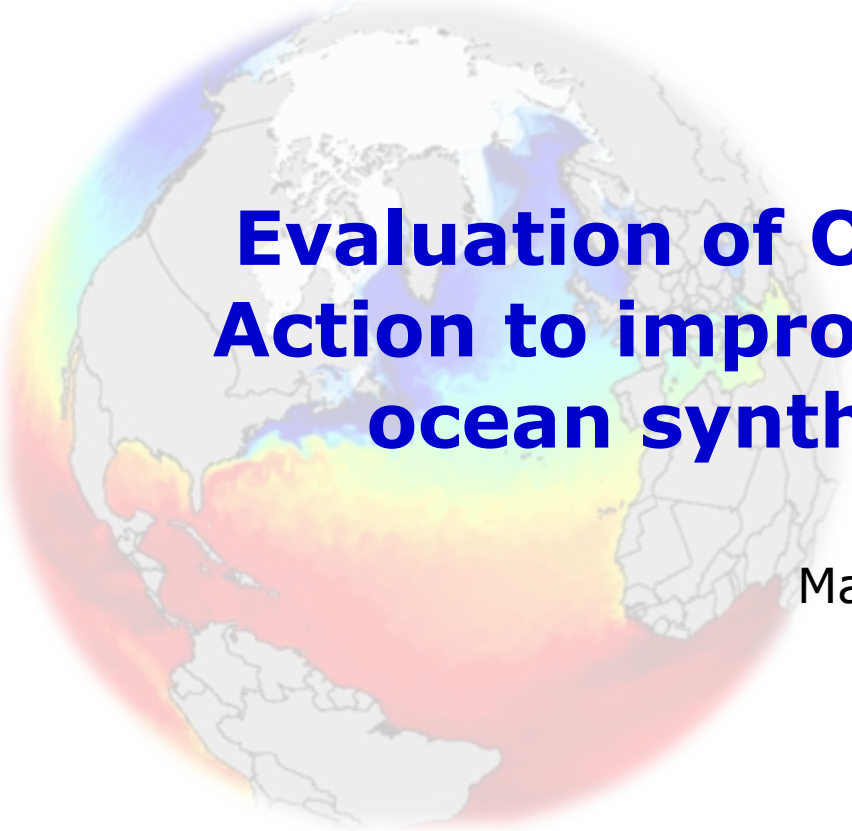
EVALUATION OF OCEAN SYNTHESES

COST Action ES1402



Evaluation of Ocean Syntheses: a COST Action to improve our knowledge about ocean syntheses and reanalyses

Malta, 18 April 2018

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COST Actions

COST Actions are a **networking instrument** for researchers to cooperate and coordinate nationally funded research activities.

They last 4 years, EOS ends in November 2018

→ Pan-European
→ Open to all researchers

Networking tools available through EOS:

- Workshops
- Conferences
- Training schools
- Short-term scientific missions (STSMs)
- Dissemination activities.

STSM:

- A research stay, aligned with the goals of the Action that is providing the funding, extending for a period from 5 days to 3 months

COST Action "Evaluation of Ocean Syntheses"

November 2014 to November 2018

Main objective: establish and consolidate a network of European scientists working on the generation and evaluation of ocean synthesis products, data providers, experts in data assimilation and ocean modelling...

Support individual mobility, strengthen existing networks and foster collaboration between researchers.

↓

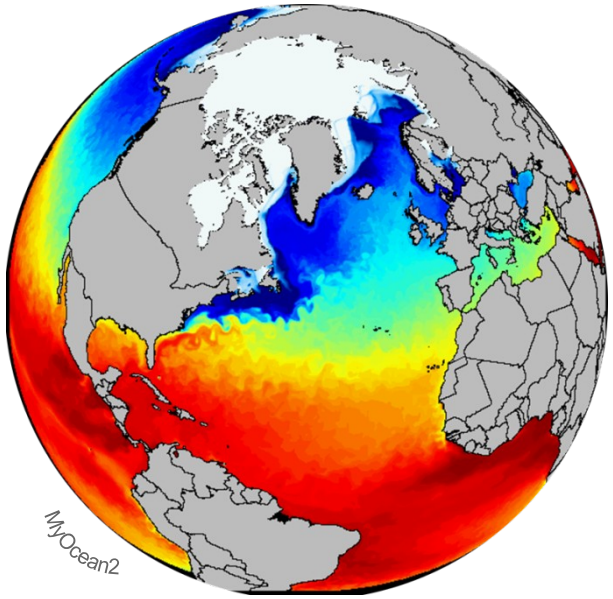
- compile an inventory of end-user requirements (quality and availability of ocean syntheses)
- improve the understanding of the value and use of ocean syntheses
- issue recommendations on which data products are the most suitable for which task.
- increase awareness of ocean synthesis products among end users

