ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

THE COPERNICUS MARINE WEEK
BRUSSELS, 25-29 SEPTEMBER 2017

CMEMS DEMONSTRATION COASTAL - MED SEA
Contract 32-DEM2-L5 Until 4 October 2019

OGS

The CADEAU directive-oriented downstream coastal service: integration of national water quality data and a model downscaling of the Mediterranean CMEMS

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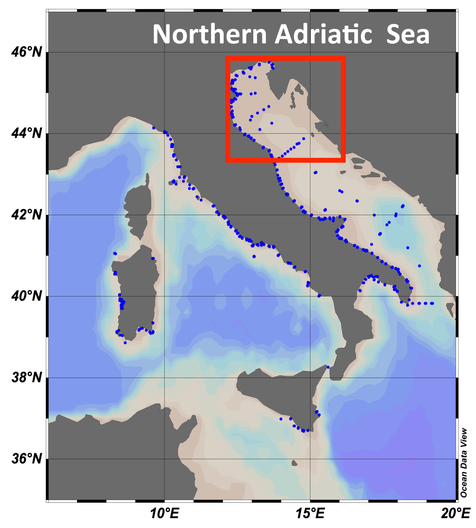
INTRODUCTION

EU countries are requested to comply with many **EU Directives** with respect to **coastal and marine environment** (e.g., WFD, UWWTD, BWD, MSFD).
Such Directives either prescribe **threshold values** to comply with, or define the process to make an **environmental assessment** and to specify **environmental targets** and **actions** to reach them.



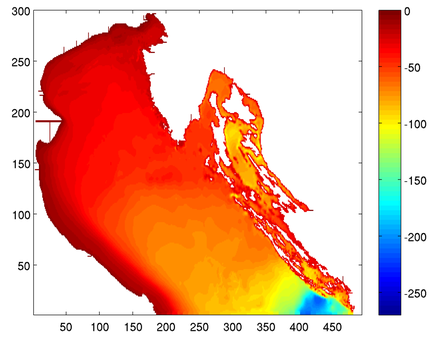


Fig. 1. Study area (left) and model domain and bathymetry (right). The model has a horizontal resolution of 1/128° (~850 × 600 m), with 27 vertical levels and 19 main freshwater sources (rivers).

CMEMS DOWNSTREAM SERVICE

CADEAU is a **downstream application** that aims to operationally produce an **annual bulletin** reporting the **marine environmental state** and the **water quality** in the Italian coastal area of the **Northern Adriatic Sea** (CMEMS Mediterranean Sea region, Fig. 1).
The service (Demonstration 32-DEM-L5) is applied to the Northern Adriatic, since it is one of the most sensitive areas along the **Italian coastline** where **eutrophication** and **marine resources exploitation** both influence and depend on the **quality** of the marine ecosystem.
CADEAU focuses on nutrient dynamics, eutrophication and bathing water quality in coastal areas in **support** of the application of the EU Directives.

IMPLEMENTATION OF THE SERVICE

The system is based on the high-resolution, **coupled MITgcm-BFM model** (*Adcroft et al.*, 2017, *Cossarini et al.*, 2017, Fig. 2 and 3). The meteorological forcing is obtained from the **COSMO-LAMI** model. The coupled model is initialized and driven by the **downscaling** of the products (hydrodynamics and biogeochemistry) of the CMEMS Mediterranean Monitoring and Forecast Centre. The **MEDSEA_REANALYSIS_PHYS_006_004** and **MEDSEA_REANALYSIS_BIO_006_008** datasets are used to obtain the daily open boundary conditions on the southern side of the domain. Further, the model will **integrate** the Italian water quality monitoring system by means of **nudging** and **data assimilation** algorithms.
The **products** are designed to provide information on the **space-time distributions** of the major parameters related to **water quality** (nitrogen and phosphorus concentration, chlorophyll, dissolved oxygen) and they will be **publicly delivered** through a dedicated **web-portal**:
http://www.sintai.isprambiente.it/faces/public/CADEAU/index.xhtml
The **annual bulletin** includes the following derived products:

