Book: Dynamical Oceanography
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Chapter: 7, Exercise: 7.4: Kelvin wave
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At midlatitudes, Kelvin waves move along coasts.

a. In which direction (north or south) propagate these waves if they move along the European Atlantic coast?

As a Kelvin wave needs a wall to the right of its propagation direction in the northern hemisphere, they propagate northward.

Suppose that a Kelvin wave propagates in a layer of water with a thickness $H_0 = 10^3$ m.

b. Calculate the Rossby deformation radius of such a wave at 45°N.

We have a Kelvin wave which propagates in a layer of water with a thickness $H_0 = 10^3$ m at 45^0. The external Rossby deformation radius is:

$$R_D = \frac{\sqrt{gH_0}}{f_0} \approx 10^6 m$$

where $f = 2\Omega \sin 45^\circ = 10^{-4}\ s^{-1}$.

c. Determine the time τ that is needed for a Kelvin wave to propagate over a distance of 1000 km.

The time τ that is needed for a Kelvin wave to propagate over a distance $L = 1000$ km is

$$\tau = \frac{L}{\sqrt{gH_0}} = 10^4\ s$$