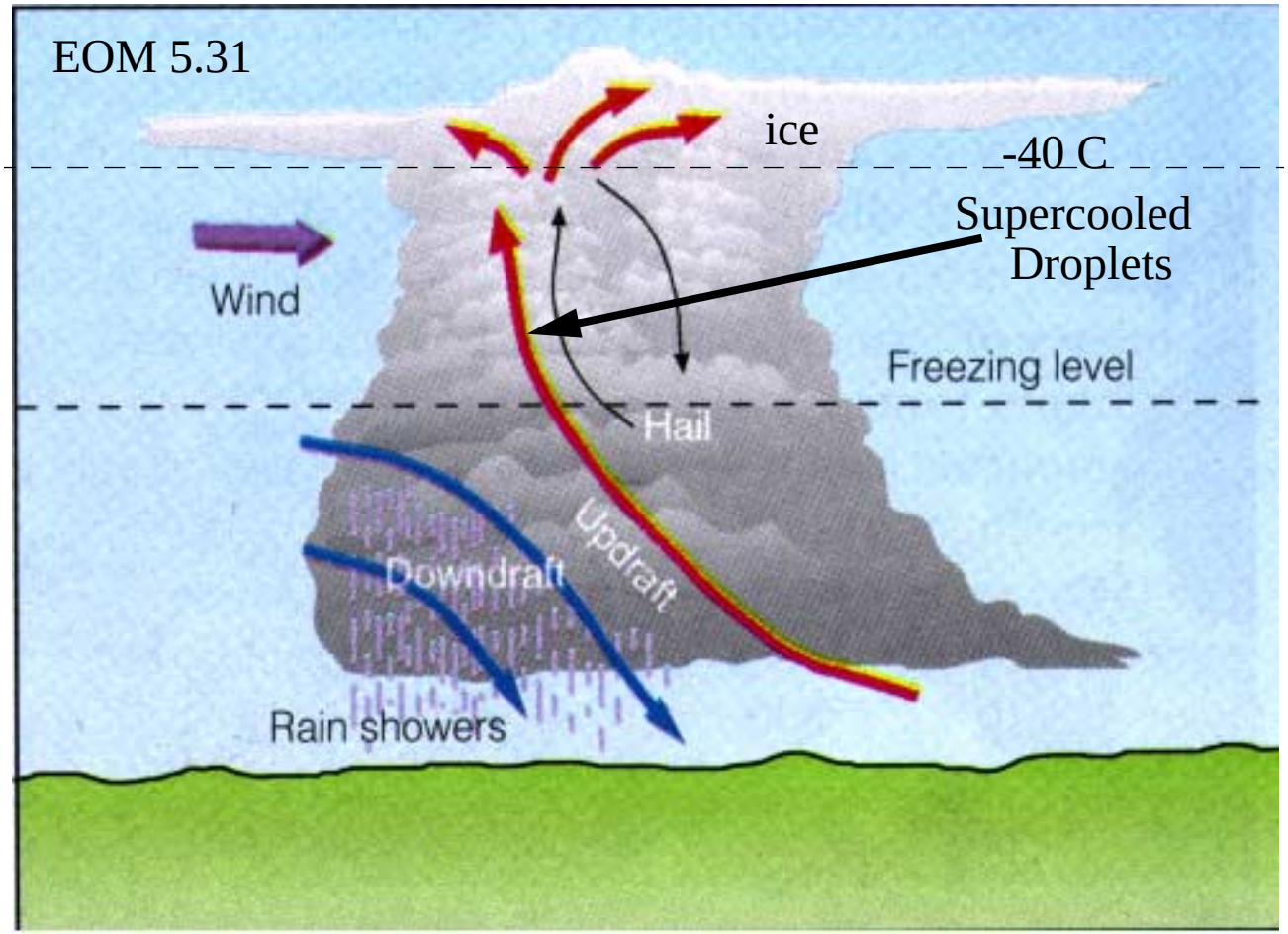
Lecture 22 Other types of precipitation

Graupel and hail

In vigorous updrafts with abundant supercooled water droplets, larger, faster-falling crystals *accrete* droplets to their crystal structure to form *graupel*. The same process can produce hail in cumulonimbi with strong updrafts which can suspend larger particles.



