SANGOMA WP5
Data assessment

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Objectives

- Assess the impact of **new remote sensed ocean data on the model state estimations** and their potential in a data assimilation setup.
- A preparatory step before those observations are assimilated in an operational context.
- Partners: ULg, UREAD, CNRS-LEGI, CNRS-LEGOS, NERSC

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Tasks

- Task 5.1 Identify new data types
- Task 5.2 Assessing observing systems
- Task 5.3 Expts. Large-scale models
- Task 5.4 Exp in regional scale models
- Task 5.5 Lagrangian sea ice parameters
- Task 5.6 Prior errors detection by observational arrays

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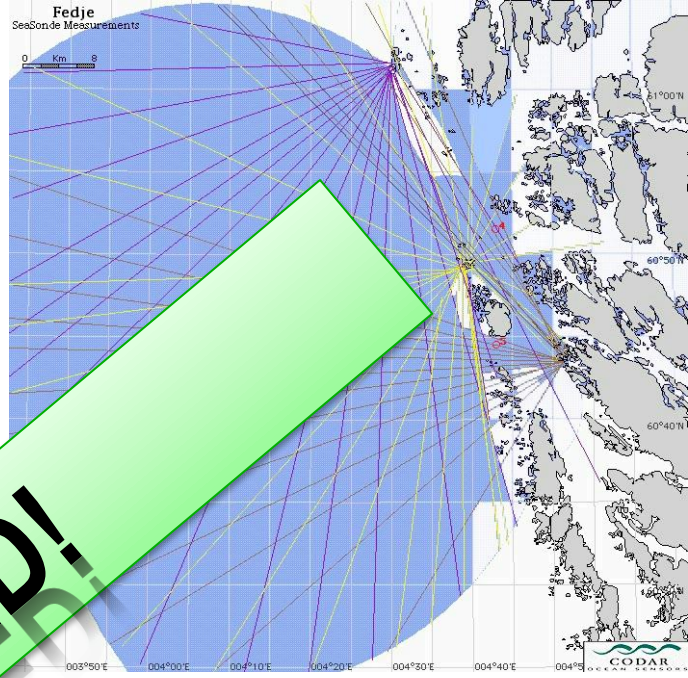
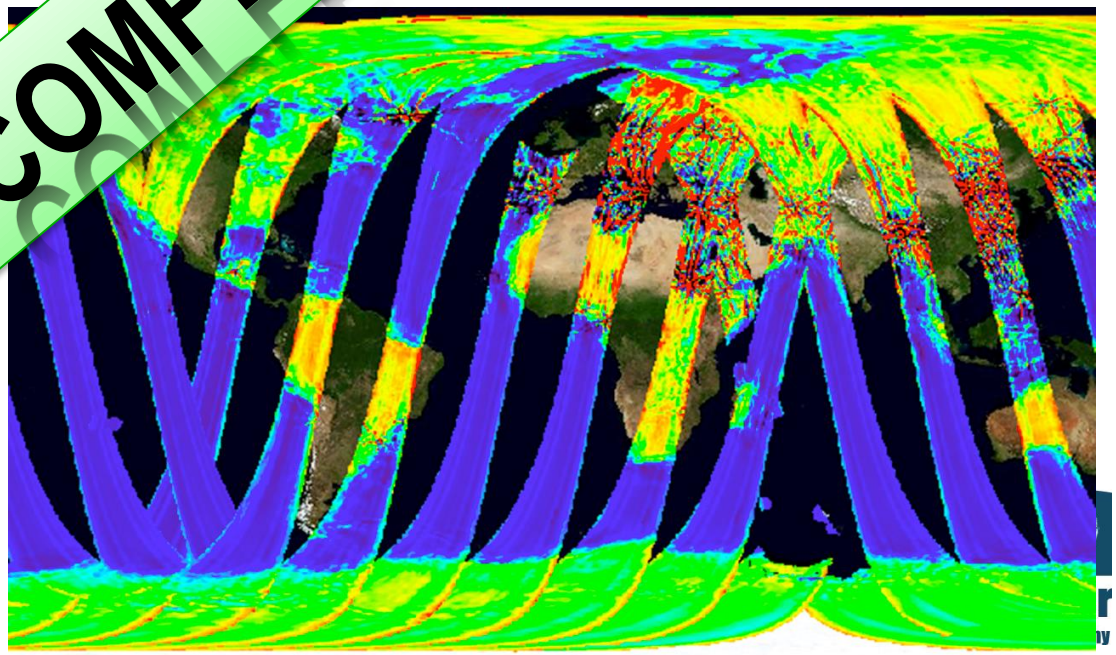
Task 5.1 Identify new data types

- Surface salinity, SST (geost. Sat.)
- Coastal altimetry, gliders, HF radars
  - Observation operators?
  - Error characteristics? (spatial scales



COMPLETED!



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Task 5.2 Assessing observing systems

- LEGI, ULg, UREAD
- Degrees of Freedom of Signal (DFS)
- Non linear methods from WP3
  - Entropy, anamorphosis
- NEMO benchmark

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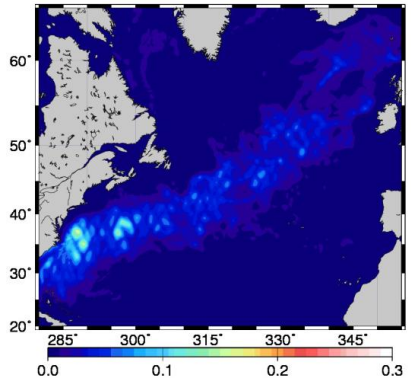
Sensitivity to space-time sampling (G. Candille, CNRS-LEGI)

