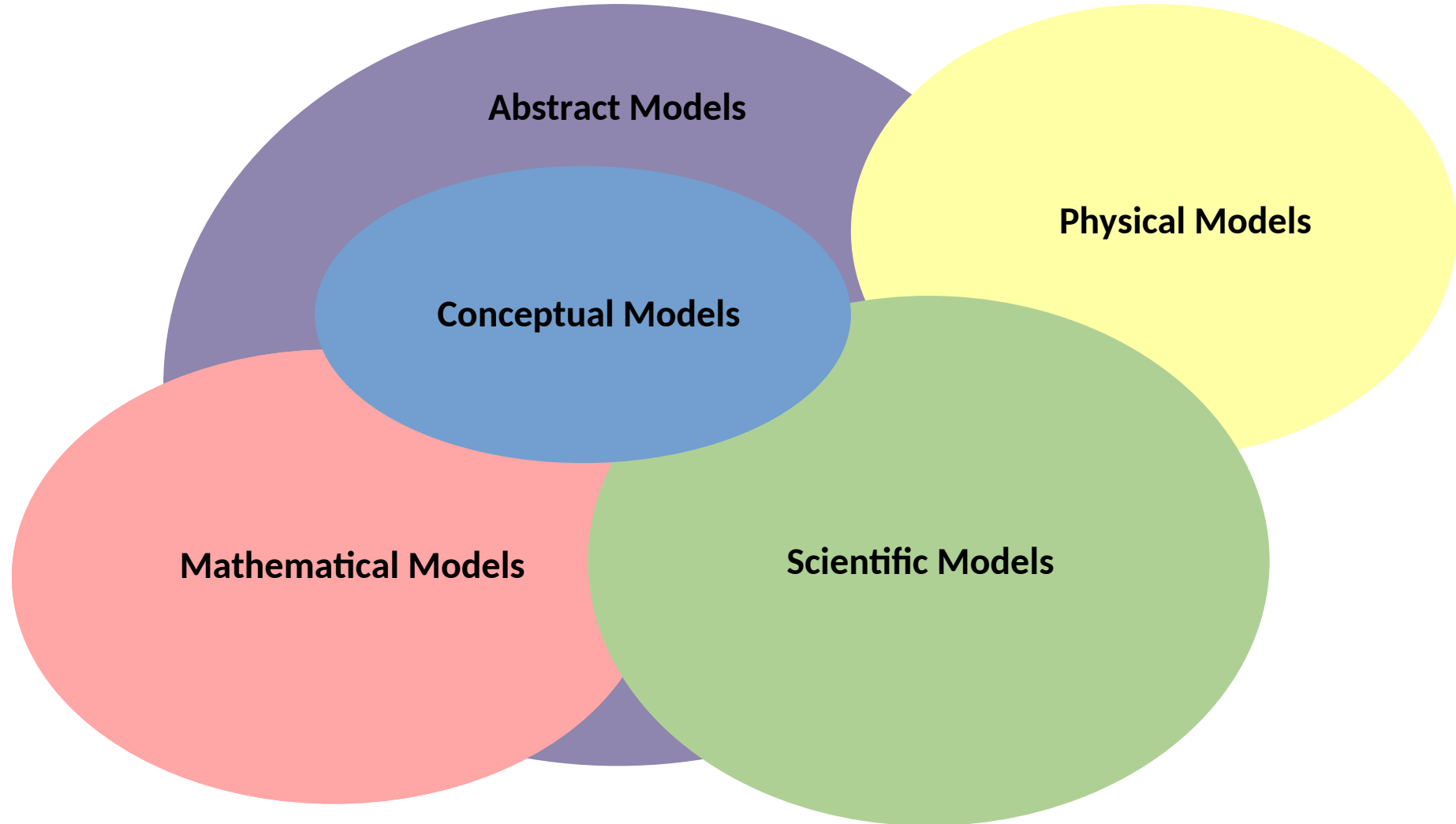


# Conceptual Models



# Conceptual Models: Simplify Complexity

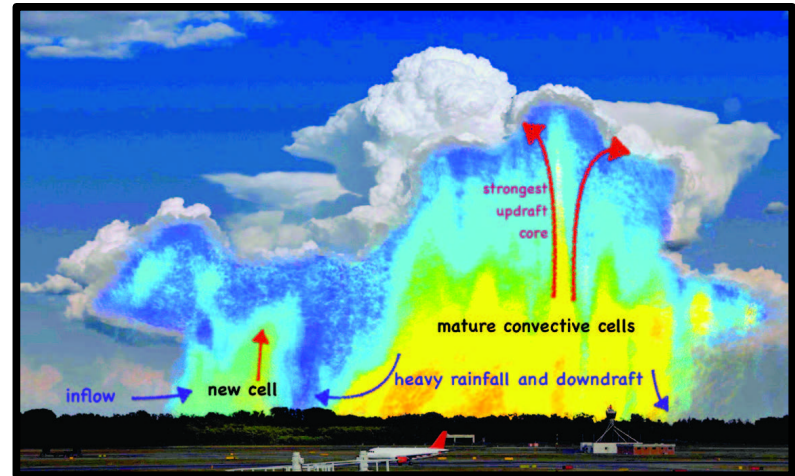
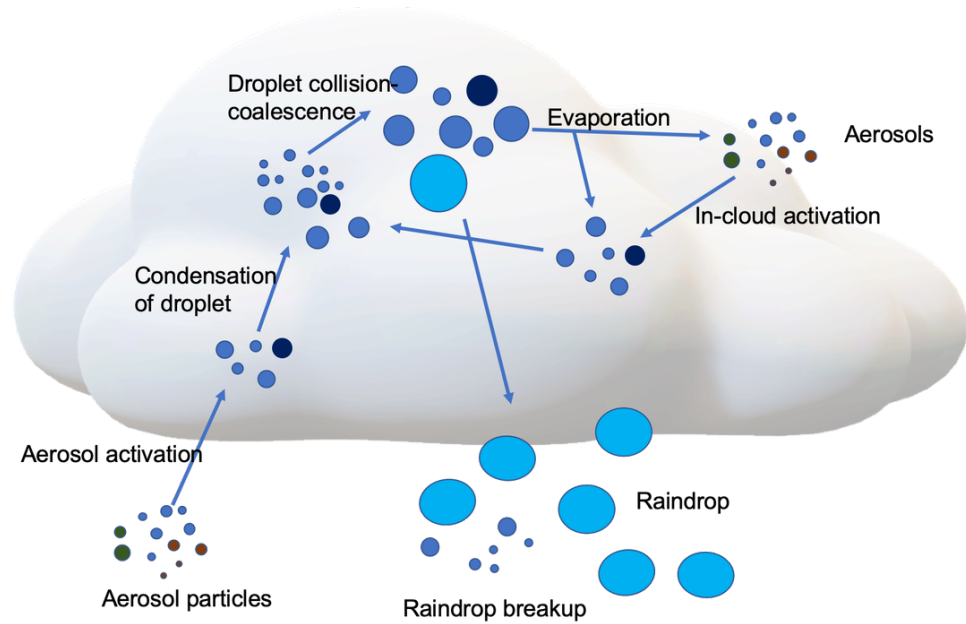
- A model is a visualization of the important aspects of the entity with which you are dealing.
- Generally, it is an attempt to simplify something that is relatively complex.
- It needs to contain the most important aspects of that entity.
- It may be a precursor to a more sophisticated numerical model.

