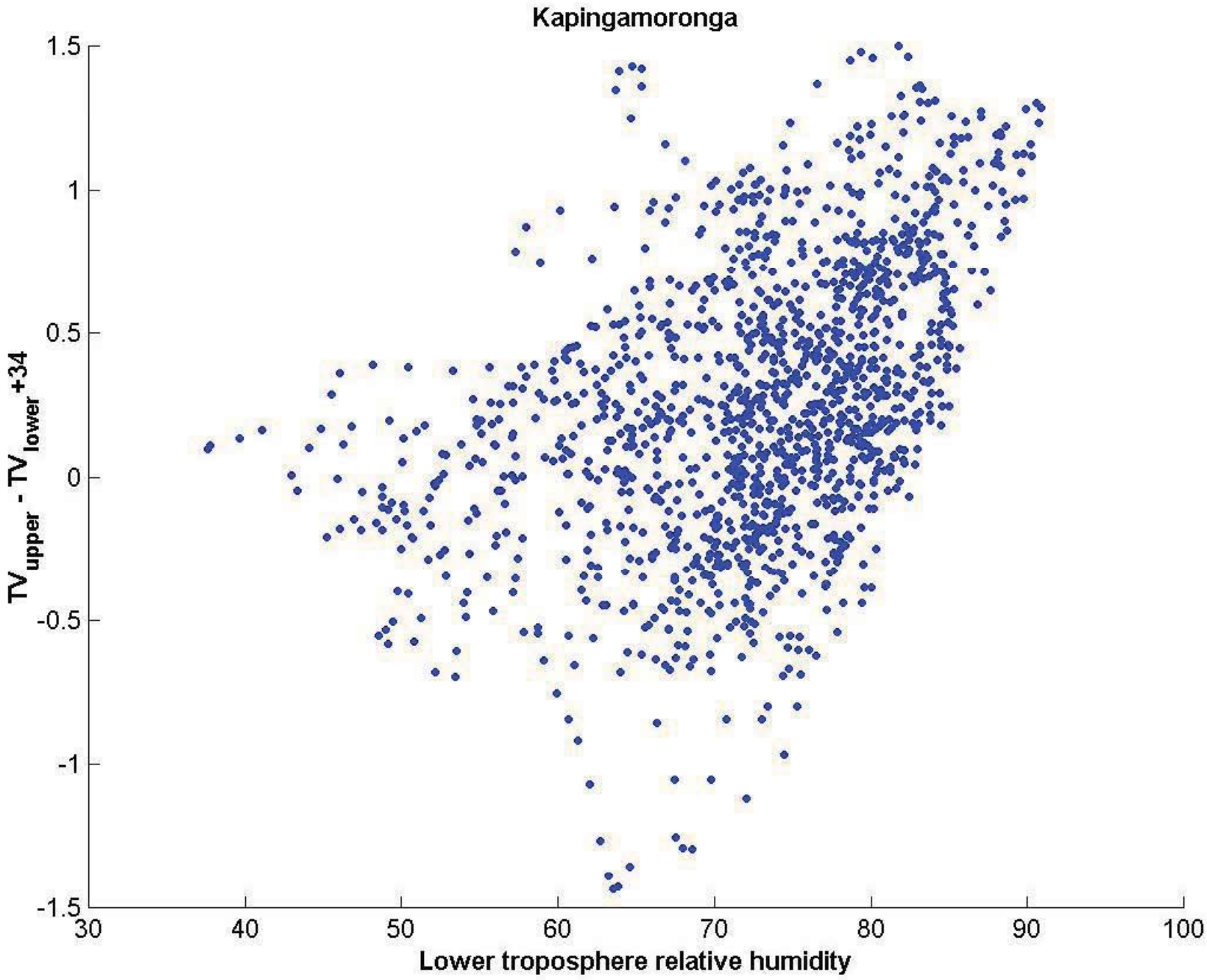
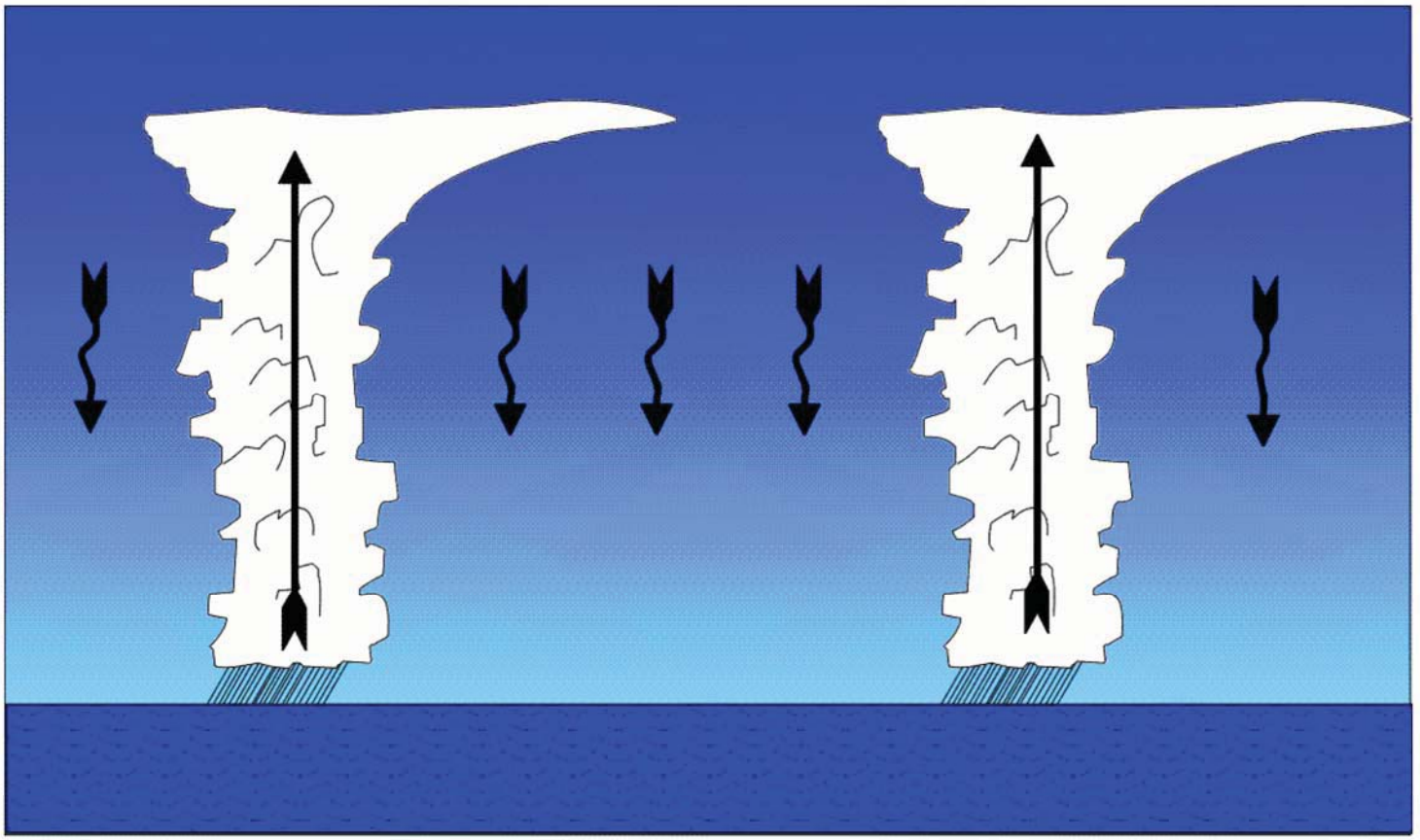

