Optimal sampling of a regional sea for ocean forecasting, physical and numerical experiments.

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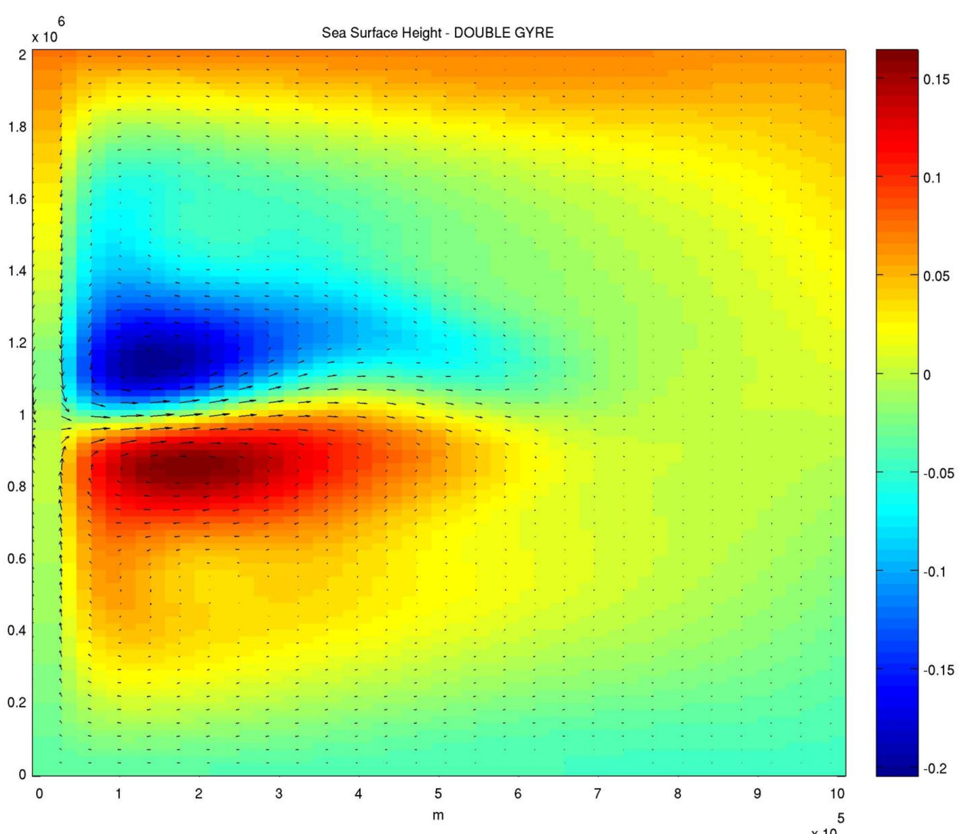
We present a preliminary study focused on finding operational criteria to support the design of sea monitoring network at regional scales. This study includes the identification of suitable instrument types, their number, and improved sampling strategies to significantly enhance the quality and reliability of ocean forecasts on a regional scale, by a combined OSE and OSSE approach.
We start from the assessment of the impact of assimilation of some standard in-situ measurements (CTD) and lagrangian devices (drifters, floats).

Different localization strategies of sensors (or deployment positions, in case of lagrangian tools) have been taken:
a. choosing them randomly
b. concentrating them in the higher error area (in the case of OSSE simulations) or on the most unstable directions (in realistic configurations).
Methods for estimating such unstable directions (or, more generally, on uncertain behavior) are in course of study (e.g. Direct Lyapunov Vectors or Breeding Vectors).

