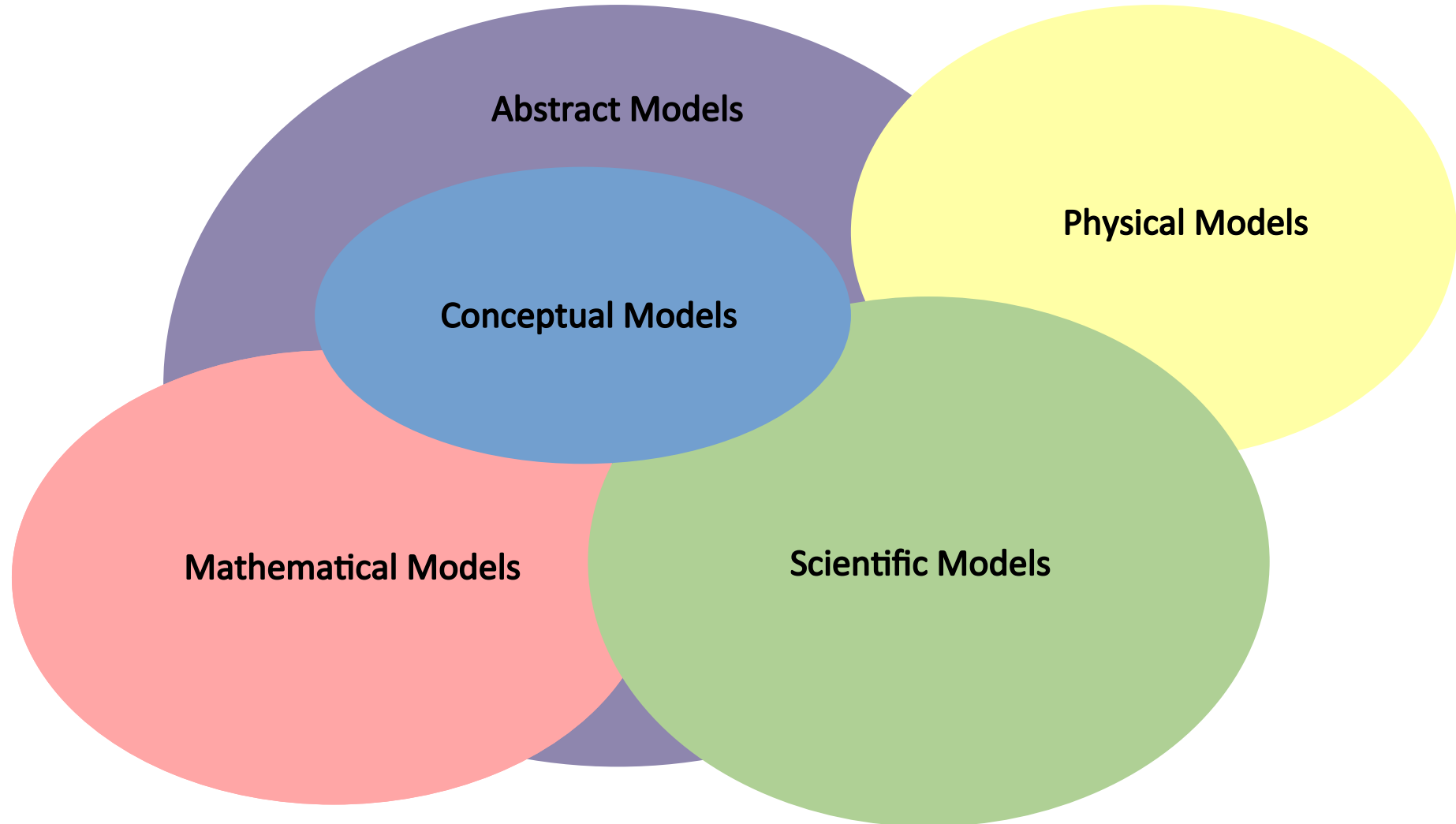


Conceptual Models



Conceptual Models: Simplify Complexity

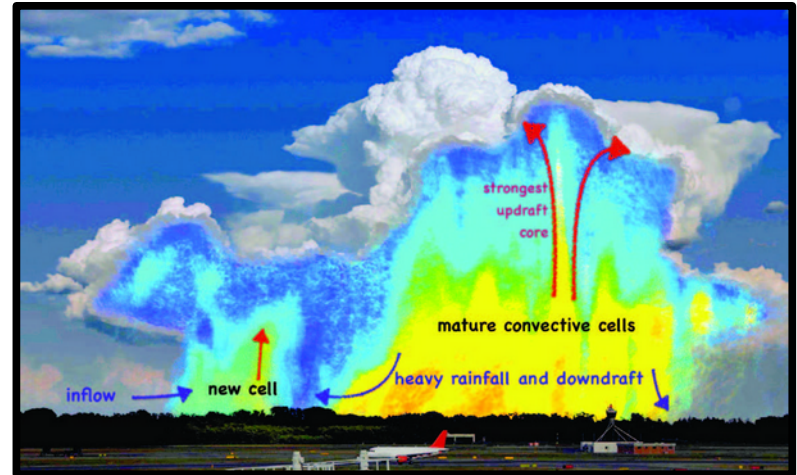
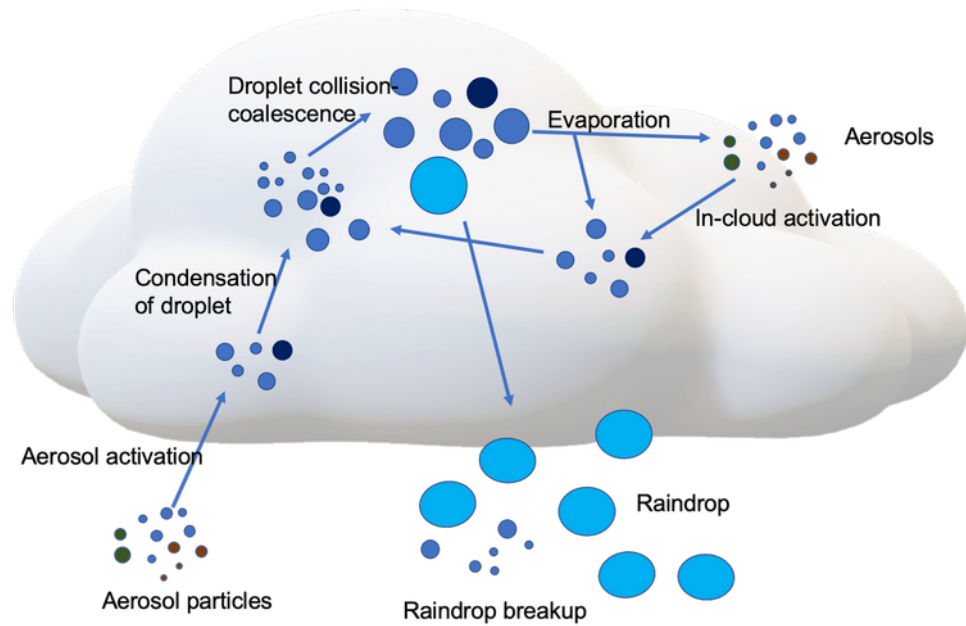
- A model is a visualization of the important aspects of the entity with which you are dealing.
- Generally, it is an attempt to simplify something that is relatively complex.
- It needs to contain the most important aspects of that entity.
- It may be a precursor to a more sophisticated numerical model.

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?

