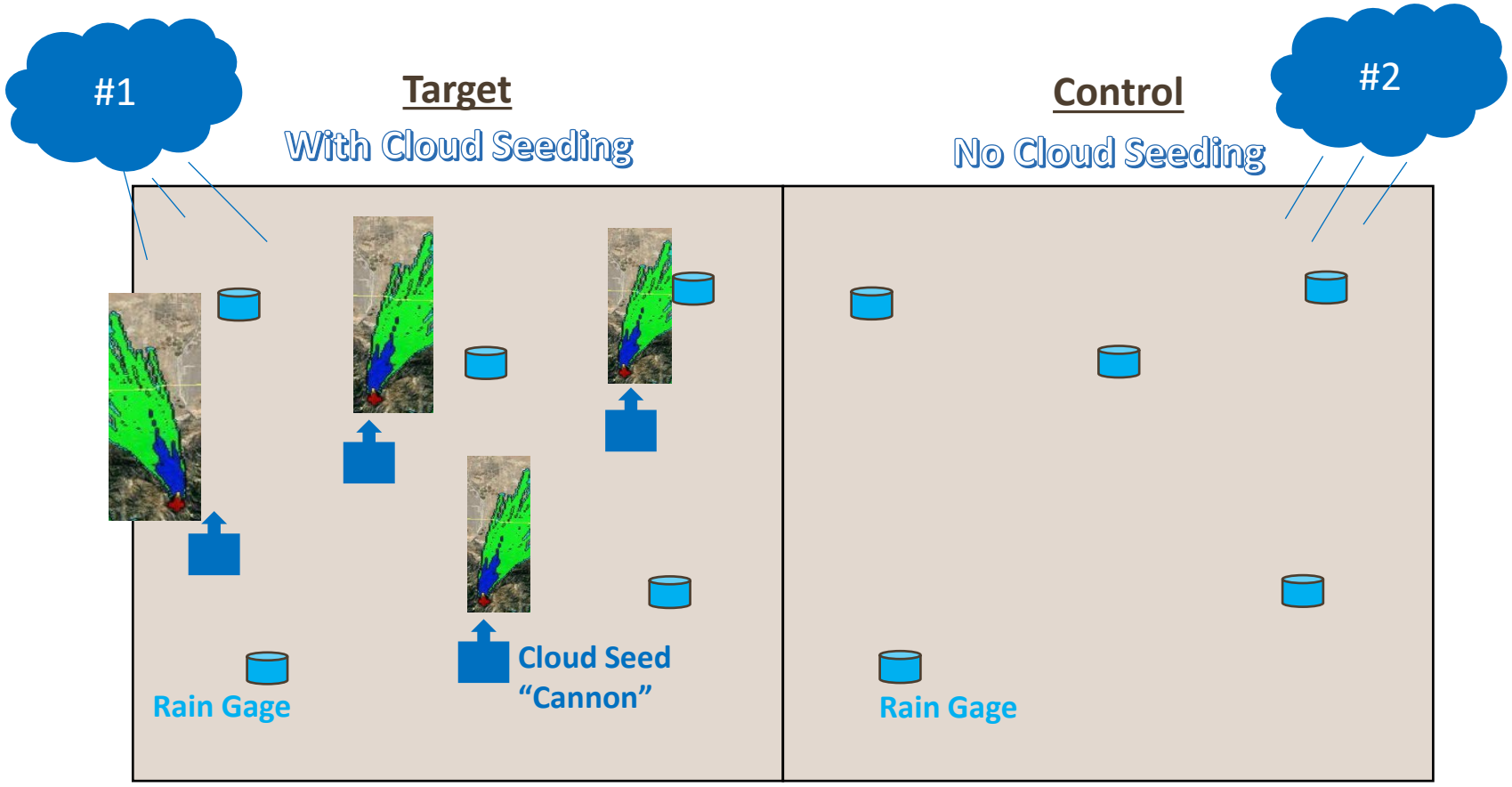
Aerial (Doppler Radar)



Why is it difficult to measure the actual benefit?

- ✓ Areas are not uniform
- ✓ The 3-dimensional dispersion is not uniform and difficult to track in nature in real-time
- ✓ Cloud seeding is not 100% effective across the entire seeded area
- ✓ It is difficult to know whether any measured increase in snow or rain is due to the cloud seeding or to the variability in nature (storm cell)

