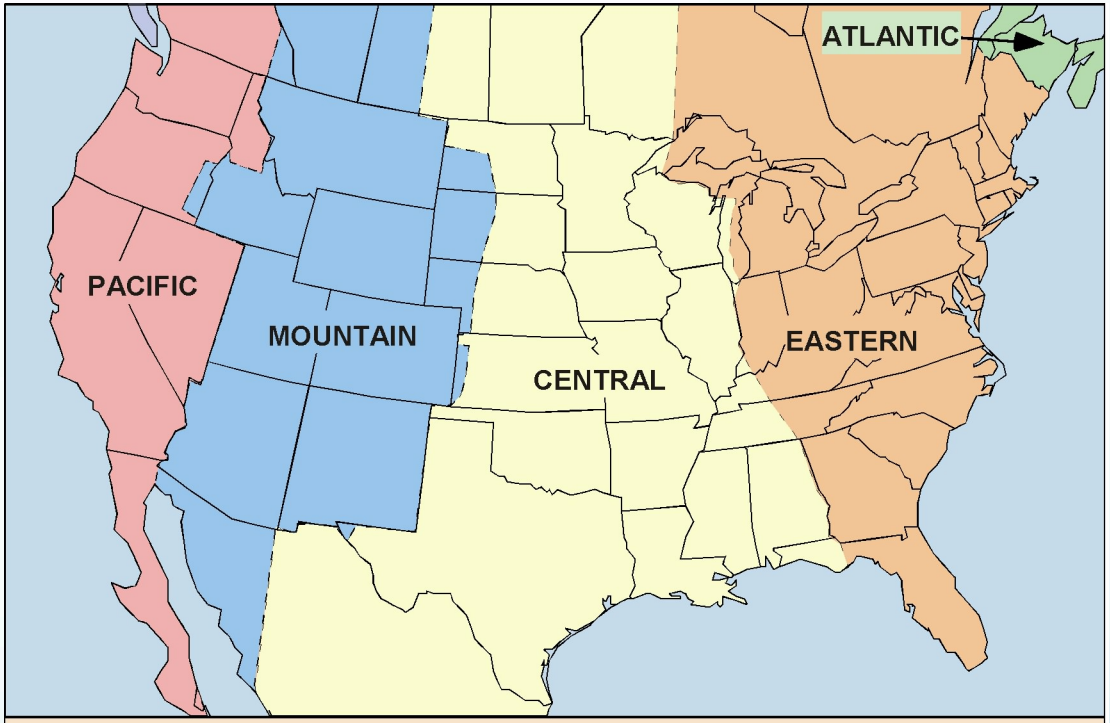
Chapter 2
Meteorological Measurements

Time

- If we want to map weather observations for the whole country, or the whole globe, how do we know that they are all taken at the same time?



		Pacific	Mountain	Central	Eastern	Atlantic
1200 UTC	STANDARD	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.
	DAYLIGHT	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.
0000 UTC	STANDARD	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.
	DAYLIGHT	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.

Universal vs Local Time

- Universal time coordinate (UTC)
  - Also know as Zulu (Z) or Greenwich Mean Time (GMT)
- UTC is based on a 24 hour clock
  - Ex. 6am would be 06 UTC
  - Ex. 6pm would be 18 UTC
- UTC is given as both hours and minutes
  - Ex. 2:15am would be written as 0215 UTC
  - Ex. 10:20pm would be written as 2220 UTC
- UTC never switches between standard and daylight savings time
  - Local time in many locations does switch

Converting to/from UTC

- From UTC to local time:
  - MST (Mountain Standard Time) = UTC – 7 hrs
  - MDT (Mountain Daylight Time) = UTC – 6 hrs
- From local time to UTC:
  - UTC = MST + 7 hrs
  - UTC = MDT + 6 hrs
- Examples
  - 6:15am MDT = ? UTC
  - 2:00pm MST = ? UTC
  - 1200 UTC = ? MDT
  - 1730 UTC = ? MST

Answers:

1215 UTC
2100 UTC
6:00 am MDT
10:30 am MST

Clicker Question

- Convert our local time of 9:45am MST to UTC
  A. 0945 UTC
  B. 1545 UTC
  C. 1645 UTC
  D. 2345 UTC