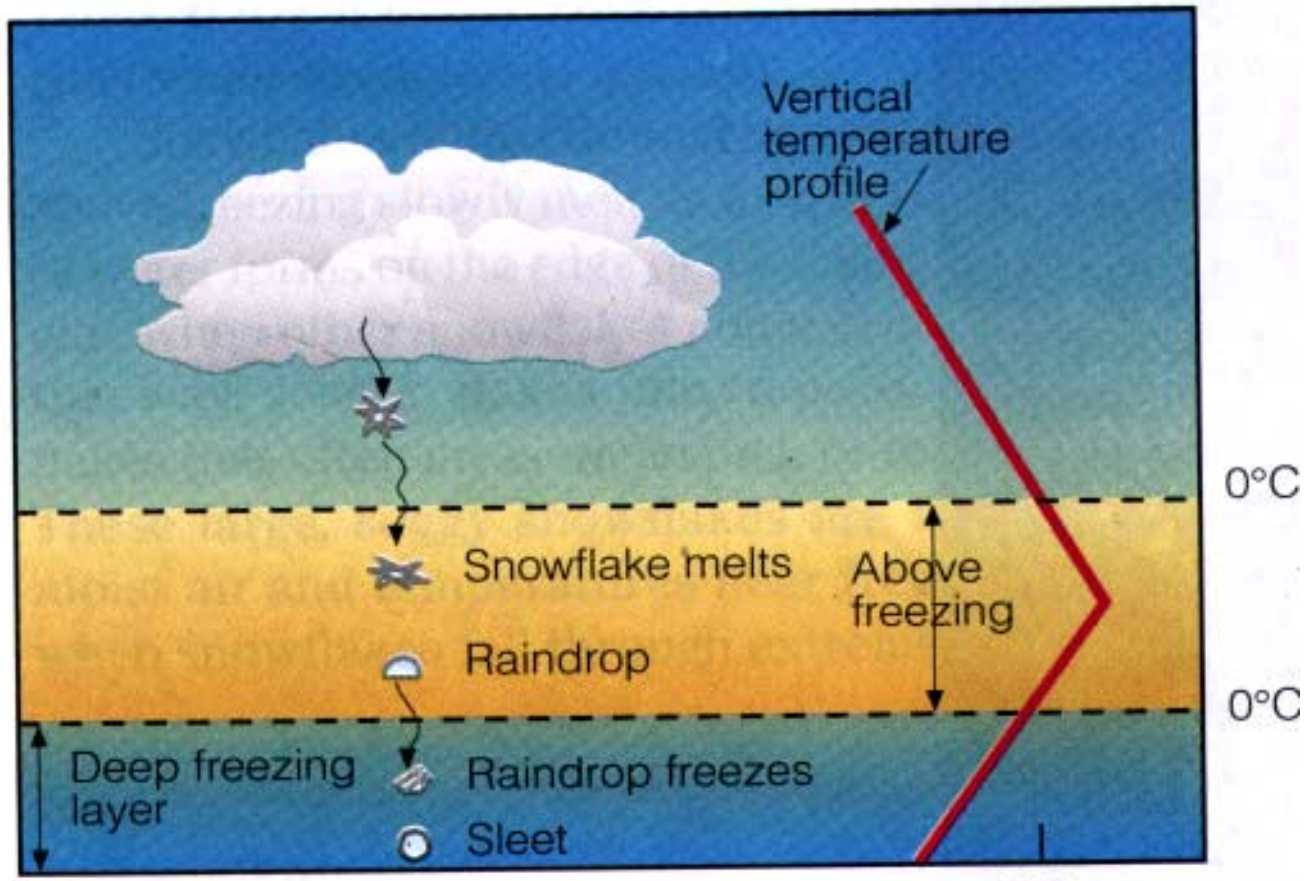
A Coffeyville, KS hailstone of 1970 weighed 1.5 lbs and was 5.5 inches in diameter!

