Dynamics of meso- and submesoscale processes from in situ data and numerical modeling in a coastal environment

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Motivations – Area of study

• Hydrodynamics in coastal areas is characterized by the presence of numerous meso- and submesoscale features.
• In the framework of the LATEX (Lagrangian Transport Experiment) project, the generation of these features, their dynamics and their potential impacts on the dispersion of coastal waters have been investigated.
• Multi-disciplinary project based on in situ measurements and numerical model simulations (SYMPHONIE, 1km spatial resolution)

Gulf of Lion (GoL):
• Hydrodynamics: complex and highly variable, influenced by three main forcings:
  1. Mistral & Tramontane – wind
  2. Northern Current (NC)
  3. Rhone delta – river plume
• Intense (sub)mesoscale activity due to NC instabilities and strong wind forcings
• Recurrent generation of mesoscale eddies

Conclusions

Synergy of model results and in situ data

New generation process of eddies in the western part of the Gulf of lion

Observations of transient submesoscale structures
Investigation of cross-shelf exchanges in a coastal environment
Quantification & validation of the gas exchange
Estimation of turbulent mixing coefficient

Latex09 - In situ observations – Numerical model

• The Latex09 campaign (August 24-28, 2009) investigated the characteristics and dynamics of a coastal anticyclonic eddy using ships measurements, surface drifters, and satellite sensors.
• The collected information allowed the near real-time determination of eddy center and the horizontal and vertical characterization of the feature.
• The numerical simulation reproduces a persistent anticyclonic eddy with dimensions and position in very good agreement with in situ measurements.

Latex09 Presence of an eddy

Eddy generation process

• The numerical results suggest a generation process for the Latex09 eddy mainly due to the pushing and squeezing of an anticyclonic circulation between a meander of the NC and the coast, leading to the separation of the circulation in two structures.

July 20 August 8 August 16 August 27

Shelf-to-shelf exchanges

• The interaction between the Latex09 eddy and the coastline induced the generation of a transient meso-scale structure.
• This model result is confirmed by the trajectories of a series of Lagrangian drifters launched during Latex09

Interstitial Loss & K_o determination

• The evolution of SF6 concentration with time due to atmospheric loss has been modeled as a negative exponential function.
• Three parameterizations of the transfer velocity are used.
• Good match between the theoretical curve (LM-86) and total SF6 mapped
• Good coverage of the patch
• The gas exchange shows the impact of the strong wind.

References