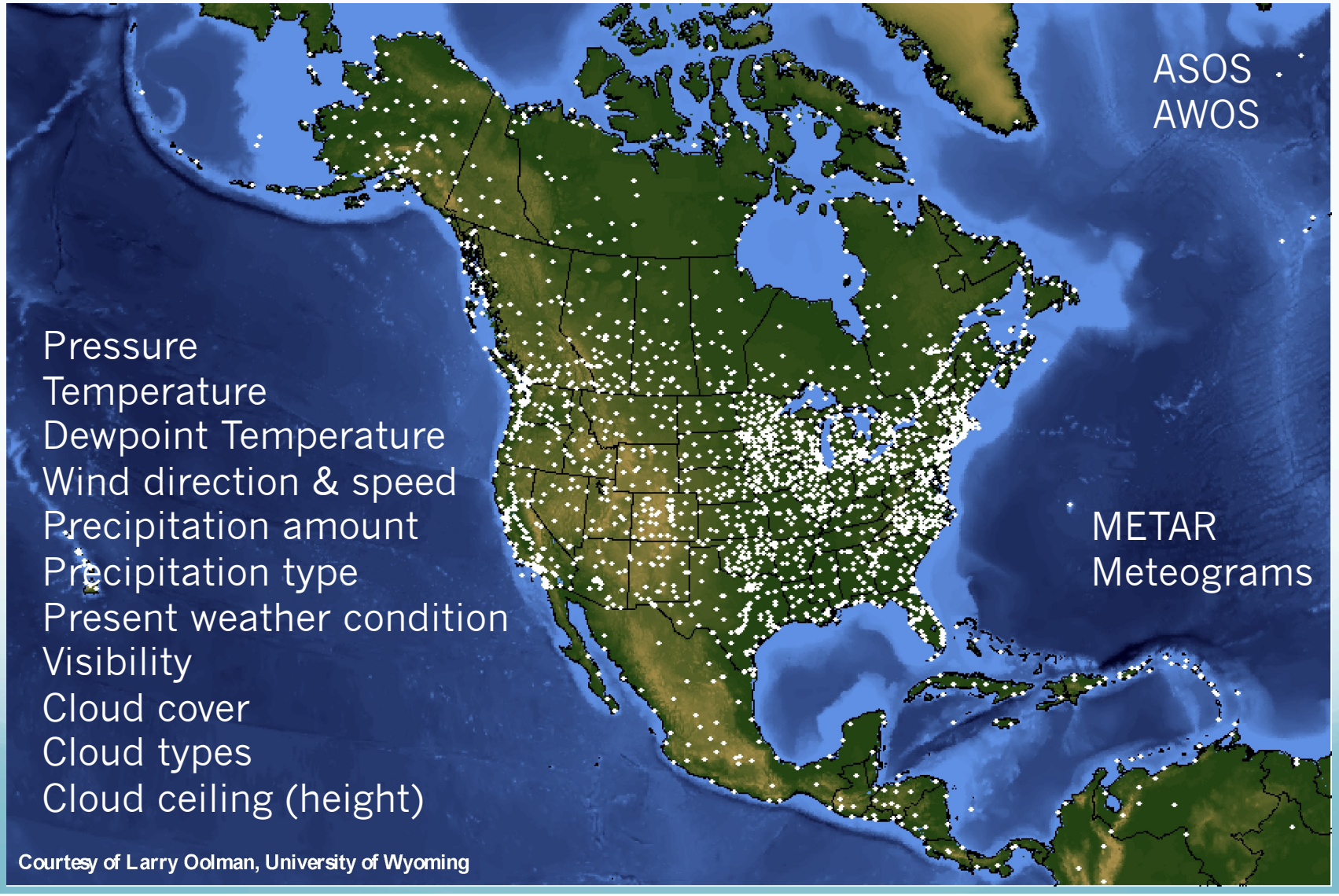
Clicker Question

- A weather observation made at 0400 UTC on January 10th, would correspond to what local time (MST)?
  A. 11:00am January10th
  B. 9:00pm January 10th
  C. 10:00pm January 9th
  D. 9:00pm January 9th

Clicker Question

- A weather observation made at 0600 UTC on July 10th, would correspond to what local time (MDT)?
  A. 12:00am July 10th
  B. 12:00pm July 10th
  C. 1:00pm July 10th
  D. 11:00pm July 9th

