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Year-to-year meridional shifts of the Great Whirl driven by oceanic internal instabilities

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The Great Whirl (GW) is a quasi-permanent anticyclonic eddy that forms off the horn of Africa in the western Arabian Sea. It generally appears in June, peaks in July-August, and dissipates in September. While the annual cycle of the GW has been described by past literature, its year-to-year variability has not yet been thoroughly explored. Satellite sea-level observations reveal that the leading mode of interannual variability (half of the interannual summer variance in the GW region) is associated with a typically ~100-km GW northward or southward shift. This meridional shift is associated with coherent sea surface temperature (SST) and surface chlorophyll signals, with warmer SST and reduced marine primary productivity in regions with positive sea level anomalies (and vice versa). Eddy-resolving (~10-km resolution) simulations with an ocean general circulation model capture those observed patterns reasonably well, even in the absence of interannual variations in the surface forcing. Interannual surface forcing variations enhance the GW interannual variability, but do not constrain its phase. Our results hence indicate that year-to-year variations in the Somalia upwelling SST and productivity associated with the GW are thus not a deterministic response to surface forcing, but largely arise from oceanic internal instabilities.