Drivers and trends of sea level variability along the east and south coast of Southern Africa

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Sea level rise and variability is of great concern in the coastal areas, where a significant part of the population is settled in many countries around the world. Therefore, understanding regional and local long-term sea level variability as well as its trend is critical. How the sea level has varied on different timescales and why, are the key questions for understanding sea level change, and hence crucial for improving future global, region and local projections. The Empirical Mode Decomposition/Hilbert - Huang Transformation (EMD/HHT) method was applied for the first time for southern Africa tide gauge records to determine the range of time scales of sea level variability and so identify corresponding drivers. The data consisted of all available tide gauge monthly mean records until December 2015, from seven sites along the east and south coast of southern Africa. The data was obtained from the Permanent Service for Mean Sea Level (PSMSL, http://www.psmsl.org/). Due to our limited knowledge of how sea level is linked to the drivers, it is still challenging interpreting a single oscillatory mode. Therefore, the timescales revealed were grouped as sub-annual, interannual and long-term low-frequency components of sea level variability. The sub-annual component indicates how sea level responds to the weather disturbances in the annual cycle, including seasonal and annual large-scale wind and atmospheric pressure pattern changes. The interannual component indicates an association with El Niño-Southern Oscillation (ENSO) through large-scale sea surface temperature patterns and large-scale wind patterns. Lastly, the low-frequency component may be associated to bi-decadal ocean dynamics or climate variability drivers, such as the 18.6-year lunar nodal cycle. The remaining mode, which is considered as the increasing trend, showed that along the study region sea level is rising at all sites mainly from the 1990s onwards, at a pattern similar to the global mean increase.