Ocean Syntheses

→ a comprehensive estimation of the ocean state over the last decades (mainly temperature, salinity, sea level and currents)

→ calculated by merging hydrodynamic ocean models and all available observations using data assimilation

Hydrodynamic model



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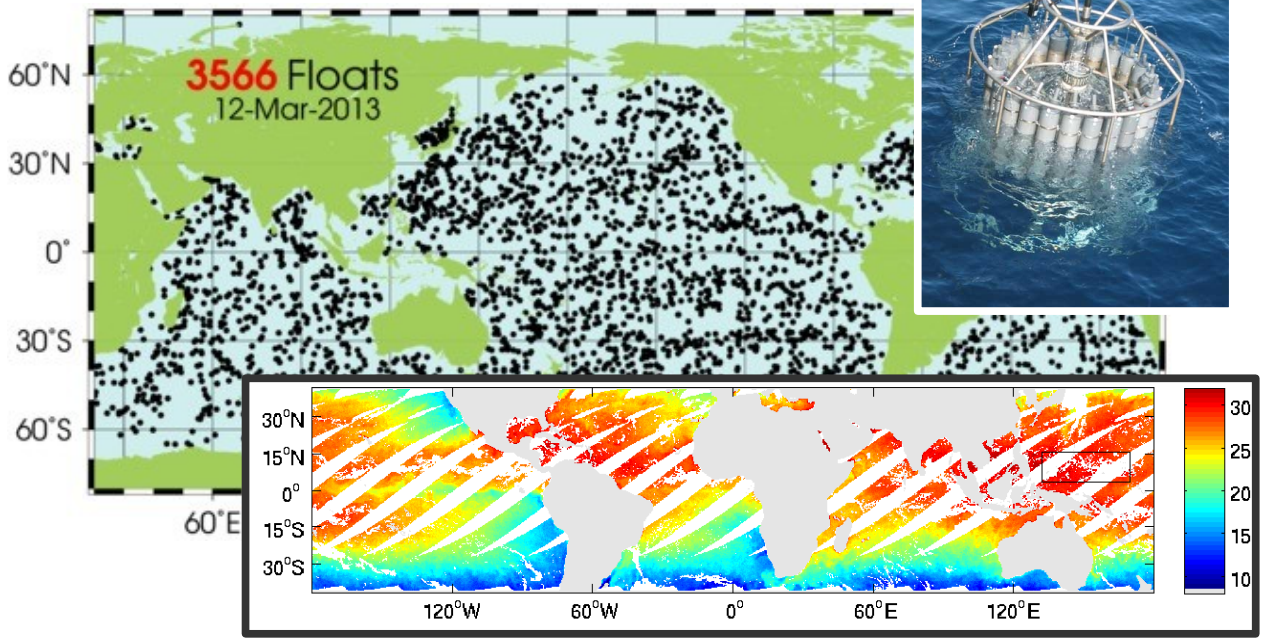
Observations



→ **Ocean syntheses are critical to understand climate and to predict future change**

Applications for Ocean Syntheses

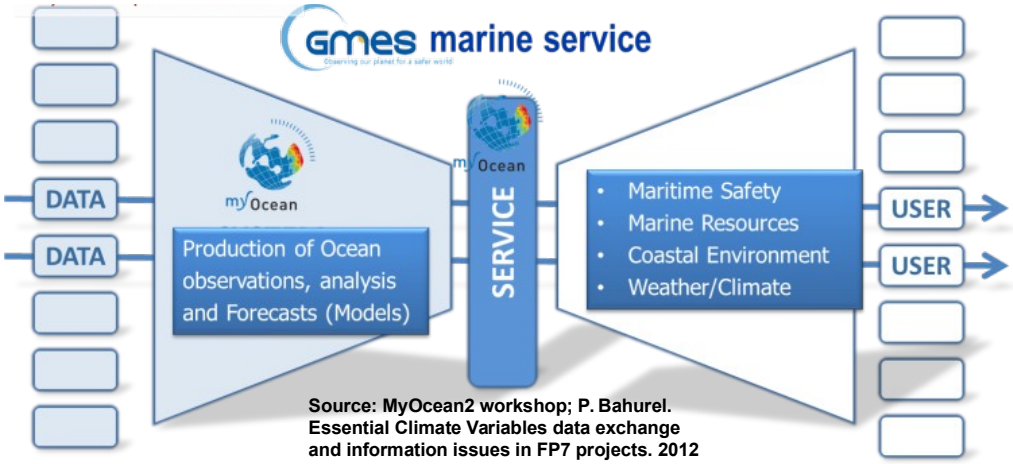
- Initial conditions in hydrodynamic models:
  - for operational forecasts of the ocean
  - for short-term predictions (study of specific processes)
  - for climate-related activities

