What is operational ecology?
Operational ecology is the systematic provision of long term information on the status of marine ecosystems to stakeholders, exploiting both observations and models. The aim of OPEC (the OPerational ECology project) was to develop and evaluate ecosystem forecast tools. To this end OPEC has developed prototype ecological marine forecast systems for European seas, which include hydrodynamics, lower and higher trophic levels (plankton to fish) and biological data assimilation.

Why it is important?
Coastal seas provide many beneficial goods and services to humankind, such as fisheries, recreation, climate regulation and coastal defences. However these marine environments are being disrupted by climate change and human activities. It is important that the marine environment is observed and monitored to provide high quality environmental information / data, understand its role in our Earth system, track changes and predict the potential response of the ocean to stressors.

What can it tell us?
The OPEC tools will help to assess and manage the risks posed by human activities on the marine environment, thus improving the ability to predict the "health" of European marine ecosystems. OPEC provides information of the past, present and future states of the marine ecosystems of the North East Atlantic, along with the Black, Baltic and Mediterranean Seas.

Reanalysis hindcast simulations use data assimilation to blend models and observations to provide a description of past states, trends and changes. Rapid Environmental Assessment simulations again blend model and observations to provide the best available estimates of the current state of the ecosystem. Finally seasonal forecasts would provide continuous predictions of potential future states of marine ecosystems.

Who are the users?
Operational Ecology products will be useful to a wider range of stakeholders including marine management authorities, government departments, coastal managers, NGOs and marine industries.

Model simulated data from the project is already freely available to download and manipulate from the projects unique data portal.

OPEC products and services

Marine Data portal: The OPEC data portal (http://portal.marineopec.eu) allows users to query and export simulated ecosystem data for European Regional Seas, visualise it, download and process it, all free of charge including:

- Simulations of the last 20 years: 20 year hindcast simulations of the NE Atlantic, Baltic, Black and Mediterranean Seas the describing past states and trends in the ecosystem in terms of physics, nutrients, plankton and fish are available on the OPEC data portal.

- Rapid Environmental Assessment: The Rapid Environmental Assessments blend model and observation data to provide the best available estimates of the current state (the past 3 months) of the ecosystem.

- Monitoring System Assessment: OPEC has assessed the effectiveness of current operational ecosystem monitoring systems across regional seas and made recommendations for future monitoring.

- Seasonal forecast: OPEC has demonstrated that its systems have the potential to make robust seasonal ecosystem forecasts. The next step is to trial a pre-operational model.

- Downstream services. Through consultation with end-user groups OPEC has developed new services and products by combining modelled and satellite data within the same work environment in a transparent and easy to manipulate manner which will provide much needed added value and downstream services. These are delivered through the WAQSS system (http://portal.waqss.de).

Links with policy: OPEC will feed into several key policy areas, such as the European Marine Strategy Framework Directive and Common Fisheries Policy. By providing information on the state of the past and current environment for key indicators related to MSFD Descriptors, regional and national stakeholders will be better able to plan, monitoring and report on their waters. Products and services generated by OPEC will provide information for environmental managers, policy makers and other related industries, laying the foundations for the next generation of operational ecological products and identification of knowledge gaps.
Monitoring Systems
Baltic: OPEC has assessed the effective coverage of the current routine monitoring system (buoys and FerryBoxes) for surface chlorophyll in the Baltic Sea. Areas in blue show regions where the system is poorly sampled.

Rapid Environmental Assessment
The REA of the Mediterranean Sea allows users to understand the current state of the system (the past three months), in this case the spatial and vertical distribution of chlorophyll. This approach illustrates the potential of models to provide information about unmonitored areas thus giving us a fuller picture of the current state of the ocean.

Ecosystem Approach
NE Atlantic: modelling of whole ecosystems from plankton to seabirds allows us to describe the spatial distributions of a range of key species including commercial fish species.

Through the development of regional modelling systems OPEC has created a prototype ecological marine forecast system for the Baltic, Black and Mediterranean seas and the NE Atlantic. Systems have been validated through novel data assimilation techniques to provide information on the hydrodynamics, lower and higher trophic levels (plankton to fish) of these regional seas.

20 year Hindcasts
Hindcast simulations of the last 20 years of the Black Sea allow stakeholders to assess the trends and changes in mid water nitrate concentrations in the central Black Sea. 20 year hindcasts are available for all regional seas for a set of key environmental indicators.

Seasonal Forecasts
OPEC has demonstrated the potential to make seasonal forecasts of anchovy biomass in the Aegean Sea. With further development this system has the potential to provide information in support of fisheries management and regional planning.
Future of OE as seen by OPEC: The OPEC project has provided a robust evaluation of the regional ecosystem forecast models, demonstrating their ability to provide information of past and present ecosystem states. We have also demonstrated the potential to make seasonal ecosystem forecasts. Our aspiration is to transition these systems into the operational suites of the Copernicus Marine Core Service.

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Operational Ecology
Marine Ecosystem Forecasting