- concentration and dynamics of nutrients (high-resolution surface fields)
- indexes of eutrophication (biomass of producers and TRIX index)
- dynamics and characteristics of ocean currents
- dispersion of pollutants around the areas of the discharge points (rivers and UWWTP outfalls)
- maps showing potential bacterial pollution sources impacting on a bathing water body
- maps of statistical correlation between organic matter and primary producers and mussels and clams weight and size

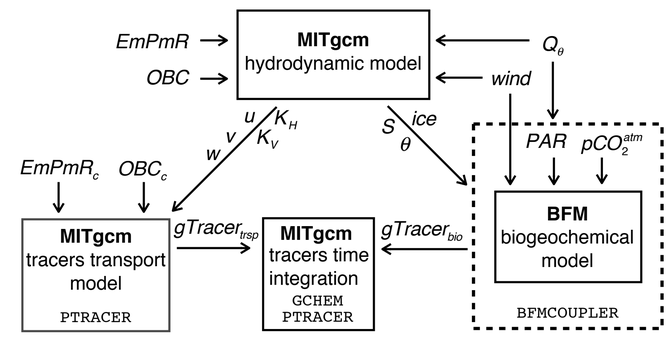


Fig. 2. Description of the MITgcm-BFM coupling and interfaces among the different components. Q_θ: heat fluxes; *EmPmR* (*EmPmR*$_c$): water (matter) fluxes; *OBC* (*OBC*$_c$): open boundary condition for hydrodynamic (biogeochemical) variables; *S*, θ, *u*, *v*, *w*, *ice*, K_h and K_v: hydrodynamic variables; *PAR*, *wind* and pCO_2^{atm}: forcing variables for the biogeochemical model.

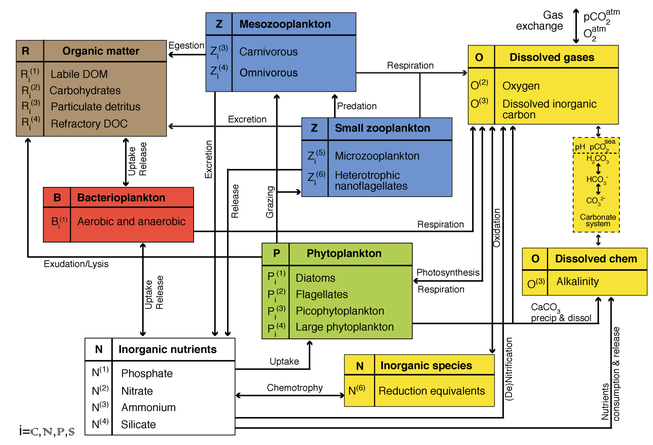


Fig. 3. BFM model: scheme of the functional interactions among the biogeochemical variables (*Lazzari et al.*, 2012).

PRELIMINARY PRODUCTS AND RESULTS

Two experimental datasets have been created (Fig. 4): **1** – ***in-situ*** **samplings** of physical, biological and chemical parameters; **2** - **UWWTP** discharges.
The sampling data have also been analysed to obtain a **synoptic view** of the dataset and to check the spatial and temporal distribution of the *in-situ* measurements (Fig. 4).
The UWWTP data are included in the model as **local bottom sources of nutrients**. The first integration of the numerical model and the experimental dataset has been tested successfully (Fig. 5): a preliminary simulation has been run to check the **numerical stability**, **computational cost** and **quality** of the output.