- Study of ocean-atmosphere interactions (heat balance, global water cycle)

- Computation of transports across ocean basins and key straits (transport of heat)

- Monitoring the ocean

- Serving Copernicus downstream services



Source: MyOcean2 workshop; P. Bahurel. Essential Climate Variables data exchange and information issues in FP7 projects. 2012

There can be:

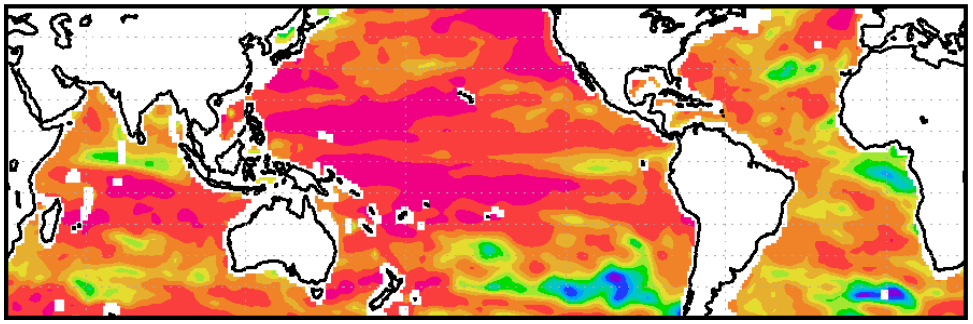
- Different hydrodynamic models
- Different data quality procedures
- Different data assimilation approaches
- Different spatial and temporal resolution
- Global of regional coverage

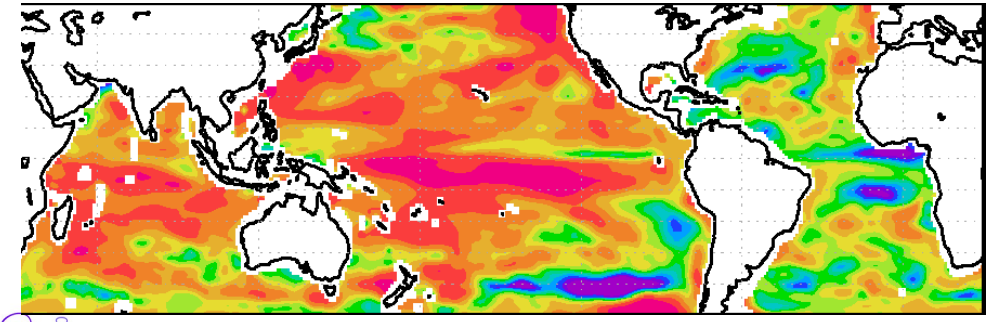
} many different estimates of the ocean!

Evaluation of Ocean Syntheses: what is missing?

- A wide range of ocean syntheses exist, each created to fulfill specific objectives.
- Ocean syntheses have been **insufficiently evaluated** – products present significant differences!
- Lack of coordination between different efforts
- Users of ocean syntheses **do not know**:

  - Which specific product to use for their application
  - How good this product is
  - How a particular ocean synthesis differs from others





End users

Scientific community (ocean, weather, climate modellers, climate researchers, oceanographers) working in:

- national research centres
- operational centres (e.g. Mercator Ocean in France)
- national weather services (e.g. Met Office in the UK)
- climate research centres...

Public sector

- Policy makers
- Local authorities in coastal regions, marine safety
- National environmental agencies

Private sector and other non-scientific representatives of the European society

- Fisheries management authorities
- Insurance companies
- Commercial shipping
- Offshore renewables as well as Oil and Gas

Plus all end users of ongoing European projects (MyOcean2, GODAE, CLIVAR/GSOP...)