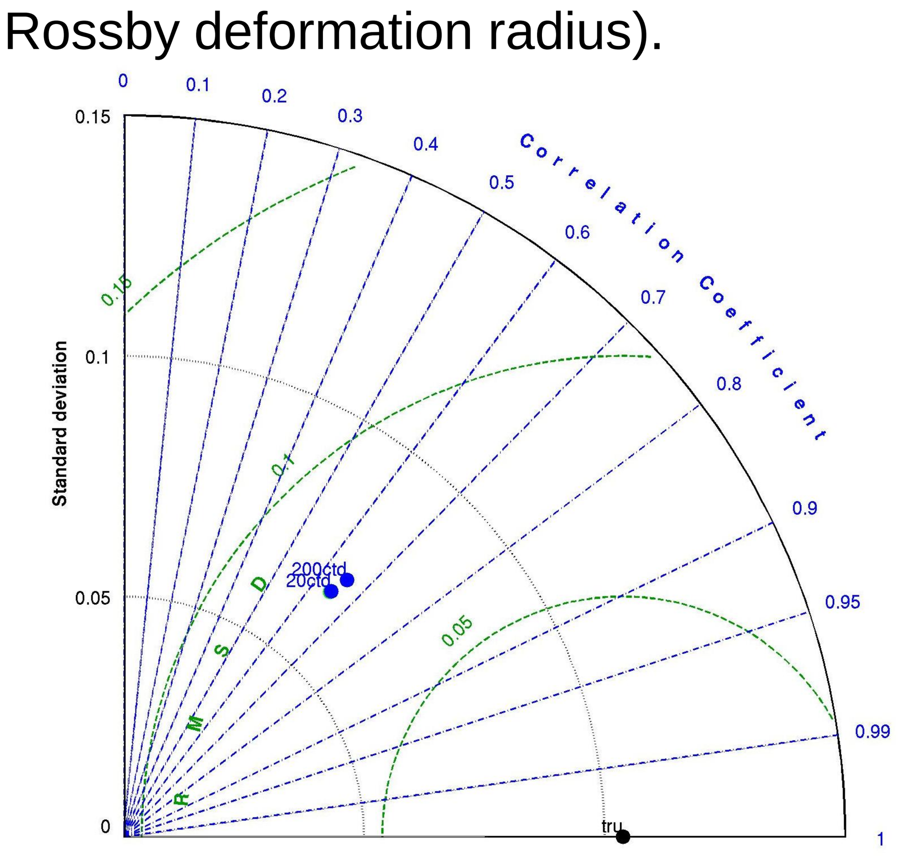
1.DOUBLE-GYRE MODEL

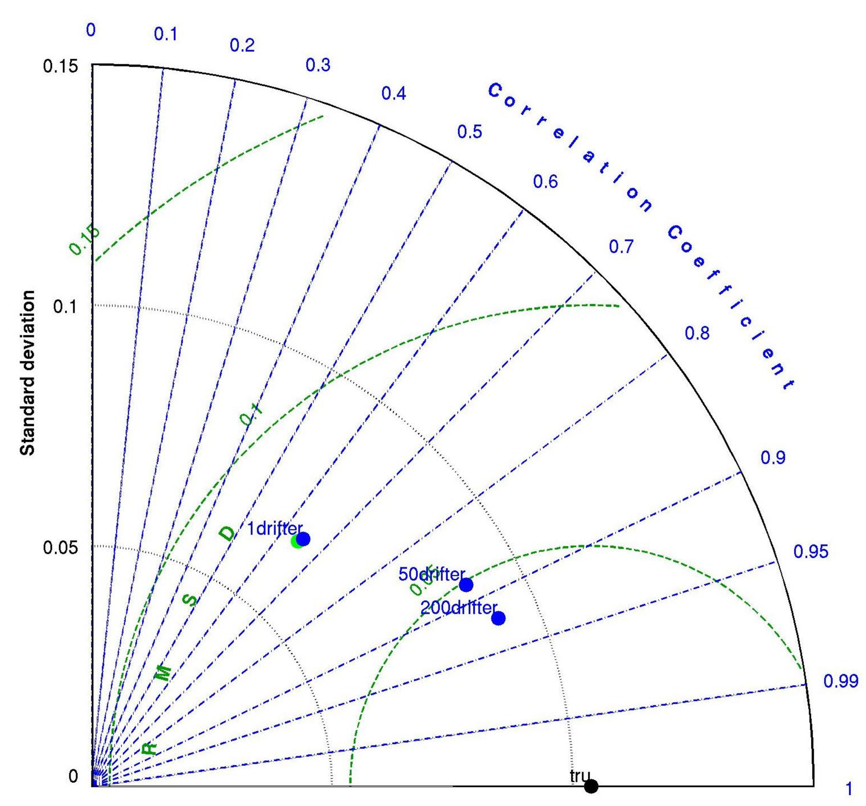
An idealized standard model configuration, reproducing a well organized hydrodynamic system