Kapingamoronga
1.5
1
0.5
0
-0.5
-1
-1.5
30
40
50
60
70
80
90
100
TV upper - TV lower +34
Lower troposphere relative humidity

Radiative-Moist Convective Equilibrium

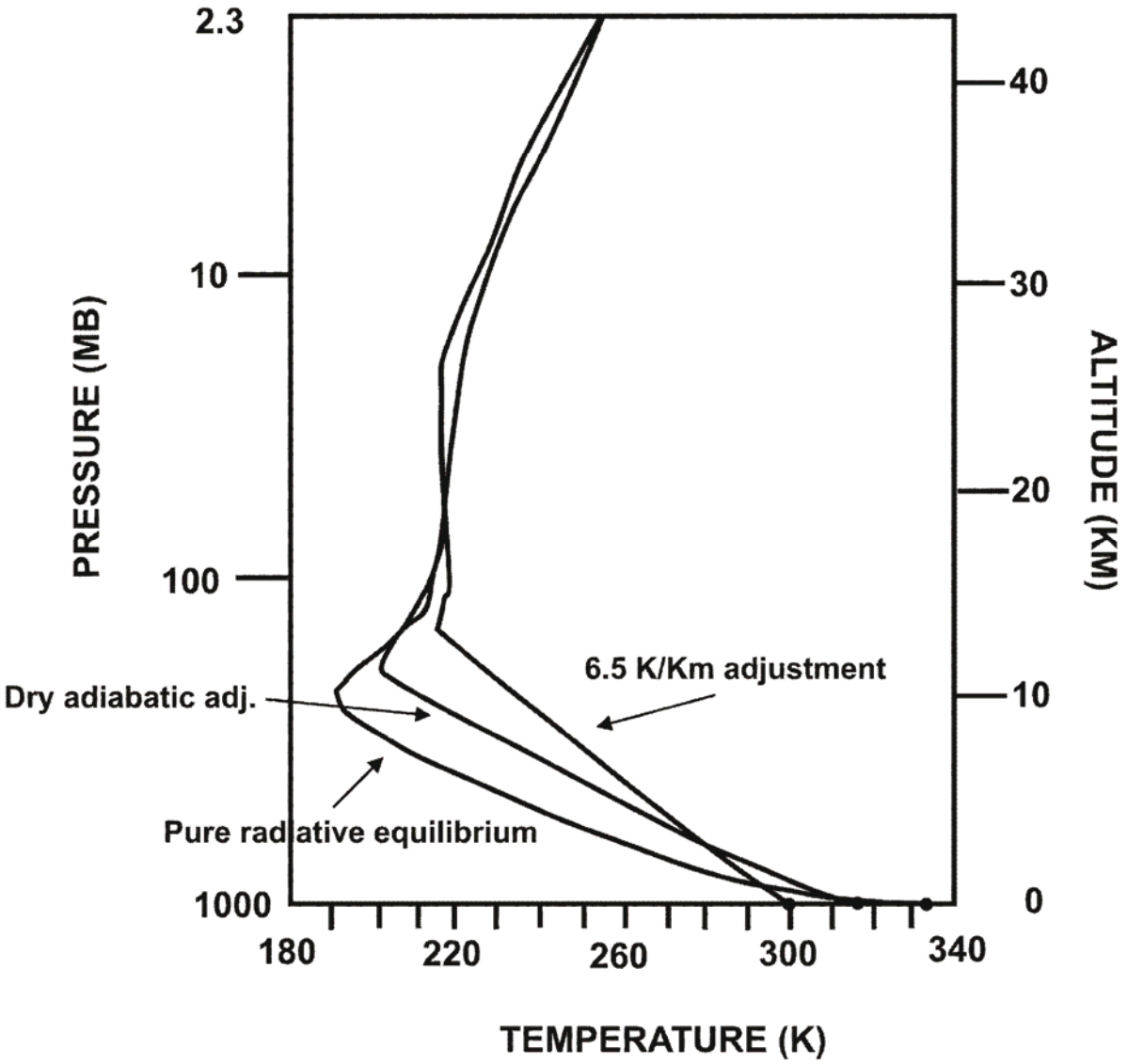
Precipitating Convection favors Widely Spaced Clouds (Bjerknes, 1938)



