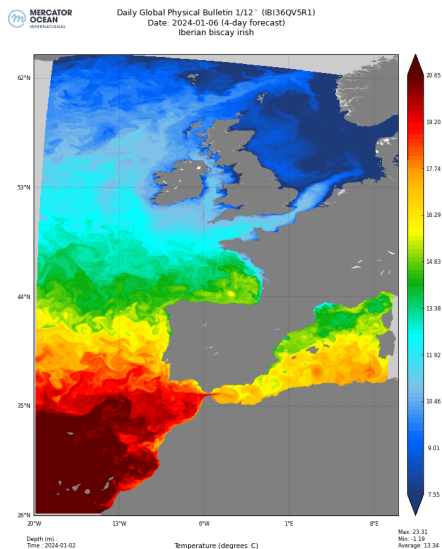


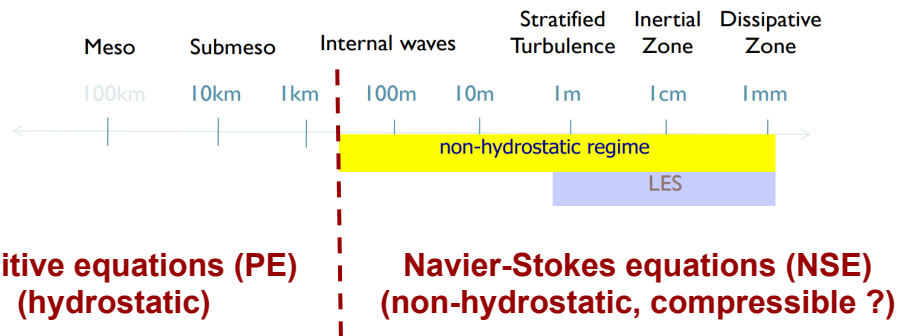
MOTIONS

Multiscale Oceanic simulaTIONS based on mesh refinement strategies
with local adaptation of dynamics and physics

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Operational system operated by Mercator Ocean International (MOI) with an horizontal resolution ~ 1.5km

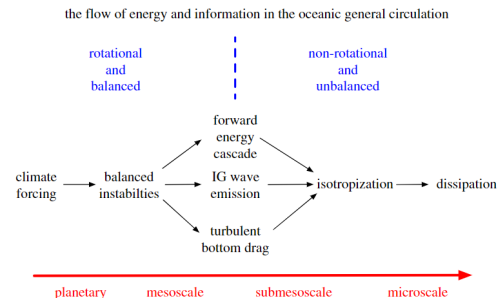


Context :

- (i) The overwhelming majority of realistic ocean models are PE based
- (ii) Compared to PE solvers, NSE solvers require a much larger computational effort
=> not affordable to move from PEs to NSEs over large areas
- (iii) Questions about the feedback of fine-scale processes on ocean circulation cannot be addressed without their explicit simulation.

About the notion of scale

The approximate scale range for the **oceanic submesoscale currents (SMCs)** is
 $O(0.1 - 10 \text{ km}/0.01 - 1 \text{ km})$ in the horiz./vert. $O(\text{days/hours})$ in time
the lower limit of the SMC spectrum : KH instabilities



“Large scales” : high part of the SMC spectrum \equiv *hydrostatically balanced* dynamics
(represented by most regional ocean forecasting systems)

“Fine scales” : finest scales of the SMC spectrum \equiv *non-hydrostatic* dynamics (not accessible for PE models)

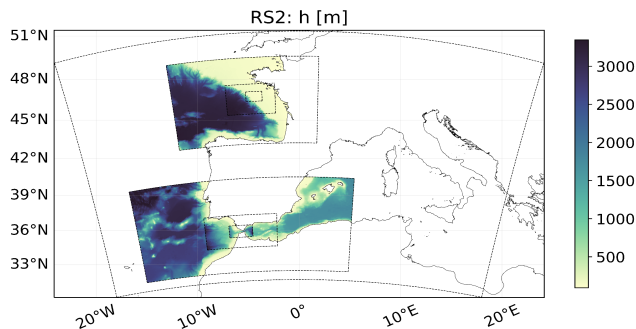
Focus :

- Transition from hydrostatic to NH dynamics (occurs around a horizontal grid size of tens of metres)
- Representing both *downscaling* and *upscaling* across the SMCs

Objectives

The MOTIONS project aims at delivering **robust and efficient numerical algorithms allowing an innovative multiscale modeling strategy based on block-structured mesh refinement with local adaptation of model equations, numerics and physics** in selected areas of interest.

The target application to evaluate numerical developments is the **simulation of important fine-scale non-hydrostatic processes and their feedback to larger scales** within the Mediterranean / North-East Atlantic dynamical continuum.



“Knowledge integrator”: **CROCO oceanic model** jointly developed by CNRS, Ifremer, Inria, IRD, SHOM and UT3

Consortium :

- Inria (AIRSEA team, Grenoble)
- Laboratoire d'aérodynamique (LAERO, Toulouse)
- Service Hydrographique et Océanographique de la Marine (SHOM, Brest & Toulouse)
- Institut Camille Jordan (ICJ, Lyon)
- Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS)

Other institutes involved : Ifremer (Brest), institut Pprime (Poitiers), Mercator Ocean International (Toulouse)

Challenges

- Embedding of a high-resolution NSE zoom in a low-resolution PE grid with 2-way interactions
- Requirements in horiz./vert. resolution, numerical schemes, and subgrid scale (SGS) models for the NSE zoom
- Processing of data from multiscale simulations and their comparison with observations
- Sophisticated diagnostics for evaluating the numerics

WP1** is devoted to the numerical and computational aspects to set-up efficient and meaningful mixed PE/NSE multiscale simulations. To evaluate the impacts of those developments, benches and realistic demonstrators are developed in **WP2**. The numerical simulations are analyzed (confrontation with theory/observations) in **WP3

Développements (Code)

- Merge NBQ3/NHINT dans le master
- Consolidation outil de preprocessing pour multi-résolution/nesting
- Couplage H/NH (possibilité de faire tourner de l'hydro sous clé NBQ (H3D ?))
- Fermeture hybride RANS/LES (cf session *paramétrisation* demain matin)
- Diagnostiques : budgets de PV en H et NH; mélange *spurious*
- En option : raffinement vertical sur la base des travaux de J. Chanut

Développements (configs)

- **Pour le volet Méditerranée** : version modernisée de la configuration MEDDY1 du SHOM avec extension vers l'Ouest. Recyclage des aspects validations issus de MEDDY1.
- **Pour le volet Golfe de Gascogne** : inspirations à prendre du côté de la config historique Hycom et du CROCO-Manga de l'Ifremer.
- **Benchmark académique**