Prior std dev



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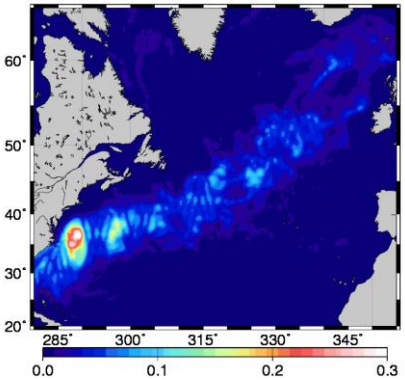
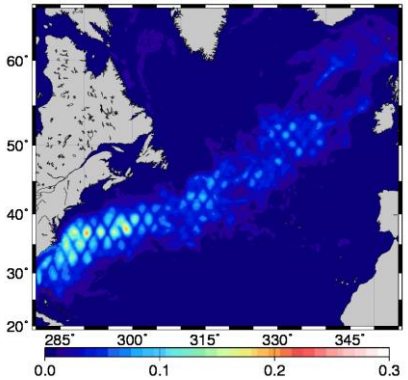


Jason-1



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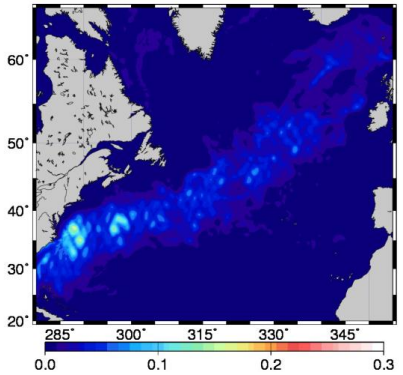

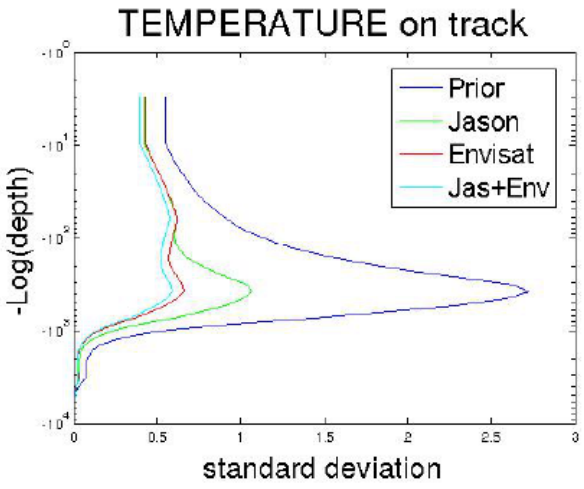

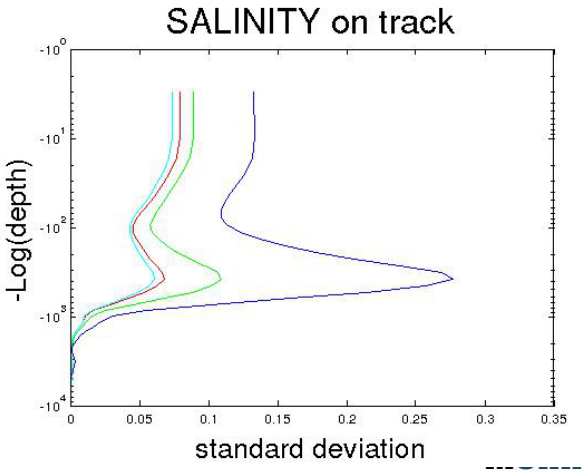

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Task 5.3 Expts. Large-scale models

- ULg, CNRS-LEGI
- NEMO configuration
- Non-linear assimilation methods from WP4
- Validation with MyOcean and SeaDataNet data

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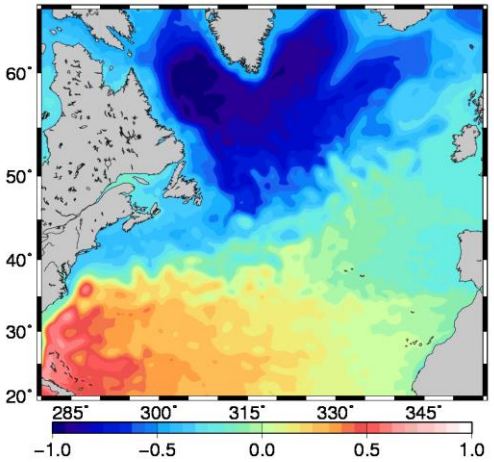
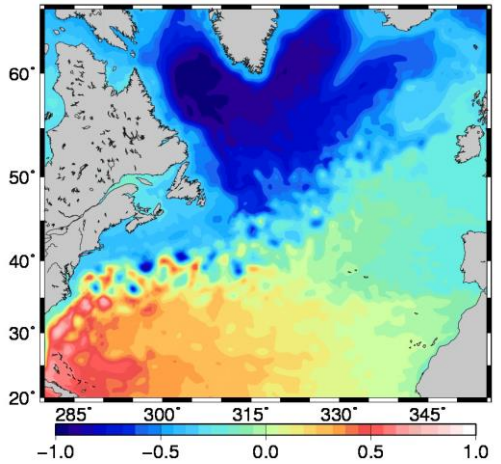
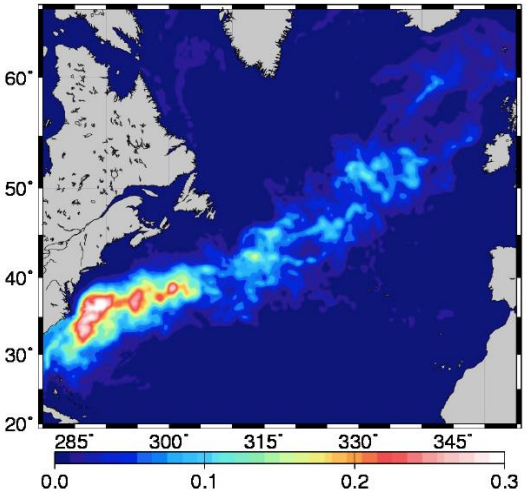
Assimilation with 3D perturbations
(Guillem Candille, LEGI)

