Intelligent Monitoring plan development for ICZM

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Abstract

In this article a general description of CZ intelligent monitoring system is given by considering the SPICOSA approach and the role of alternative strategies as support tool. An example of an intelligent monitoring application for a specific impact issue is described. In this framework, the aim of the alternative strategies for monitoring is the implementation of a monitoring plan for some relevant impacts/issues on coastal zone. This can be considered as ICZM tool in the framework of SPICOSA System Approach Framework (SAF).

Contents

1. Introduction

The intelligent monitoring does not represent a new methodology for monitoring coastal marine environments in the European countries, but rather a strategy to be followed by end-users (eg. SSAs-team) to solve some of the most common problems that can occur when the managers have to handle practical situations in which data are often scarce or information in time and space is unsuitable.

The core of intelligent monitoring of the systems is the capacity to define a specific data package (constituted by a set of parameters or proxy) to be measured in the context of a monitoring program in order to properly describe the environmental issue and the involved processes, in order to simulate and analyze the expected impacts as to permit the evaluation of policy effectiveness.

In the framework of SPICOSA, data acquisition strategy is strictly related to data purpose (eg, simulation and/or model calibration) and consequently an intelligent monitoring database is conceived as a tool to easily and efficiently support the work of SSAs in order to improve the knowledge of the studied system and to refine models.

A detailed conceptual analysis (eg. based on a cause-effect link between the variables) is necessary as a first step to identify and relate a list of all the system components (and the involved elementary parameters, such as eg. temperature, currents, etc.) that can be associated with a specific major issue/impact.

Then the measurement of these variables and/or their proxies is addressed by suggesting the combined use of the most suitable and available state-of-the-art technology. The assembling of the Intelligent Monitoring Package is then completed through an optimization based on the level of effort the manager can put in the monitoring program.

A demonstration of monitoring packages application is described for Taranto Mare Piccolo SSA14.

The aim of this application is to upgrade Coastal Zone (CZ) system knowledge in this site and for the selected issue in order to produce a more accurate system modeling and predictions based on SAF methodology.

2. Monitoring Packages definition

Once identified an issue/impact within a specific CZ and the related conceptual analysis, the monitoring packages are the basis of intelligent monitoring which allow the end-users to choose and define a strategy for performing data acquisition programs and support system modeling.

First, starting from an "Observational field" (eg. meteorology, hydrodynamics ...) a set of environmental parameters on coastal marine systems as a function of the examined CZ features can be defined.

The set of variables within the observational field defines the single monitoring package that constitutes the overall monitoring system. The monitoring can be optimized by choosing one of three (or more) different levels of monitoring packages in relation to the monitoring effort and the level of potential new-knowledge production.

In each monitoring package and for each parameter a reference to the proposed acquisition systems is reported.

An example of field observation (Meteorology, Figure 1), individual parameters, monitoring effort and measuring instruments is shown.

Meteorology (M) monitoring package				
Parameter (f(z))	**M1(level) (design)**	**M2(level) (cal/val)**	**M3 (level) (real-time sim.)**	**Ref. Instruments**
	bibliography + remote sensing	*M1 + automatic meas.&sampling stations*	*M2 + autom. network + monitoring plan*	
Air temperature	*X*	*X*	*x (time series)*	*T-sensor, Multisensor, Satellite*
Air pressure	*X*	*X*	*x (time series)*	*Barometric sensor pressure, Satellite*
Wind speed & direction	*X*	*X*	*x (time series)*	*Wind speed-direction gauge*
Humidity	*X*	*X*	*x (time series)*	*H-sensor, Multisensor*
Rainfall	-	*X*	*x (time series)*	*Rain gauge*
Cloudiness	-	*X*	*x (time series)*	*Satellite long wave, Hyperspectral*

Fig.1-Example of monitoring package for meteorology

3. Example of Application on Taranto Mar Piccolo site

Considering natural, social and economic components, the policy issue "Improvement of mussels quality" was defined by the SPICOSA team of Taranto (SSA14). In addition the Team suggested a conceptual frame which defines some basic interactions among the system components which are accounted for in the current version of the model used by the CZ managers in the SSA14 site..This first "monitoring package definition" example comes from the evaluation of incompleteness (gaps) of the currently-available dataset for the modeling purposes as suggested by the SSA14 Team itself.

The following were the main steps leading to definition of the logical-scientific monitoring strategy:

- *Based on the mussels growth (Impact Type) the cause-effect factors were identified (and a list of elementary parameters is obtained-please see the database at http://www.spicosa.eu/dataportal/index.htm);*
- *Then the parameters involved in the processes were chosen (input and internal data for model calibration – see the model description);*
- *The selected parameters were placed in the different "Observational field" packages;*
- *For each "Observational field" the optimal level of effort required to describe with an acceptable detail the involved processes was selected.*

It is clear that the choice of the level of effort in each package is of crucial importance in the economy and the structuring of the overall monitoring system. It is the structure and requirements of the model that address this choice by indicating the priority among the environmental parameters and the minimum necessary accuracy for the start-up and calibration.