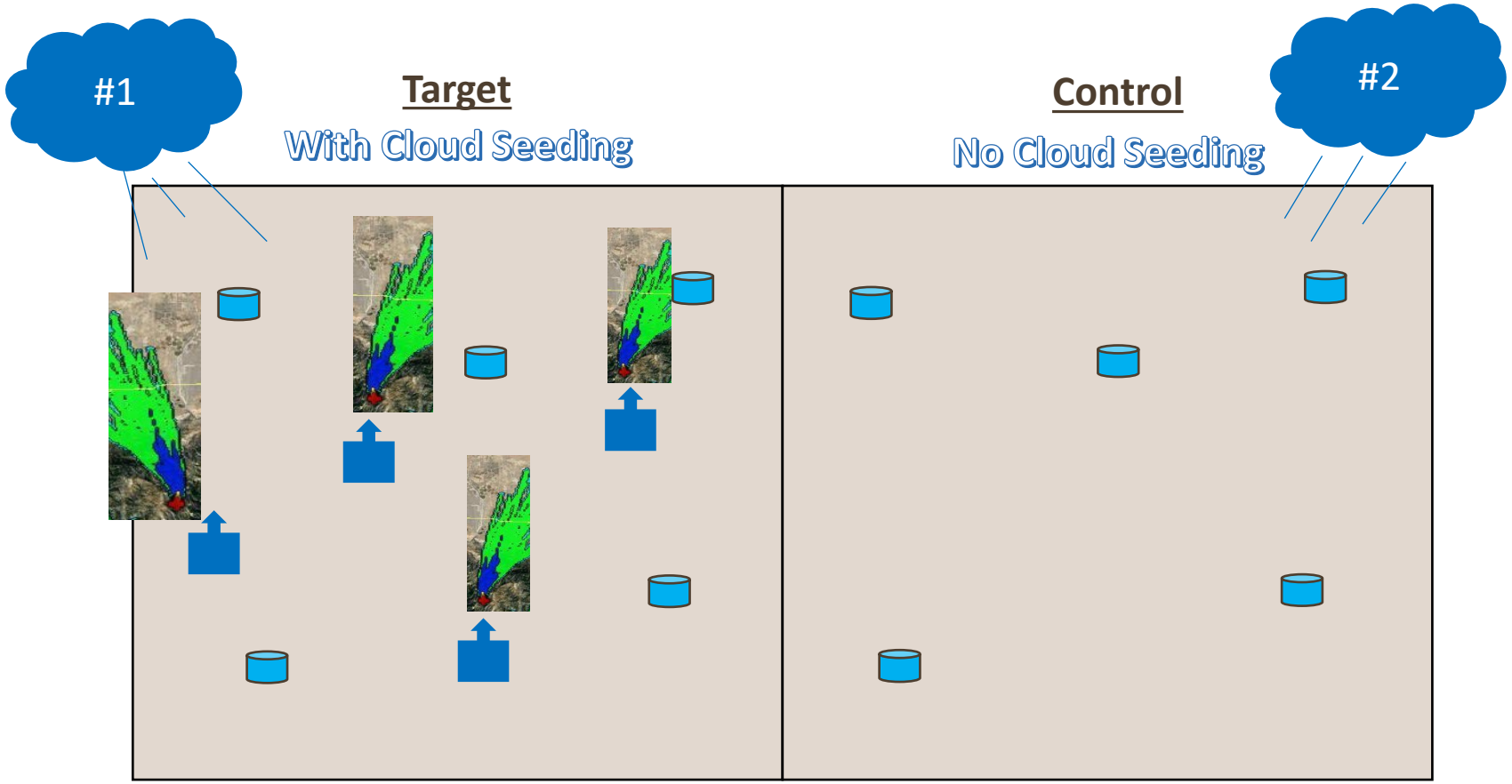
Target-Control Method



Assumptions: #1 = #2

Dispersion area of silver iodide

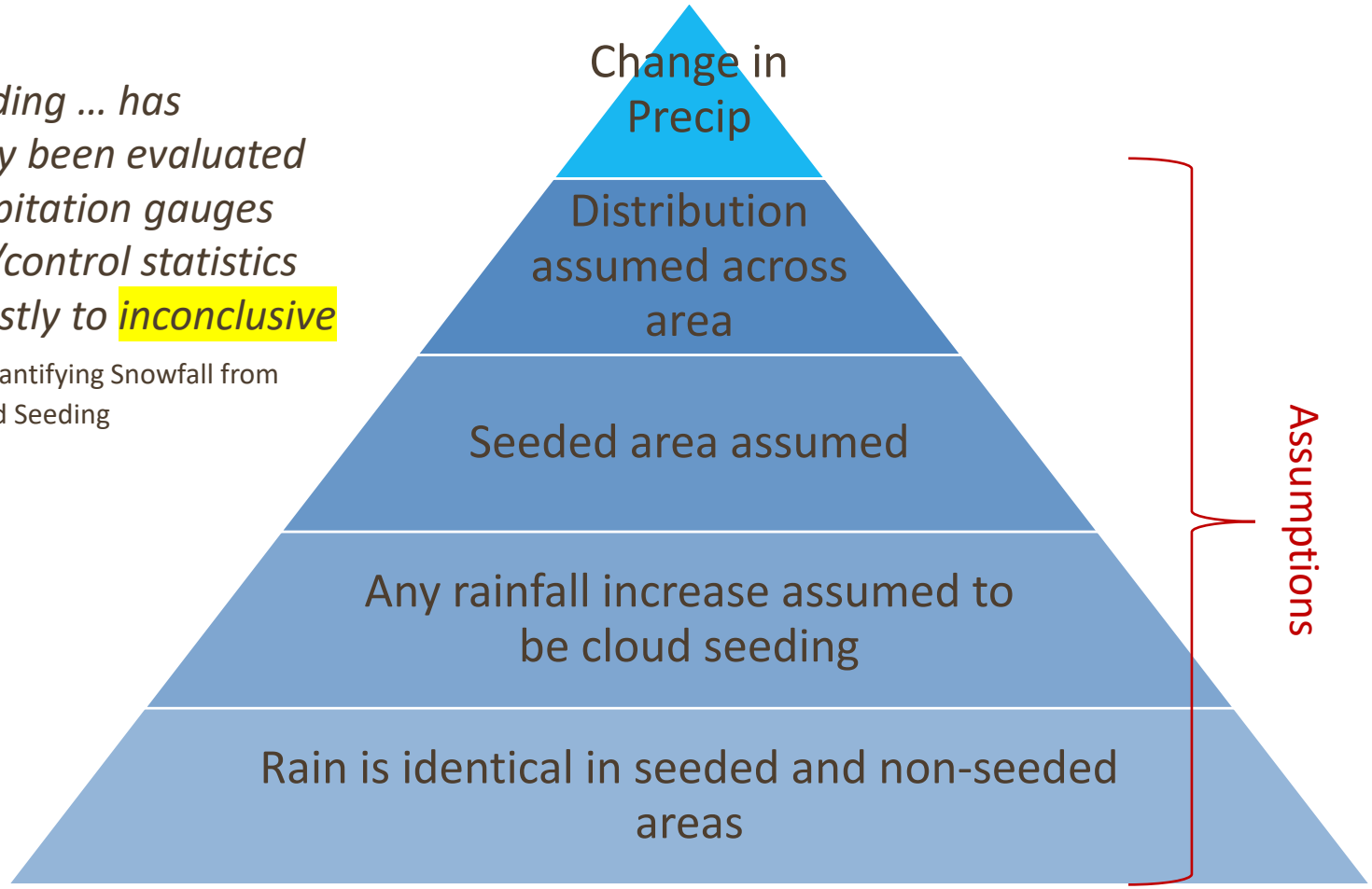
Target-Control Method



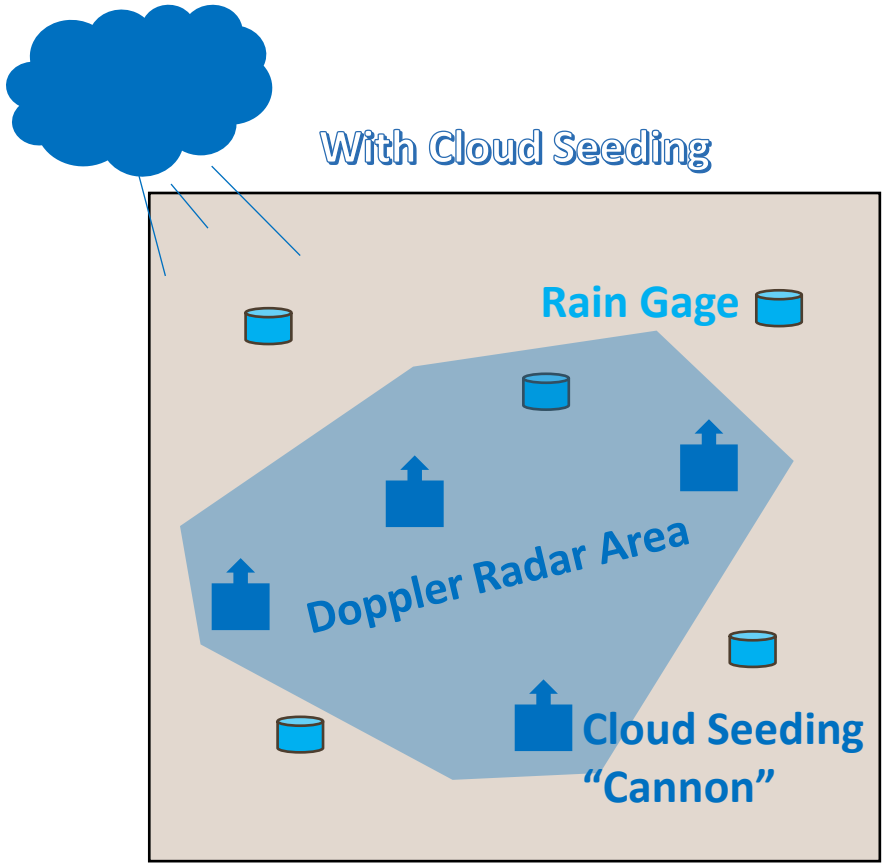