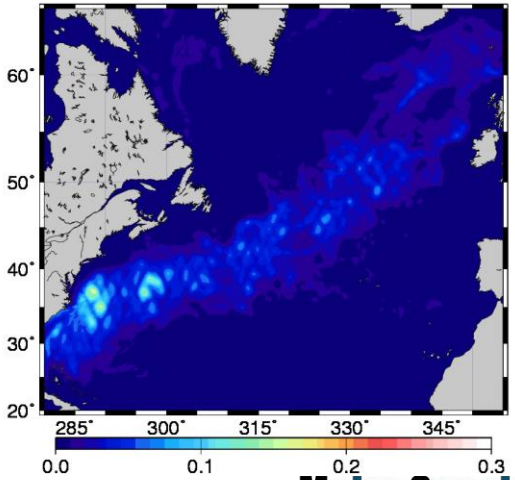
Ensemble mean





Ensemble standard deviation





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Task 5.4 Exp in regional scale models

- ULg
- ROMS in Ligurian Sea 1/60th Deg.
- HF radar data
- Same validation approach as in Task 5.3

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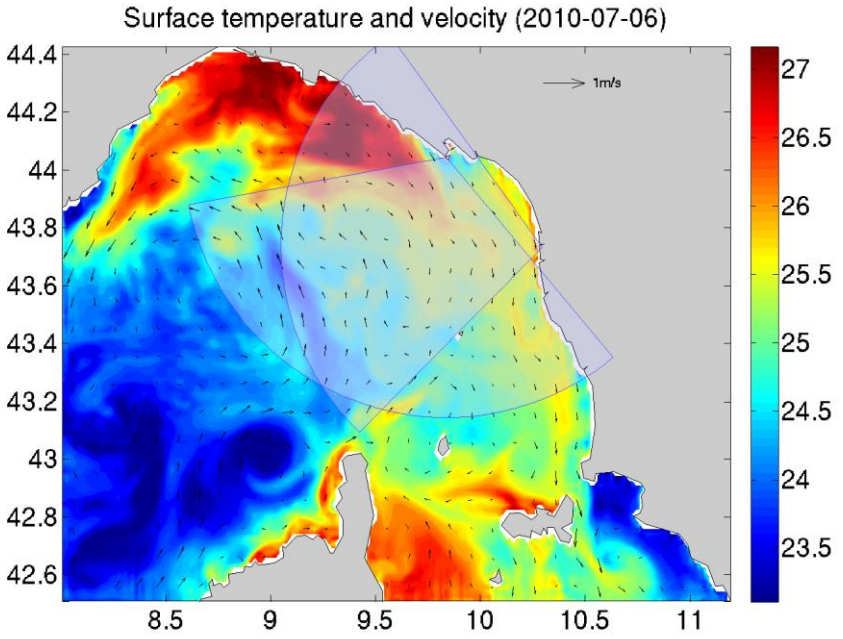
Assessment of HF Radar assimilation (A. Barth, ULg)

- ROMS nested (off-line) in the Mediterranean Ocean Forecasting System
- 1/60 degree resolution and 32 vertical levels
- Atmospheric forcings come from the limited-area model COSMO (hourly at 2.8 km resolution)
- Currents: Western & Eastern Corsican Current, Northern Current, inertial oscillations, mesoscale currents
- Two WERA HF radar systems (Palmaria, San Rossore) by NATO Undersea Research Centre (NURC) from 2009 to 2010.



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Model error covariance

(will be exposed in details by A. Barth tomorrow…)

- Estimated by ensemble simulation (with 100 members) where the uncertain aspects of the model are perturbed
- Perturbed zonal and meridional wind forcing
- Perturbed boundary conditions (elevation, velocity, temperature and salinity)
- Perturbed momentum equation
- Experience with covariance localization⟶ covariance envelope based on:
  - Statistical robustness of increment (similar to bootstrapping)
  - Expected error reduction

