axis 1

"The ocean engine at very high resolution"

SCIENTIFIC CONTEXT

Motions of intermediate scales (eddies with diameters smaller than 200km) are essential to the functioning of oceans.

These motions represent 90% of the energy of oceanic motions, they shape ocean currents, ocean biogeochemistry and marine ecosystems.

Propelled by observations of ever increasing resolution and ever more powerful supercomputers, recent research has however highlighted that mesoscale processes are strongly influenced by processes of yet smaller scale and hence labelled «submesoscales».

Keywords

- Mesoscale eddies
- Mesoscale front and filaments
- Satellite observations
- Wave-wind-current interactions
- Bio-physical interactions
- Dissipation
- Tides
- SWOT - Sentinel

Coordinators

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Participating laboratories

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  UMR 6523, CNRS, UBO, IRD, Ifremer
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- **GM**
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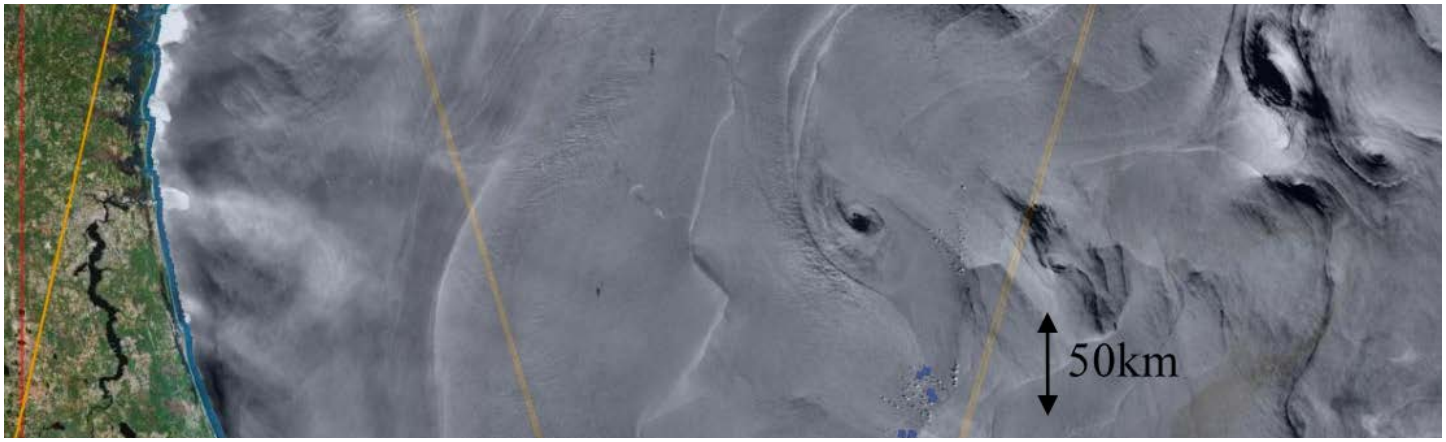
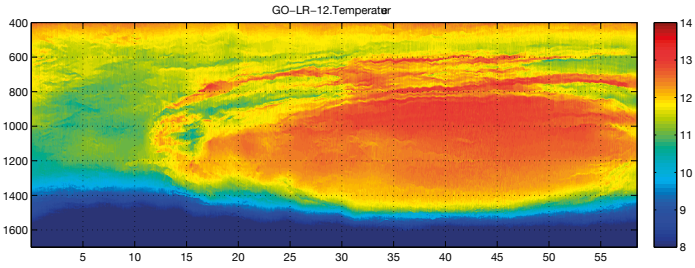


Satellite picture of sea surface roughness offshore of Florida. Sea surface roughness is modulated by the Gulf Stream and surrounding eddies.

ROADMAP

Axis 1 brings together researches that aim at better understanding, observing and predicting mesoscale and submesoscale fluctuations in the ocean, as well as their impact on biochemistry, ecosystems, and, climate. The philosophy of axis 1 is to adopt a global strategy that focuses on a broad range of scales, that combines observations of the ocean with results from numerical simulations, and, that brings scientists from different disciplines.
Axis 1 activities will concern the following scientific issues:



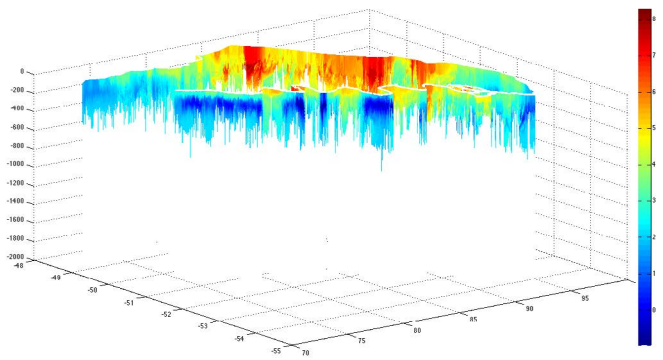
Ultra-highly resolved vertical section of temperature derived from seismic data collected in the Atlantic Ocean. This data highlights the complexity of the thermo-haline structure surrounding a lens of warm mediterranean water (MEDDY).

- Study of the 3D dynamics of the oceanic upper 500m, with high resolution satellite observations of the ocean surface. Several members of axis 1 are part of the science team of SWOT (Surface Ocean Topography, NASA/CNES). A major goal is to develop methods that will combine such data in order to better estimate the oceanic circulation within the first 500m of the ocean where most exchanges with the atmosphere and the ocean interior take place.
- Impact of the oceanic circulation between mesoscale and submesoscales on biochemistry and the marine ecosystem. The issue at stake is to understand how mesoscale eddies and submesoscale structures modulate nutrient imports near the surface, transport and disperse nutriments and living beings, and thus how they structure life within the ocean.
- Triple interaction between the atmospheric and oceanic circulation and surface gravity waves. On top of their impact on ocean atmosphere fluxes, these interactions affect directly our ability to observe the ocean at fine scale.
- Dissipation of energy in the deep ocean *via* interaction or not with topography. Tools such as seismic reflection and high resolution numerical simulations will be used.
- Interaction between mesoscale/submesoscales and tidal phenomena. The issue is to understand how this interaction affects our ability to estimate the oceanic circulation at mesoscale and submesoscale.

Scientists from Brittany are leaders in these domains and have gathered since several years a strong expertise in numerical, theoretical and experimental approaches. They belong to the Laboratoire d'Océanographie Physique et Spatiale (LOPS), the Géosciences Marine Department (Ifremer) and the Laboratoire des sciences de l'Environnement MARin (LEMAR).

EXPECTED RESULTS

Skills and synergies within axis 1 will lead to an improved understanding of the oceanic dynamic of mesoscale and submesoscale, on its impact on the circulation at larger scales, on the atmospheric circulation and waves, and on marine ecosystems and biochemistry. Tools combining observations (satellite, in situ) and numerical models will improve the ability to observe and predict fluctuations of the ocean at these scales.



Temperature data collected by elephant seals offshore of the Kerguelen Islands. This highly resolved data highlights the omnipresence of fine scale ocean variability.