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Involve to improve: A participatory approach for a Decision Support System for coastal climate change impacts assessment. The North Adriatic case

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ABSTRACT

Decision Support Systems (DSS) are considered innovative tools to cope with climate change related issues and support decision-makers in a sustainable management of natural resources and in the implementation of Integrated Coastal Zone Management (ICZM) and adaptation plans. Involving DSS end users since the beginning of the development of a DSS is recognised as fundamental in order to design a tool that can meet stakeholders needs. However, from the analysis of the risk based DSSs at the regional and/or local scale, emerges a lack of application of participatory approaches, despite their acknowledged relevance to the current scientific literature and regulations.

Accordingly, in order to respond to the needs of the DSS end users (i.e. public institutions dealing with coastal management and administration), this paper describes the development of a participative approach for a DSS named DESYCO, aimed at the assessment of climate change related impacts and risks on natural and human systems.

The participative approach was carried out by means of the integration of participative moments in the DESYCO framework, the identification of potential end users through a preliminary stakeholder analysis and finally the design, administration and analysis of a questionnaire addressed to the end users identified in the case study area of the North Adriatic Italian coast.

37 potential DSS end users for the case study were identified and addressed by a survey investigating their knowledge about climate change impacts on coastal zone, ICZM strategy and implementation, DSS functionalities.

The questionnaire allowed to gain information that both confirmed the validity of the methodology choices of DESYCO and supplied some useful contribution to the selection of further stakeholders. From the results it emerges a lack of knowledge about ICZM and climate change issues. Moreover public institutions ask for short time frame hazard scenarios while the DSS, depending on the available information supplied by models, focuses especially on long term scenarios.

1. Introduction

Worldwide coastal zones represent irreplaceable and fragile ecosystems with high ecological, economic and social relevance. Coasts are the result of a dynamic and unpredictable interdependent set of subsystems, and they are under increasing anthropogenic pressure being home for the majority of the world population and their economic activities (Nicholls et al., 2009). Climate change and sea level rise represent a serious threat to coastal areas that will increase the risks of erosion, storm surge flooding, changes in water quality and loss of biodiversity (IPCC, 2007; Mee, 2009). The Mediterranean basin has been identified as a climate change "hotspot" expected to undergo environmental impacts considerably greater than in other places around the world (Billé and Rochette, 2008; García-Ruiz José et al., 2011; Giorgi and Lionello, 2008; Lejeusne et al., 2010; Magnan et al., 2009; Perry, 2005; Plan Bleu, 2010).

Consequently, there is a growing demand of management strategies that take into account at the same time the vulnerability of the coastal zones and the needs of the various social and economic coastal sectors (Nicholls and Hoozemans, 1996). These management strategies, like the ecosystem approach, should facilitate decisions despite the high degree of uncertainty related to

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climate change and the complexity of coastal ecosystems (De Santo, 2010).

Integrated Coastal Zone Management (ICZM), born as a strategy aiming to promote sustainability in the development and management of coastal zones, emerged as the most appropriate process for dealing with current and long term problems like climate change threats. Within ICZM, adaptation strategies aim to respond to climate change impacts, and provide the needed scientific information and tools (Sarewicz and Pielke, 2007).

However, while the definition of guidelines and principles of adaptation is done at the higher international level (COM (2007) 354 final; COM (2002) 413; COM (2009) 147 final; UNEP/MAP, 2008), the actual implementation of these strategies occurs at the national and sub-national levels. The main actors involved in the coastal management process are therefore national governments, regional and local authorities and other relevant stakeholders like NGOs and representatives of economic sectors.

In order to develop appropriate adaptation strategies, national and local policy and decision-makers need significant scientific information and useful tools, provided in the most suitable way. However, a disconnect remains at the intersection between climate change science and decision making: the supply of relevant climate information and forecasts at the appropriate spatial and time scale does not currently match the requirements needed on the demand side, particularly for the implementation of adaptation measures (Cutts et al., 2011). This is so also because the issue of uncertainty constrains the ability of scientists to provide definitive answers in situations where management must continue, even in the absence of knowledge (Patwardhan et al., 2009; Stojanovic et al., 2009). For what concerns both the temporal and spatial scales, scientists are not yet able to meet the specific needs of the decision makers about climate change (McNie, 2007); decision makers ask for time horizons of 20–30 years and not long term scenarios (i.e. 100 years) as proposed so far by the scientific community (Tribbia and Moser, 2008). Considering the spatial scale, it has come to light that no method yet exists to provide confident predictions about the impacts of climate change from the regional down to the local scales (Chen et al., 2011). Therefore innovative methods are needed to bridge the gap between the large scale of future climate change scenarios provided by climate models and the fine scale where local impacts happen as a consequence of changed climate conditions.