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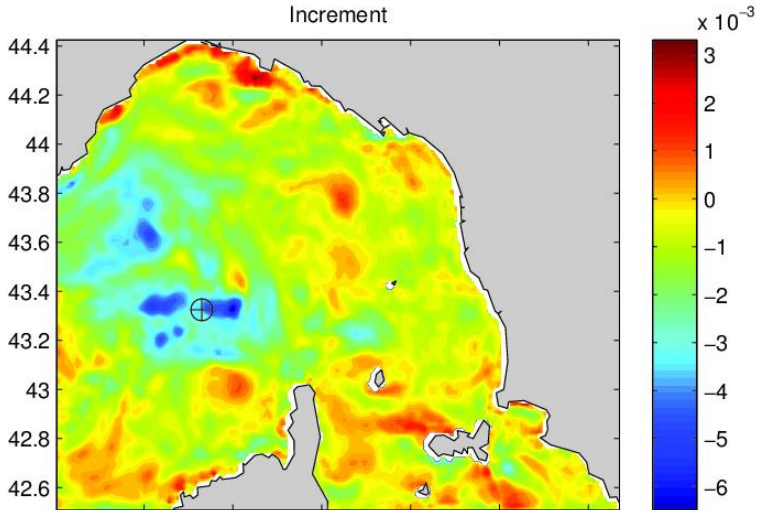
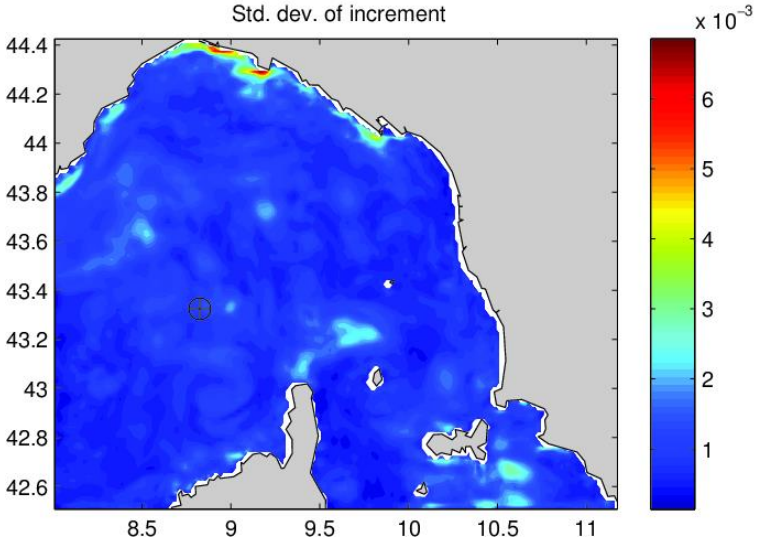
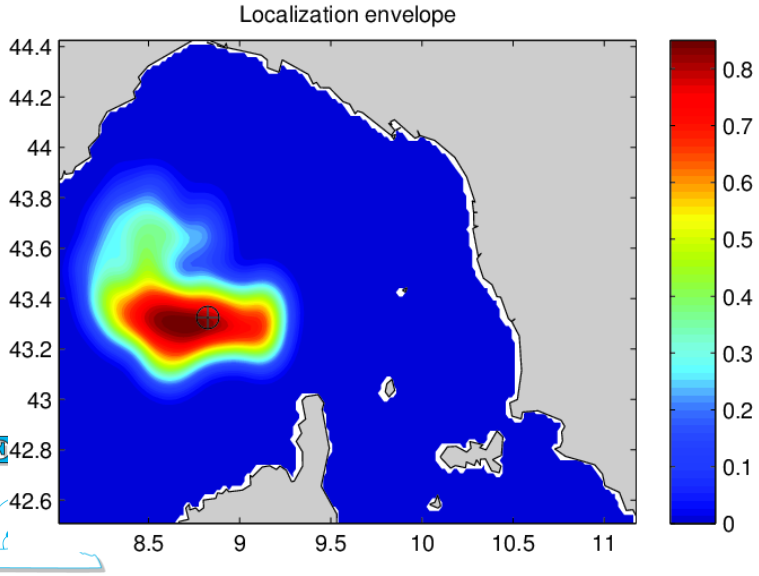
Hypothetical observations in the interior of the model domain







- Observation located at 8.8250 W and 43.3250 N
- Significant spurious long-range correlation, especially with parts of the domain having a large error variance
- The localization function naturally selects corrections near the location of the observations.

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Task 5.5 Lagrangian sea ice parameters

- NERSC
- Sea ice strength parameter from the EVP rheology.
- A Lagrangian forward model for the parameter
- Otherwise parameter estimation by a standard state augmentation procedure.
- Qualitative validation against ice types.