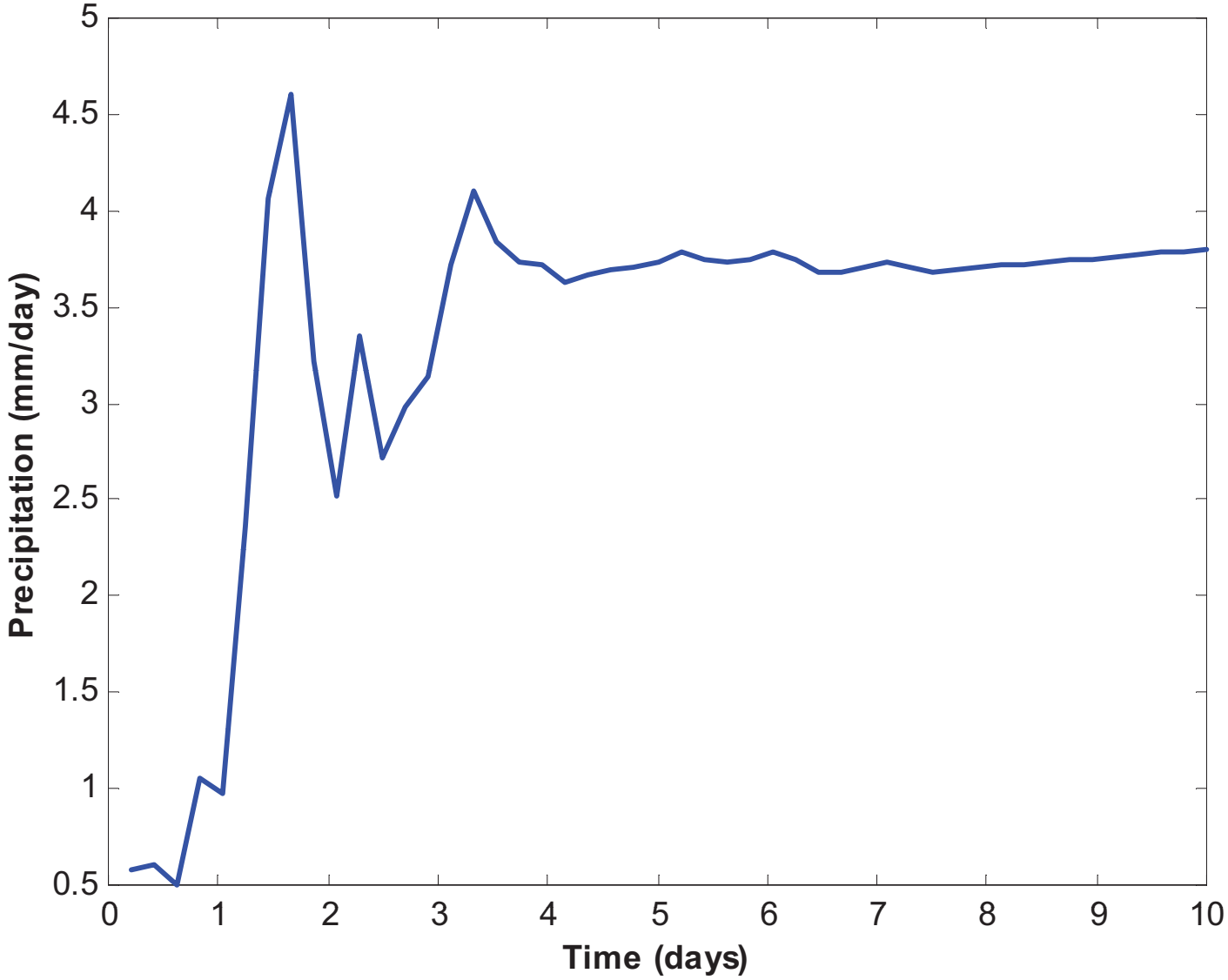
Properties:

- Convective updrafts widely spaced
- Surface enthalpy flux equal to vertically integrated radiative cooling
- $$M \frac{c_p T}{\theta} \frac{\partial \theta}{\partial z} = -\dot{Q}$$
- Precipitation = Evaporation = Radiative Cooling
- Radiation and convection *highly* interactive

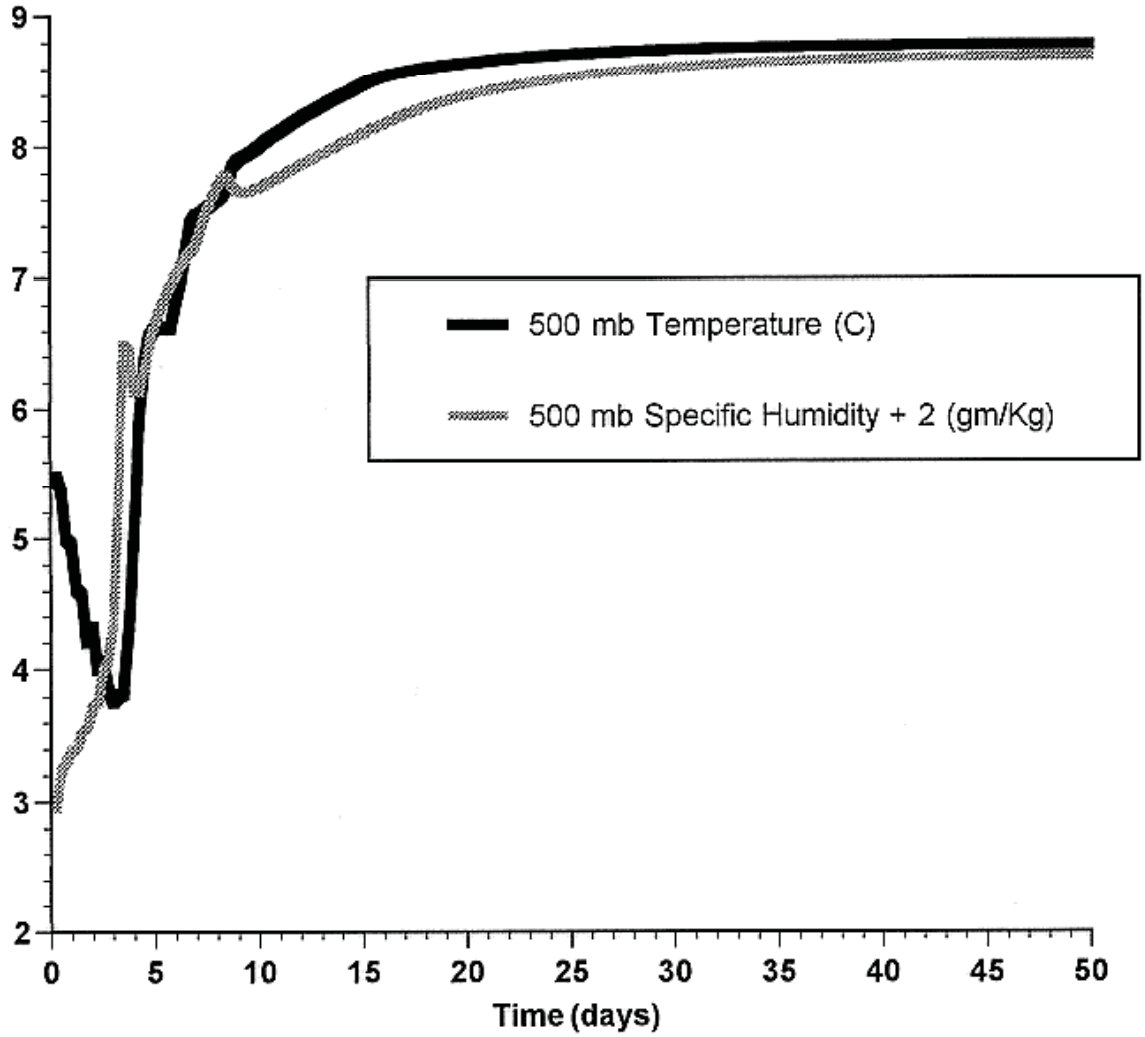
Manabe and Strickler 1964 calculation:

