

Short Answer

1. Briefly describe the three stages of thunderstorm development.

- Cumulus - updrafts
- Mature – updrafts and downdrafts
- Dissipating - downdrafts

2. What is required for a thunderstorm to be considered severe? If it is severe, who releases warnings and/or surveys the damage for storm ratings? How are tornadoes rated?

- 58 mph winds, 1 inch hail, tornado/funnel
- NWS
- Enhanced Fujita scale – based on damage, estimates winds from damage, accounts for different construction types

3. What is a multicell storm? What different modes did we talk about and how are they different?

- Cluster of cells in different stages in the same region
- MCS
 - MCC – roughly circular
 - Squall Line – roughly linear
 - Bow Echo – curved deviation from linear
 - Derecho – extremely severe, long lasting squall line

4. What is a gust front? Why do gust fronts matter (what other things do we associate with gust fronts)? How is this different than a microburst?

- Cold outflow air from a thunderstorm
- Initiate more cells (can organize convection), shelf clouds, haboobs, strong straight-line winds
- Microbursts are smaller and less sustained.

5. Describe the overall structure of a supercell. How do the different types vary? Where would you expect any tornadoes to form? What other risks are there?

- LP – no rain in updraft, high cloud base
- HP – rain obscuring the updraft
- Classic – between LP and HP
- Tornadoes form in the updraft – in the mesocyclone, under the wall cloud
- Flooding, hail, strong winds, lightning

6. How can you tell the distance to a lightning flash?

- Count the seconds between visible flash and thunder
- Divide by 5
- Results in the miles to the flash

7. Briefly describe the stages of a tornado. What are most tornadoes rated? Which do the most damage?

- Organizing – funnel and debris cloud
- Mature – peak intensity, often largest
- Rope/Dissipating – rope-like, loss of warm buoyant air
- EF0-EF1
- EF4-EF5

8. What scale is used to rate tornadoes? What is taken into account with this scale and what is not taken into account? What are some of the limitations of the rating system for tornadoes?

- Enhanced-fujita scale
- Rate tornadoes based on damage to structures and not wind speeds (hard to observe wind speeds)
- Tornadoes don't always hit structures
- Building codes may vary from state to state and county to county
- Debris may do damage to buildings, not just wind
- Subjective evaluation from surveyors
- Can't verify the damage rating (need mobile radars to assist)

9. Briefly describe the weather forecasting methods we discussed.

- Persistence – tomorrow = today
- Climatology – tomorrow = what average weather for tomorrow's date is
- Trend – whatever is upstream will be advected downstream (short term forecasts)
- Analog – whatever most similarly happened in the past will happen again
- NWP – computation of equations to determine forcings and resulting weather

10. What are the steps in running a weather model? What does each one give us? What are the main error sources?

- Data assimilation – find the most likely state given observations and previous model
- NWP – calculates the equations of state at each grid point
- Post processing – creates images, statistics from the model output
- Interpretation – the human factor, how well did the model do?
- Error: physics, initial conditions

11. What are some of the steps/tools forecasters use in the weather analysis phase? What do these different tools reveal to a forecaster?

- Observations
- Weather Maps (surface and aloft)
- Reveal what is "actually" going on, don't rely on models to tell the forecaster
- How are the models different from reality currently?

12. What are some of the ways we can investigate past climates? What are some of the larger natural impacts on climate? What about anthropogenic?

- Tree rings, ice bubbles, carbon dating, sediment
- Solar cycles, volcanic activity, current disruption, movement of plate and land surfaces
- Urban heat island, land surface changes, emissions

Fill in the Blank

13. The state of **Florida** has the highest frequency of thunderstorms due to having two sea breezes. The **west** coast has the lowest frequency of thunderstorms due to the climatologically stable atmosphere.
14. Over the past 30 years **flooding** has caused the highest number of storm-related deaths.
15. **Instability** and **Lifting** are necessary for the initiation of thunderstorms; **Instability** and **wind shear** are extremely important to how strong they become and what mode they follow.
16. A **supercell** thunderstorm is a usually isolated thunderstorm with a rotating updraft known as a **mesocyclone**.
17. A **stepped leader** is the initial step in lightning formation. **Return stroke** is the visible flash when lightning hits the ground.
18. Most lightning flashes are **IC** / **CG**. A **negative** / positive CG occurs when negative charge is transferred to the ground.
19. A **funnel** is a tornado not in contact with the ground.
20. **Tornado Alley** is in the central US and is where the highest frequency of tornadoes occurs. **Dixie Alley** is where the highest death rate from tornadoes occurs. Some of the reasons for this are **fast** movement, daytime / **nighttime** tornadoes, **HP** / LP storms, **high** / low population density.
21. A **watch** means conditions are favorable for severe weather. A **warning** means severe weather is indicated or reported.
22. A **deterministic** forecast is from a single model forecast. A **probabilistic** or **ensemble** forecast is the combination of several of these to express the uncertainty of the model.
23. The **Koppen scheme** is the way we classify climate regions.
24. **Mitigation** seeks to limit emissions of greenhouse gases which internationally has been attempted with the **Kyoto Protocol**. **Adaption** seeks to adjust our society to deal with climate changes.
25. **Geoengineering** is the purposeful, anthropogenic modification of the environment.