Some recent applications and networking activities

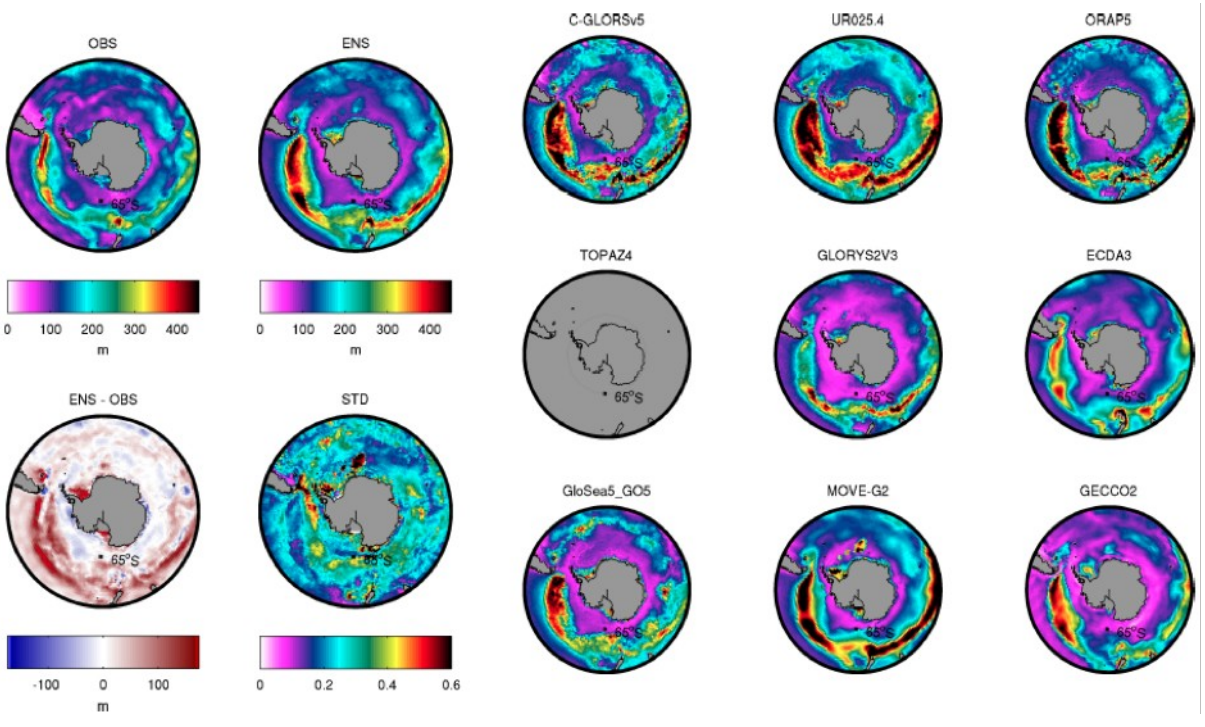
North Atlantic ORA-IP: intercomparison network aiming at better understand the differences between reanalyses of the North Atlantic

- Intercomparison of 12 reanalyses to determine variability, differences and reasons for them
- Can we learn what makes a reanalysis good at specific processes?

Polar regions reanalises Intercomparison Network

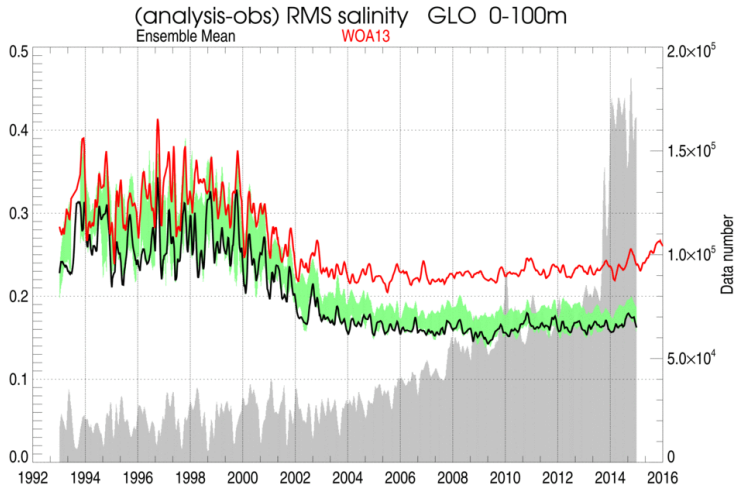
Intercomparison of 10 reanalyses in Arctic and Antarctic regions

“An assessment of ten ocean reanalyses in the polar regions”, Uotila et al, accepted in Climate Dynamics