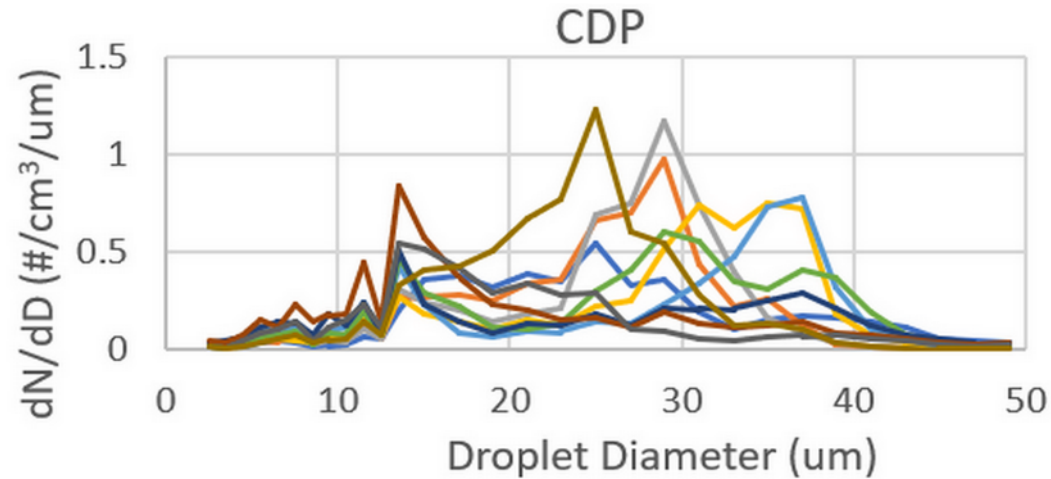
Cloud Seeding Effects

- 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

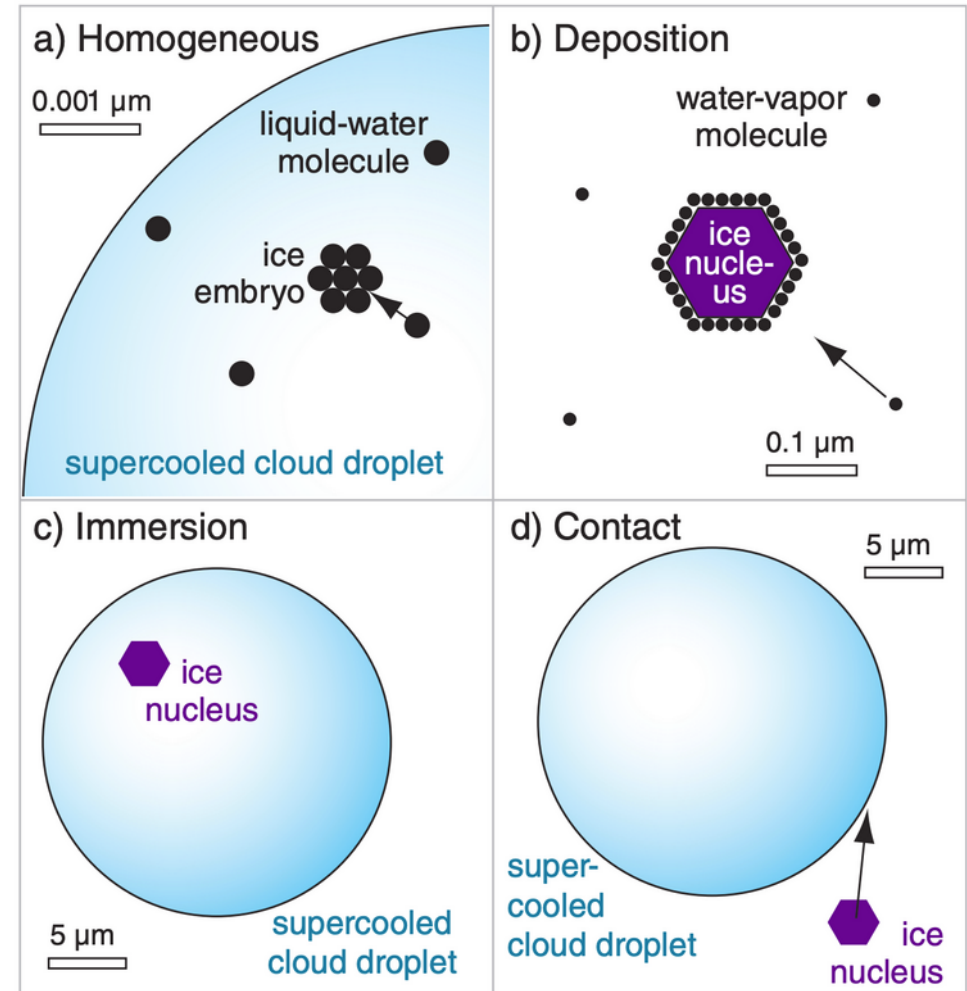


Micro-physical and Dynamic Seeding

