DIEGO: Data and dynamIcal synErGies for swOt

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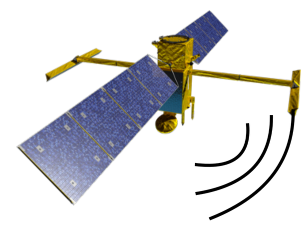
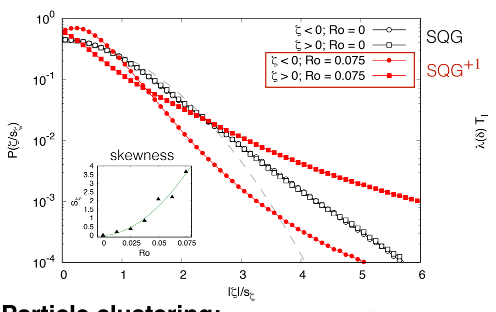


SQG with ageostrophic corrections

Developing PE to next order in Ro: $\partial_t \theta_s + \mathbf{u}_s \cdot \nabla \theta_s = F + D$ $\quad \mathbf{u}_s = \mathbf{u}_s^{(g)} + Ro\, \mathbf{u}_s^{(a)}$ $\quad$ SQG^{+1} model

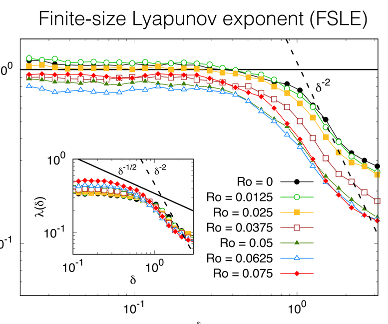
Vorticity PDF:

Dominance of **cyclones** over anticyclones



Pair dispersion:

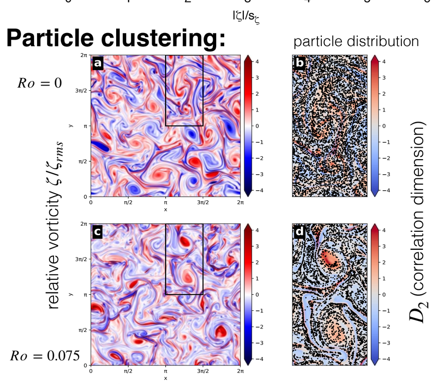
Finite-size Lyapunov exponent (FSLE)

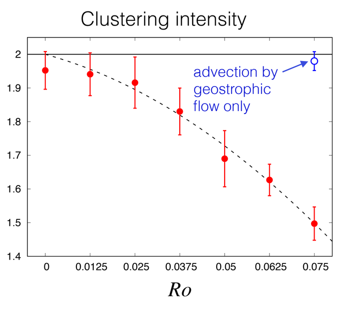


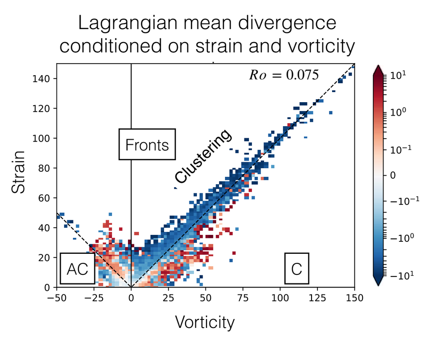
Very weak effect of ageostrophic motions on relative dispersion statistics (insensitivity of FSLE)

SWOT surface currents may be appropriate for pair-dispersion statistics applications but accessing finer details (e.g. convergence events) could be more difficult.

