Atmospheric Sciences 5300

Exercise #6

Due Friday, October 8, 2021

This exercise is about dry microburst downdrafts. Assume that the environment below the LCL is well-mixed (constant θ and constant w).

Please use the tables (next page) for your numerical answers. Please submit a skew-T log p diagram for each problem.

1. Use the same procedure as we used in class to determine the downdraft speed at the surface (where $p = 840$ mb) for a parcel that descends from the environmental LCL (at $p = 590$ mb, $T = 1°$C) and remains saturated due to rain evaporation until either 1, 2, or 3 g kg^{-1} of rain have evaporated into it, then descends dry adiabatically to the surface. For each case:
   (a) What is the SEL (sinking evaporation level)?
   (b) What are the parcel's mixing ratio, T, T_d, and RH at the surface?
   (c) What is the environment's mixing ratio, T, T_d, and RH at the surface?
   (d) What is the downdraft CAPE for the parcel?
   (e) What is the downdraft speed at the surface?
   Answers for evaporation of 1 g kg^{-1} of rain (using $T - T_e = -3°$C at the SEL): (a) 630 mb, (b) $T = 27°$C, RH = 29%, (c) $T = 30°$C, RH = 22%, (d) 276 J kg^{-1} (e) 23.5 m s^{-1}.

2. For the same environment as Problem 1, the parcel properties at the surface are $T = 24°$C and $T_d = 10.5°$C? For this case,
   (a) What are the parcel's mixing ratio and RH at the surface?
   (b) What is the SEL (sinking evaporation level)?
   (c) How much rain was evaporated into the parcel? (d) What is the downdraft CAPE for the parcel?
   (e) What is the downdraft speed at the surface?

3. This is like Problem 2, but the environment properties at the surface are $p = 800$ mb, $T = 30°$C, and $T_d = 3°$C, and the parcel properties at the surface are $T = 25°$C and $T_d = 7°$C? For this case,
   (a) What are the parcel's mixing ratio and RH at the surface?
   (b) What is the SEL (sinking evaporation level)?
   (c) How much rain was evaporated into the parcel? (d) What is the downdraft CAPE for the parcel?

(e) What is the downdraft speed at the surface?

Problem 1

evaporated rain (g/kg)			
SEL (mb)			
DCAPE (J/kg)			
parcel at surface			
w (g/kg)			
T (°C)			
T_d (°C)			
RH (%)			
vertical velocity (m/s)			
environment at surface			
w (g/kg)			
T (°C)			
T_d (°C)			
RH (%)			

Problem 2

evaporated rain (g/kg)	
SEL (mb)	
DCAPE (J/kg)	
parcel at surface	
w (g/kg)	
T (°C)	
T_d (°C)	
RH (%)	
vertical velocity (m/s)	

Problem 3

evaporated rain (g/kg)	
SEL (mb)	
DCAPE (J/kg)	
parcel at surface	
w (g/kg)	
T (°C)	
T_d (°C)	
RH (%)	
vertical velocity (m/s)	