Book: Dynamical Oceanography
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Chapter: 9, Exercise: 9.4: Sverdrup balance in a two-layer model
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Consider a quasi-geostrophic two-layer model for the wind-driven ocean circulation in a square basin of length L on the midlatitude β plane. Both layers have the same equilibrium thickness and their density difference is small compared to the mean density.

a. Show that in the part of the basin where the Sverdrup balance holds, the bottom layer is motionless.

Consider the dimensional 2-layer equations on page 201. If the upper layer is in Sverdrup balance it is a steady flow and hence the lower layer is unforced. The solution $\psi_{2*} = 0$ is then always a solution.

b. If one can measure the slope of the thermocline with an accuracy of 10%, show that one cannot measure the sea surface height with a better accuracy.

Using the results of exercise 9.1, we see that the sea surface height and the thermocline deviation are linearly related and hence the relative accuracy is the same.