

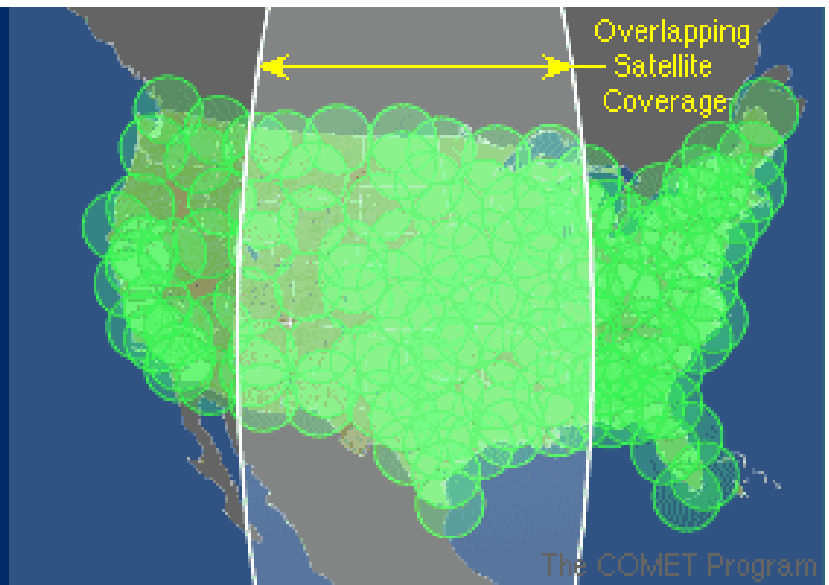
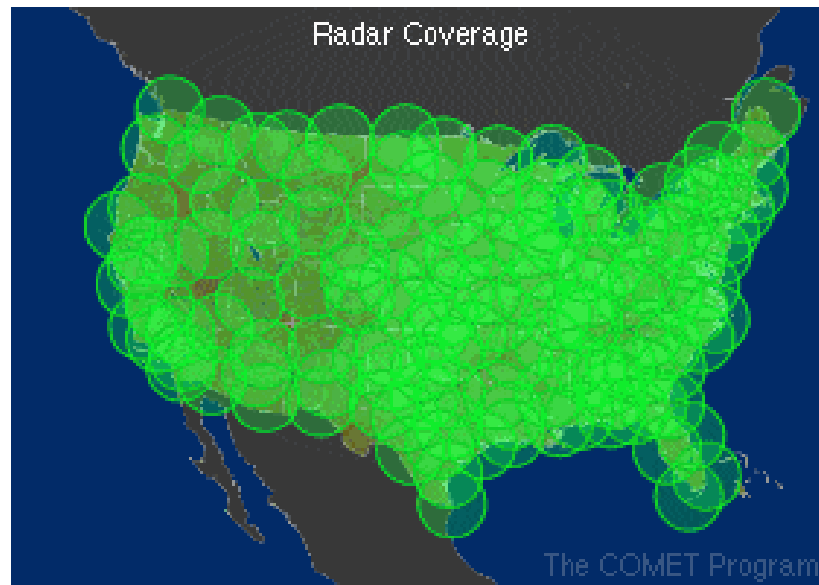
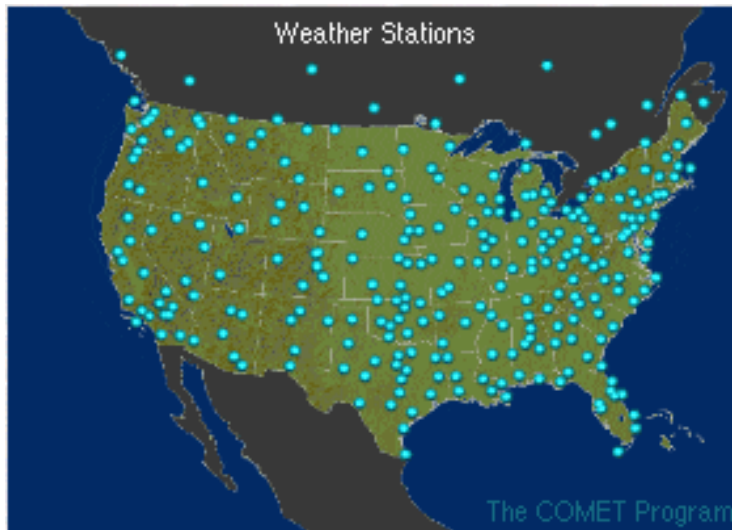
Meteorology 3110

Remote Sensing

What is it?