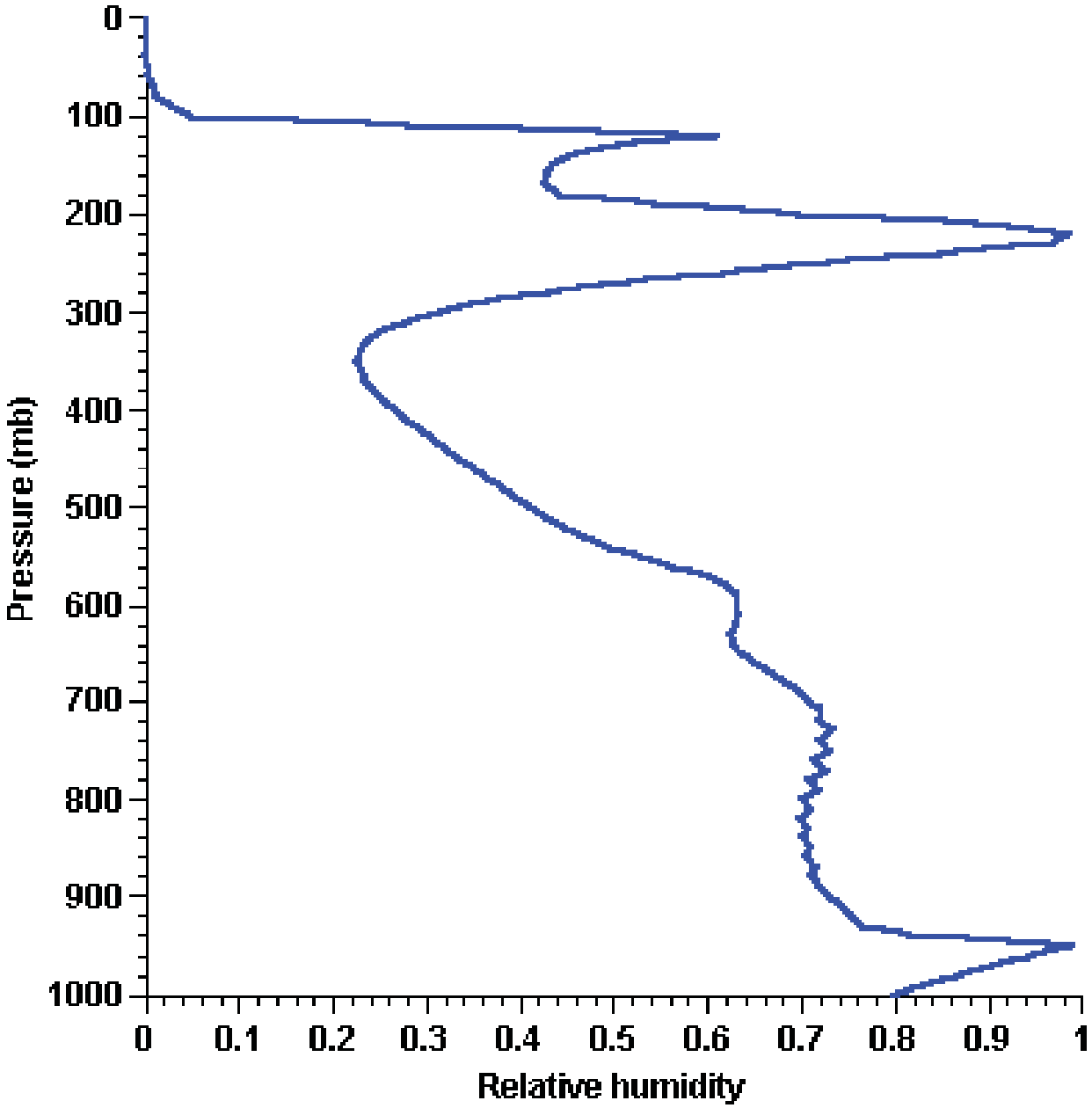


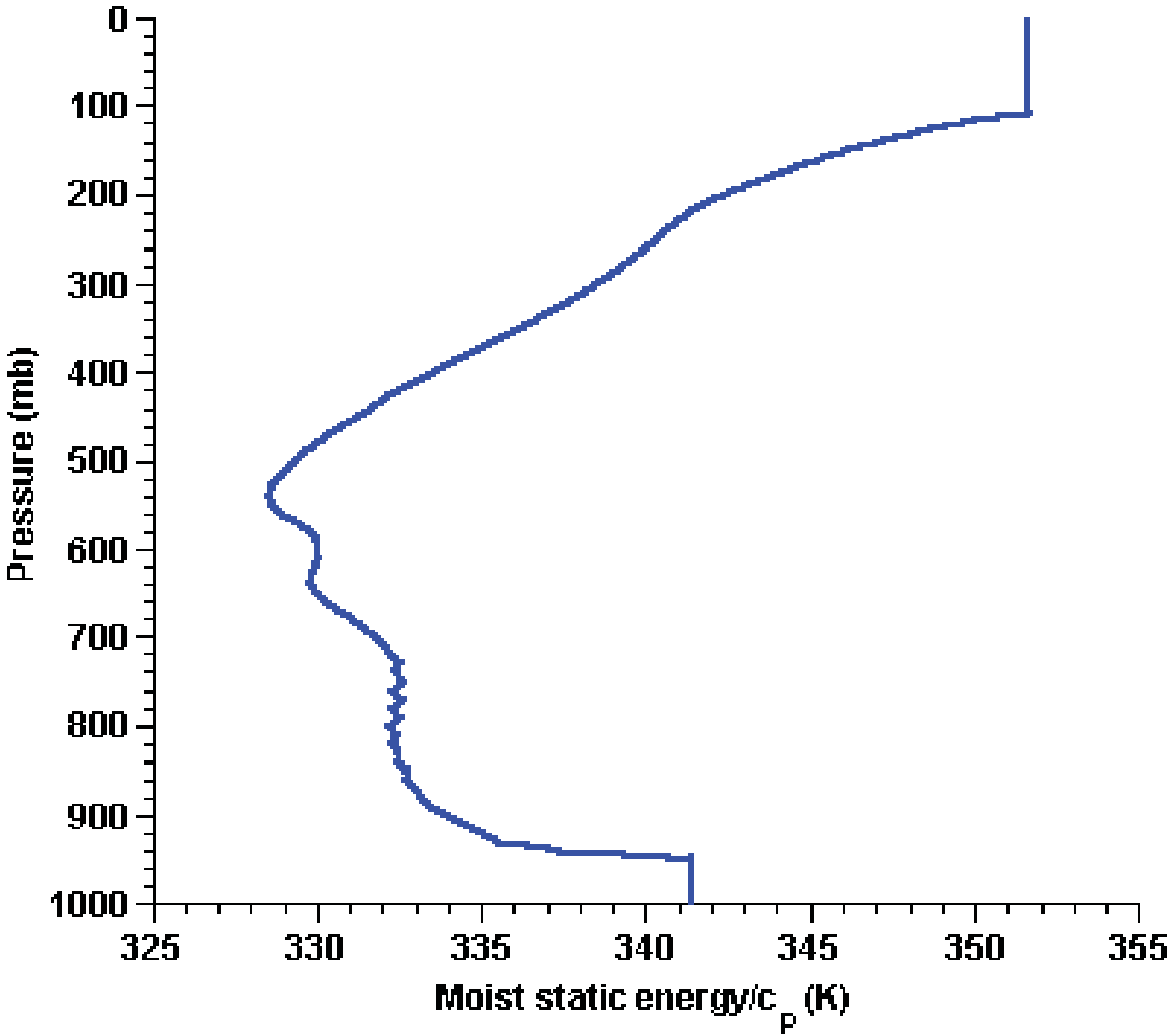
Approach to Radiative-Convective Equilibrium: Precipitation

