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Zonal Momentum Budget Along the Equator in the Indian Ocean from a High Resolution Ocean General Circulation Model

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This study examines the zonal momentum budget along the equator in the Indian Ocean, with emphasis on the Wyrtki Jets in a high-resolution ocean general circulation model. The Wyrtki Jets are wind-driven eastward flows in the upper 100 m of the equatorial Indian Ocean that appear typically twice per year during the monsoon transitions in boreal spring and fall. Our results indicate significant contributions from zonal, meridional and vertical advection of zonal momentum, with the dominant contribution coming from zonal momentum advection. These results contrast with those from previous idealized wind-forced model experiments that emphasized the importance of vertical momentum advection. The extra eastward force caused by zonal momentum advection reinforces eastward wind stress, resulting in swifter jets in the eastern basin than in the western basin. Another consequence of these nonlinearities is that, annually averaged, zonal currents in the upper thermocline flow against the zonal pressure gradient rather than down gradient. Thus, there is no mean subsurface undercurrent flowing against the surface winds in the Indian Ocean as there is in the Pacific and Atlantic Oceans. These results indicate that proper simulation of the mean and the semi-annual zonal flows along the equator in the Indian Ocean, including their climatically relevant impacts on the mass and heat balance of the region, requires accurate representation of nonlinearities that derive from a broad range of interacting time and space scales.