- Measurement using devices not in direct contact with the object they sense.
 - Remote sensing involves observing objects indirectly either actively or passively.
- In-Situ measurements: Devices in contact with the medium they are sensing.
- Anemometer, Satellite, camera, radar, thermometer, windsock, hand in boiling water, lidar, metal detector, x-ray
- In-Situ measurements: measure atmospheric conditions at discrete locations/points and time.
 - Gaps in the observation network.

Types of Sensing



Satellite Observations

- Geostationary : Remains stationary over a specific point on the earth
 - GOES (Geostationary Operational Environmental Satellite)
 - Cover a region of interest defined by the owner.
 - Elevation ~ 22,000 miles above sea level.
 - Less detail than POES, but provides many more images.
- Polar-Orbiting or Low-Earth Orbiting : Track from pole to pole.
 - Do not cover the same area.
 - Cover small strips. Each pass sees an area to the west of previous pass.
 - Sun synchronous: path does not change with respect to sun relative coordinate system.
 - Elevation ~ 600 miles (complete rotation about every 1.5 hours).
 - Passes any point on earth twice a day.
 - NOAA uses two of these so no image is over six hours old.
 - Great detail, but only sample a given area a few times per day.

Visible Images

- Record visible light from the sun that is reflected from cloud, land, oceans, snow, or ice.
 - Albedo.
 - $\lambda = 0.52 - 0.72$ microns.
- Bright clouds indicate a lot of reflecting particles.
- High and low clouds look equally as bright and are often indistinguishable.

