Phase 1 – Analysis of tide gauge stations data

Data collection
Within the first step of the project, available data coming from tide gauge stations have been collected, validated and organized within a geodatabase. More specifically historical series coming from 28 tide gauge stations located in the Venice Lagoon, in the Marano and Grado Lagoon and in the North Adriatic (including Ancona, Ravenna and Trieste) from the year 1989 have been analyzed. The amount of data made available for this project amount roughly to 700 years, with an average of 25 years for each station.

Quality checks
To ensure high quality information, raw data have been submitted to a series of quality checks, both using numerical filters within the same time series and comparing data collected in nearby stations. Doubtful data or low quality series have been dismissed. Moreover, harmonic constants have been calculated from checked data to obtain the astronomical tide (Figure 1), useful for extra quality checks (time check). When a series passes all validation steps is released.

Moreover, the analysis of harmonic constants series allows to monitor changes in the water levels related to the interaction Earth-Sun-Moon. Significant changes in the harmonic constants series can be related to changes in hydraulic assets of an area (Figure 2).

Among the 28 station for which new time series has been prepared, 14 representative stations (10 within the Lagoon of Venice and 4 in the Adriatic sea) have been selected in order to apply the Joint Probability Method (Phase 2).

Phase 2 – Application of the Joint Probability Method

The Joint Probability Method (JPM, by Pugh-Vasse, 1979) is aimed at forecasting the return period and estimating the frequency of extreme events. It is a method where the separate action of tide and surges is considered. Astronomical tides and surges will be tabulated to produce normalized frequency distributions in bands with a tabulating interval of 5 cm and the frequency distributions of the observations will be assumed to be representative of the probability of future events. Briefly, the probability for the sea level to reach the value M is the joint probability (hence, a product) for the surge to be M and the tide to be zero, plus the probability for the surge to be M and tide being -1 will be considered, and so on.

The calculations will be based on the hourly measurements. This choice is important because the focus of the present study is the North Adriatic Sea, where the separation of different surges is made almost impossible by seiches (Flaminia Pirazzoli, 1999), the free oscillations of the basin after a storm, very persistent due to the shape of the local morphology.

Phase 3 – Application of the Regional Risk Assessment methodology and the DSS DESYCO

DESYCO (Decision support System for Coastal change impact assessment) is a GIS-based tool for the assessment and management of climate change impacts in coastal areas and related environments at the regional scale. It adopts an ecosystem approach and implements a Regional Risk Assessment (RRA) methodology, based on Multi-Criteria Decision Analysis (MCDA), in order to identify and prioritize areas and targets at risk in the considered region. The RRA methodology integrates climate change hazards analysis, based on the elaboration of output from climate, hydrodynamic, hydrological and biogeochemical models, with vulnerability analysis of environmental and socio-economic features of the territory. DESYCO and the RRA result in 4 maps, representing the exposure to climate changes against which a system operates, and vulnerability maps, representing the spatial distribution of environmental and socio-economic vulnerability factors. These outputs allow the prioritization of intervention options through the visualisation of impacted areas and vulnerable receptors.