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Ocean Boundary Pressure: Insights and generalizations from Stommel and Munk models.

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The difference between eastern and western boundary pressures is strongly constrained by the zonal wind stress via the balance of angular momentum, and the meridional derivative of boundary pressure represents the bottom pressure torque, closely related to boundary current transport. Here, we use the analytical solutions available due to the Stommel and Munk models to investigate the behaviour of these boundary pressures in the case of a frictionally closed barotropic vorticity balance. We find a number of interesting results. 1) The eastern pressure torque is locally determined, whereas the western torque "mops up" what remains of the angular momentum balance. 2) with longshore winds included, the torque becomes decoupled from the boundary current, and can even occur at the opposite side of the ocean. 3) The nature of the boundary currents is sensitive to the form of friction considered, and can even produces an offshore jet maximum in the Stommel case with variable friction. 4) Even for the general case with topography, a relationship can be found between boundary pressure, longshore wind stress, and interior ocean pressure, which shows the boundary pressure relaxing towards the interior pressure as the equator is approached, but the wind stress counteracting this. This last result generalizes a result found for sea level in 2D models due to Minobe et al. (2017).

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