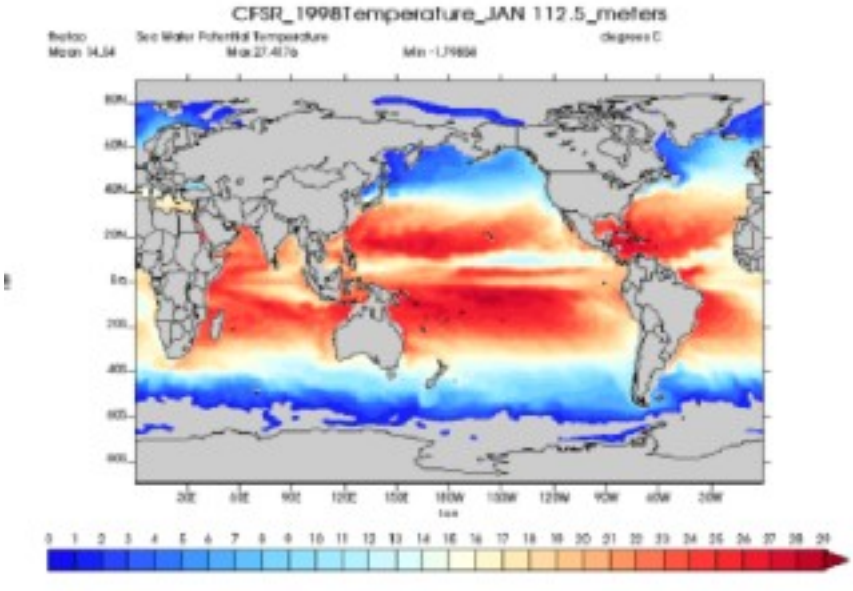
Some recent applications and networking activities

CMEMS reanalyses: assessing ocean variability
→ Powerful tool for ocean monitoring
→ necessary reference for many users of ocean analyses & forecasts



New ORA-IP: Ocean Reanalysis Intercomparison Project – Collaboration with GODAE Ocean View

- Assessment of advancement of reanalysis quality at global scales
- Air-sea fluxes, budget and transport analyses, eddy activity...



Some recent applications and networking activities

4 international workshops

4 training schools

9 working group meetings

5 Management Committee meetings

25 short-term scientific missions

So far, ~200 scientists have been involved in EOS

EVALUATION OF OCEAN SYNTHESES

COST Action 1402

http://www.eos-cost.eu

A COST Action to **improve the coordination** of European efforts in the evaluation of ocean syntheses:

- better understanding of the value and use of ocean syntheses
- promote the use of ocean syntheses

Chairs:
Aida Alvera-Azcárate (University of Liège, BE)
Keith Haines (University of Reading, UK)

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Variational analysis of high-frequency radar surface currents using DIVA

Alexander Barth[1], Charles Troupin[1], Emma Reyes[2], Aida Alvera Azcarate[1], Joaquín Tintoré[2] and Jean-Marie Beckers[1]

[1]GHER, University of Liège, Belgium [2]SOCIB, Spain

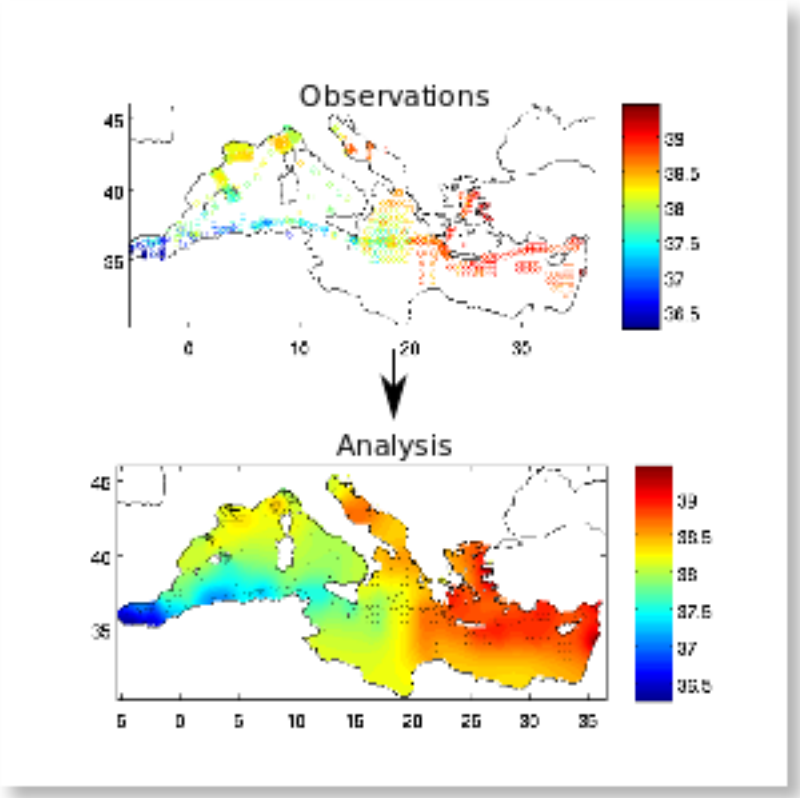
Variational analysis of high-frequency radar surface currents using DIVA

Alexander Barth et al, a.barth@ulg.ac.be

What is DIVA?