# Weather Modification Models

- The conceptual model should address the important aspects of what a weather modification effort might be.
  - Seeding with a glaciogenic seeding agent, - something that will cause ice to form in the cloud
  - Seeding with a hygroscopic seeding agent – something that will generate cloud droplets
- What would be the effect of the seeding?

# Cloud Seeding Effects

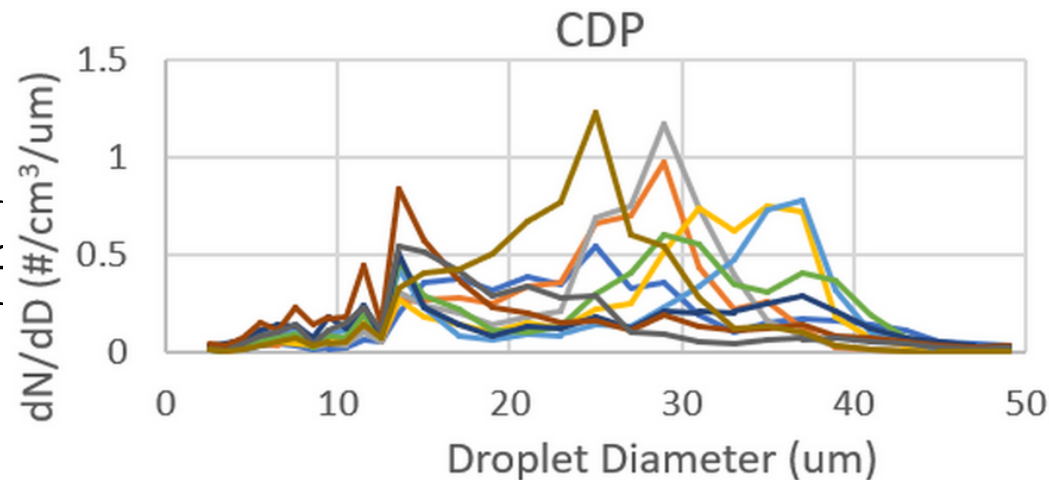
- Conceptual models for seeding are often broken down into two seeding effects:
  - Micro-physical Effects
  - Dynamic Effects



