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CIRCULATION AND SALINITY INTRUSION IN THE GUADIANA ESTUARY

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ABSTRACT

Barotropic tidal propagation, circulation and salinity intrusion in the Guadiana estuary are described, based on two-dimensional numerical simulations supported by field data. Results are integrated through selected indicators, which provide detailed insight into the variability of the estuarine dynamics with the tides, the river flow and the spatial location.

The estuarine dynamics is strongly affected by the generation of non-linear tidal constituents. Quarter-diurnal constituents distort the tide along the estuary, resulting in strong flood dominance. As a consequence, the estuary experiences accretion for low river flows. Residual velocities are directed upstream in shallow areas and downstream in the main channel. This pattern is responsible for higher salinities near the eastern margin, explaining the observed cross-sectional distribution of benthic organisms. The Coriolis effect and the residual currents patterns contribute to the efficient mixing of the river plume, promoting the renewal of the estuarine water. Residence times, computed with a new method based on particle tracking simulations, vary between four months and one week, for river flows between 8 and 300 m^3/s.

Maximum salinity intrusion depends on the tidal amplitude, which accounts for 8 km of its variability, and on the river flow. For very low river flows, the 0.5‰ isohaline penetrates up to 40 km into the estuary. The oligohaline, mesohaline and polyhaline regions extend for about 5 km each, and their locations shift by about 20 km with the tide. The estuary is stratified for river flows above 100 m^3/s, and well mixed for river flows below 10 m^3/s.

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