Particle clustering:







Intensity (i.e. probability of convergence events) increases with Ro

Particles preferentially in **cyclonic frontal regions** ($div\ \mathbf{u}_s < 0$), as from observations and realistic simulations

M. Maalouly, G. Lapeyre, B. Cozian, G. Mompean, S. Berti, submitted to Phys. Fluids (2023)

SWOT & Lagrangian data/ methods

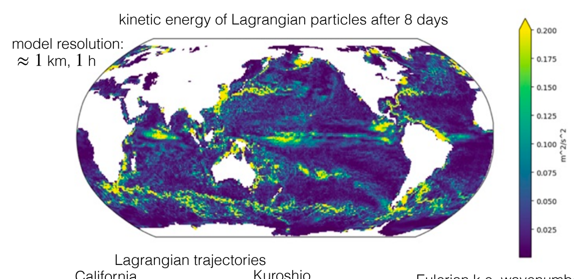
Contact: S. Berti & G. Lapeyre

From idealized to realistic models

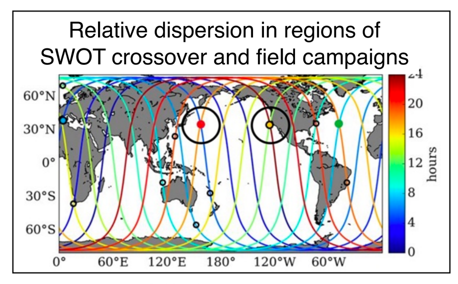
In SQG^{+1} model ageostrophic motions are related to frontogenesis (close to balanced state)

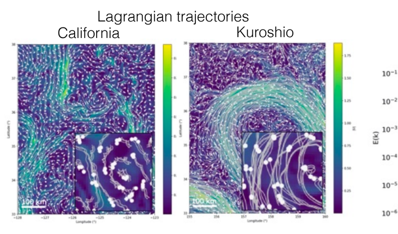
Realistic simulations with MIT gcm LLC4320 + OceanParcels: to investigate the effect of the ocean fast variability (tides, IGWs) that cannot be represented within the idealized SQG^{+1}model

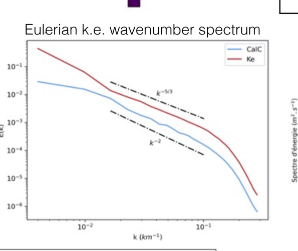
S. Berti, G. Lapeyre & A. Ponte

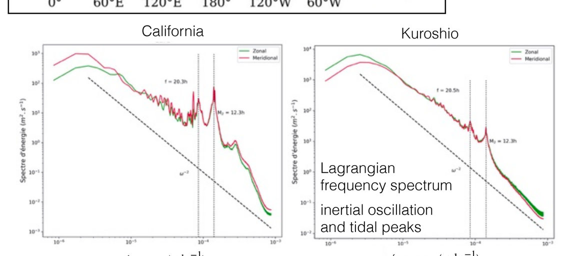


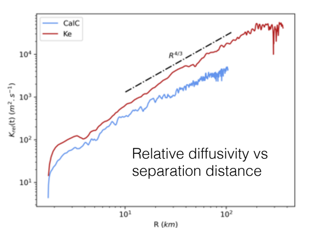
Guillem Carcanade's & Apolline Dekens' internships (2023)

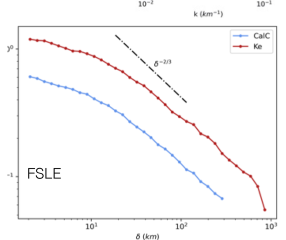












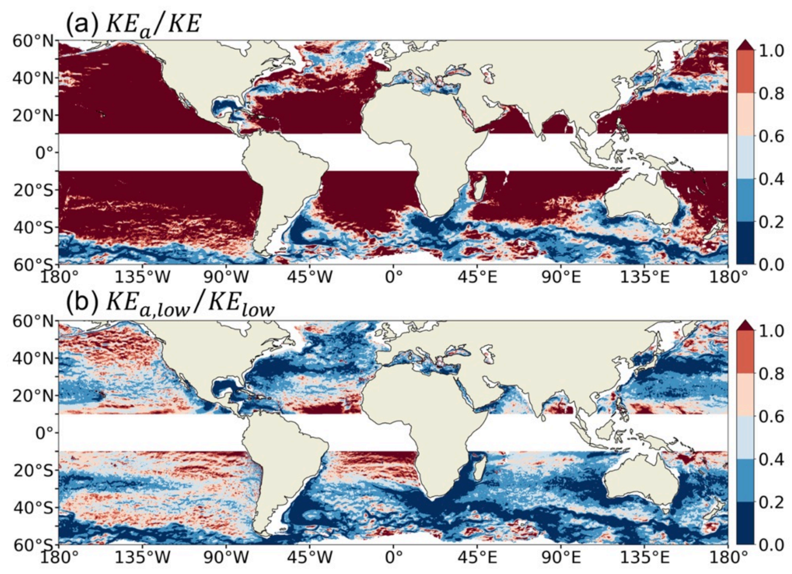
Preliminary results: good agreement with theoretical predictions from **space-dependent indicators** of relative dispersion (possibly weak effect of fast variability)