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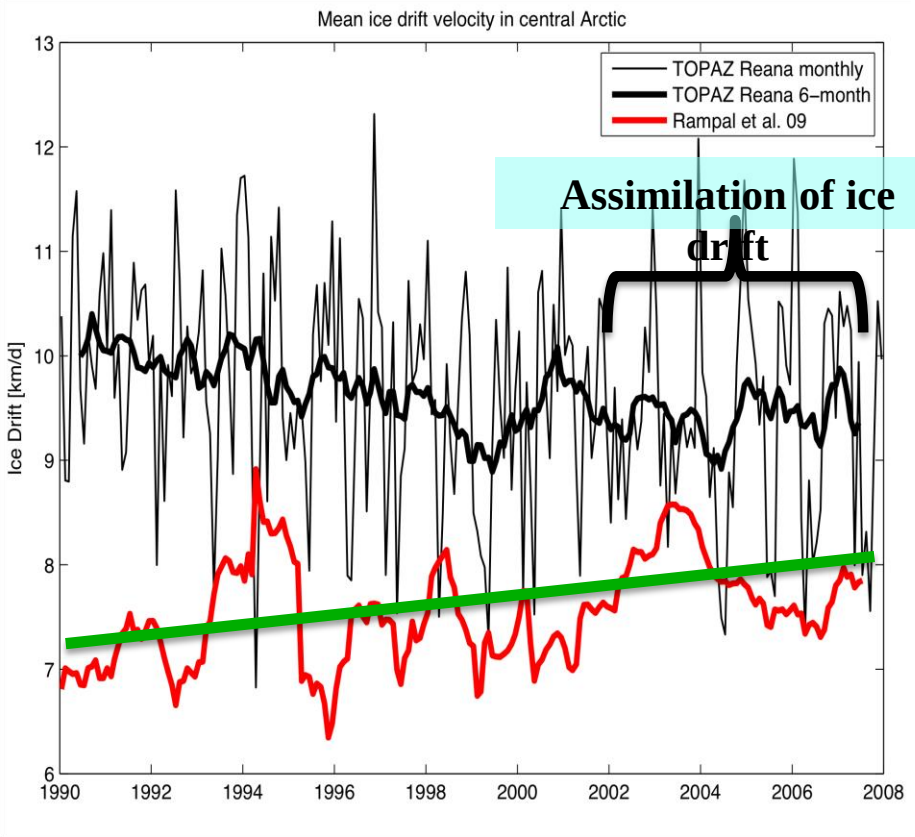
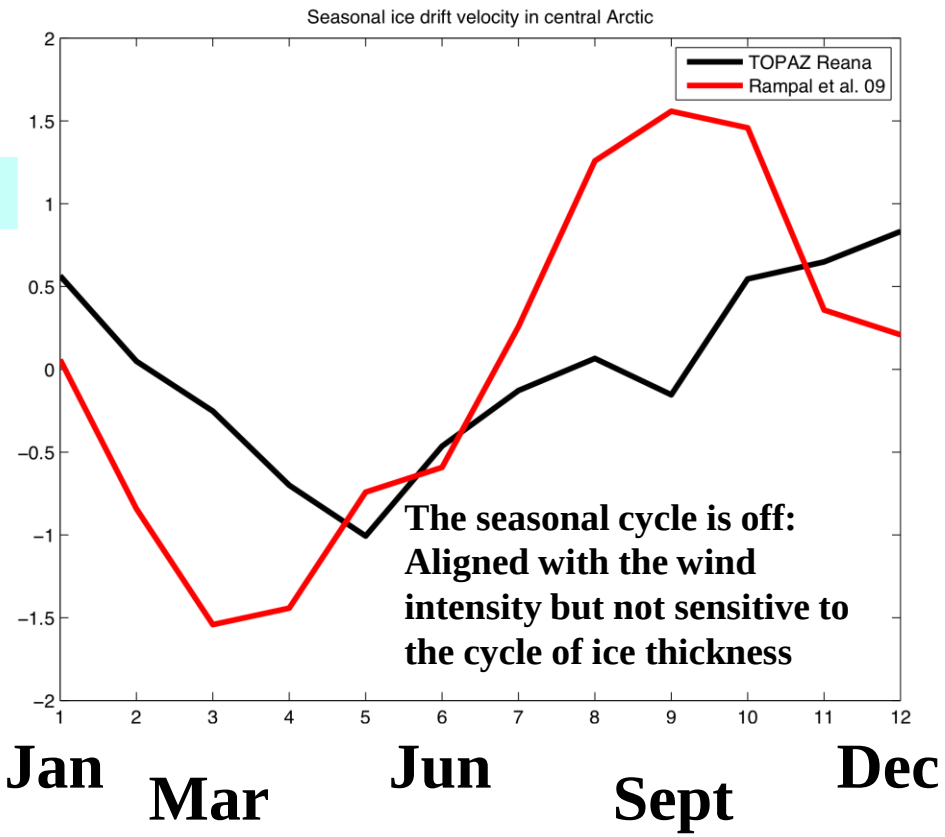
Background: ice drift in the EVP sea ice model (from TOPAZ reanalysis)





- Ice drifts too fast, seasonal signal phased off
- Can assimilation or tuning fix this?

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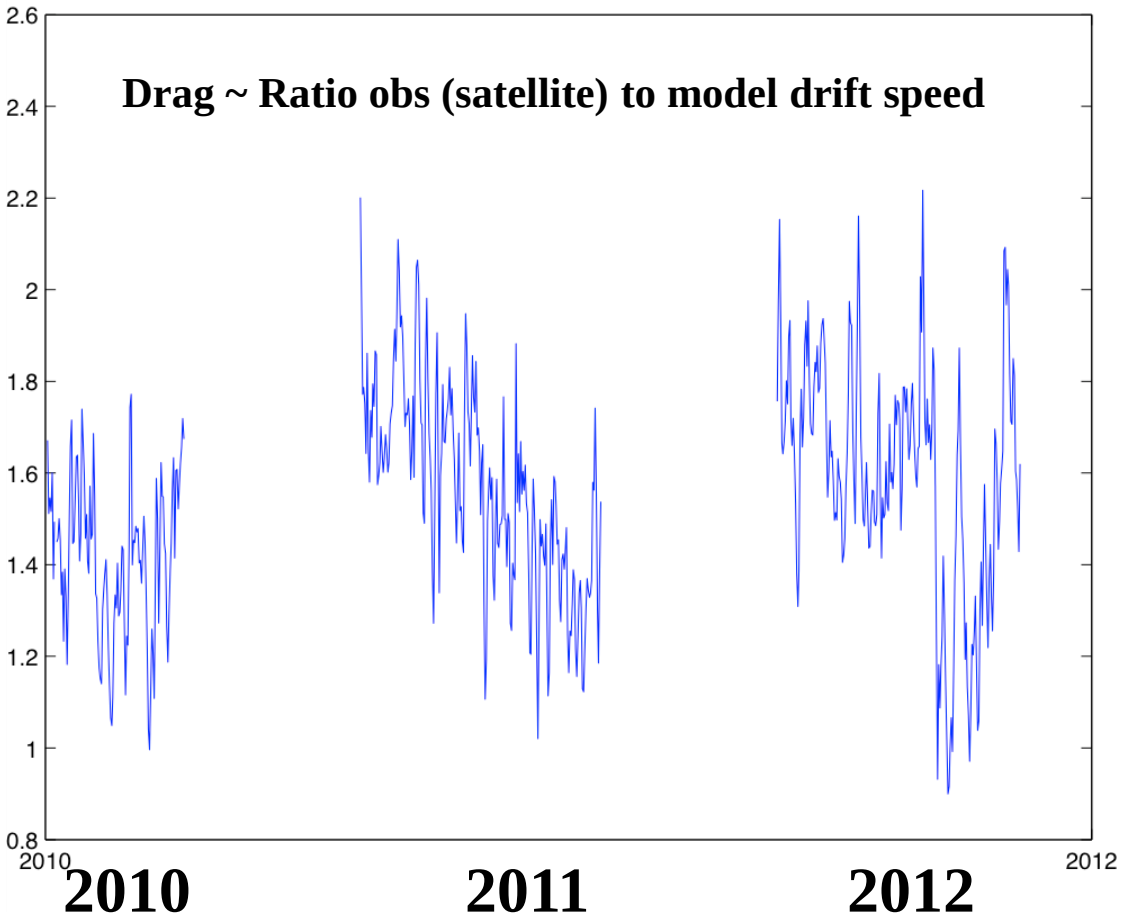
Tuning of the drag coefficient?



