Atmospheric Sciences 5300
Exercise #1: Example

This exercise deals with moisture variables and dry adiabatic processes. You may write a program to do the calculations.

1. Calculate the quantities in the table below (or on the larger version on the next page) for a parcel that ascends dry adiabatically from p =1000 mb, where T =27 °C and relative humidity = 60%, to p =900 mb.

p	RH	e	e_s	w	w_s	θ	T	T_d	T_v
(mb)	(%)	(mb)	(mb)	(g/kg)	(g/kg)	(K)	(K)	(K)	(K)
900									
925									
950									
975									
1000	60						300		

At surface: Know p, T, r

1. Get $e_s(T)$ from function or graph.

2. To get e, use $r = e/e_s$.

3. Get $w_s(T, p)$ from function; use $e_s(T)$ from (1).

4. To get w, use $r \approx w/w_s$ and w_s from (3), or use $w = \epsilon e/(p-e)$ and e from (2).

5. To get T_d, use function of T and r.

6. To get T_v, use function of T and w.

p	RH	e	e_s	w	w_s	θ	T	T_d	T_v
(mb)	(%)	(mb)	(mb)	(g/kg)	(g/kg)	(K)	(K)	(K)	(K)
875									
900									
925									
950									
975									
1000	60	21.2	35.4	13.5	22.0	300	300	291.8	302.5

Adiabatic ascent from surface

What is conserved during adiabatic ascent? θ and w. Problem is to get T, r from θ and w.

1. Get θ and w at all levels from their surface values.
2. To get T, use $T = \theta(p/p_0)^{R/c_p}$ and θ from (1).
3. Get $e_s(T)$ from function or graph.
4. Get $w_s(T, p)$ from function; use $e_s(T)$ from (3).
5. Get e by solving $w = \epsilon e/(p - e) \approx \epsilon e/p$ for e; use w from (1).
6. Get r from $r = e/e_s$.
7. Get T_d and T_v as before..

p (mb)	RH (%)	e (mb)	e_s (mb)	w (g/kg)	w_s (g/kg)	θ (K)	T (K)	T_d (K)	T_v (K)
875	106.9			13.5		300			
900	94.8	19.5	20.6	13.5	14.2	300	291.1	290.3	293.5
925	84.5			13.5		300			
950	75.6	20.6	27.2	13.5	17.8	300	295.6	291.2	
975	68.0			13.5		300			
1000	60	21.2	35.4	13.5	22.0	300	300	291.8	302.5