Surface Measurements

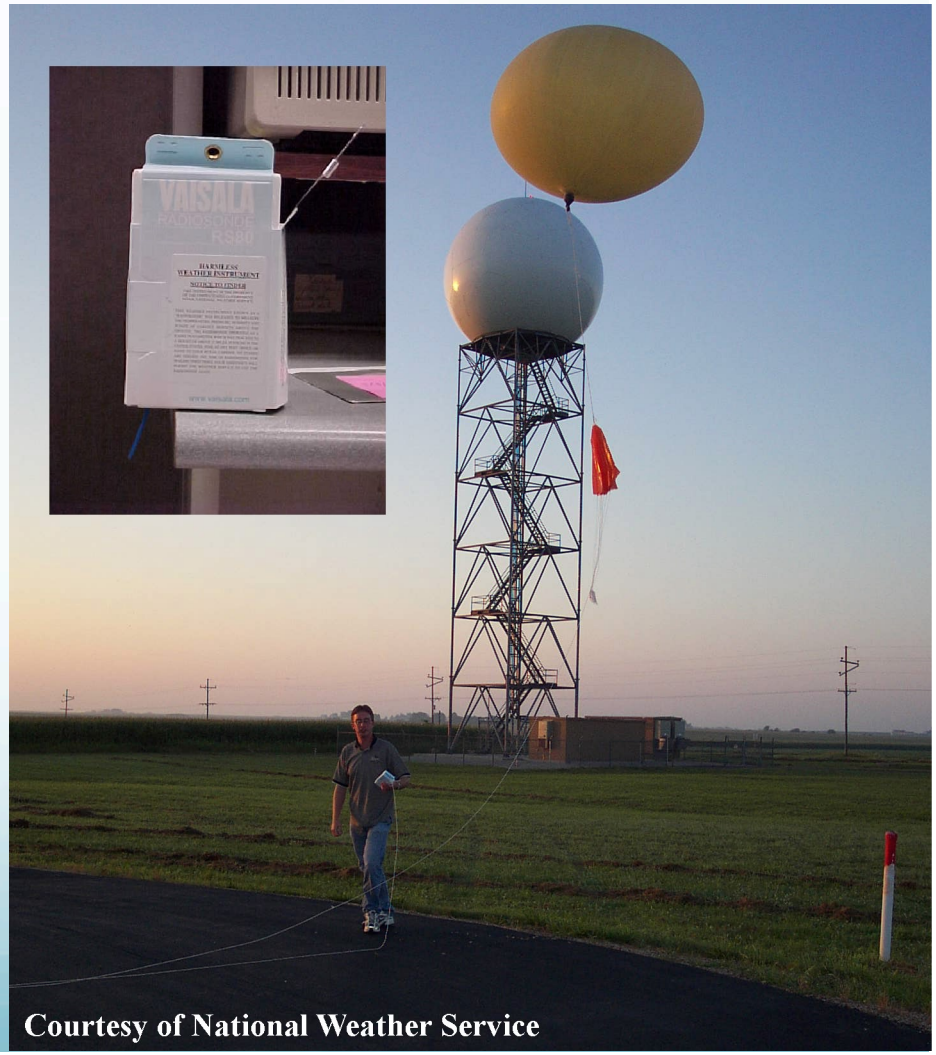


Pressure
Temperature
Dewpoint Temperature
Wind direction & speed
Precipitation amount
Precipitation type
Present weather condition
Visibility
Cloud cover
Cloud types
Cloud ceiling (height)

Courtesy of Larry Oolman, University of Wyoming

Rawinsondes

- Rawinsonde: a balloon-borne instrumentation system that measures pressure, temperature, dew point temperature, wind direction, and wind speed
- How often are they made?
  - Every 12 hours (00Z and 12Z)
  - As needed in some special locations

