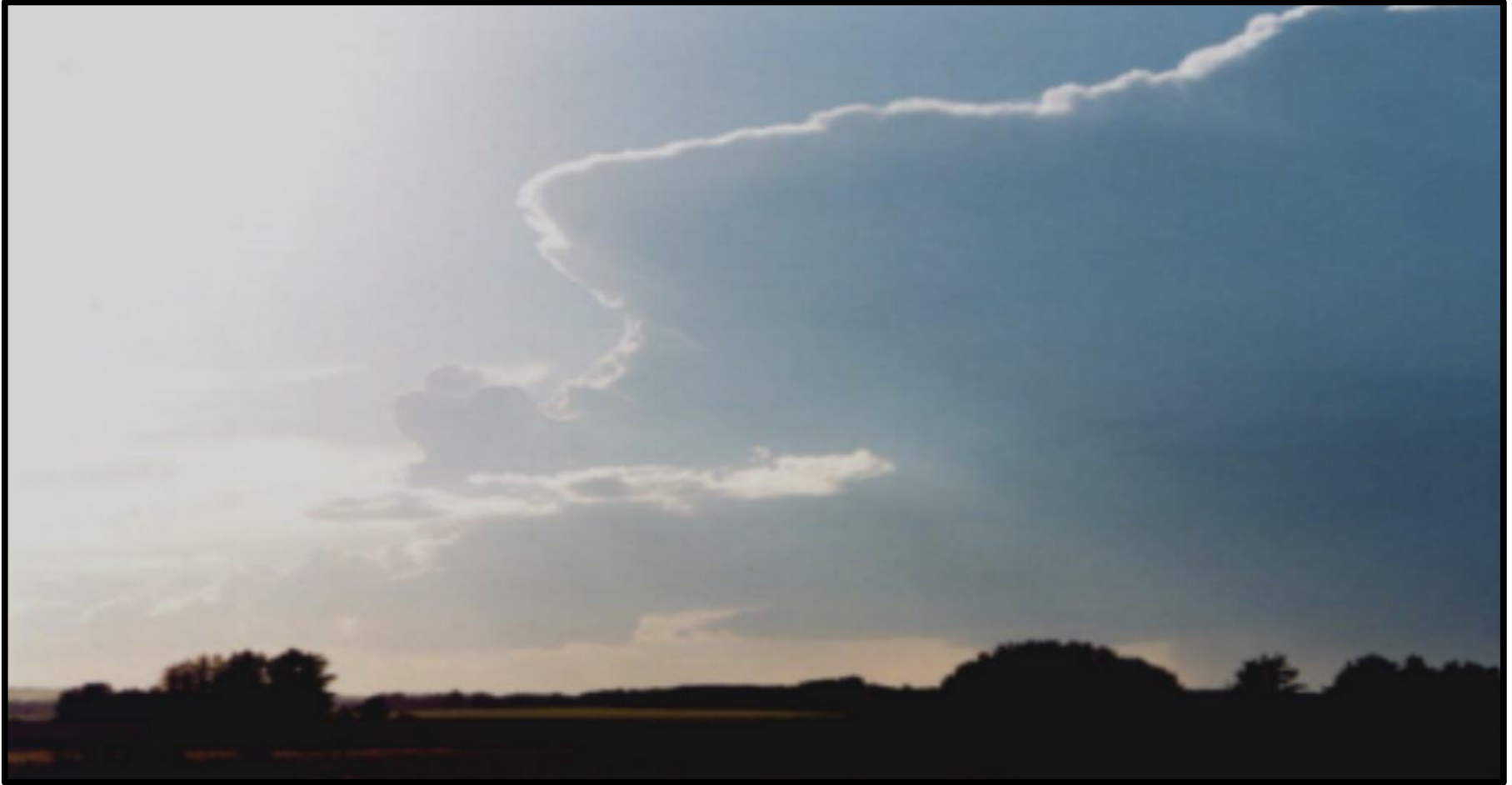


# Seeding Equipment and Methods



Presentation Based on Erich Hess Slides

# Airborne versus Ground Based Seeding

- Seeding must be done:
  - At the right place.
  - At the right time.
  - In the right amount.
  - At the best cost.



# Ground Based Cloud Seeding

## Advantages/ Benefits

- Less costly than aircraft.
- Lower maintenance costs.
- Fewer people are required.

## Disadvantages

- Location of generators is very important
- Might not be directly in line with storm
- Poor dispersal of seeding agent

# Airborne Cloud Seeding

## Advantages / Benefits

- Can place seeding agent in exact location.
- Can regulate amount of seeding agent used.
- Can provide more complete seeding of a storm.

## Disadvantages

- More costly.
- Larger down time possibility due to maintenance.



# Cloud Top Seeding

## Advantages / Benefits

- Good visual cues.
- At the right seeding temperature.
- Can view seeding effects.
- Faster nucleation.
- In-cloud sampling of updraft and liquid water.

## Disadvantages

- No information on cloud base appearance.
- Top may be embedded.
- Can't do at night.
- May be too turbulent .
- Seeding agent dispersal not as good.