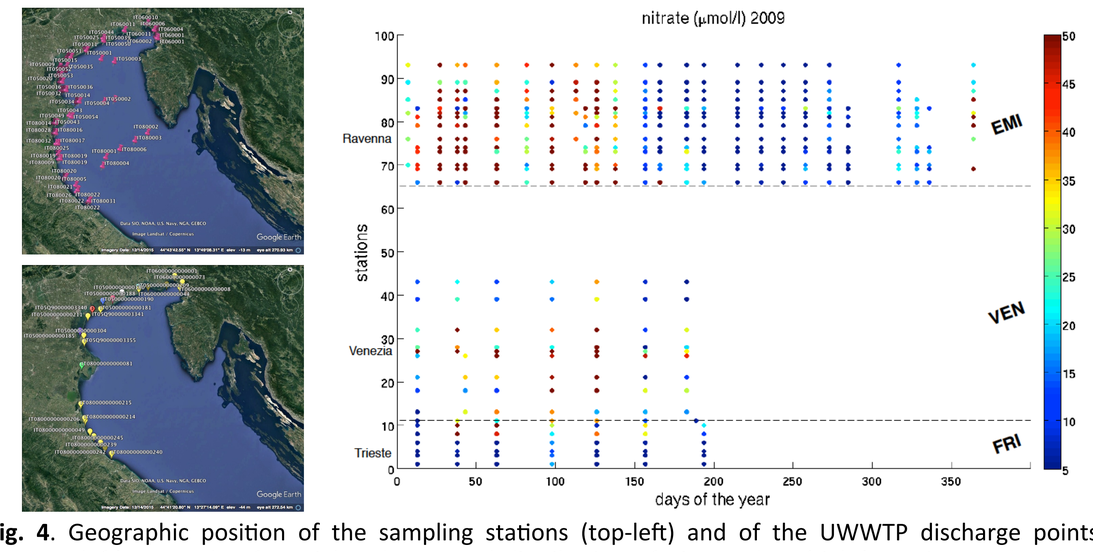


Fig. 4. Geographic position of the sampling stations (top-left) and of the UWWTP discharge points (bottom-left). Example of spatial and temporal distribution of nitrate data (right): stations ordered by administrative divisions (FRI, VEN, EMI), following the coastline in the CCW direction, starting from north.

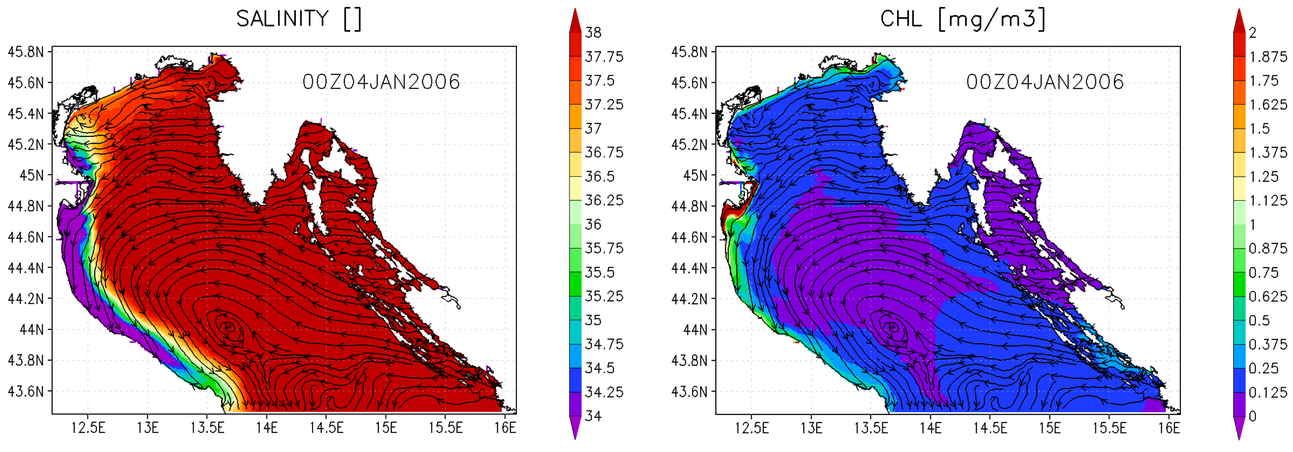


Fig. 5. Surface plot of salinity (left) and chlorophyll (right), and horizontal component of velocity (streamlines) during the first month of the simulation. Daily average on the 4th of January 2006.

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