To set the monitoring system characteristics of study area can be considerate as well as: basin dimension, inlet (width and depth) and drainage basin.

The last step defines the space (number, location and layers of observation points) and the time (period and intervals of measurement for each parameter) of the monitoring plan in relation to the processes and the detail that one intends to describe in the model.

The outcoming of the previous steps are reported in the Fig.2.

An example of the intelligent monitoring program proposed for the SSA14 is described in Fig.3. The program covers an annual cycle and has the main objective of collecting the minimum necessary dataset to overcome the incompleteness of currently-available data for modeling purposes in the SSA14, given the "mussel growth" impact issue.

Packaged - parameter	bibliography	remote sensing	1 + automatic measurement	+ sampling station	2 + automatic network	monitoring plan
Water quality	***WQ1***		***WQ2***		***WQ3***	
temperature (surface)	X	X			X	X
temperature (seabed)					X	X
salinity - conductivity (surface)	X				X	X
salinity - conductivity (seabed)					X	X
dissolved O2 (water 0m) - BOD	X				X	X
dissolved O2 (seabed) - BOD					X	X
nitrogen (surface)	X				X	X
nitrogen (seabed)					X	X
phosphorus (surface)	X				X	X
phosphorus (seabed)					X	X
SiO3					X	X
PAH						
POM (surface)						X
POM (seabed)						X
TSM	X					X
Light attenuation	X					X
Hydrodynamics	***H1***		***H2***		***H3***	
sea level	X					
sea inflows	X					
Hydrogeology	***Hy1***		***Hy2***		***Hy3***	
runoff	X					
river outflows						
stream	(annual mean)					
acquifer	(annual mean)					
groundwaters						
Ecology & biology	***Eb1***		***Eb2***		***Eb3***	
chla fluorescence	X	X		X		
phyto-production						X
chl:C						X
phytoplankton cells (nano) 0 m	X			X		
phytoplankton cells (nano) > picno.				X		
phytoplankton cells (dino) 0 m	X			X		
phytoplankton cells (dino) > picno.				X		
phytoplankton cells (diato) 0 m	X			X		
phytoplankton cells (diato) > picno.				X		
Mussels 1 (June)						
Mussels growth rates	X			X		
mussel flesh/shell				X		X
Mussels 2 (October)						
mussel flesh/shell	X			X		X
Geomorphology	***G1***		***G2***		***G3***	
coastal structure (dynamics)	X			X		
batimetry		X	X			X
suspended sand		X	X			X
sediment rates	X					X
Meteorology	***M1***		***M2***		***M3***	
air temperature	X			X		
air pressure				X		
wind speed	X			X		
wind direction	X			X		
Surface irradiance (SPAR)	X			X		

Fig.2- Monitoring packages for Taranto Mar Piccolo site

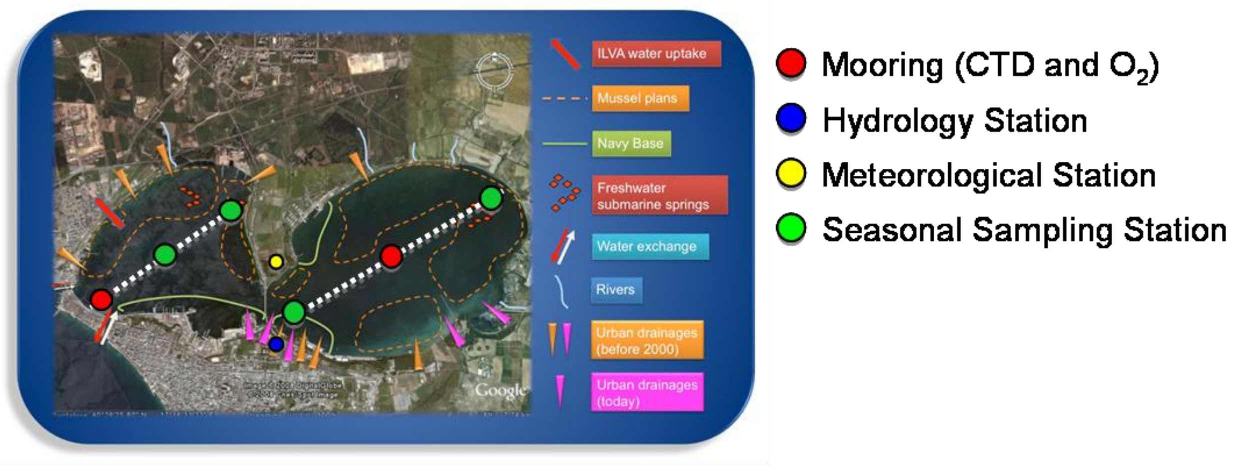

Fig.3- Features of the area and proposed intelligent monitoring system.

4. Further Readings and Links

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