Target-Control Method

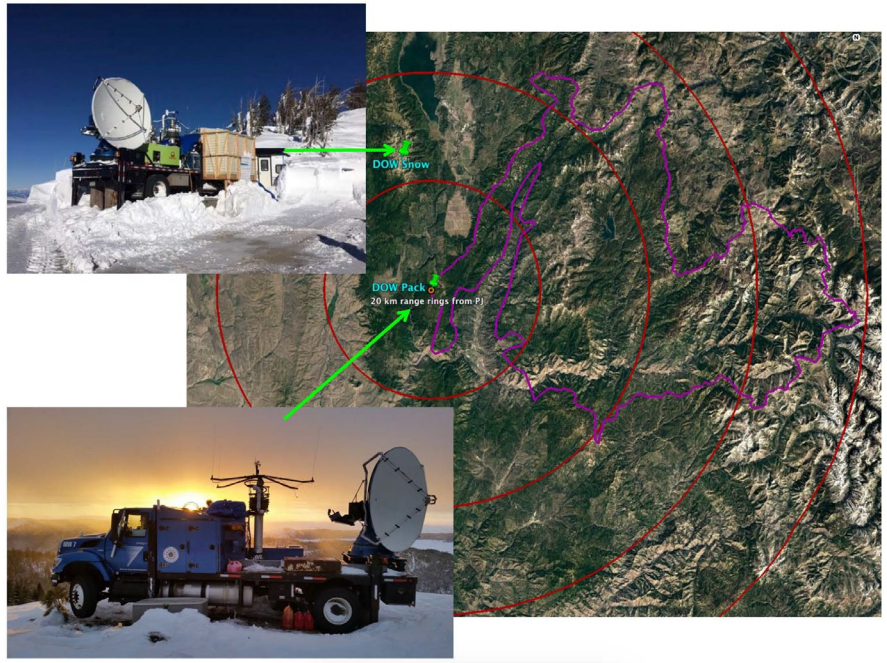
Change in Precipitation Built on Assumptions

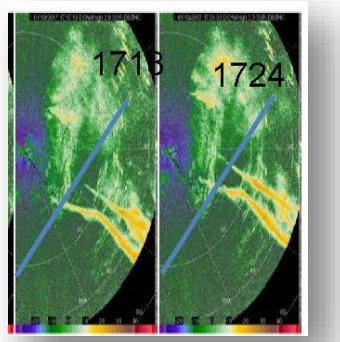
"Cloud seeding … has traditionally been evaluated using precipitation gauges and target/control statistics leading mostly to inconclusive results." Quantifying Snowfall from Orogrpahic Cloud Seeding



Target-Control with Doppler Radar (SNOWIE)