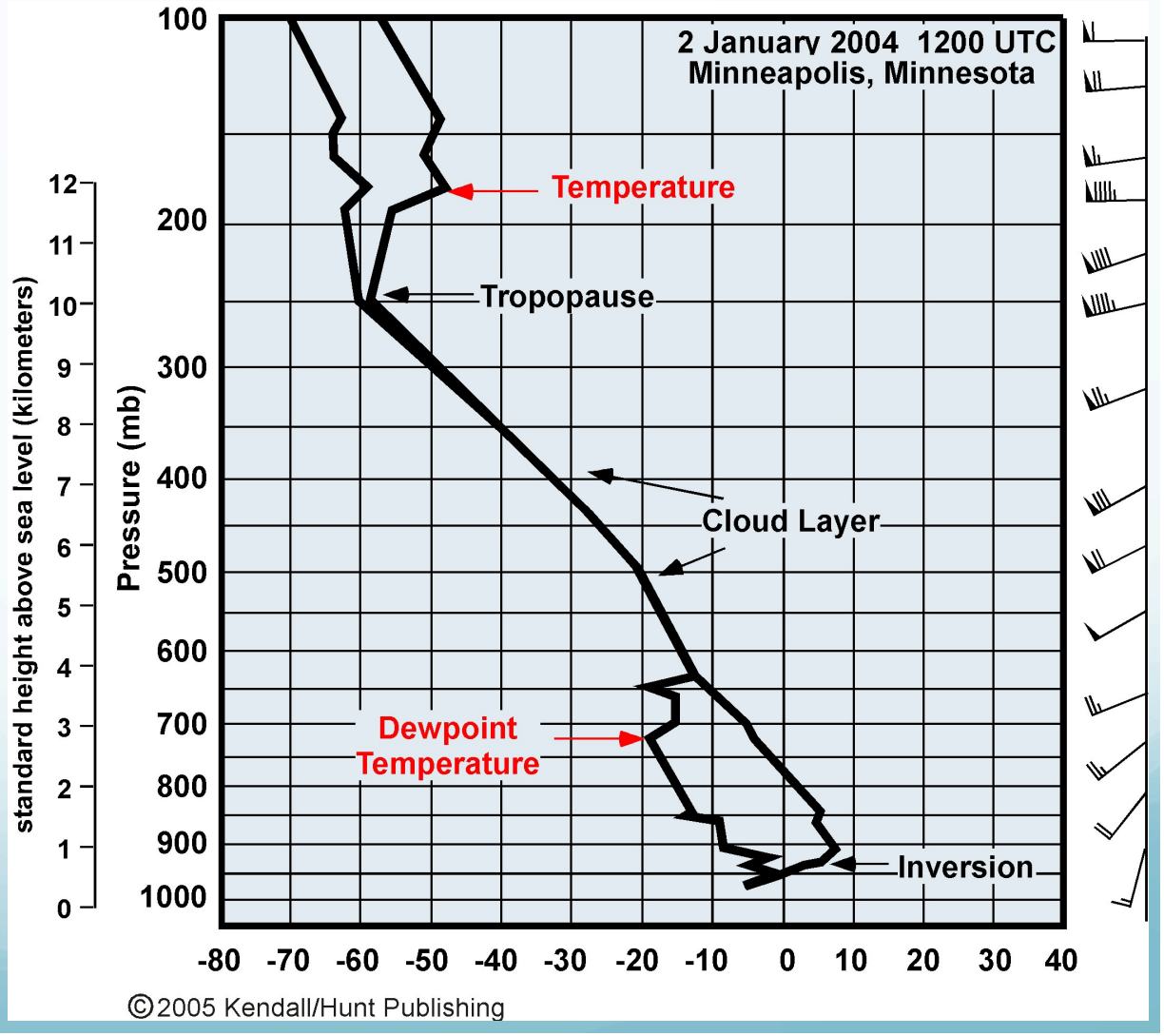


Courtesy of National Weather Service

Where are rawinsondes?

Soundings

- Sounding: A depiction of the vertical structure of the atmosphere
- What information about the atmosphere can we find on a sounding?

