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Three Dimensional Numerical Simulations of Internal Tides in the Angolan Upwelling Region

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In austral winter, biological productivity at the Angolan shelf reaches its maximum. The alongshore winds, however, reach their seasonal minimum suggesting that processes other than local wind-driven upwelling contribute to near-coastal cooling and upward nutrient supply, one possibility being mixing induced by internal tides (ITs). Here, we apply a three-dimensional ocean model to simulate the generation, propagation and dissipation of ITs at the Angolan continental slope and shelf. Model results are validated against moored acoustic Doppler current profiler and other observations. Simulated ITs are mainly generated in regions with a critical/supercritical slope typically between the 200- and 500-m isobaths. Mixing induced by ITs is found to be strongest close to the coast and gradually decreases offshore thereby contributing to the establishment of cross-shore temperature gradients. The available seasonal coverage of hydrographic data is used to design simulations to investigate the influence of seasonally varying stratification characterized by low stratification in austral winter and high stratification in austral summer. The results show that IT characteristics, such as their wavelengths, sea surface convergence patterns and baroclinic structure, have substantial seasonal variations and additionally strong spatial inhomogeneities. However, seasonal variations in the spatially-averaged generation, onshore flux and dissipation of IT energy are weak. By evaluating the change of potential energy, it is shown, nevertheless, that mixing due to ITs is more effective during austral winter. We argue this is because the weaker background stratification in austral winter than in austral summer acts as a preconditioning for IT mixing.