Development of a new methodology to try to qualitatively evaluate the physic-chemistry and socio-economical consequences due to climate change on the mouth of the Guadalquivir estuary.

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ABSTRACT

Future climate projections suggest that river flow will change. This will have a significant impact on the downstream and estuarine environment. In general, recent researches have shown that a combination of increased precipitation and river flow rates in winters and decreased precipitation and river flow rates in summers. Some of the consequences expected are: disappearance of salt marshes, soil contamination by nitrogen and phosphorus, changes in the carbon cycle, in the coast line, in the sediment transport, overtopping flood defences, etc. These changes will incurred in a reduction in the services that ecosystems provide to society, mainly in the area of supply and regulation. Guadalquivir estuary is extremely important in terms of maintaining natural habitats, flood prevention, and economic development (tourism, navigation, irrigated agriculture, fishing, shellfishing and aquaculture). For example, the intrusion of the saltwater wedge could drive the disappearance of the paddy fields. The aim of the present work is, using a calibrate and validate catchment model for the study area and satellite images of turbidity, to find the implication of the high river flow discharges with the distribution along the coast line of a turbidity plum. Along this work, the connexion, implication and socio-economic consequences will be evaluated in order to present a helpful and friendly method which lets not only to study the problem from the physic-chemistry point of view, if not can give us a qualitative estimation of socioeconomic changes. The results undoubtedly will serve to the administration to improve the management of our natural capital.

INTRODUCTION

Many estuarine studies have drawn attention to the fact that hydrological and thermal regimes of rivers are expected to change, directly affecting freshwater ecosystems, water quality and human water use, volumes of primary production, and carbon cycling in epicontinental seas with low salinity [1,2]. Also, estuaries have high biochemical variability (for instance, there is a twice daily inundation of salt water interspersed by brackish or fresh water) and extreme physical conditions (often producing strong tidal currents and turbidity). This, linked with the fact that estuaries are subject to anthropogenic modifications (e.g. dredging, land reclamation, deforestation, managed ecosystems, and coastal management such as flood defences, construction of ports and harbours, industrialization, and discharges of polluted water), make these systems extremely sensitive to climate change and difficult to study. Yet better understanding of estuarine processes, their response to climate change, and the feedback to the environment, are fundamental to the sustainability of the ecosystem [3].

The Guadalquivir estuary is a unique space located in the south west of Spain that possesses extraordinary natural, cultural, historical and economic values, where human activities have coexisted with the rich biodiversity of the river along the centuries: population settlements, traditional agriculture of the banks, activities leisure and recreation, fishing, paddy fields, etc. [4]. The estuary is navigable from Seville (~110 km - 1.800 km^2), and on its way to the mouth, it is crosses the Natural and National Park of Doñana, an UNESCO heritage site and the most important biosphere of Spain [5].

MATERIAL & METHODS

As material, the MODIS (Moderate Resolution Imaging Spectrometer) satellite images have been used in this research. For this preliminary study is been used the sensor of turbidity. Water colour might indicate the presence of high concentrations of sediment related to heavy discharges of freshwater from the river.

As catchment model, SWAT has been used. In a previous research SWAT was calibrated and validated for the study area where as main result was concluded that the model was suitable to calculate the Guadalquivir River flow and that this flow is highly regulated by the rain [5].

As methodology, MODIS images from drought periods and from high river flow periods where used join to simulations of SWAT for those periods of river flows to try to set up a connexion between the turbidity plum that can be observed with more or less intensity on this images with the river discharges.

RESULTS & DISCUSSION

As result was observed that it is seem a connexion between low/high river discharges and less/more presence of the turbidity plum that can be seen in the mouth of the estuary (Fig. 1 & 2).

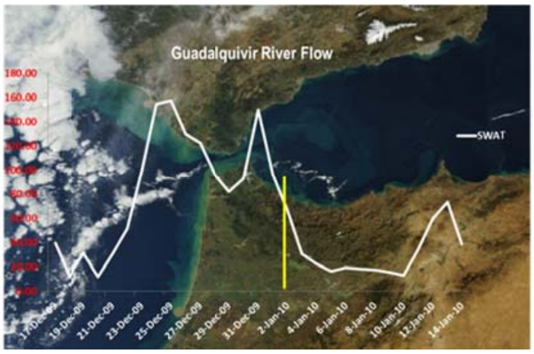

Fig. 1. MODIS image vs SWAT simulation after a high rain event 2 January 20108 (2 days after the rains).

This fact is corroborating the initial hypotheses that aimed this research and with SWAT could be modelled using rain and temperatures predicted under the different scenarios proposed by the IPCC reports (Intergovernmental Panel on Climate Change) to identify extreme river flow events and can do a qualitative analysis about the socioeconomic changes that could be affecting to the hot spot areas that are find inside the Guadalquivir estuary, and the adjacent coastal areas due to a possible distribution of contaminants that could by driven by the river and that could be flows into the Gulf of Cadiz (North Atlantic Ocean) and by comparison with the turbidity plum we can draw an image about how could be this distribution along the coast line.

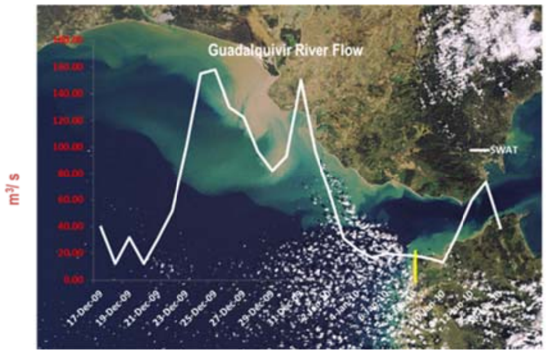

Fig. 2. MODIS image vs SWAT simulation after a high rain event 9 January 2010 (9 days after the rains).

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