Ongoing work: regional and seasonal variability; comparison with results from advection by slower flow component; effect of convergence events

Central questions:

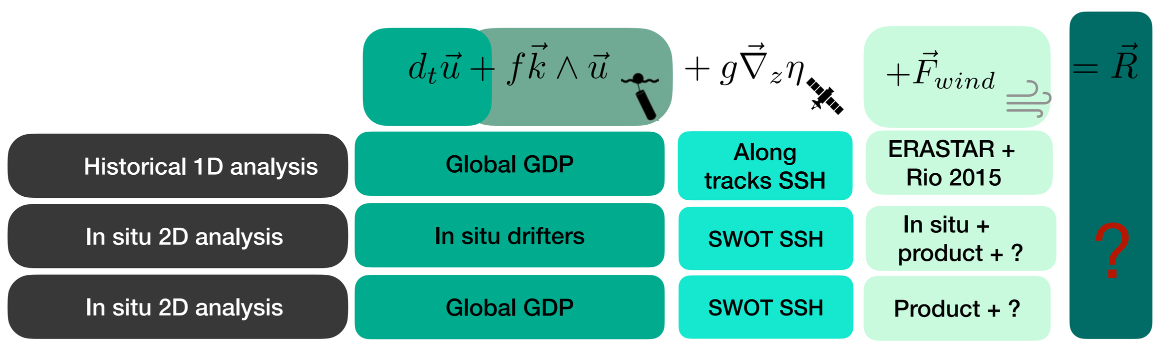
- How accurate is geostrophy for the estimation of surface currents ?
- What dynamical balances govern the upper ocean dynamics?
- How can this knowledge be leverage to estimate surface currents ?

High frequency motions control our ability at estimating surface currents from sea level (instantaneously) :



Yu et al. 2021: 10.1029/2021JC017422

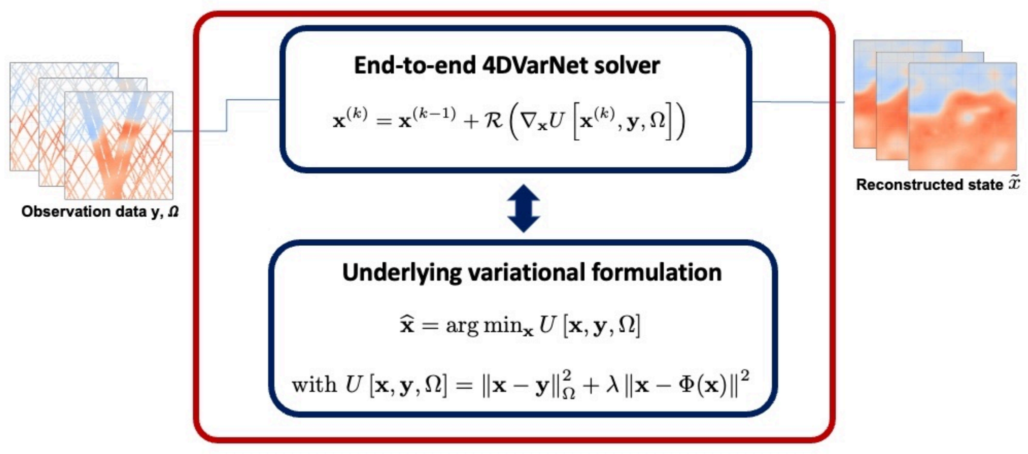
Margot Demol PhD on going - see her poster:



dynamics: classification & reconstructions

Contact: A. Ponte

4DVarNet scheme



Hybrid Deep Learning-Data Assimilation scheme applied to space altimetry

Papers:

