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Hydrodynamics and sediment transport pathways on a barred intertidal beach during high wave-energy conditions, Wissant bay, Northern France

Wissant bay comprises a 6 km-long sandy beach open to the northwest, and limited by two capes. This bay is the most rapidly eroding sector of coast in France, with a retreat of over 250 m in the last century in the central and western parts of the bay. Facing the Dover Strait, the bay is area is exposed to storm (wind and wave) activity. During calm wave conditions, the hydrodynamic circulation in Wissant bay shows a divergent current structure between the western and eastern parts. This current structure involves a large-scale tidal gyre probably related to the projecting headland of Cape Gris-Nez in the western part of the bay. Hydrodynamic measurements carried out during high-energy conditions highlight a much more dynamic and more homogeneous regime related to significant wind forcing. During conditions of significant wind stress (sustained wind speeds > 8 $m.s^{-1}$), the peak longshore spring tide velocities are two to three times larger than 'normal' spring tidal current velocities, culminating at up to 2 $m.s^{-1}$. The intertidal bar-trough beach system of this bay can be dominated for long periods of time by strong longshore wave and wind-forced unidirectional currents. From combined hydrodynamic measurements and sediment transport trend analysis, residual sediment transport directions were identified. The sand transport pathways strongly conform to the high-energy hydrodynamic regime, thus suggesting that the long-term evolution of the bay, involving significant beach erosion, is largely controlled by these high-energy events.