Climate of the Ocean – Exercise 2 **09.11.2016**

Task 1:

In lecture 3 the equations of motion for the so-called inertial oscillations were introduced:

$$\frac{du}{dt} = fv$$

$$\frac{dv}{dt} = -fu$$

Show that in the northern hemisphere (f>0) an object released at the position (x_0,y_0) orbits clockwise in a circle of radius $R = \frac{V}{f}$ about the point $(x_0, y_0 - \frac{V}{f})$ with a period $T = \frac{2\pi}{f}$.

Task 2:

In lecture 3 you had a look at the horizontal momentum equations and the scales of the different terms for synoptic motions in the atmosphere in the mid-latitudes, as can be seen in Table 1. Do the same for the circulation in the mid-latitude ocean (ϕ_0=45°).

Horizontal velocity scale	U ~ 10^{-1} m s^{-1}
Vertical velocity scale	W ~ 10^{-2} m s^{-1}
Length scale	L ~ 10^{5} m
Depth scale	H ~ 10^{3} m
Horizontal pressure fluctuations	$\delta P/\rho$ ~ 10^{3} m^2 s^{-2}
Time scale	L/U ~ 10^{6} s (10 days)

Table 2.1 *Scale Analysis of the Horizontal Momentum Equations*

	A	B	C	D	E	F	G
x-Eq.	$\frac{Du}{Dt}$	$-2\Omega v \sin\phi$	$+2\Omega w \cos\phi$	$+\frac{uw}{a}$	$-\frac{uv \tan\phi}{a}$	$= -\frac{1}{\rho}\frac{\partial p}{\partial x}$	$+F_{rx}$
y-Eq.	$\frac{Dv}{Dt}$	$+2\Omega u \sin\phi$		$+\frac{vw}{a}$	$+\frac{u^2 \tan\phi}{a}$	$= -\frac{1}{\rho}\frac{\partial p}{\partial y}$	$+F_{ry}$
Scales	U^2/L	$f_0 U$	$f_0 W$	$\frac{UW}{a}$	$\frac{U^2}{a}$	$\frac{\delta P}{\rho L}$	$\frac{\nu U}{H^2}$
($m\ s^{-2}$)	10^{-4}	10^{-3}	10^{-6}	10^{-8}	10^{-5}	10^{-3}	10^{-12}

Table 1: Scale Analysis of the Horizontal Momentum Equations (from J. R. Holton: An Introduction to Dynamic Meteorology, Third Edition)