Climate Dynamics
Summer Semester 2017

UNIVERSITÄT LEIPZIG

Homework 6
Due 31 May 2017

Problem 1 Wind climatology

(a) Using the files `/home_local/quaas/data//home_local/quaas/data/ERA_U_dp50.nc` and `/home_local/quaas/data//home_local/quaas/data/ERA_V_dp50.nc`, plot vector maps of the horizontal wind at 850 hPa and 200 hPa for climatological summer (JJA) and winter (DJF).

(b) Using the file `/home_local/quaas/data/ERA_U_zonmean_mean.nc`, plot the vertical–meridional distribution of the mean zonal wind for JJA and DJF.

Problem 2 Ekman spiral

(a) Find the general form of the solution to the Ekman-layer equations of motion, equations (2.149) and (2.150) in the lecture slides. Assume eddy viscosity friction proportional to $\partial^2/\partial z^2$, as given in the equations.

Note: assume that the solution takes the form $u_E(z) = V_0 \exp(\alpha z + \beta)$ *to turn the system of differential equations into arithmetic equations for* α *and* β*. The English word for this is "ansatz".*

(b) For a southerly wind with surface wind stress T, show that your solution recovers equations (2.151) and (2.152) in the lecture slides.

Problem 3 Heat capacities

On short time scales, land surfaces and the mixed layer of the ocean act as heat buffers in the climate system. In this problem, we will compare their heat capacities.

(a) Assume the mixed layer of the ocean extends to a depth of 100 m. Using a specific heat for water of 4×10^3 kJ kg^{-1} K^{-1} and density 10^3 kg m^{-3}, find the heat capacity of the mixed layer.

(b) Assume that the seasonal cycle of air temperature penetrates the land surface to a depth of 1 m. Using a specific heat for rock of 800 J kg^{-1} K^{-1} and density 3×10^3 kg m^{-3}, find the heat capacity of the land surface.