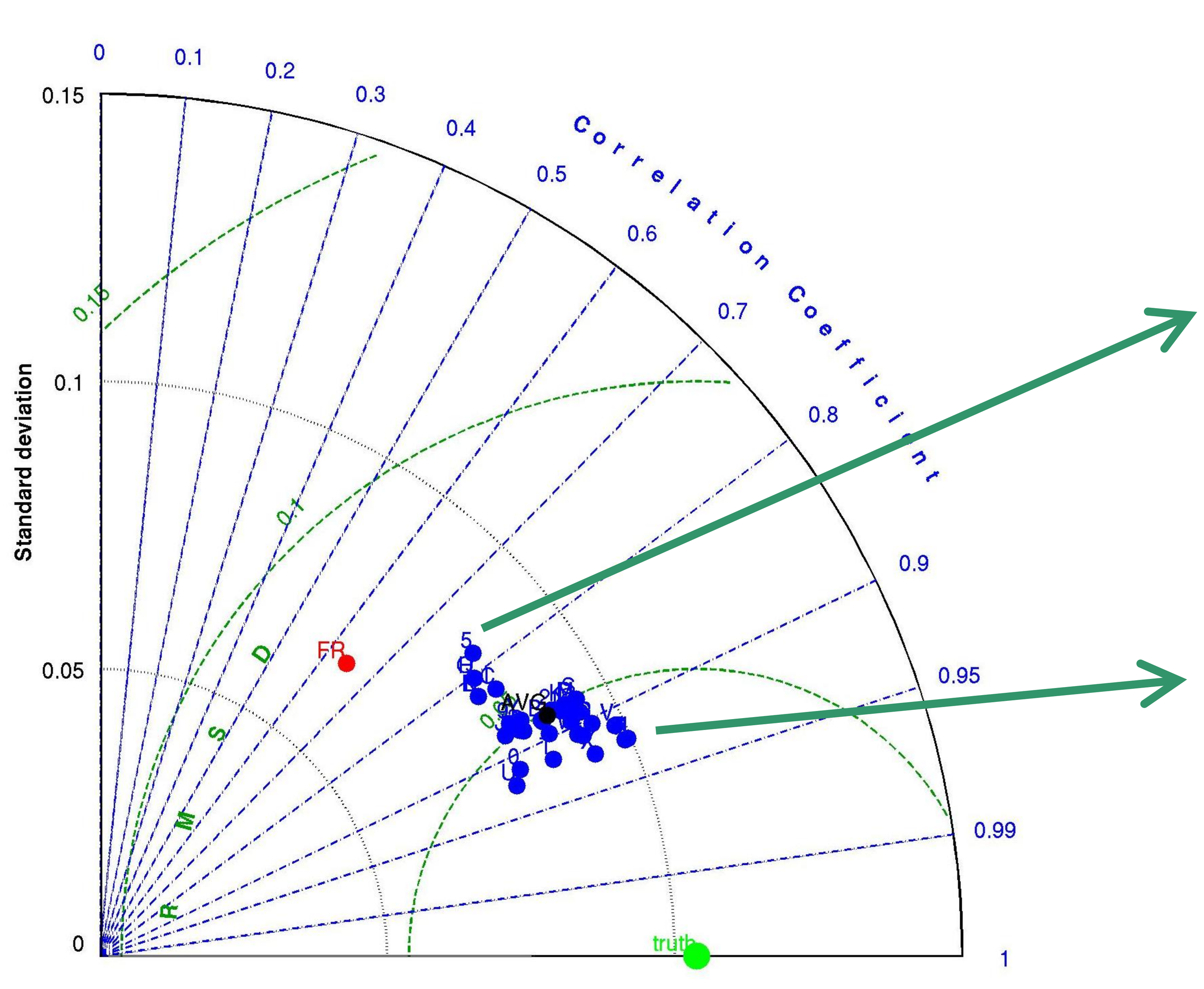
DOUBLE-GYRE MODEL CONFIGURATION and DATA ASSIMILATION PARAMETERS
Grid dimensions 54 x 108, 20 vertical levels, 1 km resolution; forced by a sinusoidal zonal wind stress.
D.A. window 1 day – forecast forward 4 days (Internal/External cycles:7,2)
Control vector = initial conditions
D.A. algorithm: IS4DVAR
Observations location: randomly choosen
Observation type: CTD and lagrangian velocities.