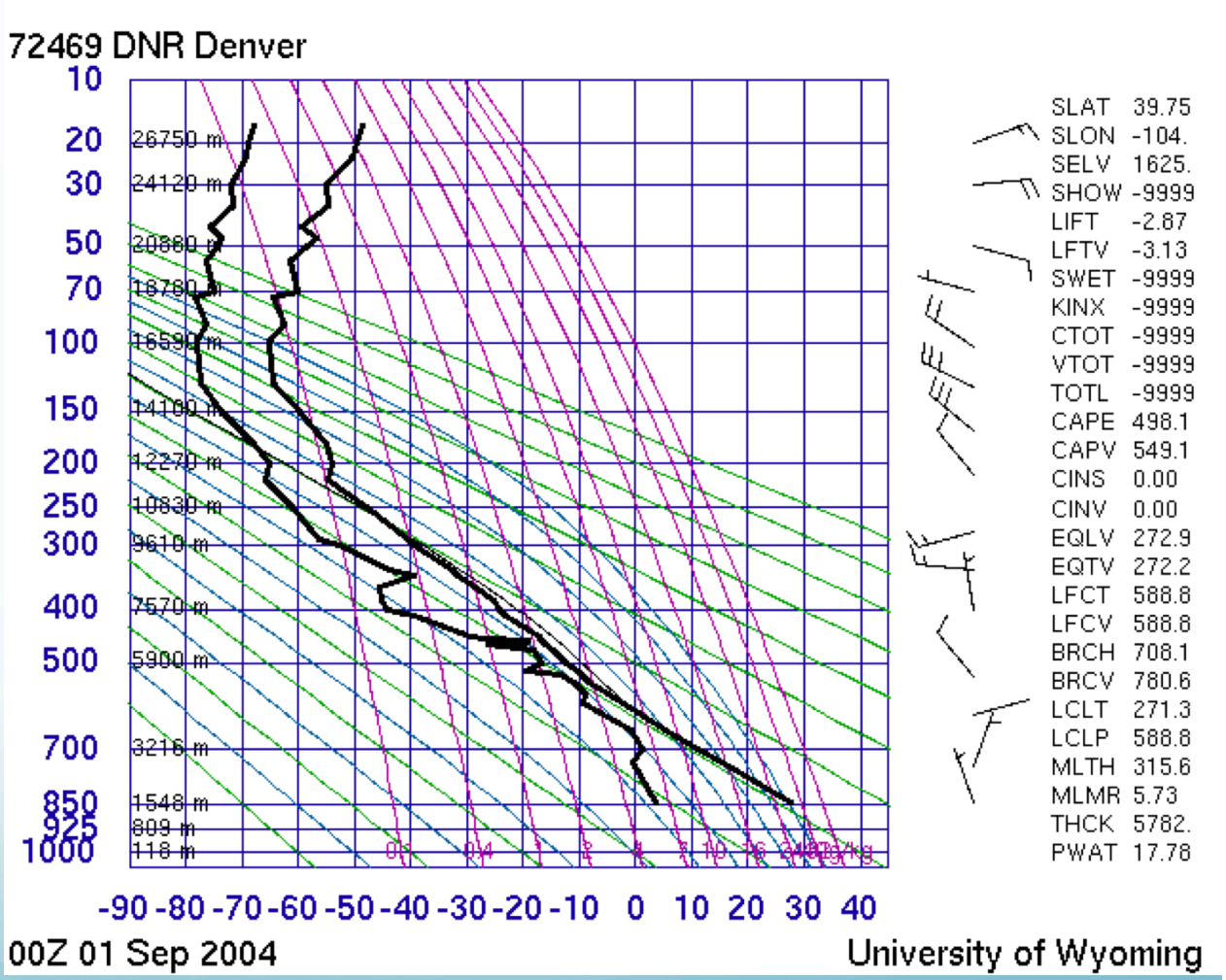


Clicker Question

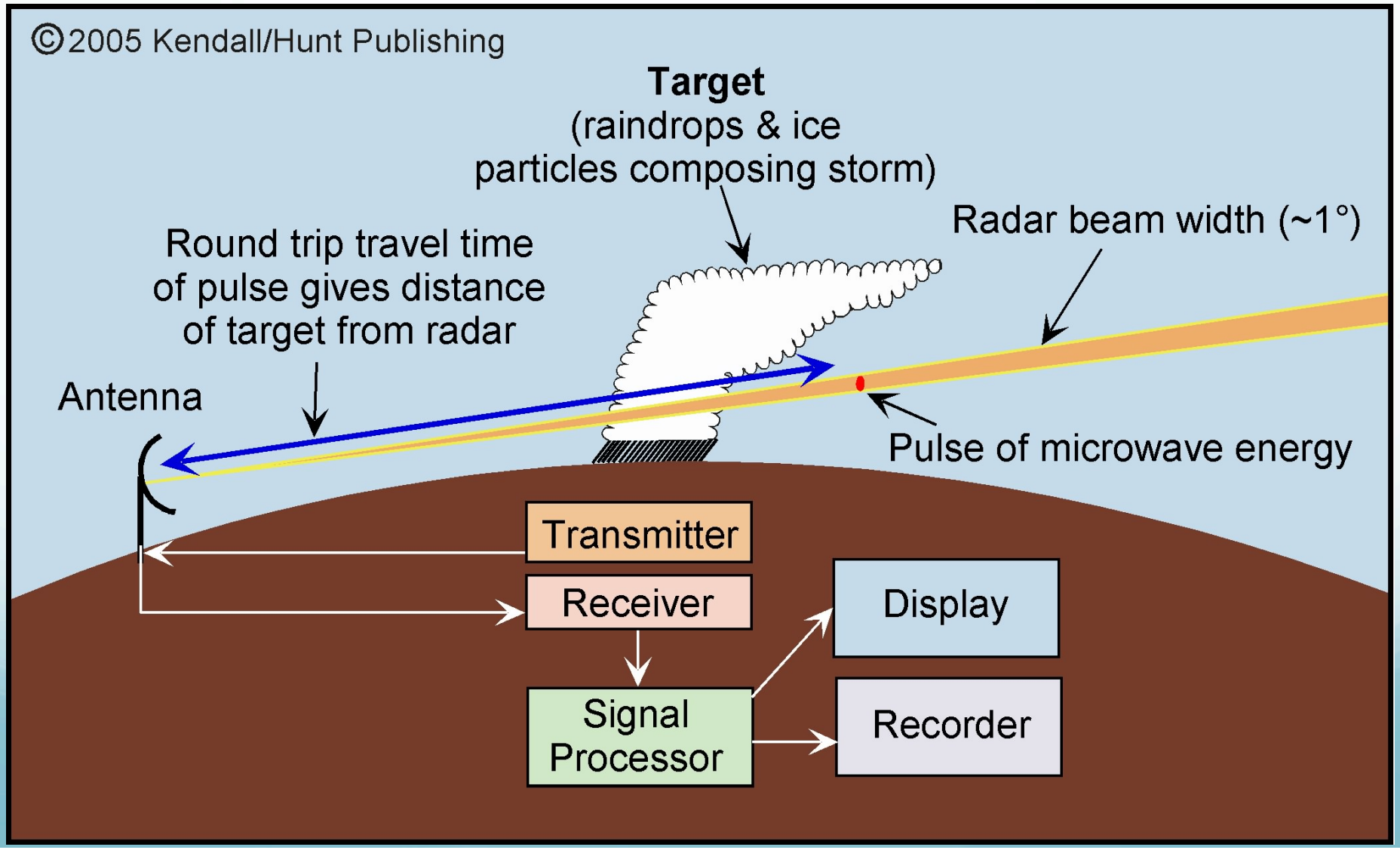
- A rawinsonde measures all of the following variables except:
  A. Temperature
  B. Dew point temperature
  C. Precipitation
  D. Wind speed
  E. Wind direction

Clicker Question

- In this sounding from Denver, the tropopause is located at a pressure of approximately:
  A. 700 mb
  B. 500 mb
  C. 300 mb
  D. 100 mb



Radar


©2005 Kendall/Hunt Publishing
Target
(raindrops & ice
particles composing storm)
Radar beam width (~1°)
Round trip travel time
of pulse gives distance
of target from radar
Antenna
Pulse of microwave energy
Transmitter
Receiver
Display
Signal
Processor
Recorder

