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Internal tides as a major process in Amazon continental shelf fine sediment transport

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The description of hydrodynamics associated with the extensive reef system on the shelf break adjacent to the Amazon River is still a challenge for ocean sciences. Despite the discharge of more than one billion tons of cohesive sediment per year, the outer continental shelf of the world's largest river presents very low concen-trations of suspended sediment near the bottom and an absence of modern fine sediment deposits nearly one hundred kilometers before the shelf break. The offshore limit of the subaqueous delta consists of a sigmoidal clinoform standing between 40 and 70 m in depth, a depositional feature that cannot be explained solely by estuarine-like gravitational circulation. This paper aims to test the hypothesis that internal tides have a major role in the control of offshore fine sediment transport. For that, we implement a set of tridimensional, non- hydrostatic, and high-resolution (up to 2 m, vertical, and 2 km, horizontal) Delft3D models. The experiments showed that even disregarding river plume buoyancy, wind drag, superficial waves, and ocean currents, the exclusive interaction between barotropic tidal currents, bathymetry, and the stratification structure of the ocean is capable of generating asymmetrical current patterns compatible with modern deposition. The maximum shelf slope and the relative depth between the outer shelf and the pycnocline represent the main factors influencing the generation and shoreward propagation of internal tides. Over time, spring-neap cycles are eventually capable of reverting cross-shore subtidal transport tendencies, while seasonal variability in ocean stratification modulates the intensity of baroclinic processes.