In such idealized system, forced by wind-stress only, the actual influence of temperature/salinity assimilation is negligible, but a much greater impact is shown when we assimilate drifter velocities.
Each point in the Taylor diagram represent the average of large ensemble of experiments.
The actual optimal number of drifters shall depend on geophysical length scales (i.e. Rossby deformation radius).

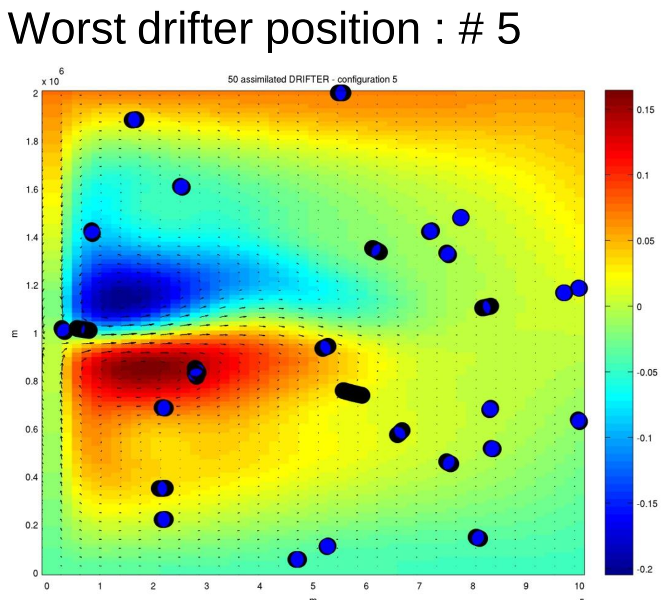




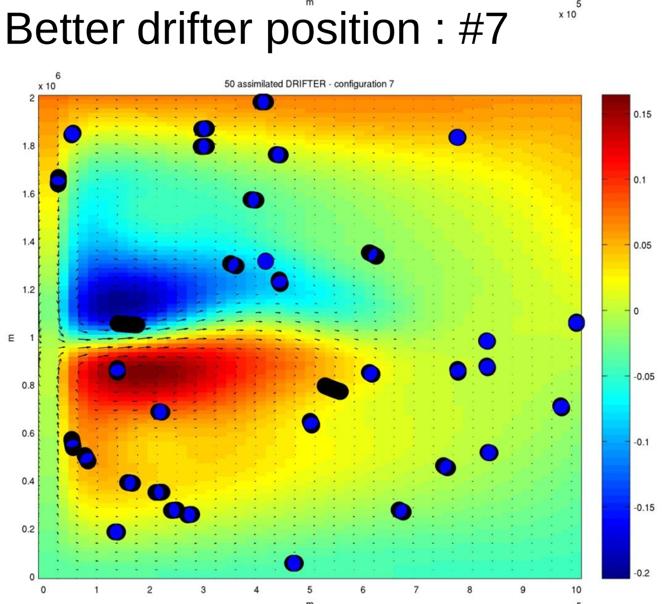
TAYLOR DIAGRAM – assimilated 50 drifter