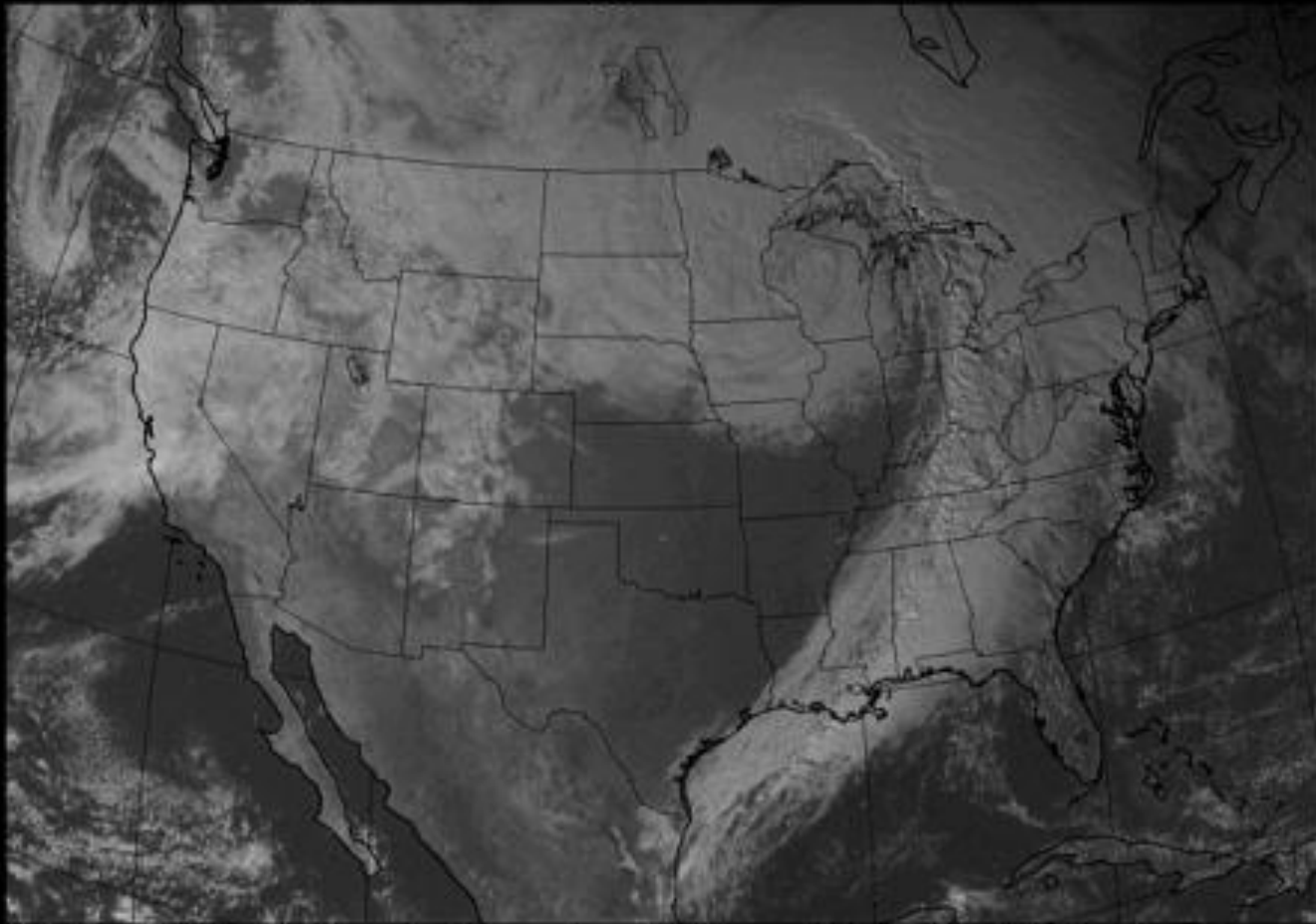
Visible Images - Albedos

- Thunderstorm – 80-90%
- Cumulus – 70%
- Stratus – 60%
- Thin stratus – 50%
- Cirrus – 40%
- Thin cirrus – 30%
- Smoke – 20%
- Blackbody – 0 %
- Fresh snow cover – 80%
- White Sands, NM – 60%
- Melting snow, salt flats - 50%
- Dry, sandy soil – 40%
- Clay, granite, glaciers – 30%
- Tundra, bare soil – 20%
- Oceans, lakes, forest – 10%

