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Inter-annual and decadal oscillations of sea level in the western Indian Ocean

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This study was inspired by a desire to elucidate the decline of sea level in some parts of the western Indian Ocean during the last few decades. The incidence occurred despite a general rise in global sea level that has been triggered by the recent changes in world climate. In this study, the tide gauge station at Zanzibar (Tanzania) was chosen as a representative site. A multiple variable regression was used to analyse the association of sea level with meteorological parameters and with indices of climatic phenomena, while the dominant modes of variability were discerned through wavelet analysis. Results showed that in the inter-annual timescale, sea level changes were largely influenced by the large scale climatic systems. In the decadal timescale, the changes were strongly associated with meteorological processes. The wavelet spectrum of combined tide gauge and satellite altimeter record (1984-2011) revealed a prominent quasi-22-year signal that mimics the Hale solar cycle, with 11-year phases of low and high sea levels. This signal gave rise to a spurious negative trend in the tide gauge record of 1984-2004. A similar signal was also prominent in extreme meteorological processes such as surface air temperatures and winds, but it was not evident in the mean values. However, the oscillatory pattern of sea level at Zanzibar may not be generalized for other locations in the region due to complex relationship between solar activity and climate which varies with both time and geographical position. Also, because of the chaotic character of the secular evolution, a longer record is needed to ascertain whether the quasi-22-year cycle will persist.