Special types of precipitation

Drizzle - droplets less than 0.5 mm diameter.
Virga -evaporating streaks of rain.
Fall streaks - evaporating streaks of ice (mares tails).
Sleet
- mixed snow/rain (UK)
- refrozen partly melted snow or rain (US)

Freezing rain - rain freezing on contact with ground.

Deeper (500 m or more) freezing layer under melting layer ⇒ sleet.
Shallow freezing layer ⇒ freezing rain.



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Aircraft Icing

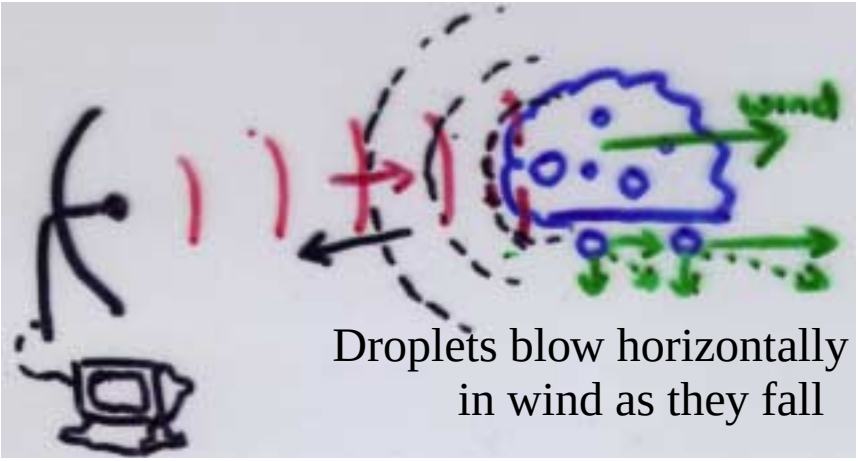
Supercooled raindrops and cloud drops freeze on contact with a plane, and can cause rapid icing.

Cloud Seeding

- Attempts to bring rain or suppress hail are age-old.
- Modern efforts (mainly in the 1970's) attempt to add artificial ice nucleii (e. g. silver iodide) to clouds to increase precipitation efficiency. Widely used, and does glaciate the clouds, but overall impact is inconclusive.
- Silver iodide can be used to clear shallow fog at airports in subfreezing temperatures. Other smoke (e. g. from gasoline) also works but results in air pollution.

