Obligatory exercise no. 1 in GEF2610, spring 2015

Deadline: Friday 14th March, either by e-mail to eyvind.aas@geo.uio.no, or in paper form to the mail box of E. Aas in the Geology building.

Question 1

In the oceans we see that the major surface currents form great anticyclonic gyres. Explain briefly the reason for this pattern. List the currents forming the gyres in the Northern and Southern Atlantic.

Question 2

a) Assume that the Norwegian Coastal Current outside Stadt (62 °N) on the Norwegian West Coast at a certain time is flowing northwards with a velocity of 0.5 m s^{-1}. Assume also that this current is geostrophically balanced. What is the value of the Coriolis parameter at this latitude? How much will the sea surface slope towards the west per 10 km? Downwards or upwards?

b) Assume that we have two stations with 10 km distance in the east-west direction outside Stadt, that density is constant in the vertical at the two stations, and that there are no horizontal pressure gradients between the two stations at 100 m depth. If the density at the utter station is 1026.000 kg m^{-3}, what is the density at the inner station, based on the slope found in question a)? We assume hydrostatic equilibrium in the vertical.

Question 3

a) The following question was earlier a part of the intelligence test used by the military to test the recruits: For the whole globe the oceans will constitute 7/10 of the surface area. For the northern hemisphere the same ratio will be 3/5. What is the ratio on the southern hemisphere?
On the northern hemisphere the mean temperature of the sea surface is 19.2 ºC, and on the southern 16.0 ºC. What will be the mean sea surface temperature for the whole globe, weighted with the sea areas on the two hemispheres?

b) Based on the mean temperature of the world ocean found in a), at which wavelength will the gross infrared heat radiation Q_b from the sea have its maximum radiation? Use Wien's Displacement Law:

$$\lambda_{max}\, T_K = 2898\ \mu m\ K$$

where T_K is in K (T_K = ºC + 273).

Gross longwave radiative flux Q_b from the sea surface is expressed by the Stefan-Boltzmann Law:

$$Q_b = \sigma\,(T_K)^4$$

where σ is the Stefan-Boltzmann constant $5.67 \cdot 10^{-8}$ W m^{-2} K^{-4}. What will be the gross emitted heat flux from the oceans if we use the mean temperature found in a)?

c) If the net heat loss by infrared radiation from the oceans is about 50 W m^{-2}, how great must the infrared radiation from atmosphere to oceans be, based on the result in b)?