- Needs endlessly repeated tuning
- Automatic parameter estimation?

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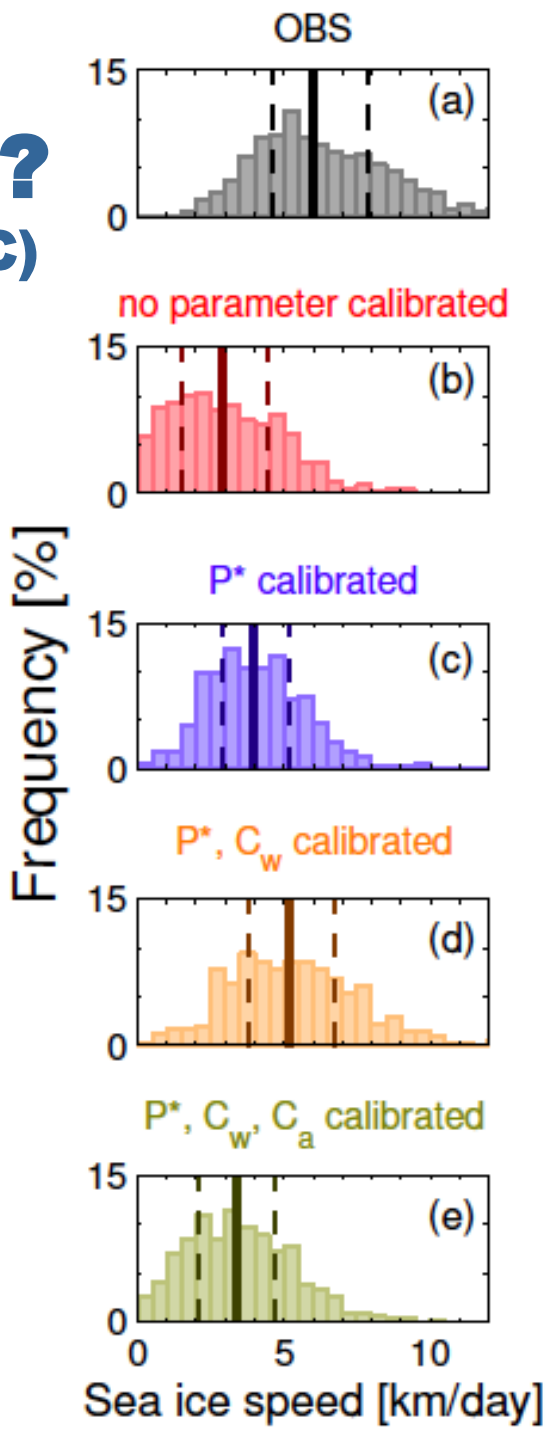
State space augmentation?

Work by Massonnet et al. (UCL and NERSC)

	Parameters calibrated	P^* [10^4 Nm^{-2}]	C_w [10^{-3}]	C_a [10^{-3}]
Twin	P^*, C_w and C_a	1.98	5.04	1.40
C1	P^*	0.94	(5.00)	(1.40)
C2	P^* and C_w	0.98	2.68	(1.40)
C3	P^*, C_w and C_a	0.81	2.31	0.81
Reference		2.00	5.00	1.40



- NEMO – LIM2 model
- DEnKF, 25 members
- Assimilation of satellite ice drift
- Global parameters in augmented state vector.
  - Laboratory for Lagrangian parameters
- Works better with 2 parameters than with 3…