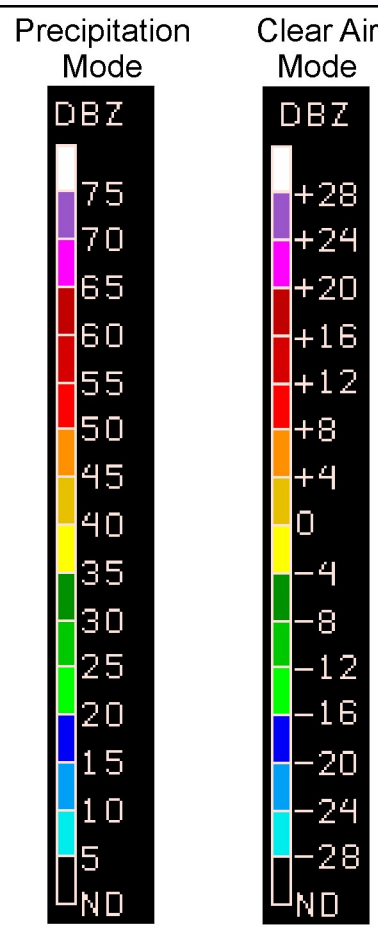
Radar Reflectivity

- What determines how much microwave energy is returned to the weather radar?
  - Size of precipitation particles
  - Number of precipitation particles
  - Type of precipitation particles (rain, snow, hail, etc.)
- Decibel radar reflectivity (dBZ): a logarithmic scale used when plotting radar reflectivity data to indicate the intensity of the microwave energy returned to the radar from targets (raindrops, hail, snow, etc)

Information from radars

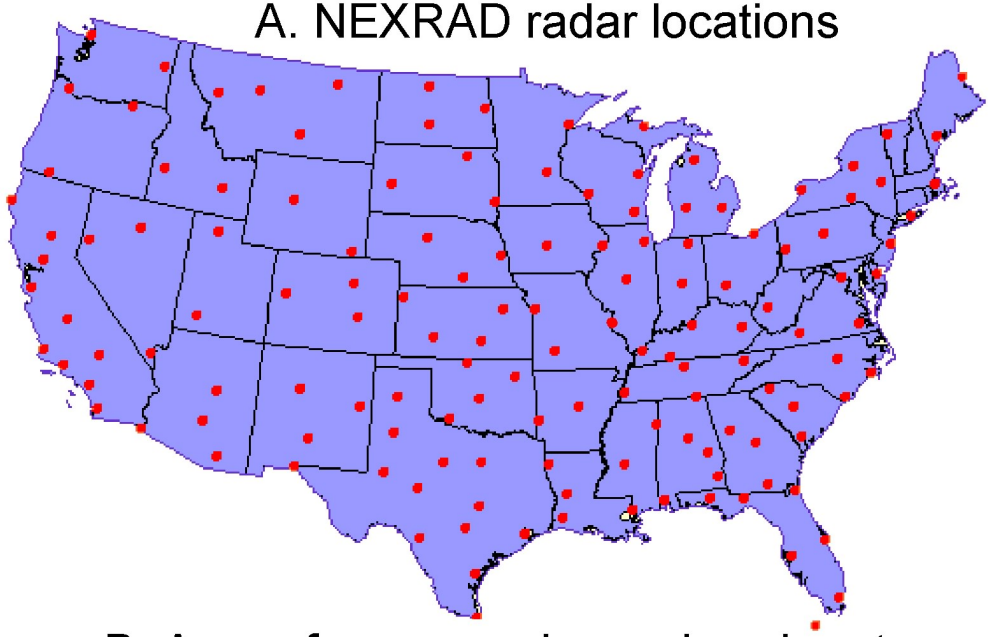
Approximate conversion of radar reflectivity to rainfall rate

Radar Reflectivity (dBZ)	Rainfall Rate (inches/hr)
65	16+
60	8.0
55	4.0
52	2.5
47	1.3
41	0.5
36	0.3
30	0.1
20	trace