Visible Image

GOES-8/10 Composite Visible Image

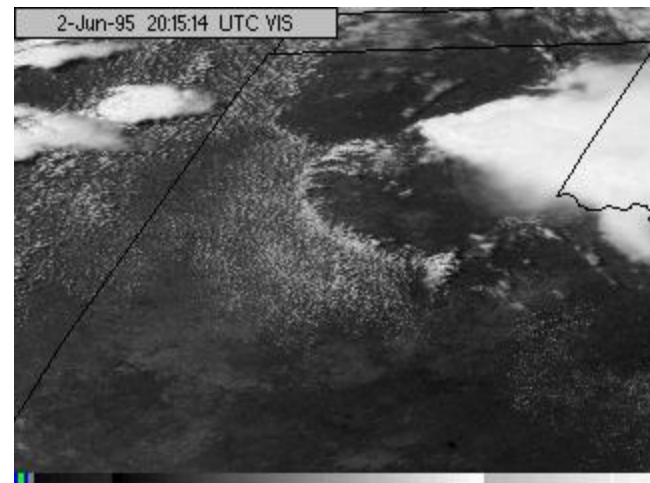
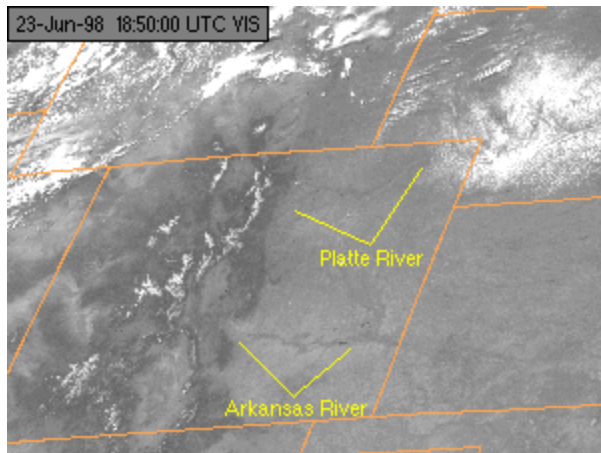
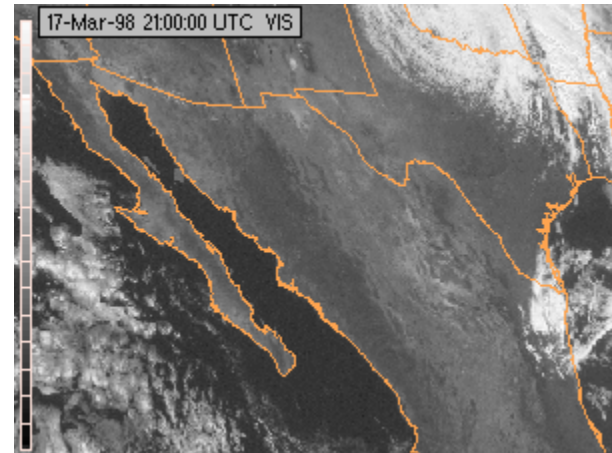
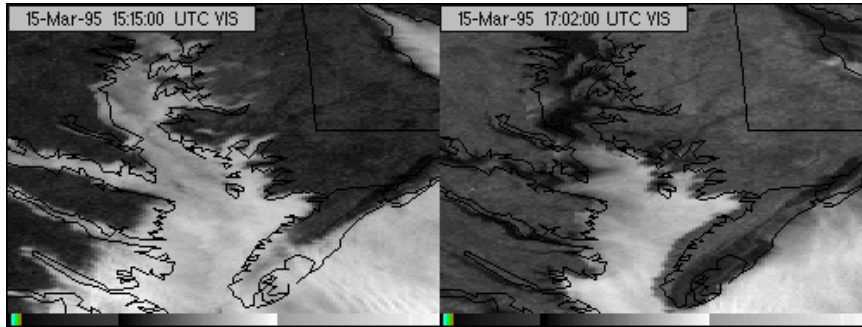
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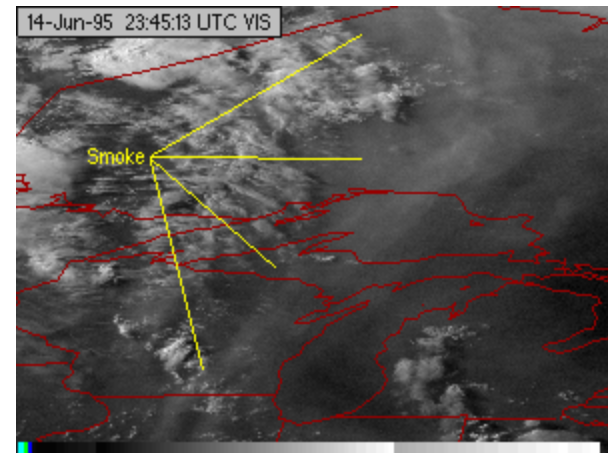
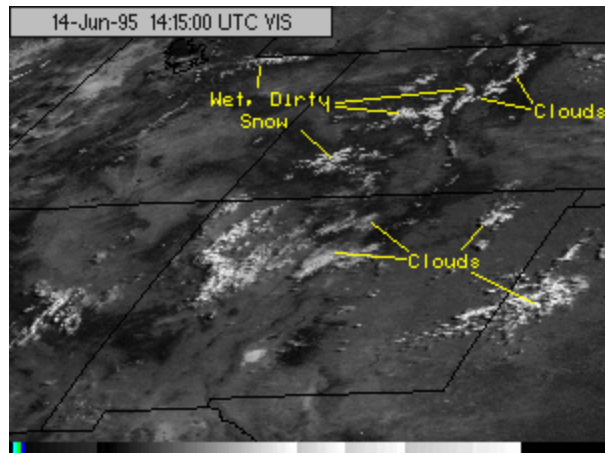
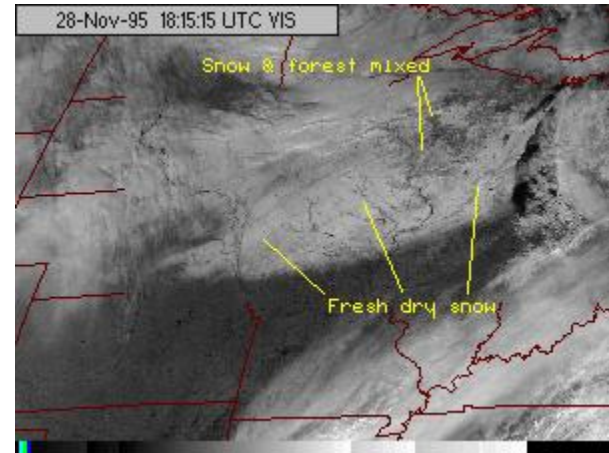
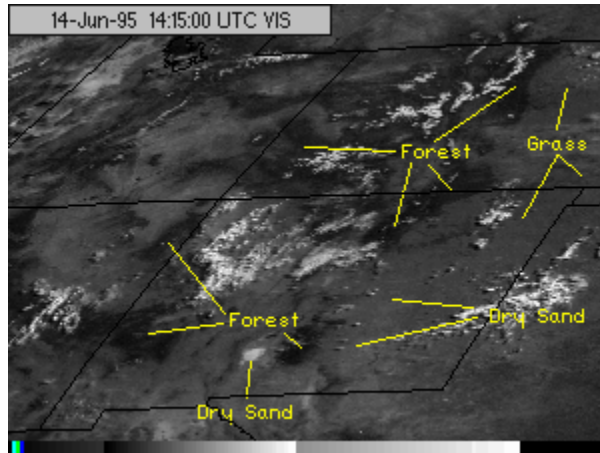
WW2010 (<http://ww2010.atmos.uiuc.edu/>)

