Modelling of environmental conditions relevant to assessment of fishery resources and ecosystems in the central Mediterranean

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Abstract

In accordance with the objectives of the FAO–MedSudMed Project Assessment and Monitoring of the Fishery Resources and Ecosystems in the Strait of Sicily, we propose an environmental modelling study that specifically relates to the Project Framework task Environmental Effects on Fisheries, and more specifically to its Research on the Relationships between Fishery Resources and Biotic and Abiotic Parameters. Our proposal focuses on the physical environment of the region and possible interactions between fishery resources and abiotic parameters, by correlating model-simulated environmental conditions, nutrition processes and ocean-colour parameters.

Fishery management is mostly based on indirect estimation of fish productivity and incomplete knowledge of the dynamics of fish populations. There is a general agreement that fishery resources strongly depend on parameters such as ocean colour, sea-surface temperature, marine upwelling and salinity. By studying these conditions, indirect evidence can be obtained about fishery resources. For example, some tuna species feed in the warm seaward side of marine thermal fronts.

There are two basic mechanisms for bringing nutrients into the photosynthetic zone: (1) the marine eddies and related upwelling that brings nutrients from the sea bed to normally nutrient-limited surface waters; (2) the mineral dust produced by aeolian desert erosion and transported and deposited in the marine environment. Both processes stimulate plankton production (hence chlorophyll production) visible in satellite imagery as modified ocean colour. This primary plankton production is the first element in the fishery food web.

Use of the high-resolution sophisticated environmental models for predicting/simulating environmental parameters relevant to fisheries is a promising approach that may substantially complement marine observations. The multidisciplinary aspect of the fishery production requires use of mathematical models that integrate atmospheric, aerosol, and ocean environmental parameters and provide their feedback interactions. Such models produce 4-dimensional distribution of environmental conditions favourable for growth of fish populations. Use of model data could increase our understanding of fish life-cycles and improve assessments of fishery resources.

The recent NASA study (The Correlation between Atmospheric Dust Deposition to the Surface Ocean and SeaWiFS Ocean Color: A Global Satellite-based Analysis) is an example of increased scientific interest in linking environmental conditions with fish productivity. In this study, dust-deposition climatology was simulated by a global dust model and correlated with satellite-derived ocean colour data. The study clearly identified areas with a high correlation between received nutrients from wind-blown dust and ocean productivity.

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We suggest evaluating the regional model climatology of parameters responsible for the following major nutrition mechanisms: (1) ocean circulation (upwelling); and (2) dust deposition. They will be correlated with the satellite ocean-colour data in order to identify the central Mediterranean areas favourable to the growth of fish populations. The study will produce evidence with respect to spatial and temporal (seasonal) distribution of potentially high fish productivity.

By anticipating results from the proposed climatology study, design and development of a prototype modelling system for routine prediction of environmental conditions relevant to the assessment of the time and locations of fish populations in the central Mediterranean will be assured.