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Contribution of vertical land motions to coastal sea level variations: a global synthesis of multisatellite altimetry, tide gauge and GPS measurements

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Coastal sea level variations result from a complex mix of climatic, oceanic and geodynamical processes driven by natural and anthropogenic constraints. Combining data from multiple sources is one solution to identify particular processes and progress towards a better understanding of the sea level variations and the assessment of their impacts at coast. Here, we present a global database merging multisatellite altimetry with tide gauges and Global Positioning System (GPS) measurements. Vertical land motions and sea level variations are estimated simultaneously for a network of 886 ground stations with median errors lower than 1 mm/yr. The contribution of vertical land motions to relative sea level variations is explored to better understand the natural hazards associated with sea level rise in coastal areas. Worldwide, vertical land motions dominate 30 % of observed coastal trends. The role of the crust is highly heterogeneous: it can amplify, restrict or counter the effects of climate-induced sea level change. A set of 182 potential vulnerable localities are identified by large coastal subsidence which increases by several times the effects of sea level rise. Though regional behaviours exist, principally caused by GIA (Glacial Isostatic Adjustment), the local variability in vertical land motion prevails. An accurate determination of the vertical motions observed at the coast is fundamental to understand the local processes which contribute to sea level rise, to appraise its impacts on coastal populations and make future predictions.