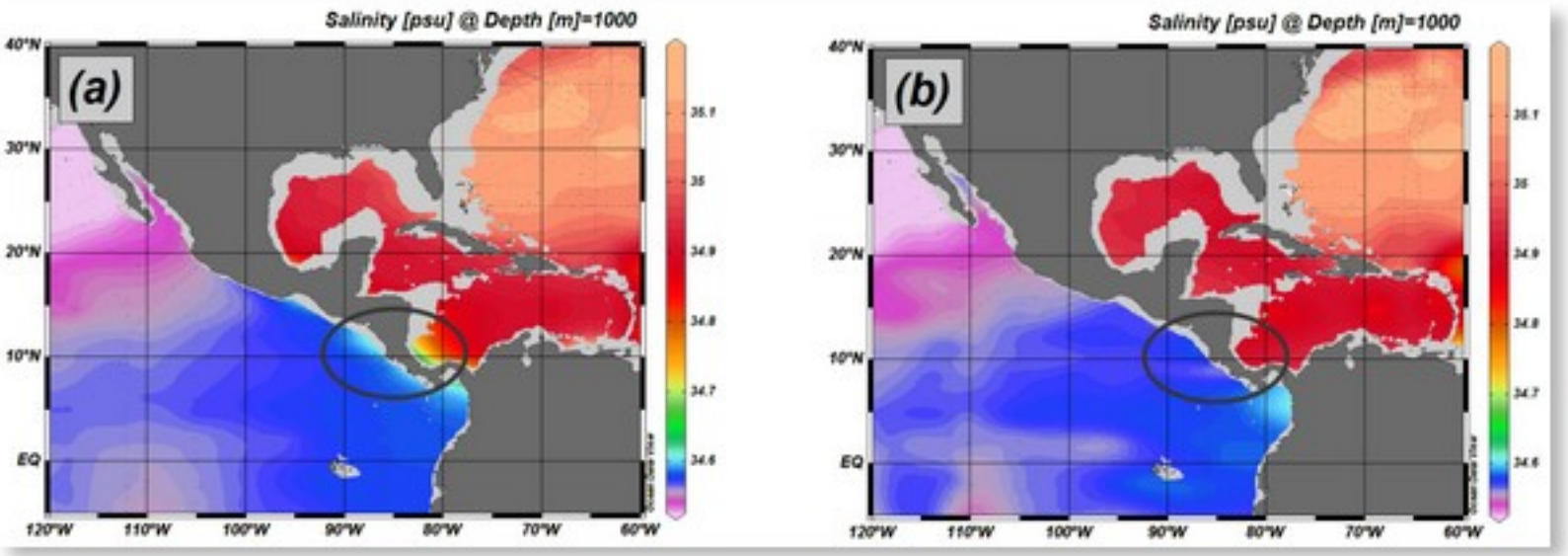
- DIVA: Data Interpolating Variational Analysis
- Objective: **derive a gridded climatology from in situ observations**

- The variational inverse methods aim to derive a continuous field which is:
  - **close to the observations** (it should not necessarily pass through all observations because observations have errors)
  - "**smooth**"