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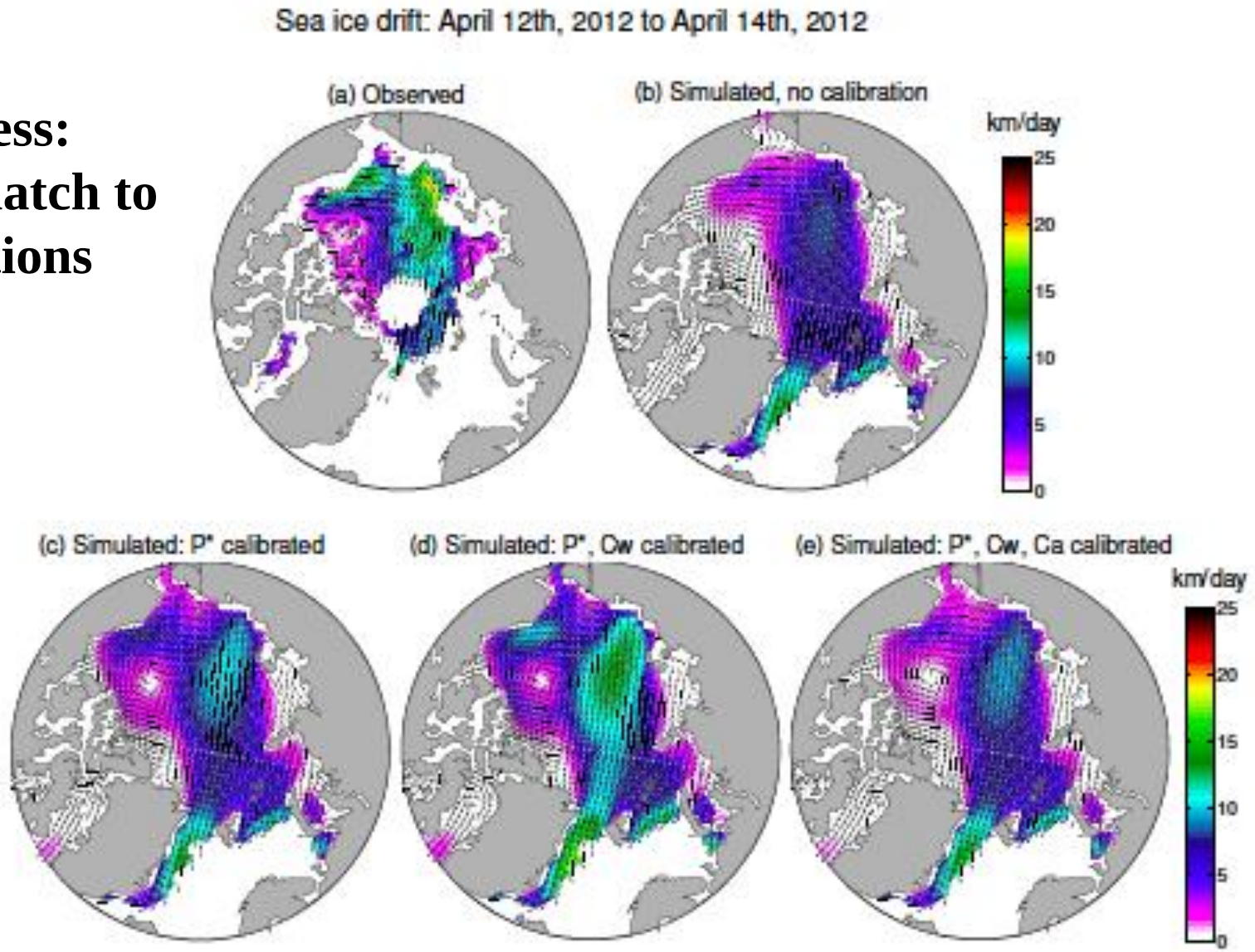
Effect on ice drift velocities
(Massonnet et al. in review)

Partial success: Improved match to the observations assimilated.



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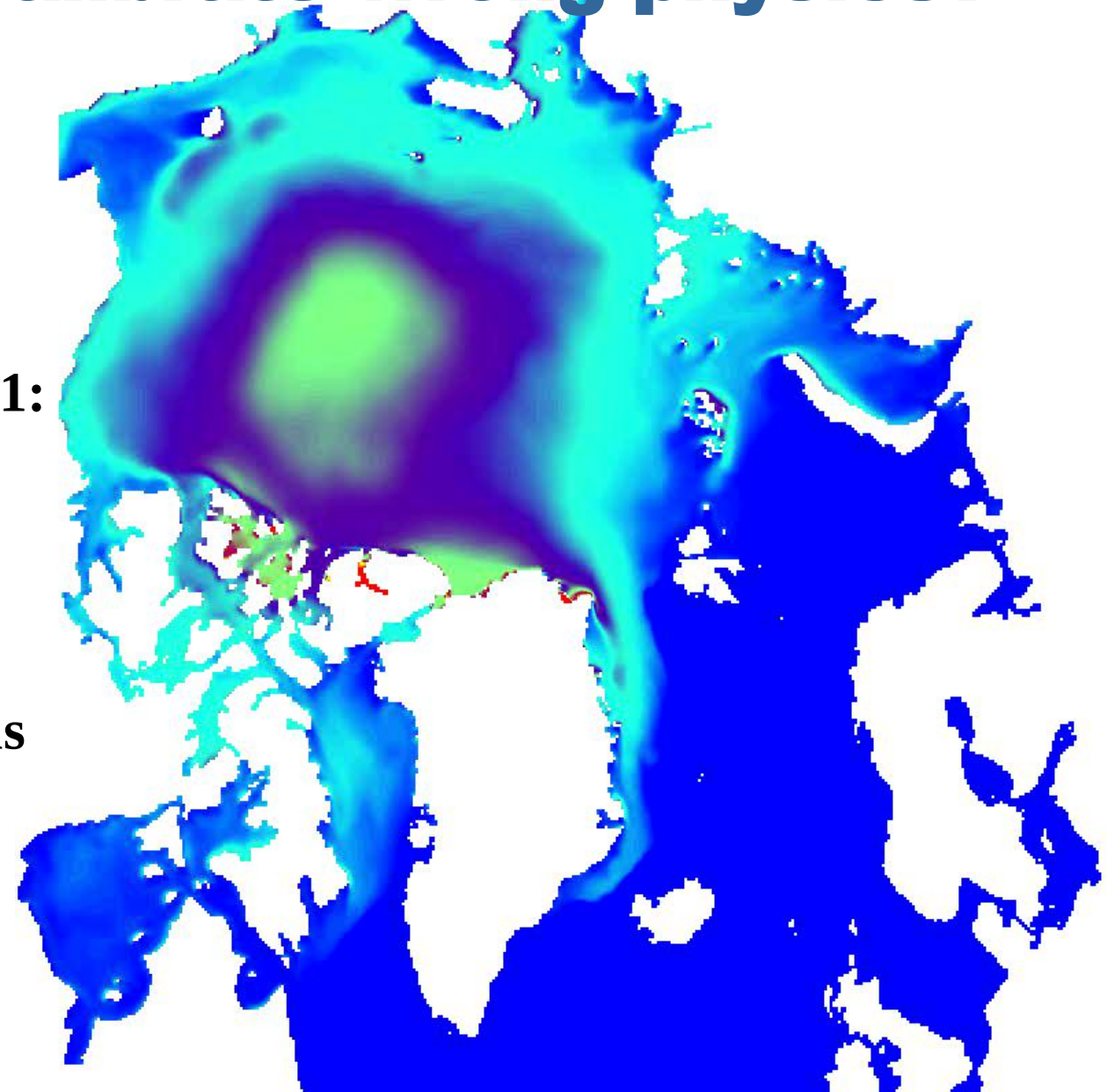
Can one calibrate wrong physics?