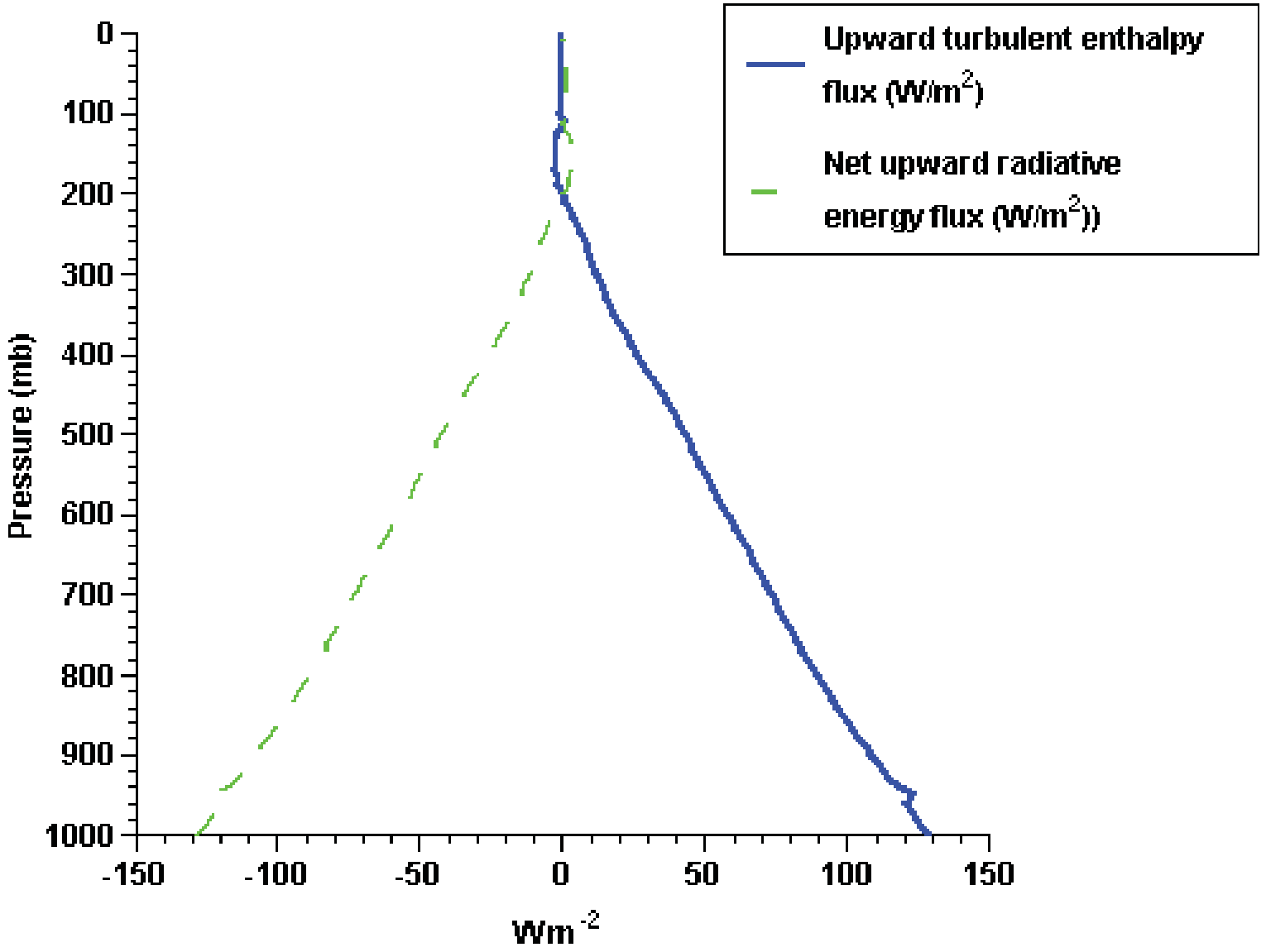


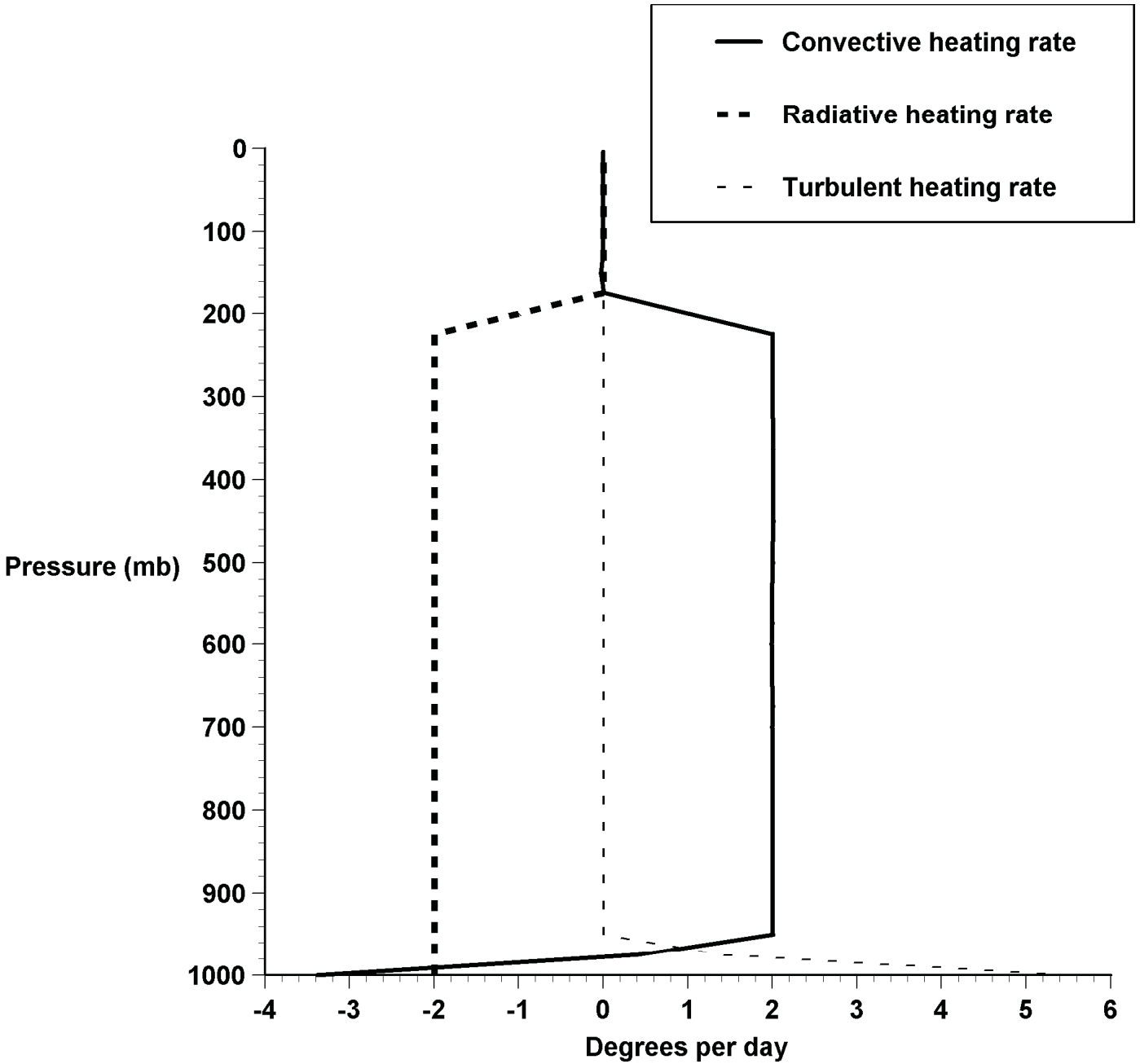
Approach to Radiative-Convective Equilibrium: T and q

