



Secular Global Changes in different Tidal High Water, Low Water and Range levels

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Tides exert a major control on the coastal zone by influencing high sea levels and coastal flooding, navigation, sediment dynamics and ecology. Therefore, any changes to tides have wide ranging and important implications. In this paper, we uniquely assess secular changes in 15 regularly used tidal levels (five high water, five low water and five tidal ranges), which have direct practical applications. Using sea level data from 220 tide gauge sites, we found changes have occurred in all analysed tidal levels in many parts of the world. For the tidal levels assessed, between 36% and 63% of sites had trends significantly different (at 95% confidence level) from zero. At certain locations, the magnitude of the trends in tidal levels were similar to trends in mean sea level over the last century, with observed changes in tidal range and high water levels of over 5mm/yr and 2mm/yr respectively. More positive than negative trends were observed in tidal ranges and high water levels, and vice versa for low water levels. However we found no significant correlation between trends in mean sea level and any tidal levels. Spatially coherent trends were observed in some regions, including the north-east Pacific, German Bight and Australasia, and we also found that differences in trends occur between different tidal levels. This implies that analysing different tidal levels is important. Because changes in the tide are widespread and of similar magnitude to mean sea level rise at a number sites, changes in tides should be considered in coastal risk assessments.