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Deep Coherent Vortices and Their Sea Surface Expressions

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Mediterranean Water eddies, known as Meddies, are an important dynamic process occurring at depths of 1000-meters in the Northeast Atlantic Ocean. Meddies occur as a direct result of the Mediterranean Outflow exiting through the Gibraltar Strait, and represent a prevalent mechanism that can be found extensively throughout the ocean. Moreover, Meddy cores are known to produce measurable expressions at the sea surface in the form of rotating coherent vortices, not only affecting the sea surface from beneath, but also allowing for the possibility to remotely study these deep phenomena through data gathered at the sea surface. While many past studies have focused on the properties of Meddy cores, only a handful of studies focus on the physical characteristics and behavior of the surface expressions produced. Are Meddy surface expressions different from other like vortices that dominate the physical ocean surface? What are the relationships between deep and surface mechanisms, and do any feedbacks exist? To shed light on these questions, we investigate the relationship between Meddies and their sea-surface expressions through observations using in-situ float and drifter profiles and satellite altimetry. A total of 782 Meddy cores were examined in the Northeast Atlantic using temperature and salinity data obtained by CTD and Argo during the Mecanismos de transporte e de dispersão da Água Mediterrânica no Atlântico Nordeste (MEDTRANS) project, and their corresponding sea-level expressions were geo-temporally matched in satellite altimetry data. We report several statistical properties of the sea-surface expressions of Meddies, including their mean diameter and vertical magnitude, and compare the properties of their surface features to the underlying Meddy cores. We investigate how the deep core affects the surface, and whether surface expressions may in return yield information about the underlying cores. Additionally, we examine the variability of the surface expressions, including seasonal and geographical variability.