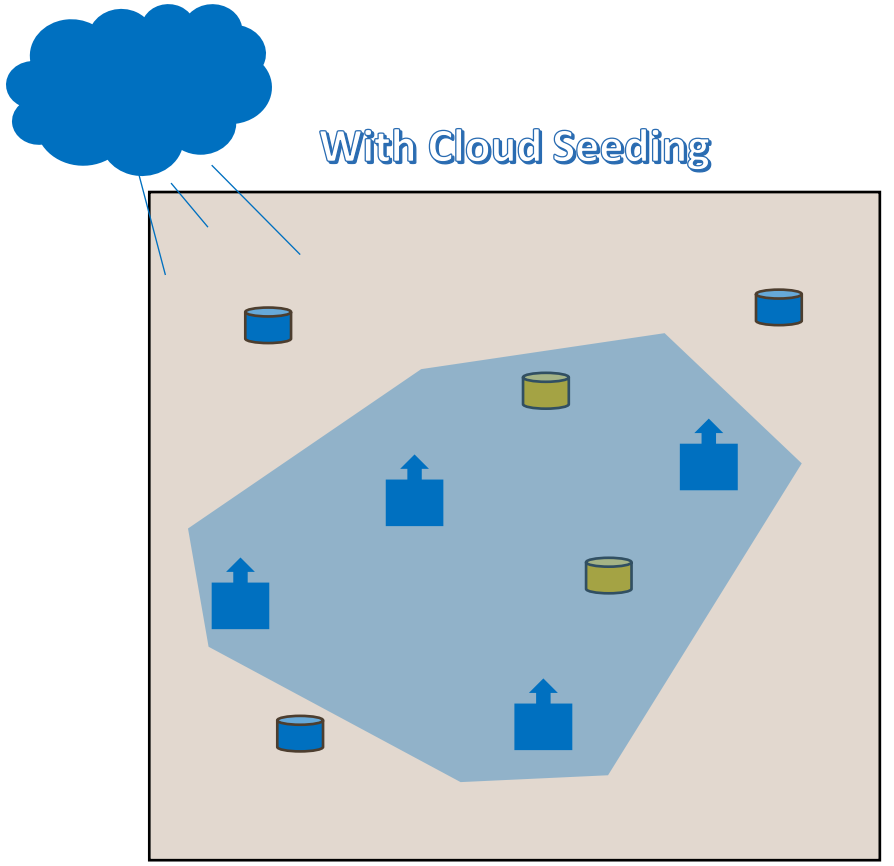


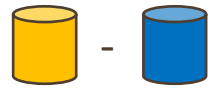
Better defines the "footprint" of the seeded area using Doppler radar

Target-Control with Doppler Radar

"A thorough analysis was conducted to establish a best-match relationship…To address the…related uncertainty, an ensemble of…relationships was also developed…"

Quantifying Snowfall from Orogrpahic Cloud Seeding



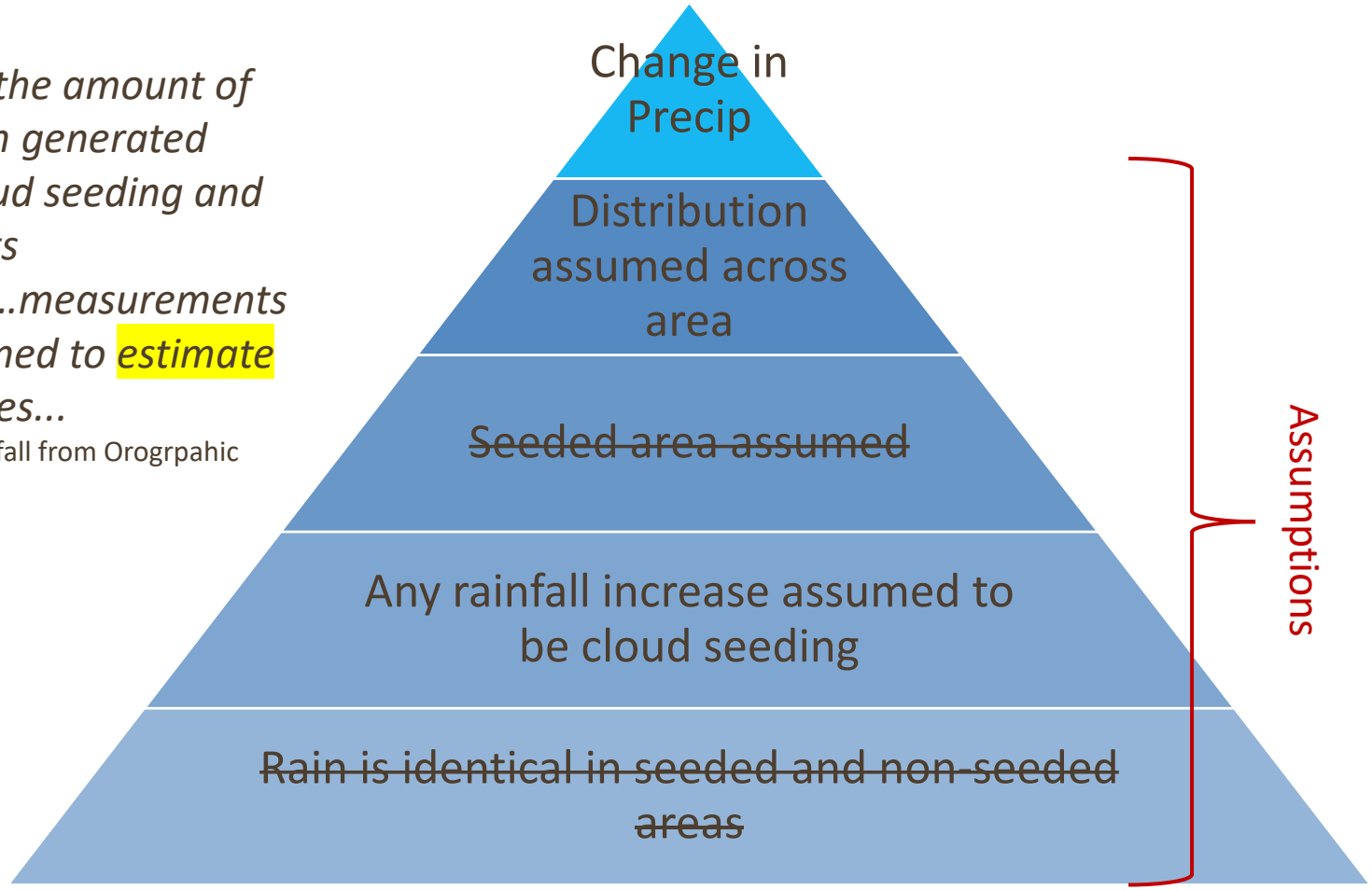
Change in Precipitation 

Target-Control with Doppler Radar

Comparison Built on Assumption

To quantify the amount of precipitation generated through cloud seeding and determine its distribution…measurements …are combined to estimate snowfall rates...