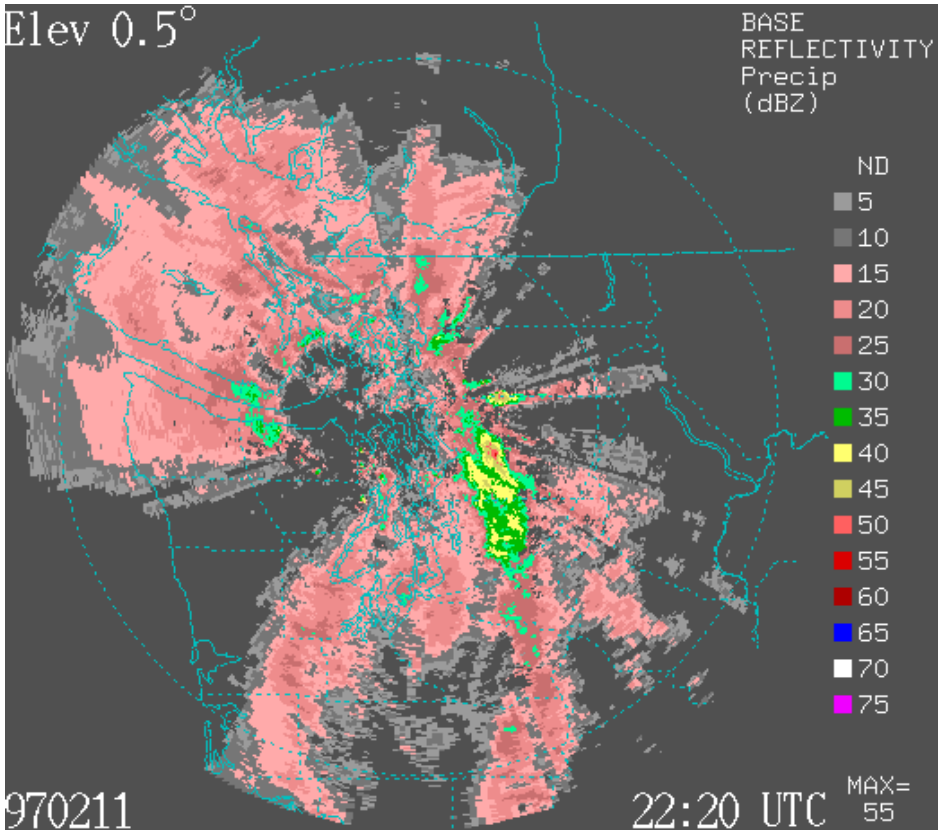
Weather Radar

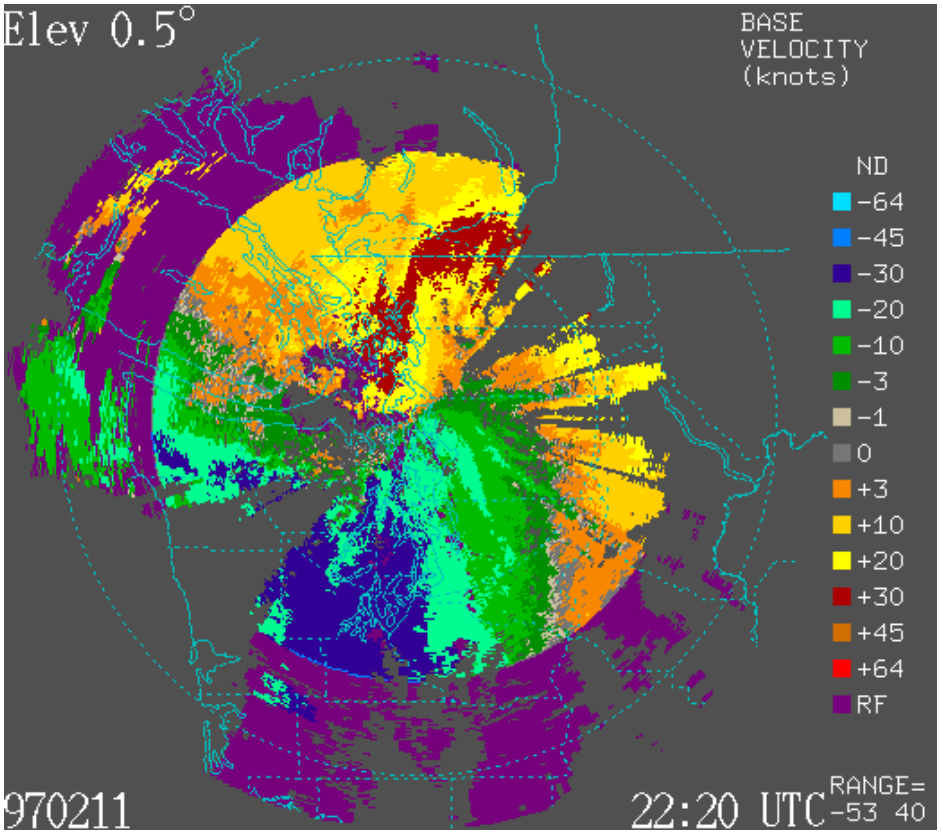
Radar sends pulse of EM radiation of 5 cm wavelength.