Atmospheric Sciences, University of Illinois at Urbana-Champaign

Visible Imagery



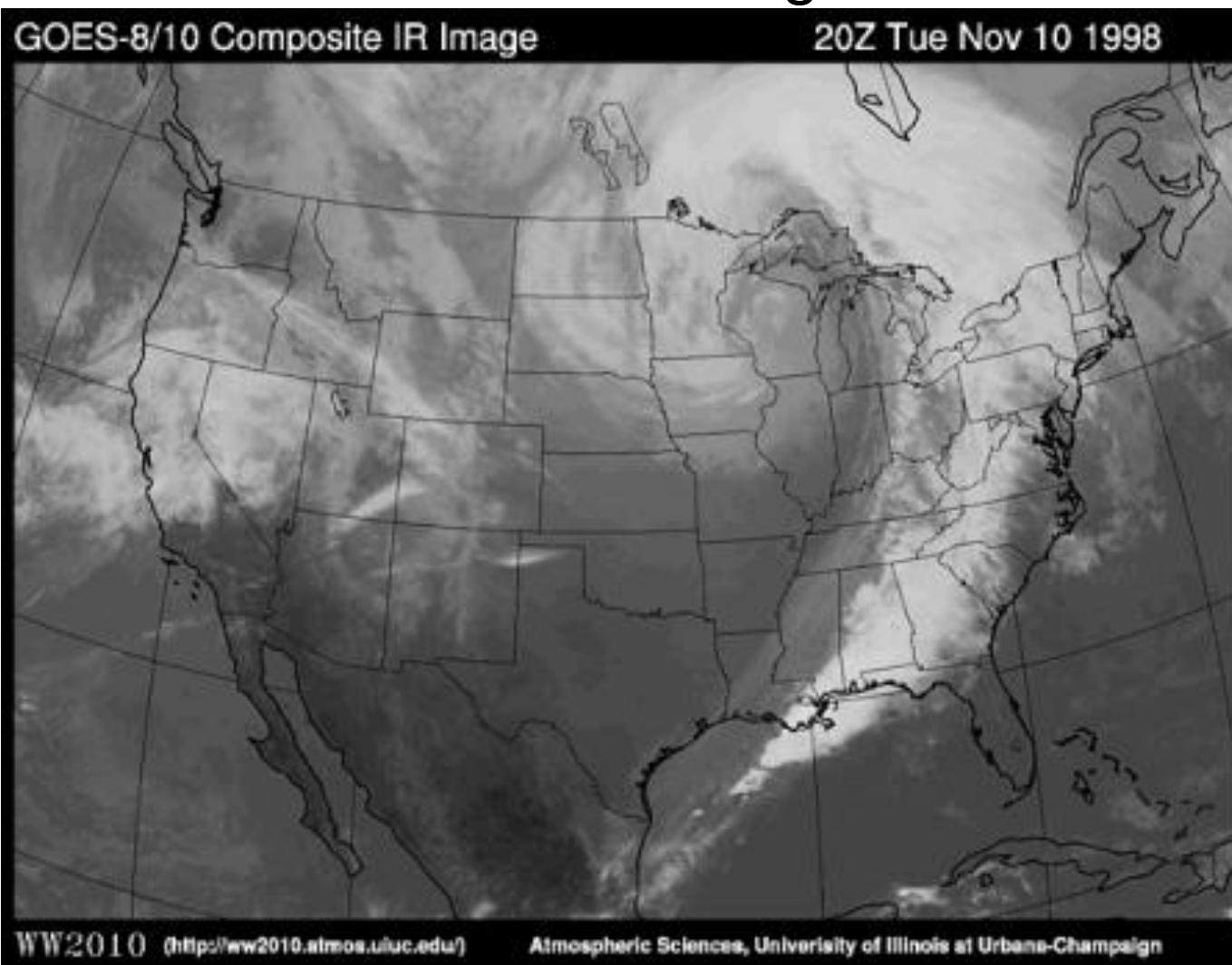