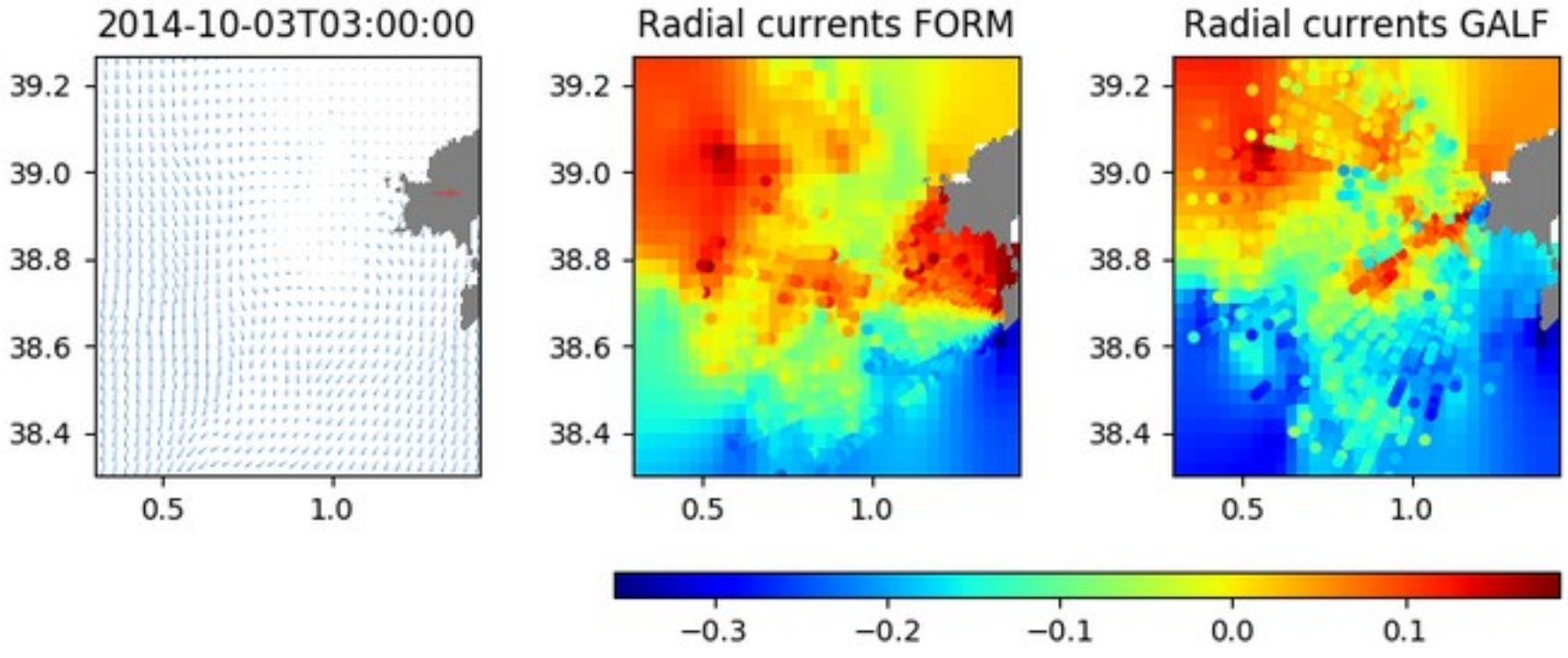
Properties

- decouples basins based on **topography**
- can take **ocean currents** into account
- can detect **trends** in your data
- can detect and remove **outliers**
- consistent **error variance estimation**
- Former version of DIVA: analysis operates in 2 dimensions
- The rewrite DIVAnd does not have this limitation