Worst drifter position : # 5

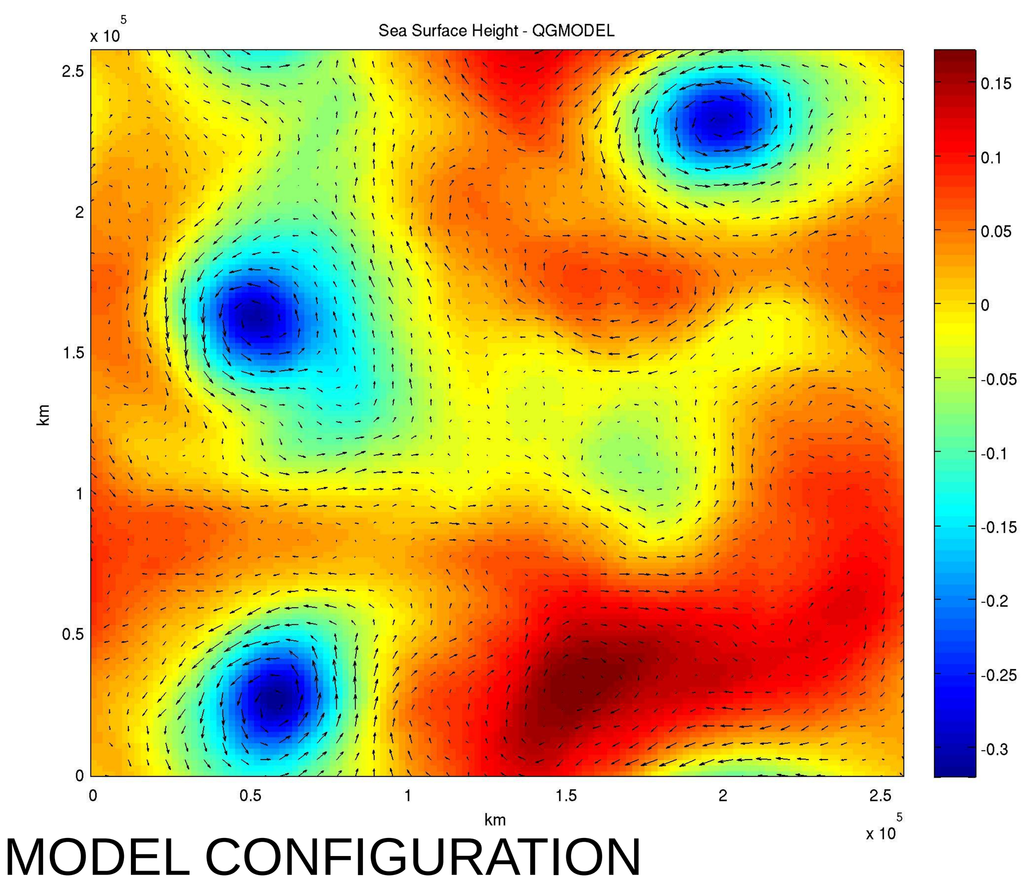


Better drifter position : #7



2. QG MODEL

An idealized model configuration, more chaotic of mesoscale eddies (QG turbulence)

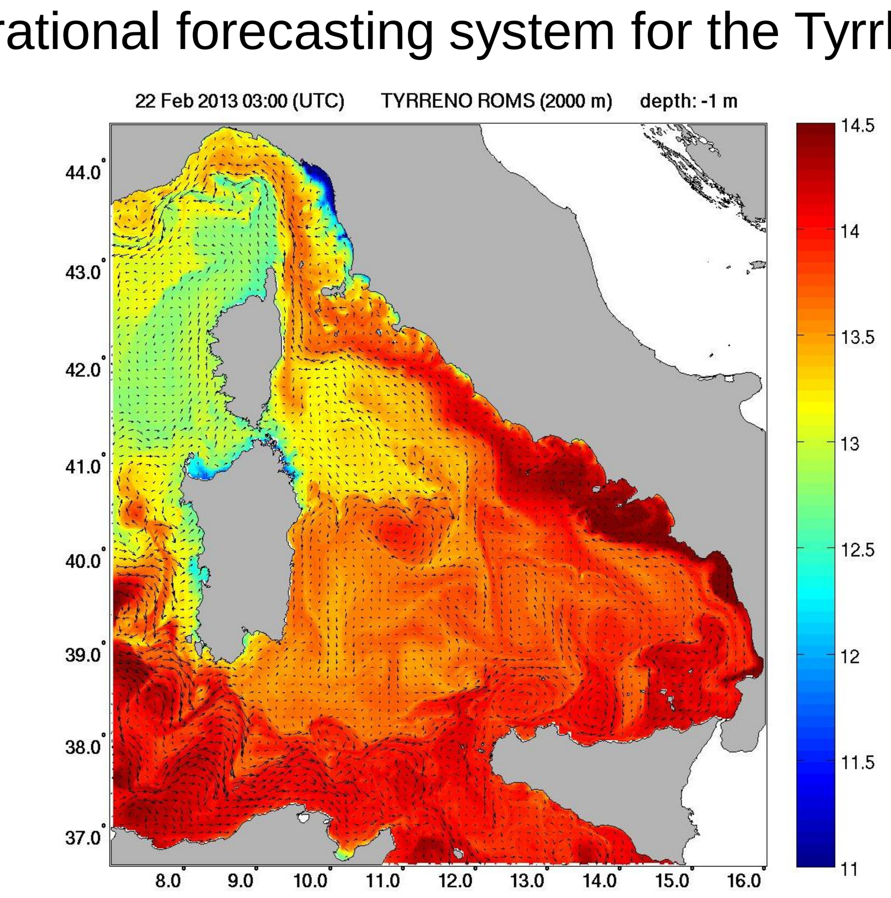


QG MODEL CONFIGURATION
Grid dimensions 128 x 128, 20 vertical levels, 2 km resolution. GLS turbulence closure
Forcing: narrow-spectra forcing with kx=ky=6, and slightly modulated in frequency, phase and amplitude. Doubly periodic boundary conditions.