- Pulse reflects off droplets, dust, insects, etc. Mainly sees rain (or hail or snow); droplets a tenth as large only reflect a millionth as much.
- Reflections from further away take longer to come back.
- Doppler radars also measure speed of the raindrops toward or away from the radar, which is mainly due to wind.
- Polarized Doppler radars can also detect whether the reflectors are flattened (raindrops) or spherical (hail or snow).
- 160 Natl. Weather Service NEXRAD Doppler radars with 200 km+ range give nationwide coverage. Camano Island radar is closest to Seattle.

Camano Island Examples



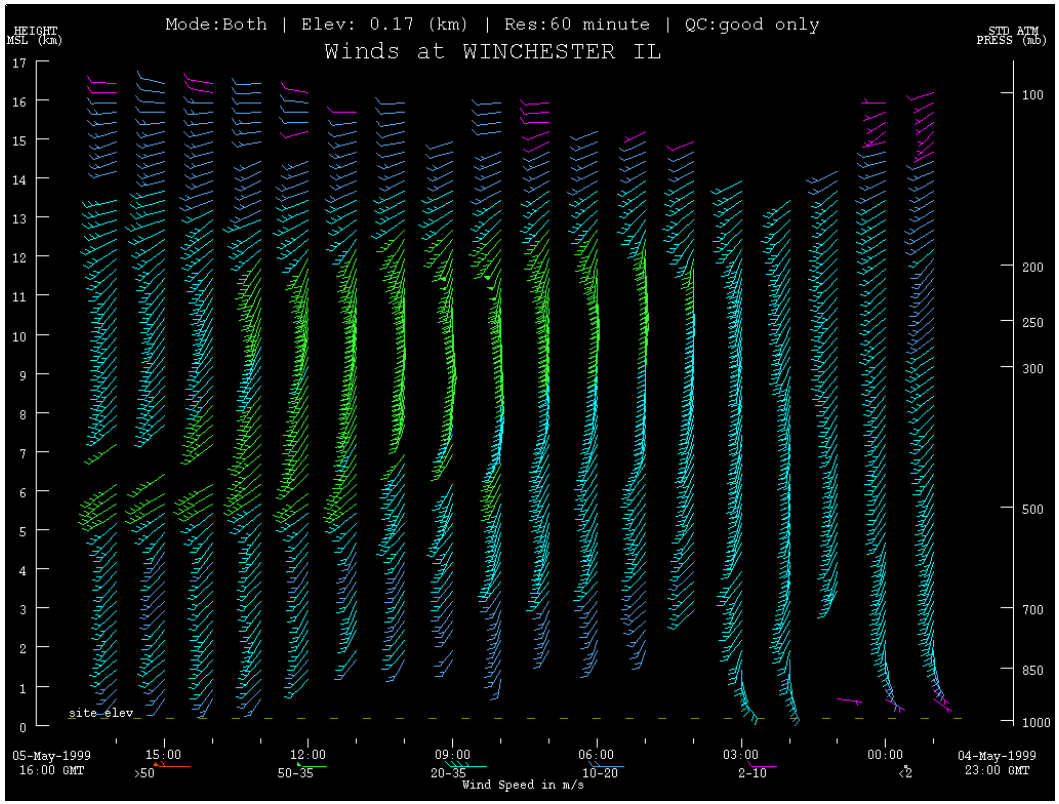


Radar beam is 1.5 km above ground 50 nm (92 km) away, 4.3 km at 100 nm.
Note higher reflectivities (heavier rain) over Cascades
Wind is toward radar at 30+ kts from S at surface, from SW at 1 km.

Use of radar for wind profiling

Precipitation radars can determine the profile of wind with height when there is enough cloud, precipitation, or other scatterers (e.g. dust and insects).

However, to obtain reliable wind profiles throughout the troposphere (to supplement radiosondes), NOAA has deployed an experimental network of **profilers**, sensitive longer wavelength (60 cm) Doppler radars, whose beam also scatters off of inhomogeneities in the moisture and temperature of the air itself. A profiler does not scan, but instead has several fixed beams pointed upward in different directions to measure the wind components in these directions.



Example of profiler data