GEF2200: Oppgaver til 28. februar 2007

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WH06 3.31 (WH78 2.35)
(Denne kan gjøres veldig lett, men mer detaljerte beregninger er også mulig.)

WH06 3.28 (WH78 2.34)

A.16.T
We have $g_0 dZ = g dz$, and intuitively we see that if g decreases with height, dz will have to be greater than dZ. Use that

$$g = \frac{GM}{(r_E + z)^2} \tag{1}$$

where G is the universal gravity constant, M is the mass of Earth. r_E is the mean radius of Earth and z is the height above surface (so that $r_E + z$ is the total distance from the center of Earth).
Show the relationship between dZ and dz by integration (by substitution of $u = z/r_E$). You will have to use that for $z/r_E \ll 1$, we can write

$$\frac{1}{1 + z/r_E} \approx 1 - \frac{z}{r_E} + \left(\frac{z}{r_E}\right)^2 \tag{2}$$

A.19.T
Define the following:
a. Mixing ratio and saturated mixing ratio.

b. Relative humidity.

c. Dew point temperature (duggpunktstemperatur).

d. Saturated adiabat (fuktigadiabat).

e. Lifting condensation level.

f. Level of free convection.

g. Equivalent potential temperature.

h. Conditionally unstable atmosphere.

i. Convective unstable air.

A.20.T
– *a* –
Define potential temperature (θ).
Assume that the air is dry. What is the criterion for static stability of the atmosphere, given by θ?

– *b* –
Draw the two points A and B on a sonde diagram, with temperatures $T_A = 10°\text{C}$, $T_B = 0°\text{C}$ and pressures $p_A = 1000\text{hPa}$ and $p_B = 700\text{hPa}$.

Is the layer between A and B stable?

– *c* –
Define the following quantities:

1. Water vapor mixing ratio, w (vanndampens blandingsforhold)
2. Water vapor saturated mixing ratio, w_s (vanndampens metningsblandingsforhold)
3. Dew point temperature, T_d (duggpunktstemperatur)

For a new parcel of air, find the values above when the temperature is $T = 15°\text{C}$, $RH = 80\%$ and $p = 1000\text{hPa}$.

- *d* –
In two different cases, the temperature is $T_1 = 15°\text{C}$ and $T_2 = 20°\text{C}$, respectively. The pressure is $p = 1000\text{hPa}$, and relative humidity $RH = 80\%$.
In both cases, the air is lifted to 800hPa. Find the amount of condensed water for each of the air parcels.

Can you relate this answer to global warming?

– *e* –
For the air parcel with start temperature T_1, 80% of the water condensed at 800hPa falls out as rain. Find the following quantities before and after the air parcel is lifted to 800hPa and then lowered back to 1000hPa:

T, w, w_s, RH and θ.

Which of the quantities are conserved?

Which kind of weather phenomena is this exercise describing?

– *f* –
On the sonde diagram, the dry and moist (pseudo) adiabats are shown as functions of temperature and pressure. Explain the differences and similarities of the slope of the lapse rates at different heights.

A.14.T
Derive the adiabatic lapse rate for dry air using the definition of enthalpy.

A.15.T
Derive the potential temperature.

WH06 3.40 (WH78 2.26)

WH06 3.41 (WH78 2.29)

WH06 3.30 (WH78 2.31)