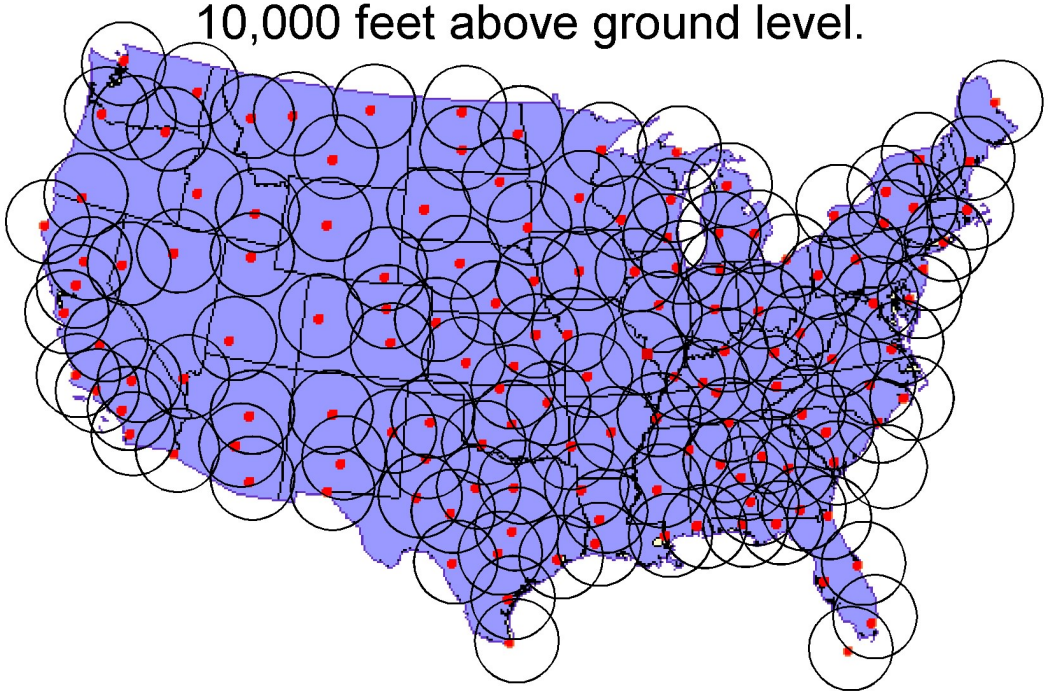


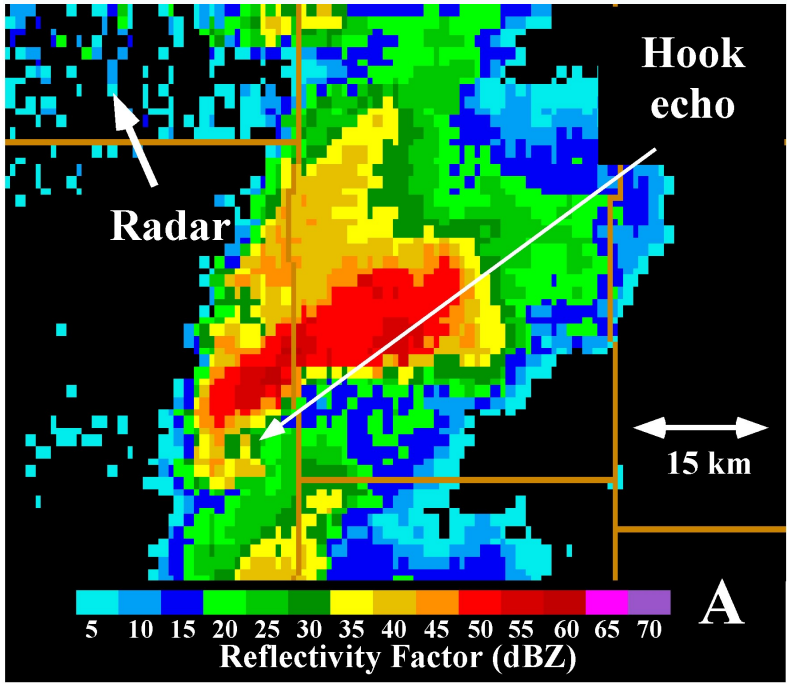
- What does radar reflectivity show us?
  - Position of precipitation
  - Intensity of precipitation
- Doppler radar indicates the position and intensity of precipitation (like a regular radar) but can also estimate the radial wind speed from the Doppler shift of the transmitted and received signal.

