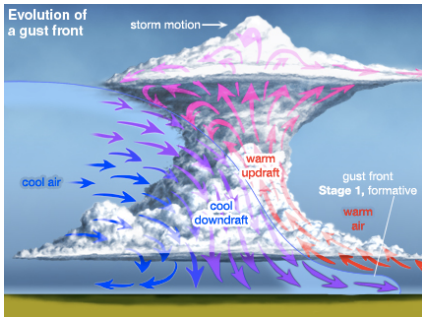
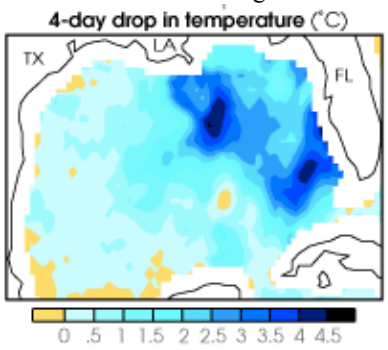
Homework–Module 4 Name:

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 10 and earlier chapters. There is a 600-character limit.



Schematic of the cool downdraft in a severe thunderstorm. Figure Credit: Encyclopedia Brittanica, Inc.

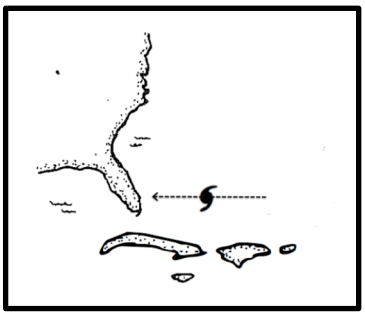
2) Explain why the surface (skin-layer) water temperatures are so much cooler after the passage of an intense hurricane. It turns out that most of the cooling is not due to sensible heat transport and evaporation of sea water, processes that account for a smaller portion of the net cooling. Consider 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 Chapter 3 on how wind affects the formation of the nighttime surface inversion and unassigned material in Chapter 7 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. In fact, the circulation of Katrina was so intense that it cooled most of the Gulf of Mexico!

Figure Credit: NASA

3) You are on the beach of Miami, Florida, facing due east. Hurricane Esteban is moving due west toward you. The storm is expected to make landfall with a forward speed of 40 mph. (See figure to the right.) Which one of the two scenarios, a) or b), would you expect to bring faster winds and a higher storm surge at your location? Explain.



a) Esteban making landfall as a minimal Category 1 hurricane (74 mph) just to your south.

b) Esteban making landfall as a minimal Category 3 hurricane (111 mph) just to your north.

Hint: Refer to Fig. 11.16 of the text and the Saffir-Simpson Hurricane Wind Scale (Table 11.2 of the text). The categories are based on a hurricane's maximum sustained wind speed. The fastest winds are located on the hurricane's forward flank, which is where the rotation winds point in the same direction that the center of the hurricane is moving. It may help to sketch a diagram, similar to Fig. 11.16 in the text, where you show your location, the rotational speed of the vortex, and the forward speed of the hurricane.