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on GNSS-IR technique for measuring shallow sediment compaction

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The solid Earth aspects of relative sea-level change can dominate in low-lying coastal areas with potentially vulnerable to accelerating rates of sea-level rise. Global Navigation Satellite System (GNSS) as companion tools to tide gauges allow long-term assessment of solid Earth deformation, thus essential for disclosing climate-forced mechanisms contributing to sea-level rise (SLR). So far, it has not been possible to measure shallow displacements that occur above the base of GNSS monument because conventional positioning determines the vertical component of position changes resulting from displacements occurring beneath the foundation. We use an emerging technique, GNSS interferometric reflectometry (GNSS-IR), to estimate the rate of this process in two coastal regions with thick Holocene deposits, the Mississippi Delta and the eastern margin of the North Sea. We show that the rate of land motion from shallow compaction is comparable to or larger than the rate of SLR. Since many of the world's great coastal cities are built on river deltas with comparable Holocene sections, our results suggest that estimates of flood risk and land loss have been underestimated. We demonstrate environmental impact of parking lots and streets surrounding several monitoring sites on GNSS measurements. Such kinematic environments will perturb the amplitude of reflected signals to GNSS sensors and leave time-variable imprints on GNSS observations. Thus, obtaining desirable reflections for shallow subsidence monitoring could be challenging.