Quantifying Snowfall from Orogrpahic Cloud Seeding



SNOW PACK AUGMENTATION IN THE SAN BERNARDINO MOUNTAINS

WATER YEARS

1976-77

AND

1977-78

by
Norm Caouette

SAN BERNARDINO VALLEY MUNICIPAL WATER DISTRICT

G Louis Fletcher
District Engineer

Valley District's 24-year (1954-78) History with Cloud Seeding

- 1948: a group of cooperators explore the feasibility of cloud seeding in the Santa Ana River watershed
  - Aerial and ground-based
- 1950 - 60: The Santa Ana River Weather Corporation formed. Funding from water agencies including Valley District
- 1954: Valley District formed
- 1960 - 78: Valley District weather modification program
  - 1975: Environmental Impact Report
  - 1976-78: Valley District snowpack augmentation Project

- Louis Fletcher became General Manager and served until 2001. During his tenure, he no longer pursued cloud seeding.

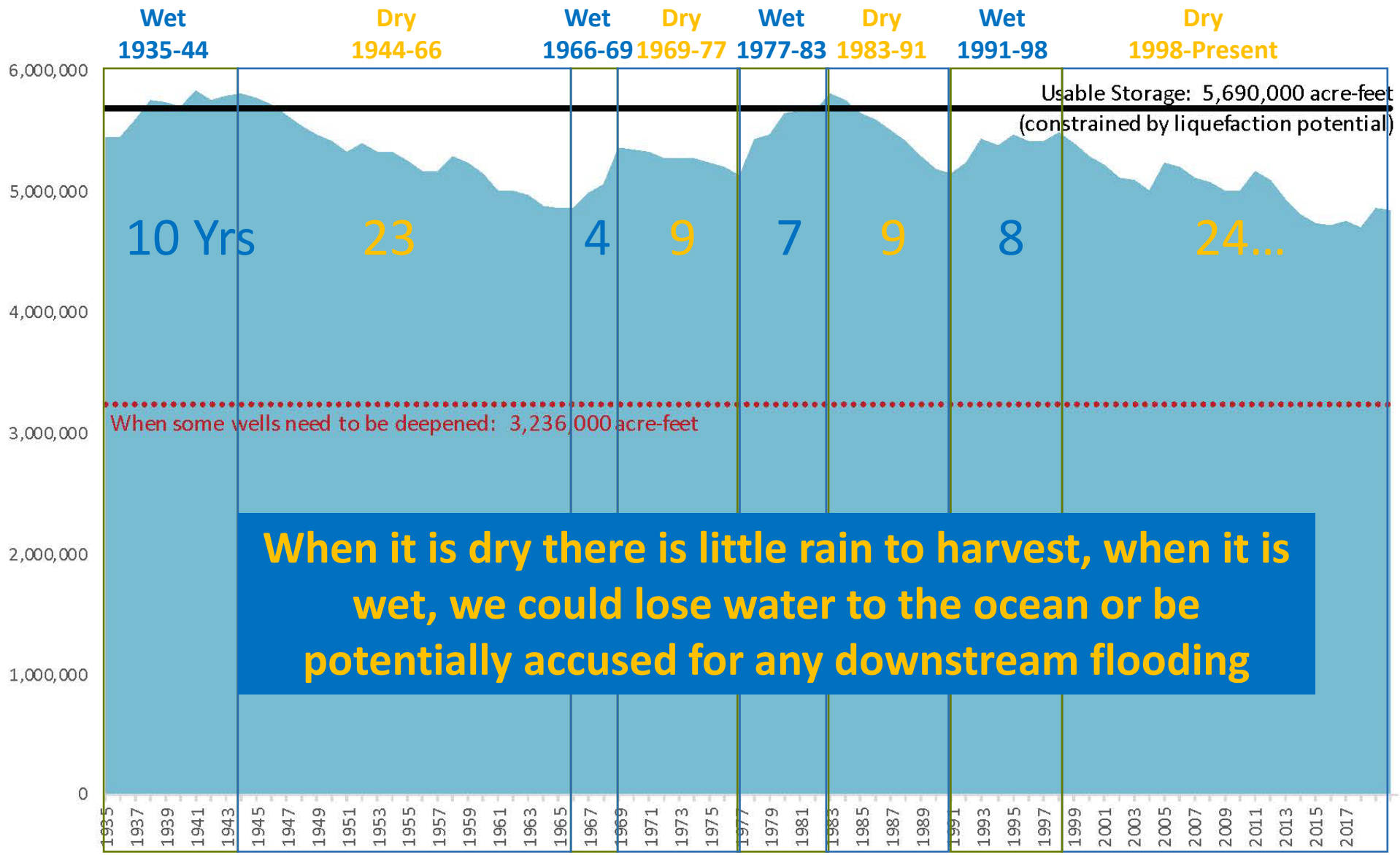
Results from 1976-78 Project

- 1976-77: driest year on record
- 1977-78: 3rd wettest year on record

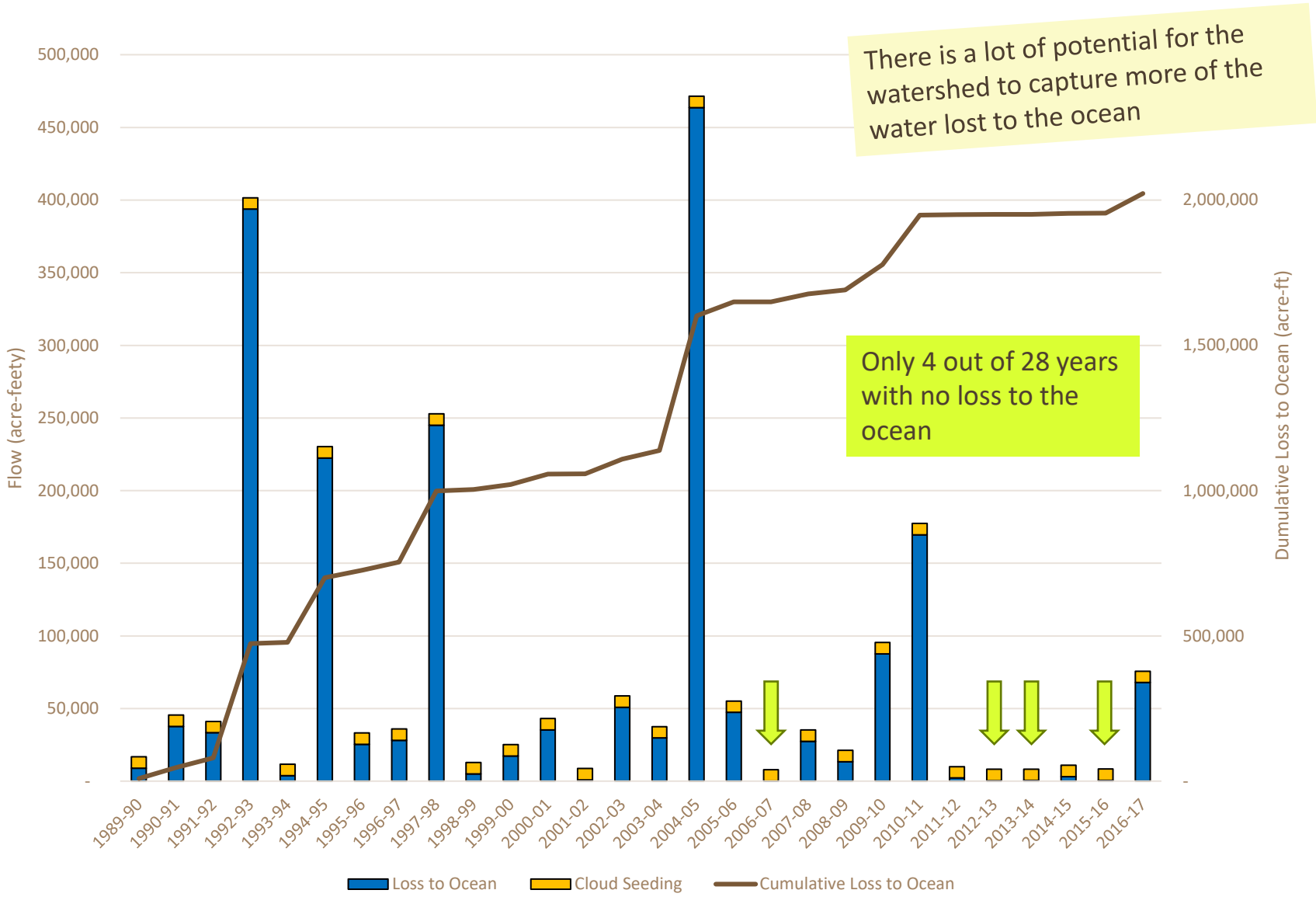
Our typical
”Feast or Famine Hydrology”

- Conclusion:
  - Inconclusive
    - Minimum number of seeding events
    - “Some influence” (not quantified) did occur during one storm

