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POTENTIAL USE OF REMOTE SENSING IN THE STUDY AND PREVENTION OF WATERBORNE HUMAN DISEASES.

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Introduction

The main aim of the European Concerted Action on Algal Bloom Detection, Monitoring and Prediction (ABDMAP) is to consider the current use and future possibilities of the use of Earth Observation (EO) data in this field.

The Italian National Institute of Health (ISS) is actively involved in the activity of the Concerted Action and fully shares its objectives.

Earth Observation (EO) data in the prediction, detection and monitoring of algal blooms in the marine environment is of particular interest for ISS, especially because some of these algal blooms can be produced by toxic algae, which can represent a threat to human health especially because of the occurrence of algal toxins in seafoods.

EO data can be conveniently used also for studying, monitoring and preventing the microbiological and chemical risks associated with the quality of waterbodies.

ISS has the scientific expertise in this fields (Catena e Palla, 1980; Catena e Palla, 1988; Catena e Palla, 1989a; Catena e Palla, 1989b; Funari, 1999; Draisci et al., 1998; Funari and Silano, 1997) and consolidated relationships with national and local possible end-users of EO data.

EO data and toxic algal blooms

Even though at present many problems must be solved before using EO data for toxic algae blooms in the Italian (as well as other) Seas, these techniques could offer favourable conditions for these activities in the near future.

Traditional local, regional and national activities of detection and monitoring of toxic algal blooms are carried out through *in situ* programmes, with increasing frequency in the main algal bloom season. The presence and extention of the phenomenon are detected through the determination of algal species in water samples coming from a necessarily limited number of stations: the research is time-consuming and requires a demanding organization and the use of boats.

Compared to traditional research methods, remote sensing has the potential to provide greater spatial and temporal coverage, and additional environmental information.

The use of EO data would allow to better describe the presence, extension and evolution of the phenomenon of a toxic algal bloom in a certain waterbody and

represents a predictive tool for a whole basin. Moreover, the availability of EO data, which show the course of surface currents, wind speed and direction, would permit shifts of algal masses to be forecast and possible immediate measures to be taken.

The Northern Adriatic Sea is particularly affected by the eutrophication phenomenon. This is due to the huge number of nutrients discharged through the rivers, to the conformation of the coastline and its shallow waters.

The first algal bloom in this area was observed in 1969. Then, after some years of absence, the phenomenon reappeared in 1975 and rather regularly in the following years. These blooms caused in particular a diffused anoxia of deep waters, and consequently death of benthic organisms. This has led to significant changes of the benthic ecosystem and a general reduction of the original populations. Algal blooms have given rise to negative implications also on tourists activities, fishery and mollusc cultivation.

Algal blooms in the northern Adriatic Sea are due to diatoms and dinoflagellates. Diatoms produce blooms in the winter-spring period. Dinoflagellates produce algal blooms in the autumn-winter period. The occurrence of *Dynophisis* spp. producing DSP toxins has led in many occasions to the impossibility of gathering molluscs for commercial purposes.

A number of phytoplankton-related phenomena due to toxic dinoflagellates have been repeatedly recorded in Italy in the last decades. Yet, the first case of diarrhoeic shellfish poisoning (DSP)-contaminated mussels collected from the northern Adriatic Sea (Emilia Romagna region) has only been recently reported (Boni et al., 1992). The episode was associated with the simultaneous presence of some toxic algae of the *Dinophysis* genus, including *D. fortii*, both in sea-water and in shellfish hepatopancreas.
In order to prevent the risk of DSP-contamined seafood consumption, the Italian Health Authority has established measures involving the monitoring of shellfish growing areas to examine phytoplankton in sea-water and to determine DSP toxicity in molluscs by mouse bioassay (G.U., 1990).

Particularly, in the monitoring of phytoplankton(1989-1994) along Emilia Romagna coast (northern Adriatic Sea) significant levels of *D. sacculus* and *D. sp.* similar to *D. acuminata* were usually observed at the beginning of summer, whereas *D. fortii* and *D. caudata* generally predominated at the beginning of autumn, which corresponded to the highest levels of toxic phytoplankton.

To date, DSP phenomena in Italy have been related to the presence of okadaic acid (OA) (Fattorusso et al., 1992; Draisci et al., 1994, 1995, 1996) and dinophysistoxin-1 (DTX-1) (Draisci et al., 1995) in Adriatic mussels, although the presence of other toxins has been repeatedly suggested (Zhao et al., 1993, 1994; Draisci et al., 1994, 1995).

As the *Dinophysis* species have successfully been brought into culture, analyses of DSP in these organisms are limited on field collected material. Although a direct correlation between the presence of *D. fortii* in sea water and the OA concentration in shellfish suggested that this species was involved in the Adriatic OA mussel contamination (Della Loggia et al., 1993), *D. fortii* has only recently been unambiguously shown to transmit OA to shellfish (Draisci *et al.*, 1996).

In 1994, the first case of PSP mussel contamination at levels above those admitted by the national regulations was recorded in Italy in an area offshore Cesenatico (Poletti *et al.*, 1998).

EO data and microbial and chemical risks

Remote sensing data can represent a significant advantage also in the study and management of the risk posed to human health by chemical and microbiological agents.

Monitoring activities to control microbial and chemical agents are conventionally carried out through the direct determination of these agents or of some of their indices. These activities are often planned without adequately considering the nature and the origin of the inputs and the conditions which can be responsible for their transport from the area of the input to that of concern (where drinking waters are collected, recreational activities are performed or waterbodies are devoted to mussel and fish farming). So, without an adequate knowledge of the sources and processes of these pollutions, the traditional monitoring systems hardly permit any measure to be taken.

The use of EO data in monitoring microbial and chemical agents in waterbodies can be complementary to the traditional activities. Through these EO data it would be possible to obtain information on a large scale, to identify the sources of contamination and follow their transport processes.

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