Book: Dynamical Oceanography
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Consider a flow having a width of 200 km directed northward with a maximum velocity of 2 ms^{-1} near the latitude 27° N.

a. Calculate the value of the Coriolis parameter f_0 of this flow.

The Coriolis parameter is given by $f_0 = 2\Omega \sin\theta_0$ [s^{-1}], where $\Omega = 7.3 \times 10^{-5}$ s^{-1} is the angular velocity due to Earth rotation and $\theta_0 = 27°$N is the latitude of the fluid element in question. Hence $f_0 = 6.63 \times 10^{-5}$ s^{-1}.

b. Determine a typical value of the relative vorticity of the flow.

A typical value of the relative vorticity of the flow is of $O(\frac{U}{L}) = \frac{2m/s}{200 \cdot 10^3 m} = 10^{-5}$ s^{-1}.

c. Provide estimates of the time scales τ_f, τ_a and the Rossby number ϵ.

The advective time scale τ_a associated with the flow is given by $\tau_a = L/U = 10^5$ s. The inertial timescale is given by $\tau_f = 1/f = 1/(2\Omega \sin\theta_0) = 1.5 \times 10^5$ s. The Rossby number ε is the ratio of τ_f and τ_a according to $\varepsilon = \tau_f/\tau_a = U/(fL) = 1.5$.