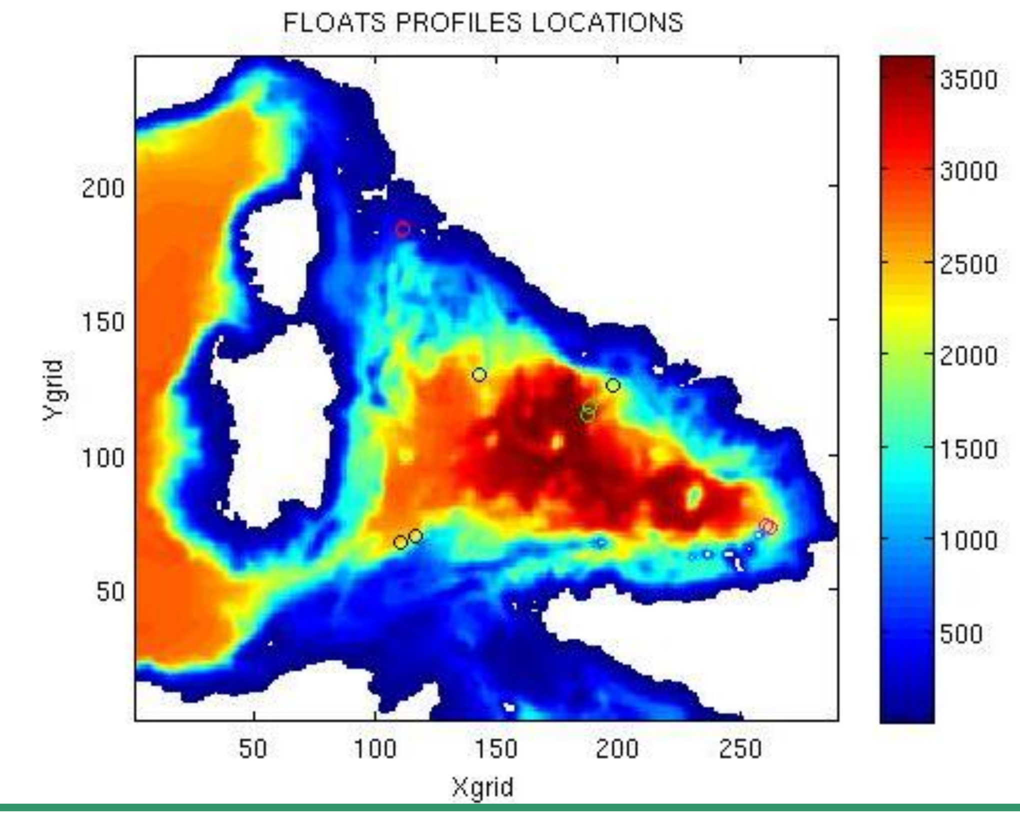
The system is similar to that used by Koszalka et al. (2009) as an approximation of mesoscale/submesoscale eddy activity.

3. TYRRENO MODEL:

An operational forecasting system for the Tyrrhenian Sea



TYRRENO MODEL CONFIGURATION
Grid dimensions 288 x 247, 30 vertical levels
Resolution: 2km, GLS turbulence closure
Forcing: 3km LaMMA operational WRF model
Initial and boundary conditions: MyOcean-MFS
DA Algorithm : IS4DVAR
(Internal/External cycles:3,2)



This kind of assessments have been used in order to find an operational strategy to set optimal parameters for lagrangian floats (i.e. ARGO floats):
- number of floats - parking depth - frequency of profiles - deployment location.

A number of physical experiments are in course of realization in the Tyrrhenian basin, and related data are assimilated into the operational model.
Results of this physical experiment are used to validate a larger set of numerical experiments in order to extend the range of validity of our study.