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# Analysis of coastal water levels in Gulf of Lions

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The Gulf of Lions, located in the western part of the French Mediterranean sea, is mainly constituted by large sandy beaches. This micro-tidal coast area is made of many lagoon systems filled by coastal rivers among which the Rhone. This area is often put forward in relation to its vulnerability to coastal hazards, erosion and coastal flooding.

Sea level data were low capitalized because of their little interest for navigation in this low tidal sea. An important work of digitization of old data in paper form was carried out. These data, often poor quality and without metadata allowing a vertical setting, presented mostly in the form of weekly tidal papers of a semidiurnal tide of the order of 30 cm plus a meteorological component. Looking in more detail, the tidal signal showed severe oscillations and particularly during storm.

The retrieval was made through the development of the software NUNIEAU by CETE. This software is available on the web and has been downloaded today by 72 organizations from 13 countries. NUNIEAU is based on the recognition of a band of color that can retrieve not only mean water level but the range of fluctuation. About 150 years of cumulative data on the Gulf of Lions and series of more than 30 years of data are now available think to this method.

Work to improve the reliability of these data was then undertaken to check their quality for different applications, namely, studies of historical levels and storm surges, statistical analysis and sea level rise. This work was based on a thorough analysis of the constancy of tidal constants in phase and amplitude. This allowed us to correct the series and switch to GMT, checking for problems of scale scanning and correct drifts of tidal gauges or at least know them. The vertical setting (different from the verification of the amplitude) was then conducted with methods of homogenization of the data by comparing the 5 day averages between stations. Summaries for each series have been produced to qualify the data.

The retrieval of these data enabled a graphically analysis of historical events in the Gulf of Lions, visualizing differences and the level reached on the various stations in ports and in ponds. This allows to see the filling of low-lying areas and the water surface tilting in ponds due to high winds.

Classical statistical analysis have been carried on tidal gauges of long data series studying the hourly sea level, the instantaneous sea level, the hourly storm surge, the instantaneous storm surge, and fluctuation of the sea level in the hour. Statistics of extreme sea level of two stations on the sandy coast shows exactly the same behavior. It is also interesting that the statistical storm surge at sea and in the Thau pond are equivalent, showing that the extreme coastal flooding is not minimized by the filling of ponds and can even be stronger with land flooding events. The behavior of the station located on a rocky coast near the Spain border is different.