# Micro-physical Effects

- Those effects that change the microphysical characteristics of the clouds, such as drop size distributions or the amount of ice or water in the cloud.

- These effects are generally aimed at the **efficiency** of the precipitation process.



# Intended: Micro-physical Effects

- Rain and snow earlier in cloud lifetime.
- Rain and snow for longer time.
- Convert more cloud water to precipitation.



# Dynamic Effects

- Dynamic seeding effects are those that affect the **growth or longevity** of the updrafts of the clouds.
- Dynamic effects are generally aimed at changing the manner in which the cloud grows rather than trying to affect the efficiency of the micro-physical processes.

# Intended - Dynamic Effects

- Increased updraft speed
- Increased updraft diameter
- Larger cloud
- Process more water
- Last longer



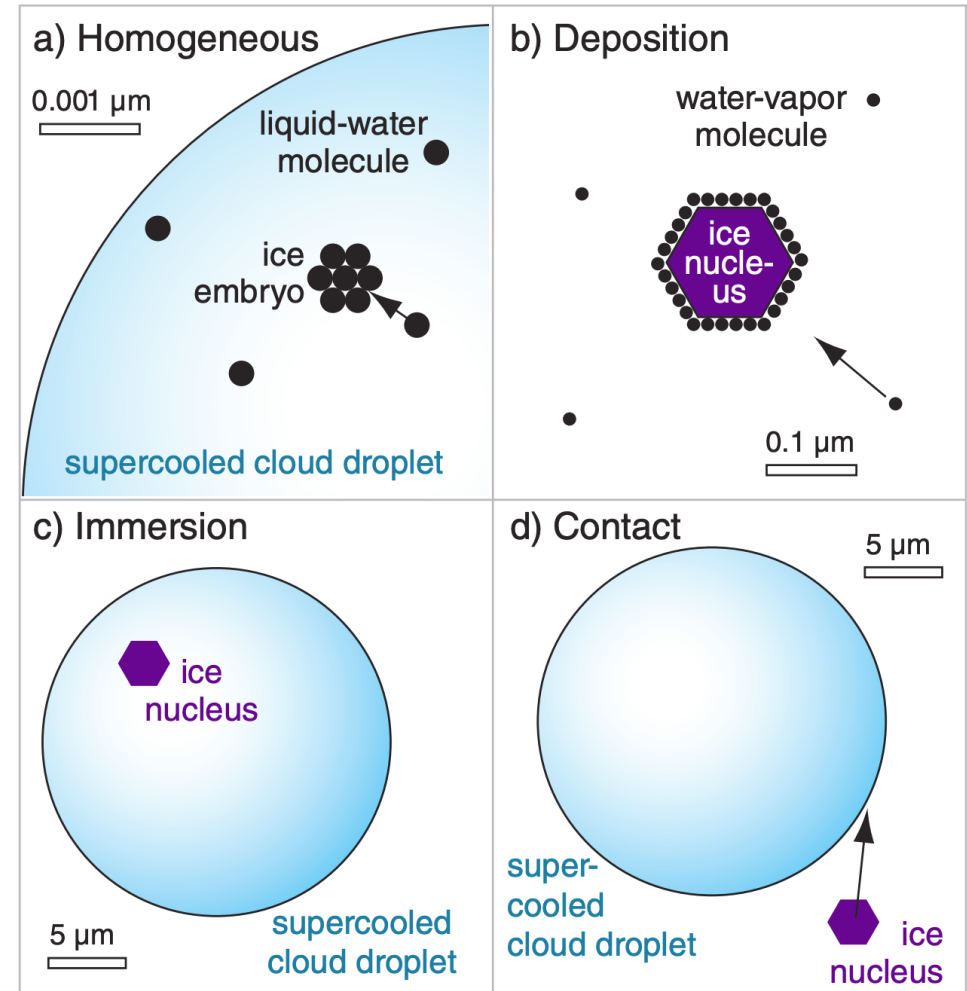


# Micro-physical and Dynamic Seeding

- It is typically very difficult to seed for one effect without affecting the other. For example,
