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Internal waves and Equatorial dynamics: an observational study in the West Atlantic Ocean

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Internal waves present several fascinating aspects of great relevance for geo- and astro-physical fluid dynamics. These waves are supported by all kinds of stratified and rotating fluids, such as, for example, our ocean, atmosphere, a planet fluid core or a star. In a non linear regime, because of their oblique propagation, they are thought to play a key role in diapycnal mixing, as well as in angular momentum mixing. Unfortunately, a complete analytical description of internal waves in arbitrarily shaped enclosed domains is still an ongoing challenge. On the other hand, internal wave energy is observed travelling along rays, whose behaviour can be traced and whose reflections off the container's boundaries appears crucial in producing phenomena such as focussing of wave energy onto specific trajectories (attractors), and in triggering localized instabilities. Ray tracing studies have shown that equatorial regions of stratified and/or rotating spherical shells are likely affected by these features, being the place where the simplest shaped and most energetic attractors occur.

In this study we aim to investigate the possible presence and role of internal wave attractors in determining the equatorial ocean dynamics. Internal wave attractors, observed in laboratory and numerical experiments, have not been observed in Nature, yet. A unique set of observations, collected in the deep Equatorial West Atlantic Ocean, will be used here in order to explore this possibility, the dataset consisting of 1.5 year long time series of current measured acoustically and with current meters moored between 0°and 2°N, at 37°W, off the Brazilian coast. In particular, angular momentum mixing due to internal wave focussing, is explored as a possible mechanism for maintaining the Equatorial Deep Jets. These jets are stacked alternating zonal currents that are ubiquitously observed in all the oceans and whose nature is still largely unknown. Remarkably, jet like structures are also observed in the equatorial regions of fluid planets, suggesting that their existence could be related to general properties of the system such as shape, stratification and rotation.

The equatorial ocean shows a different dynamics compared to off-equatorial regions, in terms of mean flow, internal wave and mixing properties. Despite the crucial role it plays in the global circulation and in our climate, this region is still poorly understood. We propose that the use of a new framework of interpretation, together with long term, *in situ* measurements can shed some light on the processes taking place in this peculiar region, and constitutes a key step towards a better understanding of energy fluxes in the ocean, as well as in other stratified, rotating fluid domains.