Centennial variations of sea level in the northern Mediterranean

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Abstract

Sea level variations have been long recorded worldwide because of their relevant socioeconomic impacts. A significant rise in sea level would threaten safety and prosperity of the large share of the world population living in coastal areas. It would harm coastal ecosystems and could even cause saltwater intrusion into freshwater aquifers. At the global scale, it has been established that sea level has been rising at an average rate of 1,7±0,2 mm/yr over the last century (IPCC AR5). However, regional differences are well documented in the literature and their assessment contributes critically to the physical understanding of the processes controlling sea level variations.
This study focuses on the Northern Mediterranean. We revised the long-term sea level trends recorded by six tide gauges, namely Alicante (Spain), Marseilles (France), Genoa, Marina di Ravenna (formerly Porto Corsini), Venice and Trieste (Italy). These tide gauges were all installed at the end of the 19th Century and their time series were accurately documented to be homogeneous. As such, these dataset provide a unique source of information concerning local sea level variations over centennial time scale. During this period, the analyzed stations were characterized by a consistent rise in the order of 1,2-1,3 mm/yr. An Empirical Orthogonal Functions (EOF) analysis on the annual Mean Sea Levels (MSL) revealed that this rising trend explains almost half of the total variance of the dataset.

For the station of Marina di Ravenna, we also present the results of a recent endeavor concerning the rescue of the daily high and low waters recorded between 1873, when the tide gauge was first installed, and 1922. Up to now, the sea level data prior to 1896 were unknown to the scientific community and considered lost. For the period 1896-1922, only monthly means were previously available. We carefully assessed the quality of these new data by checking their internal consistency, as well as by comparing these records with those of neighboring stations. The Marina di Ravenna time series is now 145 years long. It is characterized by three different patterns, mainly due to the contamination of the true sea-level signal by the local land subsidence. This was particularly active for about 40 years, from 1940 until 1980. After modeling the subsidence behavior, and removing it from the tide gauge data, the estimate of the linear long-term trend over the 145-year period is fully consistent with the result previously obtained.

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