#### **Opportunity Recognition & Seeding Methods**



# **Operational Program Outline**

- Seeding Opportunity
- Cloud Structures
- Seeding Criteria
- Delivery Techniques
- Seeding Procedures
- Strategy



# **Opportunities to Conduct Cloud Seeding**

- Operational Program
  - Seed all Possible Opportunities
  - Produce Maximum Effect
- Pilot's Primary Job
  - Recognize Opportunity
  - Deliver Seeding Material
    - Right Amount
    - Right Time
    - Right Place



What makes a seedable cloud? Depends on the hypothesis.

## **Rain Increase Cloud Seeding Opportunity**

- Liquid Water
- Updraft
- Lack of Ice
- Cloud Bulk
- Cold Cloud
- Low Bases



# Hail Suppression Cloud Seeding Opportunity

- Very strong updrafts.
- High liquid water content.
- High radar reflectivity or hail forecast.
- Occur in a very unstable atmosphere.



### **Rain Increase – Isolated Tcu- Single Cell**

- Visible Growth
- "Hard" Tops
- Solid Base
- Depth of 6,000-8,000' and Growing
- Lifetime ~15 30 minutes
- May, or May Not be sheared.



### **Rain Increase – Non-Severe Storm Complex**

- Multiple Cells, Updrafts
- Cells Develop and Mature, with Precipitation
- New Cells Develop Close to Mature and are Called "Feeder Cells"
- Visible Growth of Turrets
- Often Merge with Mature Storm



## Hail Suppression – Multi-cell Storm

- A stronger convective complex.
- Cells build and merge with mature cell.
- Feeders on side of low level flow, or feeders develop along convergence line.
- Outflow may change location of inflow.



# Hail Suppression – Squall Line Storm

- •Long Line of Multi-cell Storms
- Inflow (new development) along Front of Line
- Preceded by Cirrus Shield
- May be Accompanied by Shelf, Roll, Pedestal Clouds
- Inflow Weakens with Distance from Line
- Inflow may be Marked by Scud Clouds

#### **Cloud Structures – Squall Line Storm**



#### **Cloud Structures – Supercell Storm**

- Steady-state
- Shelf Cloud
- Inflow in Front, on South Portions





### **Rain Increase – Delivery Techniques**

- Best done at cloud top.
- Fly at -5 °C to -10 °C.
- Stabilize before penetration.
- Look for updraft, liquid water.



**Figure 14.** Seeding in the absence of shear. The "X" denotes the approximate seeding position.

### View Effects of Seeding (90/270 Turns)





## **Mulit-cell Storm – Delivery Techniques**

- Smooth, dark base.
- 500' below base.
- Racetrack pattern.
- 500 fpm updraft.
- Adjust power, configuration to hold altitude.
- Back off if updraft increases.



**Figure 15.** Rainfall augmentation seeding in a forward-shear environment.

#### **Mulit-cell Storm – Delivery Techniques**



## **Squall Line Storm – Delivery Techniques**

- Below shelf, 1000' below base.
- 500 fpm updraft
- 2-10 miles from precipitation.
- Racetrack pattern.
- Move out if updraft increase.



If on top, fly parallel to line, turns away from line.

#### **Squall Line Cloud – Delivery Techniques**



## **Supercell Storm – Delivery Techniques**

- 1000'-2000' below base.
- 500 fpm updraft.
- On top may be hazardous.





#### **Supercell Storm – Delivery Techniques**

