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# Propagation of meridional transport anomalies along western and eastern coastlines

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A number of recent studies have described the response of the meridional overturning circulation to transient forcing in terms of the propagation of (large-scale) Rossby waves and (small-scale) Kelvin waves (or coastal-trapped waves). A marked asymmetry is found between adjustment process on the western and eastern boundaries: pressure anomalies decay but meridional transport anomalies are nearly constant as they propagate equatorward along a western boundary, whereas pressure anomalies are nearly constant but meridional transport anomalies decay as they propagate poleward along an eastern boundary. This asymmetry leads to the "equatorial buffer" that confirms high-frequency variability in meridional overturning circulation to the hemispheric basin in which it is generated (Johnson and Marshall, 2002).

In this paper, following ideas of Clarke and Shi (1991) and others, we argue that a separation of the adjustment process into Rossby and Kelvin waves is artificial. At moderate frequencies, "Kelvin waves" are no longer trapped at the boundary and assume the character of radiating short and long Rossby waves at the western and eatsern boundaries respectively. At lower frequencies still, the western boundary wave again becomes trapped, but over the frictional boundary layer scale. This latter regime also describes the adjustment process as captured in a planetary geostrophic (or coarse-resolution) ocean model. The asymmetry in the behaviour of pressure and meridional transport anomalies along western and eastern boundaries, as well as the speed of propagation (or otherwise) is easily explained using the theory. Implications for the adjustment of the meridional overturning circulation in numerical ocean models (in which the boundary waves are often sub-grid scale) will be discussed.