  - Seeding to enhance the Bergeron-Findeisen mechanism (micro-physical effect) by adding ice nuclei to the cloud will cause some ice crystals to form. This will release latent heat of fusion, giving the cloud additional buoyancy (dynamic effect).

# Conceptual Models of Cloud Seeding

- There is an underlying assumption for most cloud seeding of a lack of some sort of nuclei for a desired effect, which in many cases is a lack of effective ice nuclei.



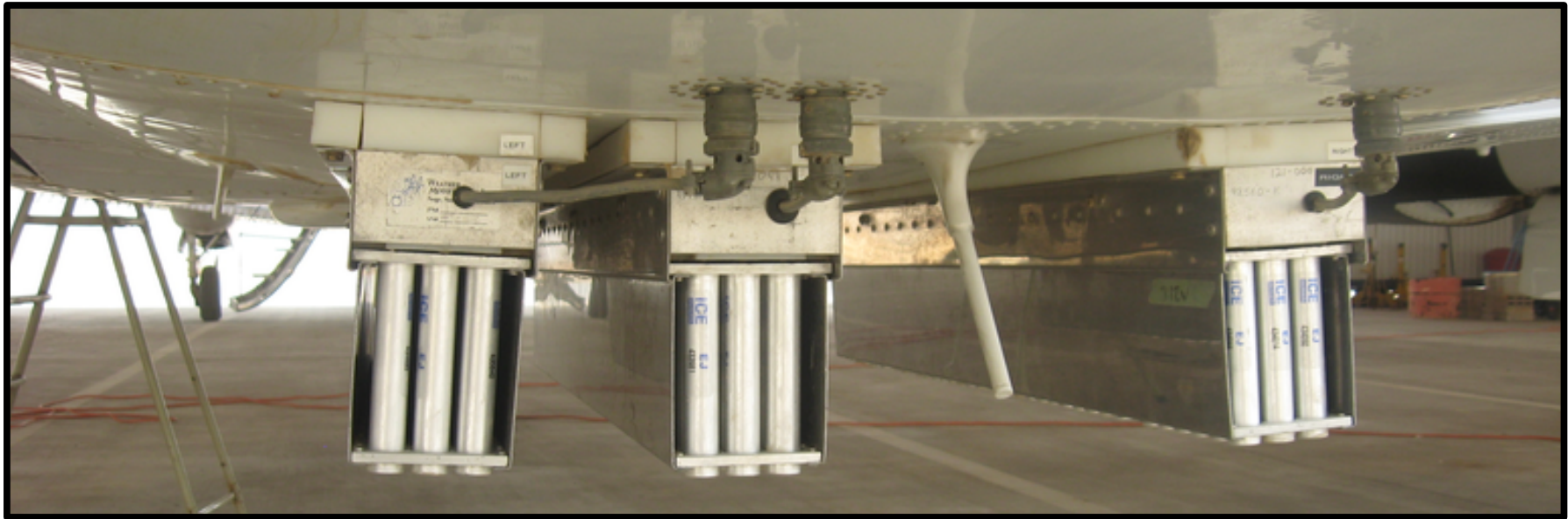
# Precipitation Augmentation (micro-physical)

- This is done by introducing a relatively small number of nuclei into the cloud to enhance or speed up the precipitation particle growth process.
- Two methods:
  - Glaciogenic Seeding  
(most common)
  - Hygroscopic Seeding



# Glaciogenic Seeding

- Ice nuclei or some sort of cold substance (such as dry ice) is introduced into the cloud to promote the cold rain process or to give dynamic effects.
- This classical seeding technique dates to 1946.



# Hygroscopic Seeding

- Addresses the fact that warm clouds can produce precipitation if there are giant Hygroscopic nuclei available. The inherent assumption is that there is a lack of such nuclei in the atmosphere.
- This is becoming more common.