- 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.



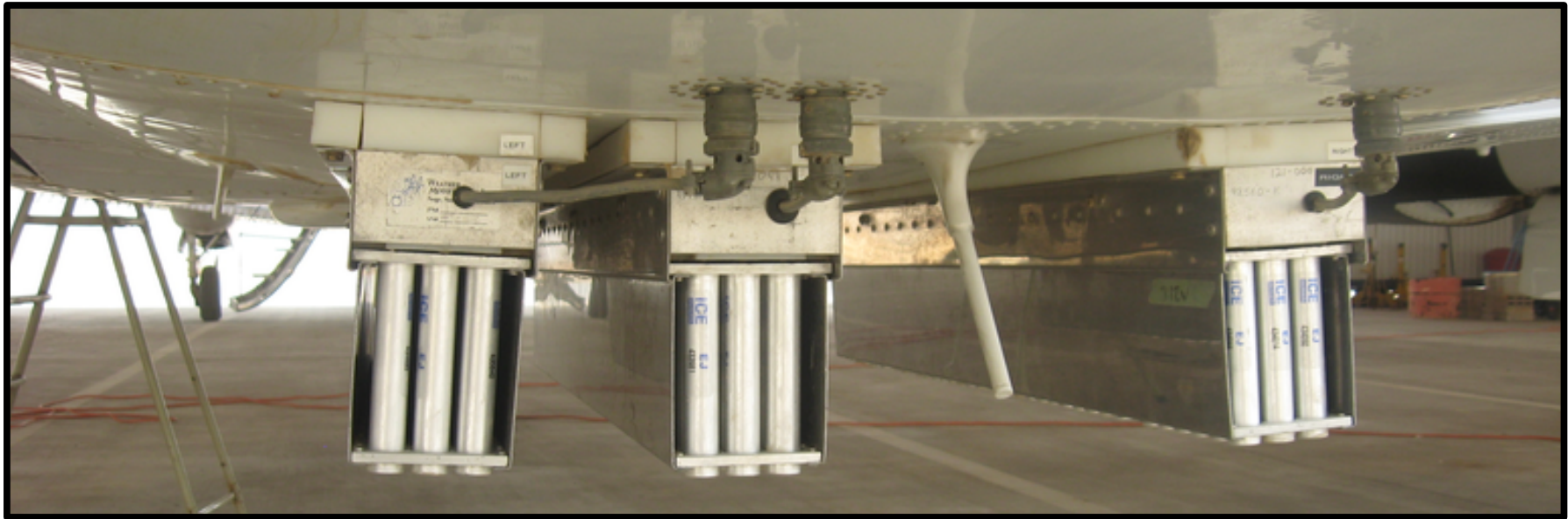
Precipitation Augmentation (micro-physical)

- 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.