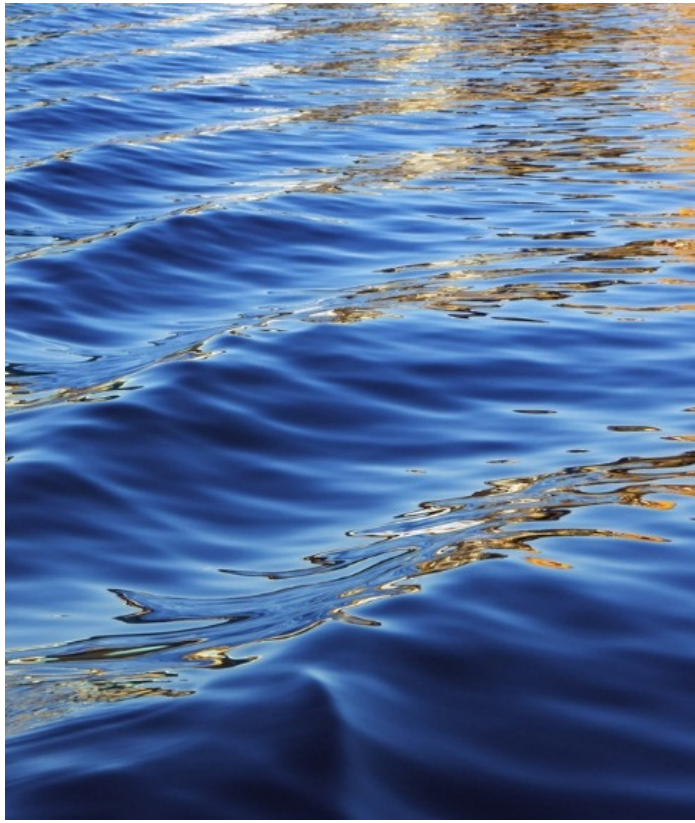
Cloud Seeding will be Challenging with the Watershed's "Feast of Famine" Hydrology



Any Cloud Seeding Benefit Could Flow Into the Ocean



Pilot Scale Project



A Cloud Seeding Pilot Scale Project is Consistent with Our Strategic Plan

RESILIENT.
Resilient to seismic conditions, drought, population growth and climate change.

RESTORATIVE.
Reduce carbon footprint and recover environmental health.

SCIENCE BASED.
Built from reliable regional data shared among all partners.

COST-EFFECTIVE.
Optimize operational efficiency and maximize benefits from ratepayer investments.

INTEGRATED.
Holistically optimize value to the region.

COLLABORATIVE.
Dedicated to work inclusively.

TRUSTWORTHY.
Committed to earn respect.

INNOVATIVE.
Proactive and effective problem- solvers.

DRIVEN.
Passionate and empowered leaders.

OUR *strategies* ARE TO...

1. Achieve climate resilience through prioritized adaptation and mitigation.
2. Proactively manage a diverse, adaptable water supply portfolio to maximize the value of the region's water assets.
3. Drive science-based decision making and proactive risk management.
4. Build trust by being a collaborative and resourceful partner through effective communication and engagement.
5. Attract and support top talent and promote a rewarding culture of growth and opportunity.
6. Commit to effective governance through Board leadership development.

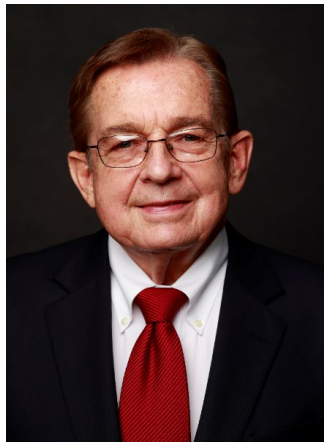
Considerations for a Cloud Seeding Pilot Scale Project

1. **To address questions regarding the actual benefit from cloud seeding:**
   a. Consider independent measurement, analysis and peer review of the results from an entity that has expertise in weather but is not involved in cloud seeding such as the Center for Western Weather and Water Extremes (CW3E), USGS and/or RAND
   b. Look for ways to improve the Target-Control method to avoid the possibility that the study results will be inconclusive
   c. Provide a list of all assumptions used in the estimation of the benefits
   d. Look for a method that can be used to determine the probability that increased precipitation is from cloud seeding and not due to variability in the weather
   e. Provide error bands on the results
   f. Include SAWPA member agency staff in the process
2. **To address questions about cloud seeding benefits possibly flowing into the Ocean:**
   a. Consider using the watershed's calibrated flow models to track the water from cloud seeding
   b. Consider comparing daily flow to the ocean with the estimated cloud seeding benefits to help determine whether the water flowed into the ocean
3. **To address questions regarding liability for potential floods:**
   a. Show how SAWPA will avoid potential liability for any flood events

Director Comments and Discussion

Paul Kielhold
President

June Hayes
Vice President



T. Milford Harrison
Treasurer

Gil J. Botello
Director

Susan Longville
Director

Staff Recommendation

Receive and File

Future Business

Adjournment