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Coastal freshwater resources management in the frame of climate change: application to three basins (Italy, Morocco, Portugal)

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Climate change becomes an increasing constraint in IWRM and many effects are expected in coastal watersheds like sea level rise and its consequences (i.e. beach erosion, salt water intrusion, soil salinization, groundwater and surface water pollution...) or water budget changes (i.e. seasonal and inter-annual fluctuations) and an increase of extreme events (i.e. floods, rainfalls and droughts). Beside this physical changes one can also observed the increase of water demand in coastal areas due to population growth and development of tourism activities. Both effects (e.g. physical and socio-economical) must be included into any coastal freshwater management option for a mid-term / long-term approach to set water mass/basin management plans as expected in European countries by the WDF or elsewhere in an IWRM objective.

The Waterknow project funded by EraNet-Circle-Med program aims to develop a tool to help decisions makers in the implementation of IWRM plans in coastal areas that will have to cope with climate change effects and socio-economical pressures. This interdisciplinary project is applied to three basins (e.g. Fiumi Uniti Bevano, Italy; Terceira Island, Portugal and Taheddart, Morocco) and seeks to integrate and to develop research achievements in coastal hydrogeology, economical and land use modeling in each basin.

In the Fiumi Uniti Bevano basin, a detailed hydrogeological survey was performed during the summer 2008. Twenty auger holes with an average spacing of 350 m where drilled with the objective of determining the top groundwater quality in the coastal aquifer. At the same time, we collected the chemical and physical parameters of the surface waters. The data collected in the field show that a fresh groundwater lens is still present in the aquifer of the backshore area below the coastal dunes and that the surface water is all brackish to salty. In the northern part of the study area, the fresh groundwater lens in the backshore zone is missing, as dunes were eroded and a series of saltwater ponds are present right behind the active dunes. The central part of the study area is characterised by the presence an active dune system and of a large pond in the innermost side of the backshore. In this case, there is a narrow freshwater lens in the aquifer of the active dunes area, whereas inland the aquifer is completely salty up to the agricultural fields. The southern area has the best preserved and tallest dunes and do not contain any pond. Here, the freshwater lens in the aquifer is wider than everywhere else and the aquifer becomes salty only where the drainage ditches are causing upcoming of deeper salty groundwater. This study has recognized the importance of coastal dunes in counteracting saltwater intrusion in the phreatic aquifer. Therefore, it is important to consider measures and interventions in order to preserve the integrity of the dunes not only for the purposes of avoiding shoreline erosion and coastal ecosystem destruction but also for freshwater resources protection. On the other hand, in low level coastal areas, drainage and the construction of ponds may enhance seawater upcoming. In this Italian case, a socio-economical modelling has to be developed to help decision making in both water and economical management to step toward an integrated water resource management.

In the Terceira Island, a spatial interaction model has been developed including land and water uses combined with economical sectors related to Corine-Land-Cover (i.e. CLC) classification applied to urban areas and its surroundings. The spatial competition between different economical sectors and population pressures for land use and water use is resulting from the calibration of bid-rents. This economical model requires a dataset based on the spatial distribution of population, land uses and the calculation of distances between each economical sector including socio-economical indicators (i.e. employment, labor productivity, human consumption, land aptitude and water availability). Model results have been integrated to a GIS which has also been used for the dataset development.

Climate change scenario, water uses and planning options are also included in this economical modeling tool that can already simulate future water demand for the Terceira Island. In this Portuguese case study a coastal hydrogeological analysis will be implemented within the Waterknow project to help decision making to integrate the coastal freshwater vulnerability and its seasonal fluctuations into the economical, urban and water management plans.
In the Taheddart basin, both economical and hydrogeological analysis are lacking and the Waterknow project objective is to integrate and to apply the previous achievements (i.e. hydrogeological and economical spatially distributed models) to simulate water demand evolution and coastal freshwater vulnerability in the frame of climate change and sea level rise. In the Moroccan case a land use analysis is undertaken using SPOT5 images and an object oriented classification methodology. This remote sensing approach has to provide spatial data to be included in to a GIS to feed the economical model adapted from the Portuguese case study. This methodology will also be applied to both Terceira Island and Fiumi Uniti Bevano basin to update and enhance existing CLC data.
In the three cases water management issues are strongly felt among the number of stakeholders and the lack of integration of both hydrological and economical knowledge. The Waterknow project tries to step forward this challenge to adapt and enhance IWRM practices to climate change issues in an interdisciplinary approach.