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Seasonal statistics of highest sea levels along the northwestern Adriatic coast

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Joint spatial analyses of marine flood drivers may provide important insights into the assessment of the related impacts on the low-lying coastal areas of the northwestern Adriatic coast. Identification of seasonality in the highest sea levels represents a first step in performing the analysis.
Seasonal variability is investigated in the long term tidal gauge series of Punta della Salute (Venezia), Molo Sartorio (Trieste) and Porto Corsini (Ravenna) and in the short and fragmentary one of Rimini for which the available historical information, extracted from Hydrological Annals and provided by ISPRA and the Institute of Marine Science - CNR of Trieste , includes data collected with different criteria (monthly high water levels, daily high and low tides, hourly values and ten-minutes records).
Following Carter and Challenor (1981) the variability of extreme high sea levels is initially studied modelling monthly maxima separately with the Generalized Extreme Value (GEV) distribution, combining them to extrapolate the distribution of annual maxima and comparing the resulting curve with that derived from the canonical approach based on annual maxima series.
Monthly and annual maxima have been first declustered selecting the maximum value in a 78 hrs window and, aiming to remove the effect of sea level rise and local subsidence, detrended subtracting the regularized mean sea level.
After the removal of these effects, monthly and annual maxima do not exhibit a specific multi-decadal trend. The results, expressed in terms of monthly average values, show instead a uniform behaviour for the analyzed stations, characterized by a large variability of extreme sea levels throughout a year with a systematic concentration of potential dangerous events in late autumn and winter seasons.
In spite of the limited extension of the Adriatic basin, the most significant historical storms responsible of disastrous impacts on coastal areas were recorded in different years from the two northern tide stations, Venezia and Trieste, meaning that not only the combination of several meteorological and marine factors involved in the phenomenon but also the coastline exposure to the dominant winds must be taken into account. Also the differences observed in the standard deviation between the northern and southern stations seem related to local characteristics like coast orientation.
Shape parameter does not differ significantly through a year, even if most negative values are observed mainly during the autumn and winter seasons.
Serial dependence between the maximum water levels in successive months is analyzed examining the correlations once the seasonality has been removed and testing the capability of a synthetic auto-regressive moving average (ARMA) approach in reproducing the process.
The annual cycle of location and scale parameters exhibits a similar pattern of mean and standard deviation of monthly maxima respectively suggesting to model the extreme water levels with a more efficient time-dependent GEV distribution (Méndez et al., 2007) that includes seasonal trend in terms of harmonic functions in the location, scale and shape parameters.

References

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