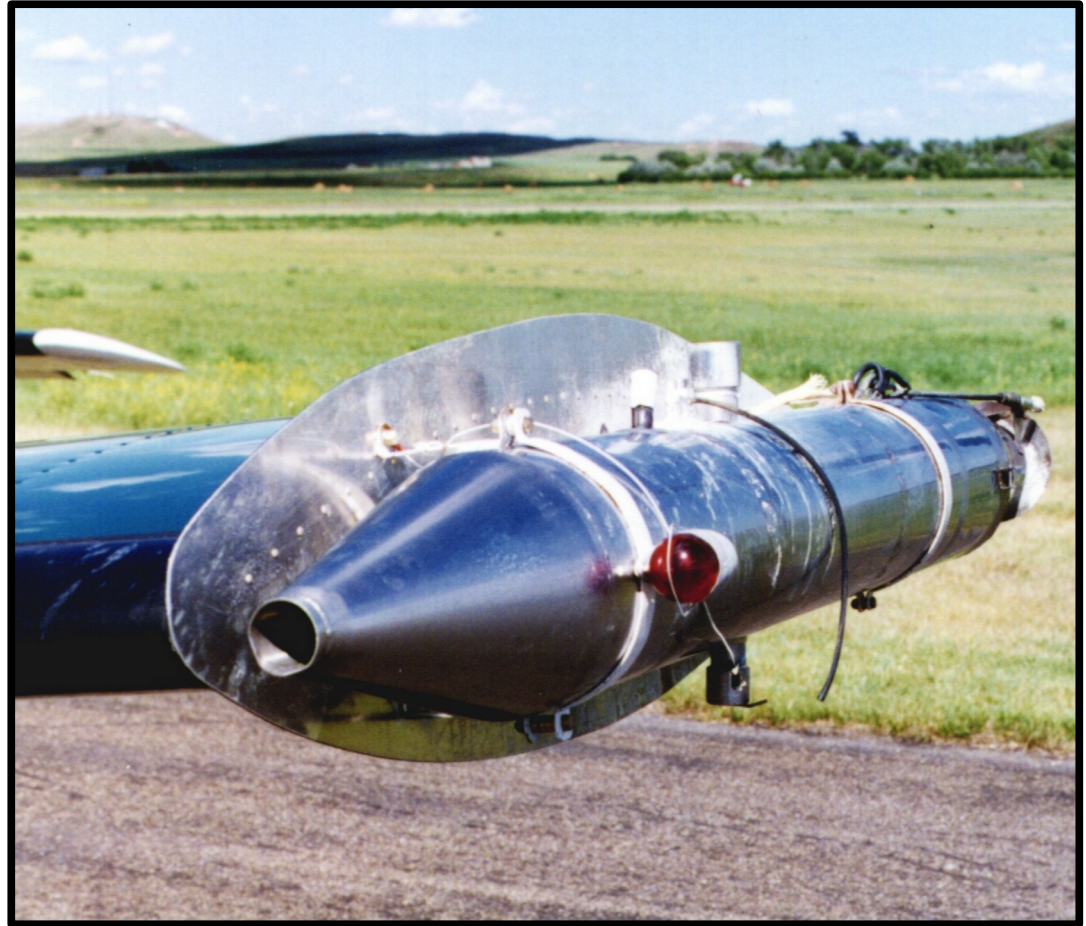
# Types of Cloud Seeding Tools

- Wingtip Generators
- Pyrotechnic Devices (Flare Racks)
- Chemical Devices (Dry Ice)



# Lohse Cloud Seeding Generator

- Use ram air pressure for combustion.
- 8 gallons total capacity, 7 usable.
- Variable flow rate that can be set upto 3.2 gph.
- Used on base seeders in North Dakota.





# Carley Cloud Seeding Generator

- Uses pressurized air for solution flow.
- Used when ram air pressure would be too high or too low for Lohse generators.
- Must be charged on the ground.
- 6 gallon capacity.
- Variable flow rate, up to 2.5 gph.



# Perchlorates Chemical Information

- Chemicals in the seeding mixture are strong oxidizers, meaning they can pose a fire hazard.
- Contact with the materials should be avoided at all costs.



# Pyrotechnica Devices Information

- Always wear rubber gloves. Clothing that comes in contact with the chemical should be thoroughly washed.
- Wear protective goggles.
- Store perchlorates in closed containers. Do not drop, skid, or slide containers.
- Do not smoke when handling the chemicals.
- Work with acetone in a well ventilated area.

# Pyrotechnica Devices Information

- Typically use silver iodide (AgI).
- 2 kinds of flare racks used:
  - Burn in place
  - Ejectable
- Flares may also contain hygroscopic material (salt).



# Burn in Place (BIP) Information

- Attaches to the back of the wing
- Holds twelve 82 gram AgI flares
- Burn for just over 2 min.





# Ejectable Flare Rack Information

- Attached to the belly of top-seeder aircraft.
- Hold 20 gram AgI flares.
- Flares are ignited and then dropped.
- The flares should never be dropped below 15,000 ft AGL.



# Storage and Handling of Flares

- Always store flares in the sealed storage containers provided.
- Must be stored in a dry area.
- Should be treated as an explosive object.
- If dropped, inspect for damage. If there is damage, return it.
- If one accidentally ignites, remove other flammable objects from nearby.



# Usage of Dry Ice for Cloud Seeding

- Has been used since 1940s.
- Carried in 150 lb. hopper in top-seeders.
- Dry Ice lowers the temperature of the surrounding air to  $-104^{\circ}\text{F}$ .
  - This is cold enough to create ice crystals without ice nuclei.
- As it falls, it promotes the cold rain process.



# Dry Ice Storage and Handling

- Lids on storage boxes should be kept tightly sealed, except when needed to get more dry ice.
- Should sift pellets through 1/4" hardware cloth to remove any water ice before loading into hoppers.
- Have sifted dry ice ready, only load hopper immediately before launch.
- Avoid contact with bare skin.

# Reaction Times of Seeding Agents

