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OBSERVATIONAL EVIDENCES OF STRAIN-INDUCED PERIODIC STRATIFICATION (SIPS) IN THE GUADALQUIVIR ESTUARY

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Abstract: The G&M14 stratification-circulation diagram allows to classify estuaries on the basis of river flow and tidal forcing in terms of the freshwater Froude number and a mixing parameter that accounts for the vertical structure of the water column [Geyer & MacCready, 2014]. In this study, instead of computing these parameters for the whole estuary as was originally proposed by these authors, both are computed locally, at different stretches along the Guadalquivir estuary. The analysis is based on the data collected at 21 stations in a 3 year continuous monitoring campaign (2008–2011), during which the estuary experienced a wide range of environmental conditions [Navarro et al., 2011]. Remarkably, the results reveal that conditions in the inner stretches fall most of the time in the Strain-Induced Periodic Stratification (SIPS) regime mapped in the G&M14 diagram [Simpson *et al.*, 1990]. Near the mouth, the estuary is mostly partially-mixed. Freshwater discharges may shift the state of the lower stretches toward a salt-wedge structure whose location depends strongly on the fresh water volume discharged. Estimates of the Simpson number during the same period confirm this picture. The SIPS regime implies that the covariance between eddy viscosity and vertical shear of the longitudinal current drives part of the subtidal circulation, even more efficiently than the classical gravitational circulation does [Burchard & Hetland, 2010]. This may have a significant impact on the estuarine suspended matter distribution. Results further point out the limitations of estuarine classification of estuarine systems as a whole on the basis of stratification-circulation diagrams. Even spatially close stretches may transit different regions of the G&M14 diagram. A specific stretch of an estuary may change its structure and its state in the stratification-circulation diagram may undergo large excursions under changing environmental conditions.

Key words: circulation-stratification, strain-induced periodic stratification, regimes, Guadalquivir estuary

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References: please follow the examples below

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