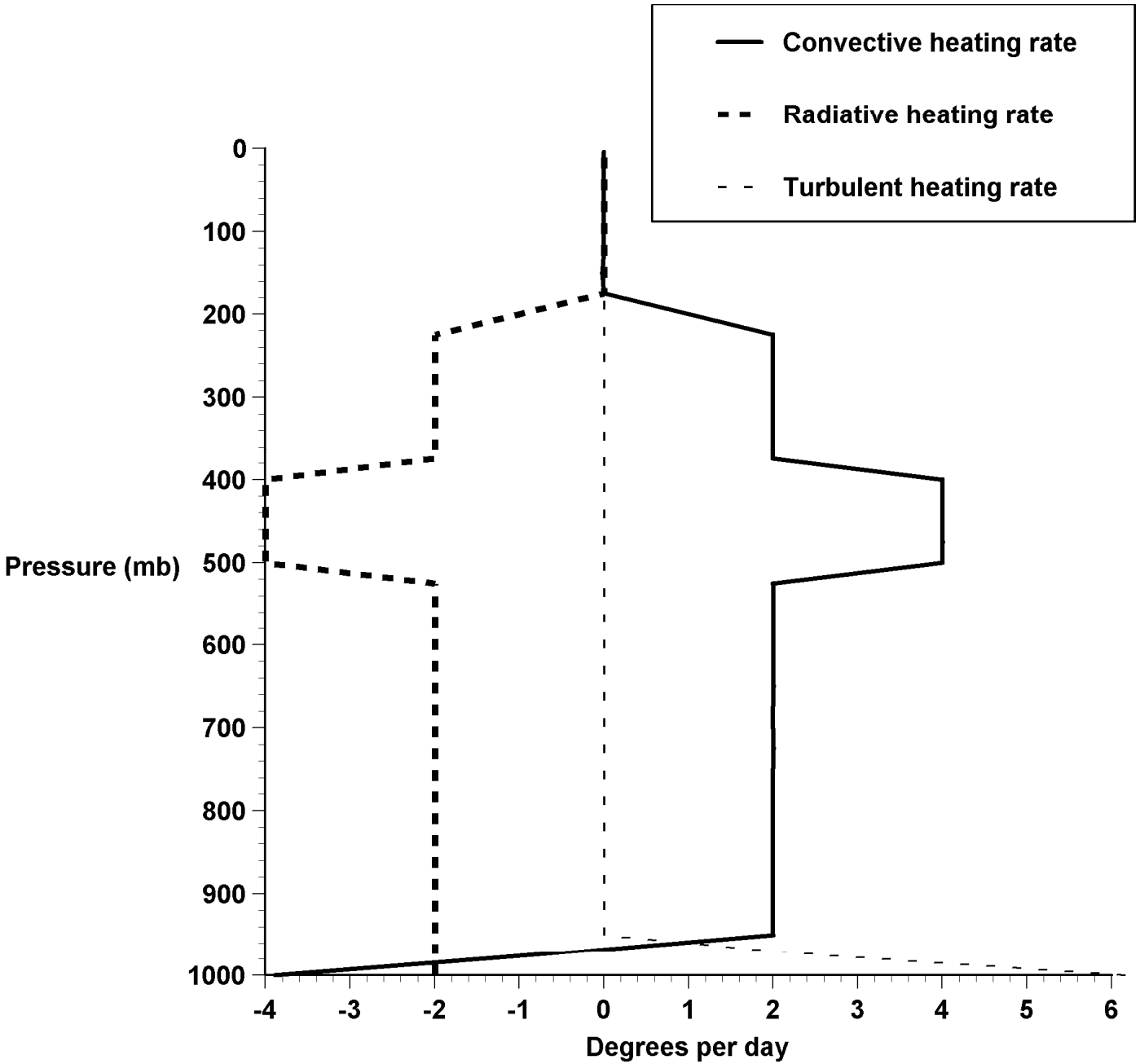


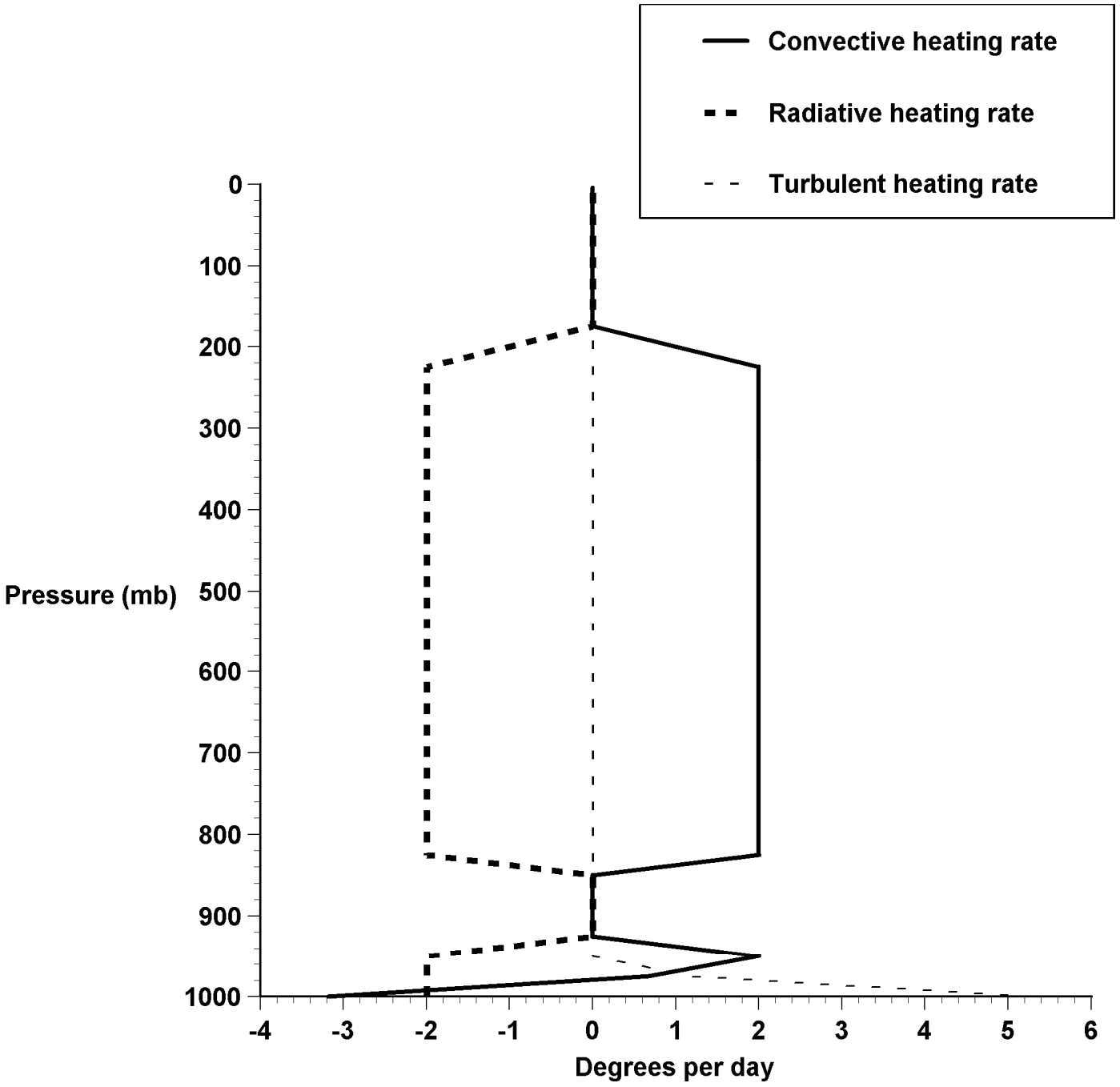

Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Relative humidity

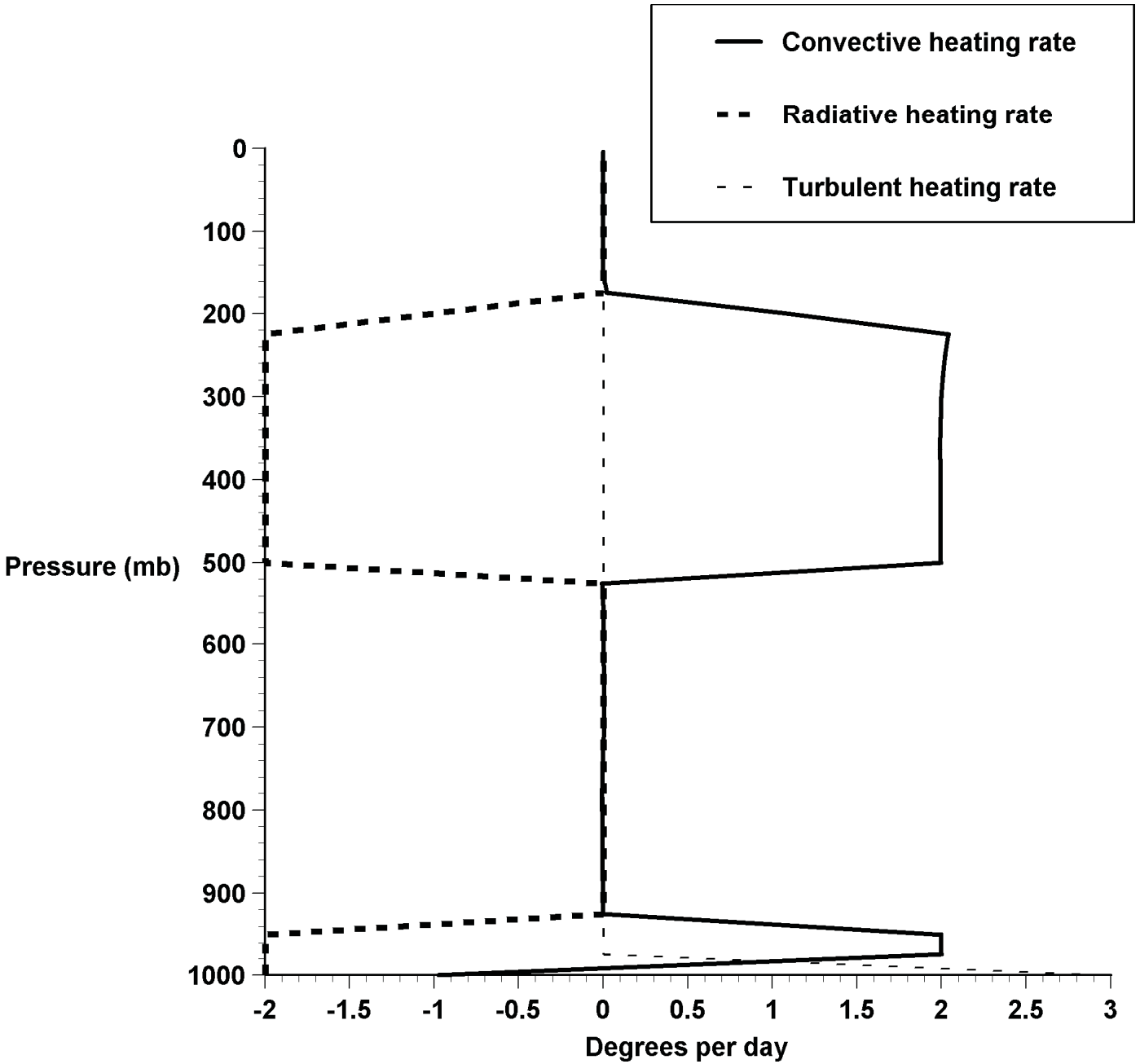

0
100
200
300
400
500
600
700
800
900
1000
Pressure (mb)
325
330
335
340
345
350
355
Moist static energy/c p (K)


Upward turbulent enthalpy flux (W/m2)
Net upward radiative energy flux (W/m2))
Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
