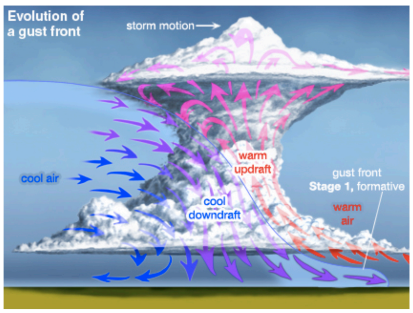
Homework–Module 4 Name:

1) We learned in Module 3 that adiabatic compression always works to warm sinking air. Yet the thunderstorm downdraft beneath the base of the cloud is usually much colder than the air surrounding it. Explain the apparent paradox using concepts in Chapter 11 of H&P and material in Module 3.

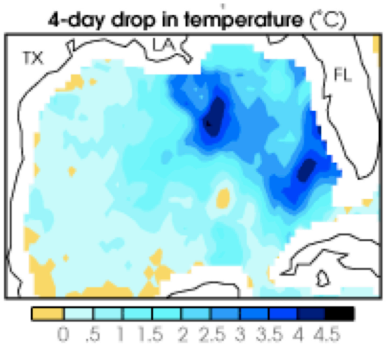
   There is a 600-character limit for all questions.



Schematic of the cool downdraft in a severe thunderstorm. Figure Credit: Encyclopedia Briannica.[1]

[1] https://media1.britannica.com/eb-media/32/24032-004-75D4F911.jpg

2) Explain why the surface (skin-layer) water temperatures are so much cooler after the passage of an intense hurricane. It turns out that most of the cooling is not due to sensible heat transport and evaporation of seawater, important processes that account for a smaller portion of the net cooling. (Hint: Consider what strong hurricane winds would do to the surface water and water a few tens of meters below the surface. You may want to revisit material in Module 1 on how wind affects the formation of the nighttime surface inversion and Fig. 9.19 of H&P to infer on how ocean temperatures vary with depth.)



Satellite estimates of the change in surface water temperature in the wake of Hurricane Katrina, four days after its passage. Surface cooling of up to 4˚C occurred in regions where Katrina passed. Figure Credit: NASA [2]

[2] https://earthobservatory.nasa.gov/IOTD/view.php?id=6223

3) Describe four meteorological factors that frequently occur together during summer and early fall over the Los Angeles Basin that set the stage from a major buildup of photochemical smog, being certain to explain how each factor would contribute to a buildup. You can neglect seasonal differences in the input of primary pollutants that are the ultimate cause of photochemical smog.

Los Angeles Basin shrouded by smog.
Photo: Robert S. Donovan

4) Paleoclimate data reveal that recent ice ages in the northern hemisphere coincide with climate regimes having colder summers in high latitudes. Explain why periods of glacial advance in the higher latitudes of the Northern Hemisphere tend to occur with colder summers, but not necessarily with colder winters.

Glacial maximum 15,000 years ago