Visible Imagery



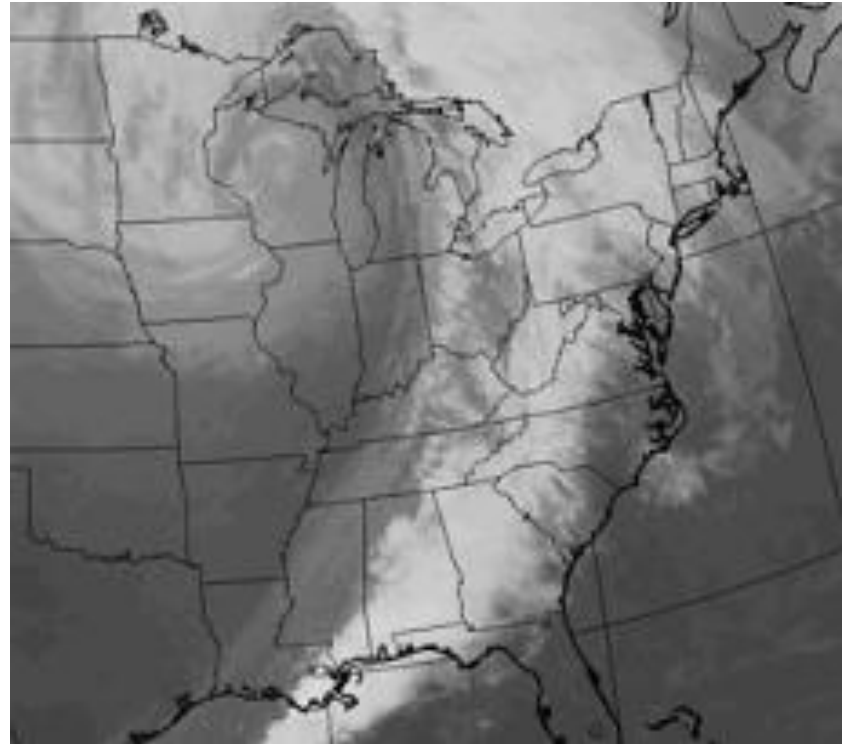
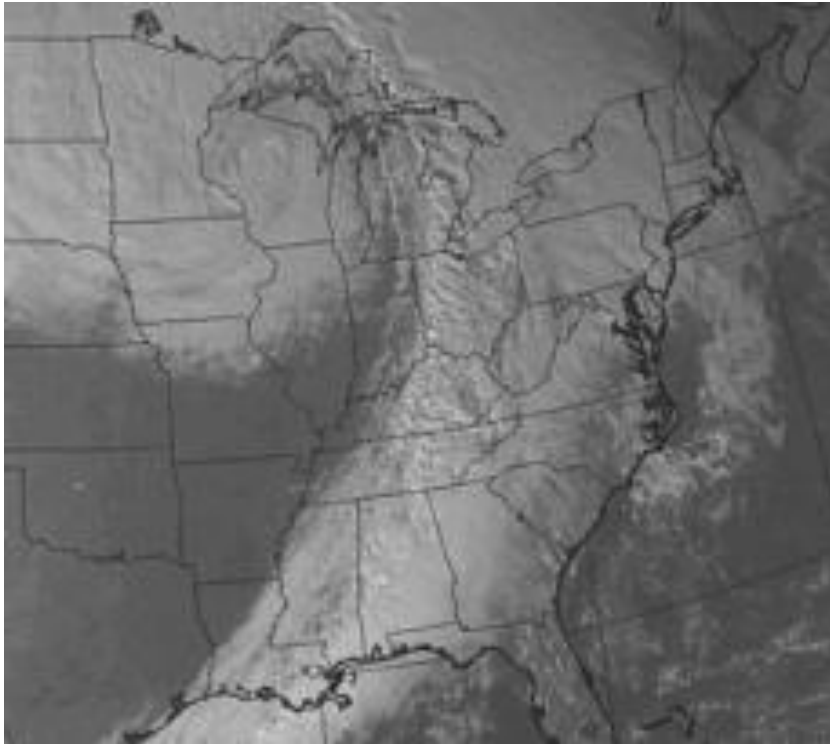
Infrared Images