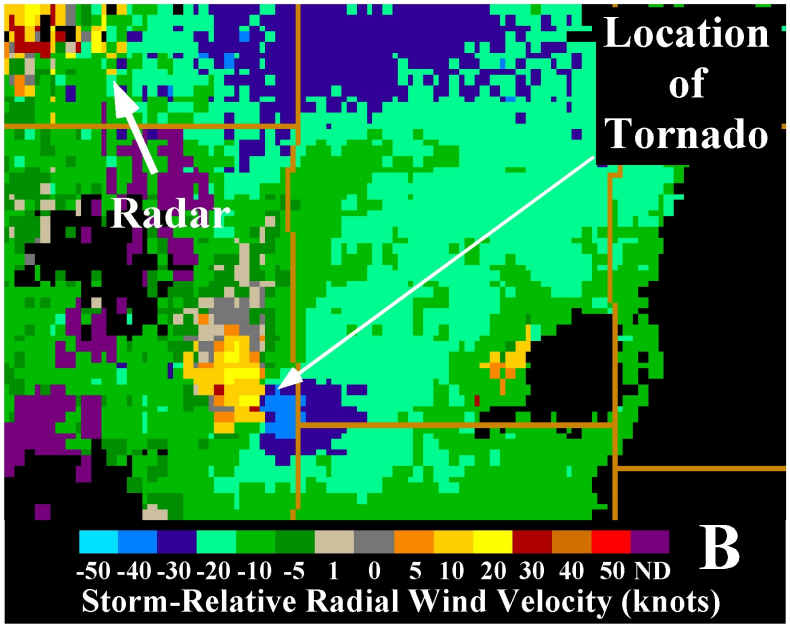
A. NEXRAD radar locations



B. Area of coverage by each radar at 10,000 feet above ground level.



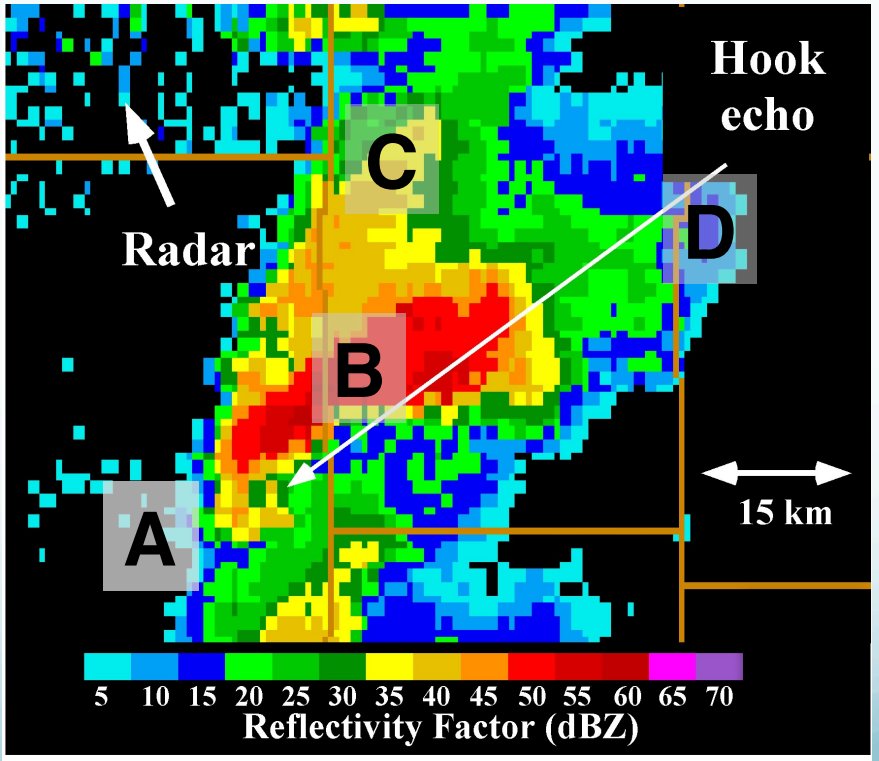




Clicker Question

- Which letter on this radar reflectivity image has the highest rainfall rate?

  - A.
  - B.
  - C.
  - D.



Clicker Question

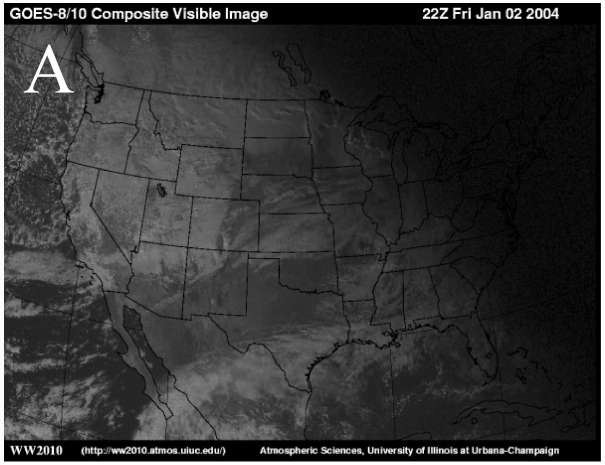
- What can a Doppler weather radar measure?
  A. Position of precipitation
  B. Intensity of precipitation
  C. Radial wind speed
  D. All of the above
  E. Only a and b

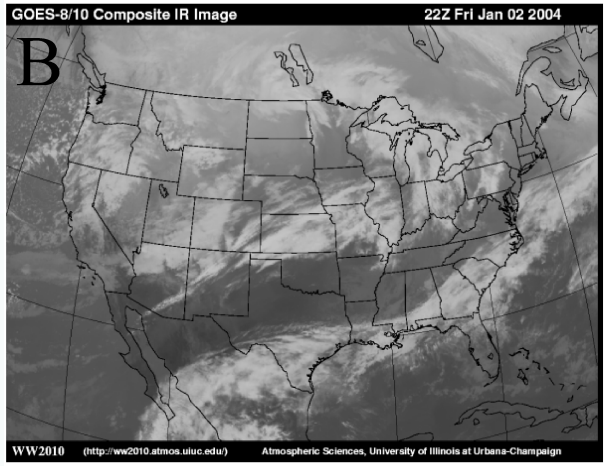
Satellite Imagery

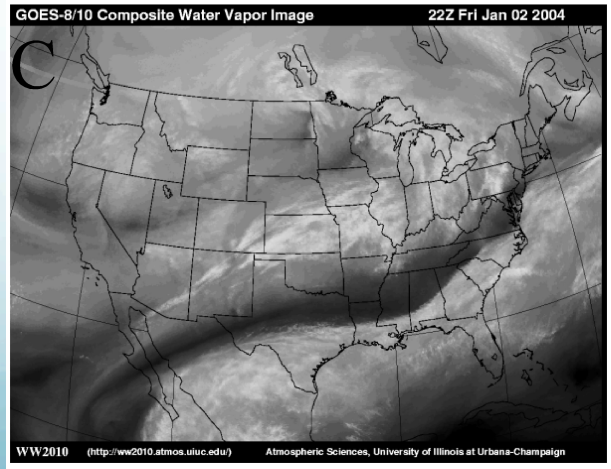
- What do satellites measure and what does this tell us about the weather?

Interpreting Satellite Imagery

	Visible	Infrared	Water Vapor
Satellite measures	reflected solar radiation	emitted infrared (temperature)	infrared radiation emitted by water vapor only
Brightest regions	thick clouds, snow	coldest clouds or surfaces	moist air
Darkest regions	ocean, forests	warmest clouds or surfaces	dry air







Courtesy of Department of Atmospheric Sciences
University of Illinois at Urbana-Champaign

Global views-What type of imagery?

Always look at date and time

Is it sunny everywhere at once?

What other notable features?