Ice thickness Video 1: one year of EVP (Sakov et al. 2012 NERSC)

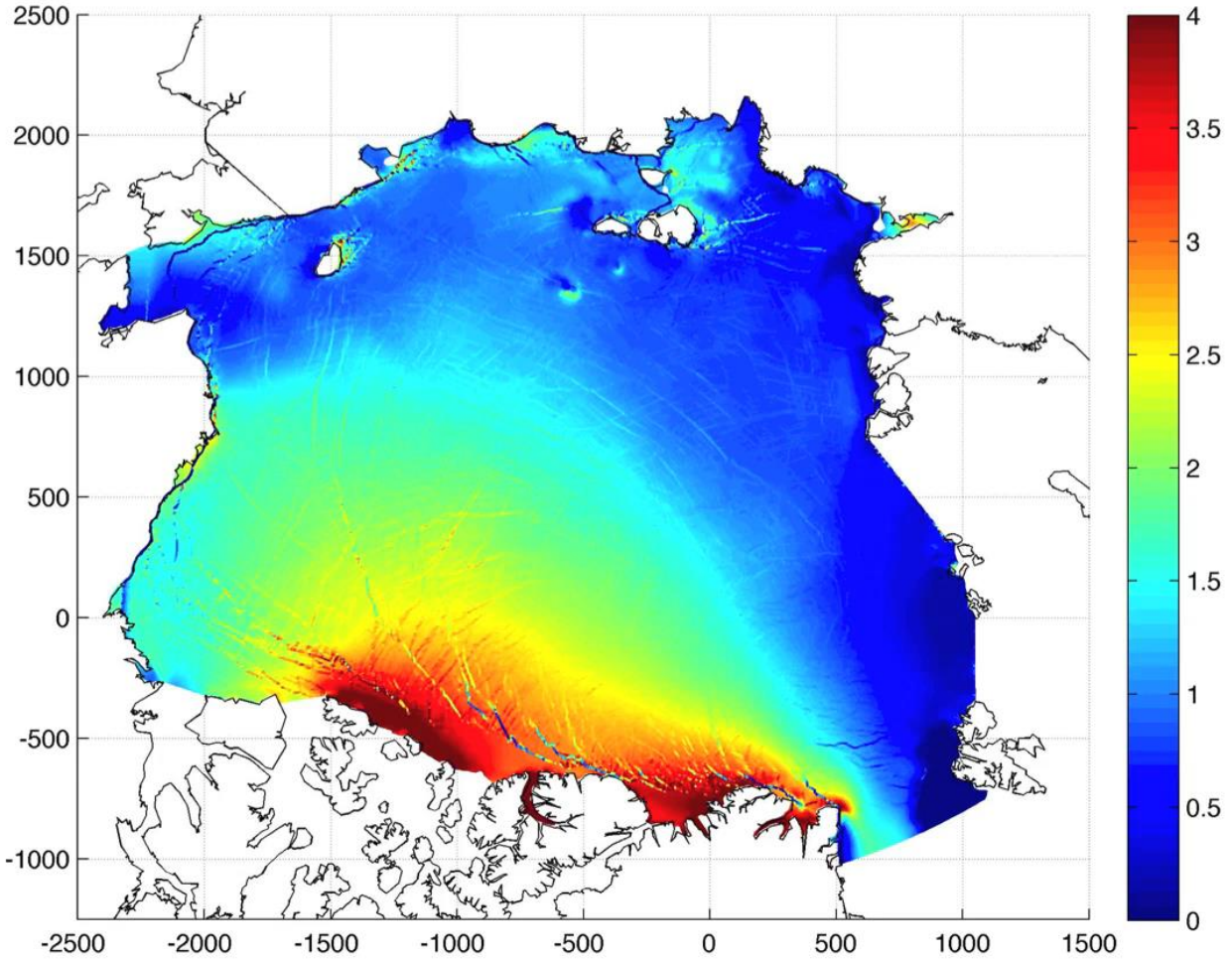
EVP (Elastic Viscous Plastic) = fluid dynamics



Ice thickness Video 2: 11 days of EB model (Bouillon & Rampal, NERSC)

EB (Elastic-Brittle) = solid mechanics

Designed to represent the linear sea ice deformations statistics



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Task 5.6 Prior errors detection by observational arrays

- CNRS-LEGOS
- Representer Matrix Spectrum in asynchronous (4D) mode.
  - A modular formulation: portability to other Ensemble-based systems
  - Regional array performance assessment, Bay of Biscay, BELUGA EnKF implementation. Observations as in Task 5.1.
  - Large-scale array performance assessment in 1-2 other Ensemble-based assimilation systems.

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Deliverables

- D5.1 List of remote-sensed variables with their associated characteristics (Completed, M12, **all**)
- D5.2 Report on the impact of new ecosystem data (M36, **CNRS-LEGI**)
- D5.3, D5.4 Results of a data assimilation experiment with a large-scale ocean model (ongoing V1 at M36, V2 at M48, **CNRS-LEGI**)
- D5.5, D5.6 Results of a data assimilation experiment with a regional-scale ocean model (ongoing V1 at M36, V2 at M48, **ULg**)
- D5.7: Result of the data assimilation experiment aiming to estimate Lagrangian sea ice parameters (M48, **NERSC**)
- D5.8: RMSpectrum library and results of array performance analyses (M48, **CNRS-LEGOS**)

M36 = 31 Oct 2014
M48 = 31 Oct 2015

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