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Rates of Present Natural Subsidence and Sea Level Rise along the Texas Coast Derived from GPS and Tide Gauge Data

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ABSTRACT

Coastal submergence caused by land subsidence and sea level rise exerts significant impacts on coastal economic development and ecosystems. This study investigated the rates of sea level rise and natural subsidence along the Texas Coast using multi-decadal to century continuous tide gauge and GPS datasets. The rates of land subsidence and sea level rise are aligned to the Gulf of Mexico Reference Frame 2020 (GOM20). The regional stable reference frame is established using long-history (13.5 yr on average) observations from 55 continuously operated Global Navigation Satellite System (GNSS) stations adjacent to the Gulf of Mexico (GOM). GOM20 provides a robust reference for ruling out regional tectonic movements and highlighting natural subsidence along the coastline. According to this study, the average eustatic sea level rise rate within GOM is 2.6 mm/yr from the 1970s to 2010s, revealing that is about 0.6 mm/yr faster than the global mean sea level rise during the same period. Present land subsidence along the Texas coastline is dominated by the natural subsidence with an average rate of 1.4 mm/year. The rates vary from 0.6 to 0.8 mm/yr in the central coastal area (Port Mansfield, Corpus Christi, Rockport), 1.6 mm/yr in the southern coastal area (South Padre Island), and 1.5 to 3.5 mm/yr in the northern coastal area (Freeport, Galveston Island, Texas City, Sabine Pass). The average rate of land submergence along the Texas coastline is 4.0 mm/yr, with a maximum of 6.6 mm/yr in the Galveston Island area. Four scenarios (lowest, mediate-low, mediate-high, highest) for future coastal submergence are developed by integrating the global sea level scenarios and the spatial-temporal variations of sea level and subsidence along the Texas coast. Our analysis projects that the average submergence along the Texas coastline from 2020 to 2100 would be greater than 0.3 m, likely between 0.6 m and 1.2 m, but unlikely to exceed 2.0 m.

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