GEF2200: Oppgaver til 14. mars 2007

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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.

WH06 6.11 (WH78 4.13)

WH06 6.10 (WH78 4.12)

WH06 6.8a, b, c, o, x, kk

WH78 4.7

Aerosol with diameter D between about 2 and 40 μm experiences a so-called Stokes drag force given by $3\eta Dv$, where η is the viscosity of the air, and v is their velocity through air. Neglecting the density of air compared to density ρ of an aerosol, derive an expression for the terminal fall speed v_s of the aerosol. Use this expression to calculate the terminal fall speeds of aerosol with diameters 1 and 10 μm. (Assume that $\rho = 10^3\text{kg m}^{-3}$, $\eta = 1.7 \cdot 10^{-5}$ SI units.)

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)