- Record blackbody temperature of an object.
 - Amount of radiation $\sim T^4$.
 - Measures $\lambda = 10.2\text{-}11.2$ microns $= 10.2\text{-}11.2 \mu\text{m}$.
- Shows cloud top temperatures in cloudy regions, and, possibly, surface temperature in clear regions.
- Bright clouds are COLD clouds, which are usually high.
- Low clouds are hard to distinguish from the surface. Why?

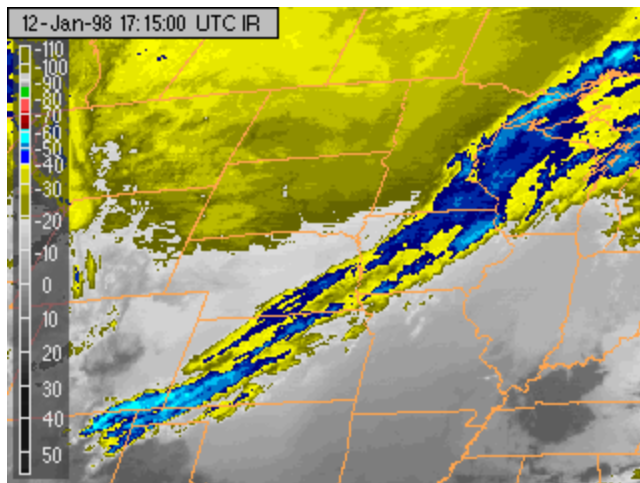
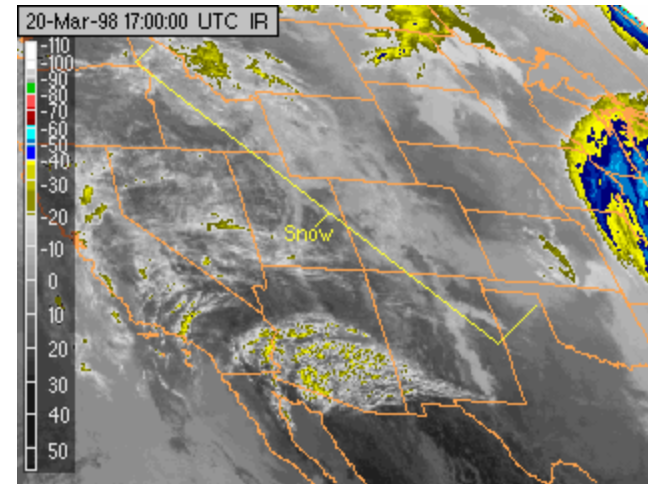
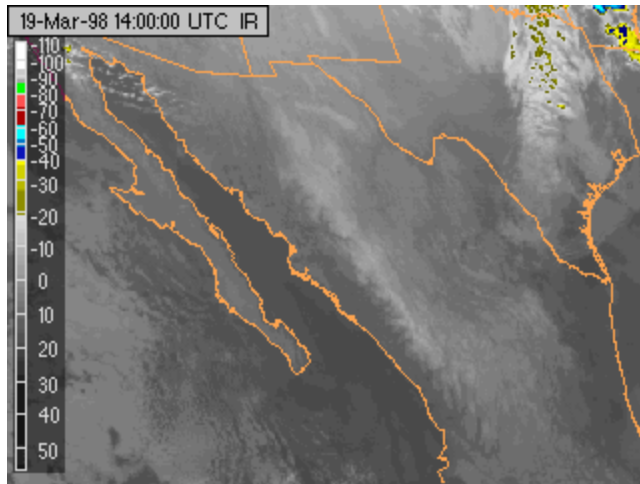
Infrared Images



