



The Tides They Are a-Changin’

Ivan Haigh and the RisingTide

(i.d.haigh@soton.ac.uk)

Tides remain one of the most persistent and dominant forces that shape our planet. Scientists and engineers have observed for some time that tidal amplitudes at many locations are shifting considerably due to non-astronomical factors. Here we review comprehensively these important non-astronomically driven changes in tidal properties, many of which remain poorly understood. Over long geological time-scales, tectonic processes drive variations in basin size, depth, and shape, and hence the resonant properties of ocean basins. On shorter geological time-scales, changes in oceanic tidal properties are dominated by variations in water depth. A growing number of studies have identified widespread, sometimes regionally-coherent, positive and negative trends in tidal constituents and levels during the 19th, 20th and early 21st centuries. Determining the causes is challenging because a tide measured at a coastal gauge integrates the effects of local, regional, and oceanic changes. Here, we highlight six main factors that can cause changes in measured tidal statistics on local scales, and a further eight possible regional/global driving mechanisms. Since only a few studies have combined observations and models, or modelled at a temporal/spatial resolution capable of resolving both ultra-local and large-scale global changes, the individual contributions from local and regional mechanisms remain uncertain. Nonetheless, modelling studies project that sea-level rise and climate change will continue to alter tides over the next several centuries, with regionally coherent modes of change caused by alterations to coastal morphology and ice sheet extent. Hence, a better understanding of the causes and consequences of tidal variations is needed to help assess the implications for coastal defense, risk assessment, and ecological change.