-150
-100
-50
0
50
100
150
Wm-2

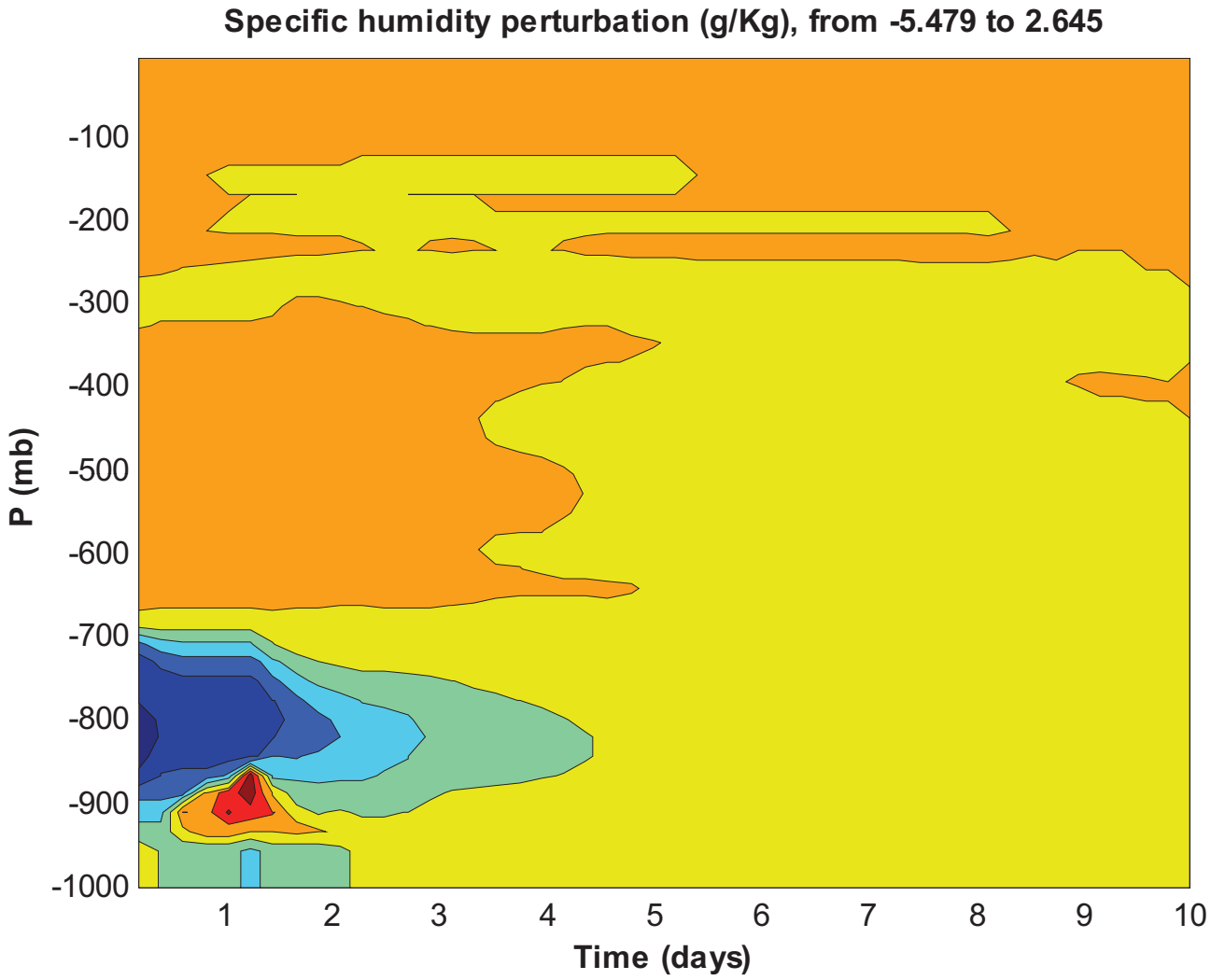

Convective heating rate
Radiative heating rate
Turbulent heating rate
Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
-4
-3
-2
-1
0
1
2
3
4
5
6
Degrees per day


Convective heating rate
Radiative heating rate
Turbulent heating rate
Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
-4
-3
-2
-1
0
1
2
3
4
5
6
Degrees per day


Convective heating rate
Radiative heating rate
Turbulent heating rate
Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
-4
-3
-2
-1
0
1
2
3
4
5
6
Degrees per day


Convective heating rate
Radiative heating rate
Turbulent heating rate
Pressure (mb)
0
100
200
300
400
500
600
700
800
900
1000
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
Degrees per day

Recovery from mid-level specific humidity perturbation



12.811 Tropical Meteorology

Spring 2011