Comparison



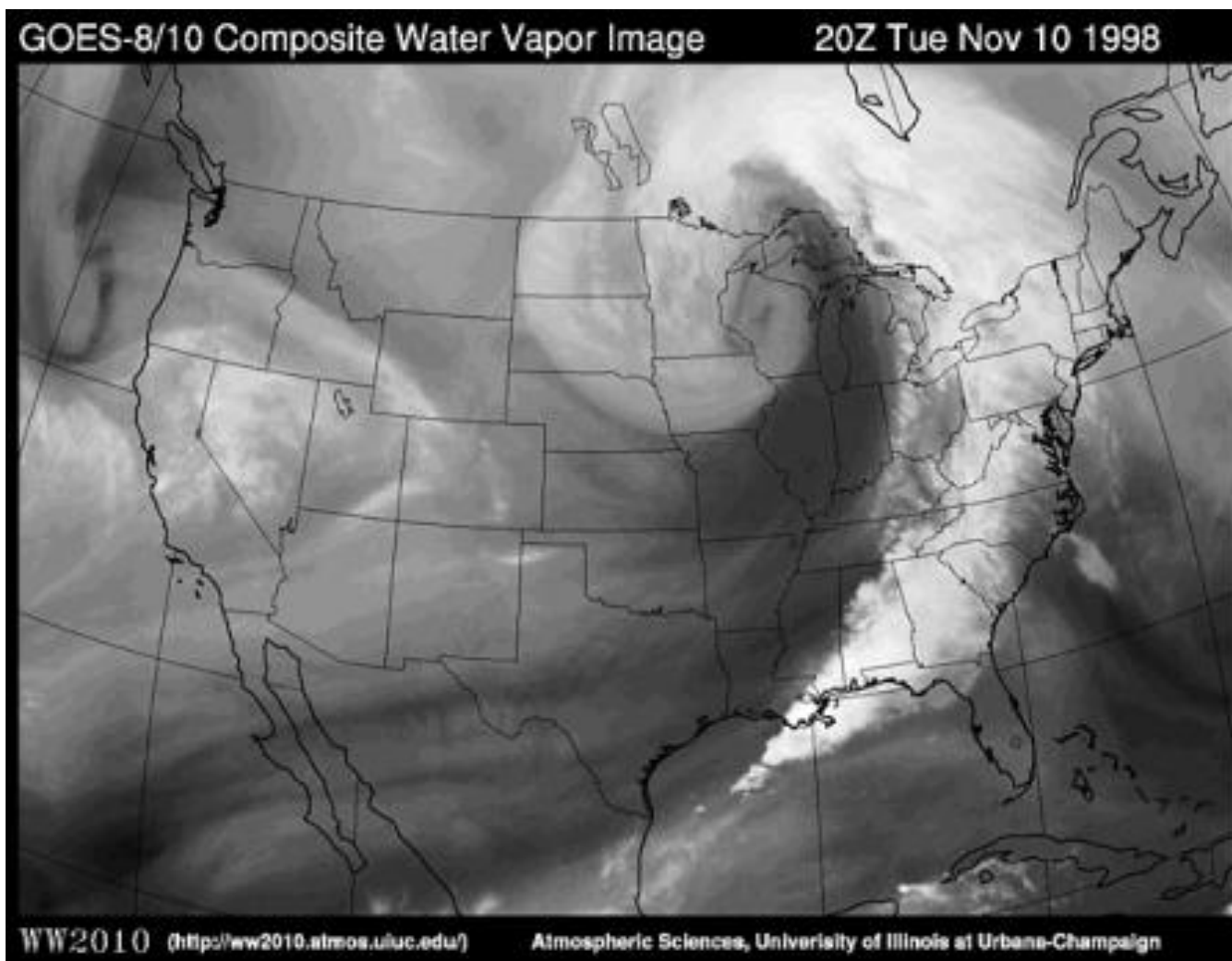
IR Imagery



Water Vapor Images

- Integrated measure of moisture in the atmosphere.
 - Measures amount of radiation emitted at 6.7 microns = $6.7\ \mu\text{m}$.
 - Water vapor heavily absorbs radiation at this wavelength.
- Absorption is greatest in the mid/upper troposphere between 600 and 250 mb.
- Good measure of mid/upper level moisture.
- Impossible to draw conclusions about low level moisture.
- Look for regions of changing characteristics (drying/moistening).

Water Vapor Image



Comparison #2

