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Interactive comment on "On the role of domain aspect ratio in the westward intensification of wind-driven surface ocean circulation" *by* Kaushal Gianchandani et al.

Anonymous Referee #1

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The authors revisit the classical linear theories of the western boundary current by Stommel (1948) and Munk (1950) to examine the role of the domain aspect ratio. A non-dimensional linear vorticity equation is derived to show the sensitivity of the western boundary current transport to domain aspect ratio (delta) and drag coefficient (alpha) and then apply the results to explain the weak East Australian Current of the South Pacific. While I agree that non-dimensional equations are useful, it is unclear what the new physical findings of this study are. Is there a change in how the vorticity balances in the western boundary layer? The authors need to clarify that the parameter dependence of the WBC solution is not just a result of the mathematical formulation that the authors have chosen.

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Discussion paper

(1) I would like the authors to discuss the sensitivity of the results to the choice of the boundary current width. In terms of mass balance, the WBC simply returns the Sverdrup interior so if the Sverdrup interior is kept constant, the transport of the WBC will not change. The meridional velocity at the western boundary also varies differently in the zonal direction for S48 and M50: for S48, it decays exponentially with epsilon while for M50, a maximum occurs near epsilon. The way the transports are estimated (Equations 4 and 8) does not seem to fully take these differences into account.

(2) The scaling of the stream function depends on delta [gamma*beta*Ly^3 = tau*pi/(rho*Ho*beta)*delta^-1]. Is the sensitivity of the WBC transport to delta a consequence of using such a scaling? As Ly changes, so do the magnitude of the wind stress curl and the scaling of the stream function. What is the benefit of using such scaling? To focus on the WBC, isn't it better to keep the wind stress curl constant and keep the Sverdrup interior the same?

(3) Figure 4 shows that the transport of the East Australian Current (EAC) is weaker than the other WBCs because of the small delta. But how was Ly determined for EAC? The meridional scale of this western boundary current appears to be different from the spatial scale of the winds. Zero wind stress curl does not exist around 22S (e.g. https://booksite.elsevier.com/DPO/chapterS10.html).

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