Among the most innovative tools to be used in coping with climate change in coastal zones, Decision Support Systems (DSSs) are meant to supply the necessary link between the climate change information provided by scientists and the information needed by coastal stakeholders at regional and local levels. For what concerns DSSs for climate change impact analysis, several examples can be found in literature (e.g. Jolma et al., 2010; IGCI, 2001), some of them focussing on coastal zones (e.g. CZMC, 1993; DINAS-COAST, 2006; Engelen et al., 1995; Mokrech et al., 2011; Warrick, 2009; Westmacott, 2001).

Involving DSS end users since the beginning of the development of a DSS is recognised as fundamental in order to design a tool that can meet stakeholders needs (Lautenbach et al., 2009; Matthies et al., 2007; Uran and Janssen, 2003; Westmacott, 2001). However, from the analysis of the risk based DSSs at the regional and/or local scale, emerges a lack of application of participatory approaches, despite their acknowledged relevance to the current scientific literature and regulations. In those few cases where participation is applied, these experiences are related to methods and results of participative approaches applied in DSS development, mostly regarding the identification of DSS stakeholders (Engelen, 2000) and the interface evaluation of the DSS made by the end users (Lawrence et al., 2002).

As far as Italy is concerned, some of the most recent water resource management DSSs (e.g. Soncini-Sessa et al., 2003; Fais et al., 2004; La Jeunesse et al., 2003) focused on the role of stakeholders participation in decision-making and were designed to involve a wide range of actors and stakeholders (e.g. by means of end users analysis and collection of preferences) (Abuzeid and Afifi, 2006). The different steps of a participative approach used in a DSS are outlined by Soncini-Sessa et al. (2003).

In order to respond to coastal stakeholders' needs for useful information and tools for climate change adaptation strategies through a participative process, the Euro-Mediterranean Centre for Climate change (CMCC) developed a participatory approach for a DEcision support SYstem for COastal climate change impact assessment called DESYCO (Torresan et al., 2009, 2010). This DSS, applied to the case study of the Italian North Adriatic coastal area, was developed to assess climate change related impacts and risks on natural and human systems.

The purpose of this paper is therefore to demonstrate the importance of participation and moreover to present the procedure, steps and results of an end-users involvement process for the development of the DSS applied in the case study of the North Adriatic coastal area.

The end users involvement was done by means of the integration of participative steps in the DESYCO framework, the identification of potential DSS end users through a preliminary stakeholder analysis and finally the design, administration and analysis of a questionnaire addressed to the DSS end-users identified in the case study area. The questionnaire was aimed at investigating the knowledge of stakeholders about climate change, DSSs and ICZM.

In the next sections, after a presentation of the case study area, the method and the results of the stakeholder involvement for the development of DESYCO are described and discussed.

2. Case study description

The area considered in the case study involves the coastal zone of the two Italian regions of Veneto and Friuli Venezia Giulia, bordering the North Adriatic Sea with an overall length of about 286 km (Fig. 1). The coastal area covered by the case study runs along the Adriatic Sea from the national border between Italy and Slovenia to the mouth of the southern tributary of the Po Delta system (i.e. Po di Goro).

From a morphological point of view, the sedimentary shores of the area include straight littoral coasts, lagoonal barrier islands, spits, river outlets and salt marshes. On the whole, the Italian Northern Adriatic Sea coast, comprises a very precarious coastal environment subject to continuous morphological changes that can be appreciable even over short geological time scales (Gambolati and Teatini, 2002). Moreover, erosion is still active in many areas both on the coastal sea floor and on the beach since the beginning of the 20th century and especially after 1960 (Bondesan et al., 1995). Many areas, particularly around the Po River Delta, are also located below the mean sea level and affected by natural or induced subsidence (Pirazzoli, 2005). Furthermore, the municipality of Venice has been experiencing an increase in high tide events and consequent flooding of the city (Ferla et al., 2007). Therefore, climate change and sea level rise are poignant issues for the case study area considering both the vulnerability of fragile ecosystems such as coastal lagoons, as well as the concentration of cultural and socio-economic values.

Considering the administrative aspects, the case study area refers to the Friuli Venezia Giulia region, including 3 provinces and 8 coastal municipalities from the Slovenian border to the mouth of the Tagliamento River, and to the Veneto region, including 2