- SSH mapping: https://gmd.copernicus.org/preprints/gmd-2022-241/
- SST-SSH synergies: 10.1109/TGRS.2023.3268006
- SSC mapping: 10.5194/gmd-16-2119-2023

Learning based methods for SWOT

Contact: R. Fablet

Main Results

SLA mapping: potential gain of 30%-50% compared with DUACS on a Gulf Stream region (OSSE and real data**)**

Extension to total sea surface currents and SLA forecasting (OSSE case-study**)**

Validation of OSSE-based training schemes for applications to real data

Learning-based calibration of SWOT data

Code: https://github.com/CIA-Oceanix

Incoherence of internal tide

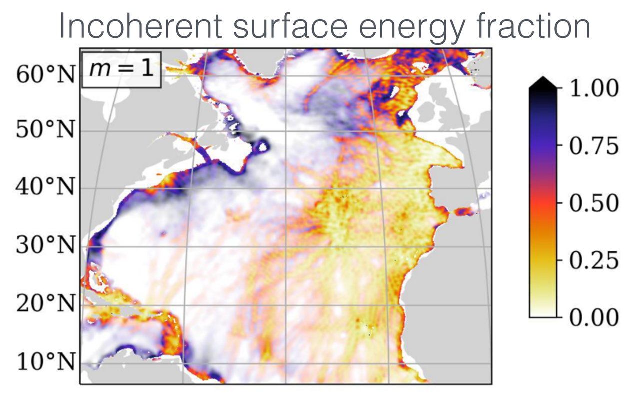
N. Lahaye, A. Ponte, J. Le Sommer

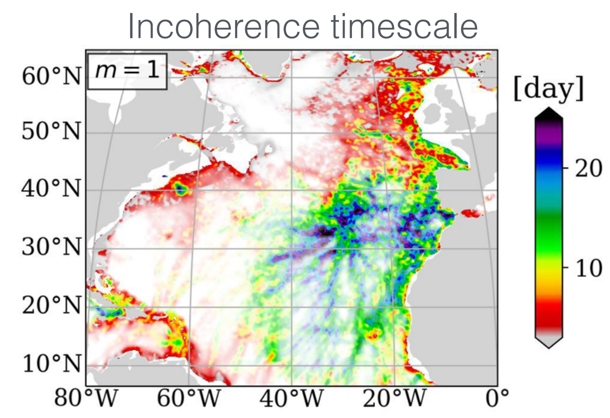
- Diagnostics on eNATL60 outputs
- Characterization of incoherence fraction & timescale

Internal tide life-cycle

A. Bella (PhD), N. Lahaye, G. Tissot

- Diagnostics on eNATL60 outputs
- Characterization of sources, sinks and interactions
- Impact on mesoscale flow on IT energy

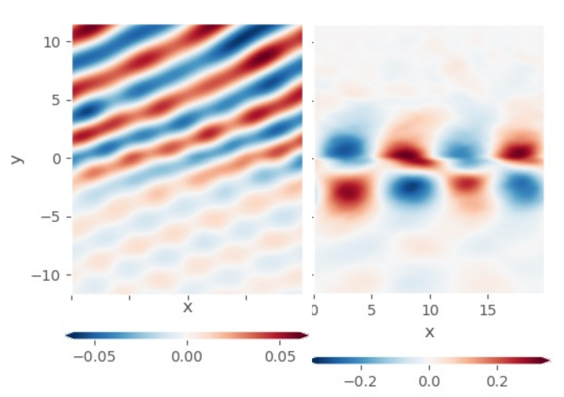




Internal waves / Balanced motions extraction

I. Maingonnat (PhD), G. Tissot, N. Lahaye

- Idealized simulation of internal wave + turbulent jet
- Exploit **wave/mean flow correlation** through **E**xtended **P**roper **O**rthogonal **D**ecomposition -> **joint estimation**



Mode of variability: wave (left) and extended jet mode (right)

Internal tide dynamics and mapping

Contact: N. Lahaye