Key Definition

• **Weather modification and control**

Changing or controlling, 
*or attempting to change or control*,
by artificial methods (cloud seeding using aircraft)
the natural development
of atmospheric cloud, or precipitation forms,
that occur in the troposphere
Physics of Seeding

-40C, -40F

Ice crystals only

Ice crystal, ice nuclei

Hailstone (small)

Supercooled Region

Liquid water particle

0C, 32F

Water, ice crystal, hailstones

Cold Cloud Micro-physical Changes Due to Cloud Seeding (Hail Suppression)

Water particles only

Desired Result: smaller hail and increased rainfall
Ejectable: 20 gram flare silver iodide

Burn in place: 40 gram flare silver iodide
Target and Control Method of Assessment

Precip in Target = \( a + b \times \text{Precip in Control} \)
Focused RESEARCH

TEXARC


- Cloud microphysical structure strongly dependent on CBTs
- Timing and targeting are crucial

SPECTRA


- Documented microphysical links between CCN and mechanisms responsible for forming precipitation
- Demonstrated that sizes of CCN are critical to formation of rainfall
THE BOTTOM LINE

Research-Based
Predicted Outcomes from Seeding

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>DURATION</td>
<td>40 percent longer</td>
</tr>
<tr>
<td>COVERAGE</td>
<td>35 percent greater</td>
</tr>
<tr>
<td>CLOUD VOLUME</td>
<td>41 percent greater</td>
</tr>
<tr>
<td>CLOUD TOP</td>
<td>3 percent higher</td>
</tr>
<tr>
<td>CLOUD MASS</td>
<td>44 percent greater</td>
</tr>
<tr>
<td>RAINFALL MASS</td>
<td>2.3 times more</td>
</tr>
</tbody>
</table>
Seedable vs non-seedable

S. Roosevelt - 82.6 vil

E. Chavez - 12.1 vil
Pinal Co. Water Augmentation Authority
Daily Chance of Rainfall
Casa Grande
Projected Seeding Opportunities

During a “window” of July through September:

50 cloud targets

160,000 acre-feet of rainwater

From an assumed 5 percent increase in rainfall from seeded storms
By seeding all available storms

Using a single aircraft for 3 months
(at a cost of $0.47 per acre-foot)

- An average increase of 0.65 in. spread evenly over Pinal County
- Reduction of nearly 13,000 acre-feet of irrigation water, saving residents $335,000
- Economic impact, including crop production, of nearly $3 million annually
THE BOTTOM LINE

Estimated *increased* rain output from seeded *(single-cell)* storms

Avg. for 10-year period (’04-13)  144,669 acre-feet

Estimated cost of rainwater produced

Avg. for 10-year period  $ 10.82 per acre foot

Estimated increased rain output for *multi-cell* storms:

Avg. 10-year period (‘04-13):  1,769,314 acre-feet
Dealing with Drought
Thank You for Your Attention