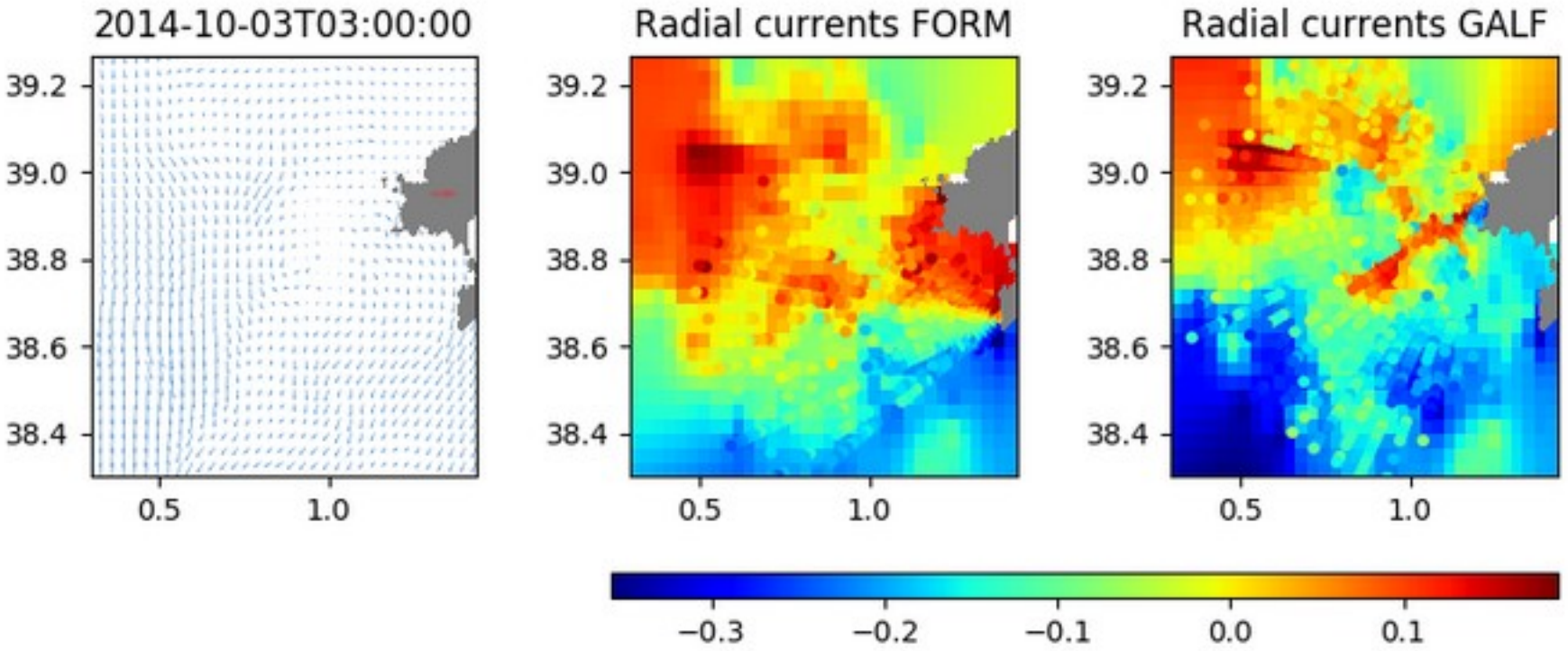
2D Analysis

- Every snapshot is reconstructed individually



3D Analysis

- Including Coriolis force and geostrophically balanced mean flow



Comparison

Case	Description	RMS	Skill
2D	classical 2D-analysis (longitude, latitude)	0.0652	0.000
2D_bc	as 2D, but with boundary conditions	0.0652	-0.000
2D_div	as 2D, but imposing small horizontal divergence	0.0650	0.006
3D	3D-analysis (longitude, latitude, time)	0.0575	0.222
3D_Coriolis	3D-analysis with the Coriolis force	0.0537	0.321
3D_Coriolis_geo	3D-analysis with the Coriolis force and the surface pressure gradient	0.0484	0.450

Conclusions

- DIVA framework was extended to handle surface currents and able to handle observations when only one component of the velocity vector is measured.
- 2D analyses were used as a base-line for different test cases.
- Including boundary conditions and the constrain on small divergence did not improve the accuracy of the constructions.
- However, taking for every time instance the previous and the following radial maps into account (i.e. a 3D analysis), the skill score could be improved.
- Every time additional dynamical information was added in the analysis the skill score was improved.
- Dynamical information appears to be highly beneficial when analyzing surface currents.

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Activities organized under EOS

Workshops:

- Workshop on the use of new satellite datasets in marine climate applications (Porto, Portugal, 29 March – 1 April 2016)

- Workshop on the use of models, reanalyses and observations to assess the health of the ocean environment (Liege, Belgium, 17 March 2017)

- Workshop on ocean reanalyses and inter-comparisons (Toulouse, France, 29-30 June 2017)

- Regional Climate System Modelling for the European Sea Regions (Palma de Mallorca, Spain, 14-16 March 2018)

Activities organized under EOS

Training schools:

1. School on Data Assimilation and Data Analysis Techniques (Lecce, Italy, 4-15 April 2016)

→ Fundamentals of combining physical data in an optimal way
→ Bayesian and Ensemble methods
→ Variational methods
→ Hybrid methods (ensemble + variational)
→ Reduced order methods
→ Optimal interpolation
→ Data-Interpolating Variational Analysis (DIVA)
24 students, 9 teachers by EOS-COST

2. The Global Ocean Week (Toulouse, France, 10-14 October 2016)

→ Outlook of Copernicus Marine Service and its added value for Blue Growth
→ Focus on Copernicus Marine Service global ocean products and practical exercises
→ Focus on downscaling of ocean syntheses
→ Intercomparisons of ocean syntheses available worldwide
→ Training on the evaluation of ocean syntheses
→ Opportunities for creating Science and SMEs Networking

21 students, 9 teachers by EOS-COST

Activities organized under EOS

3. Copernicus Marine Data in Ocean Models and Operational Applications (Hamburg, Germany, 5-9 February 2018)
This 1-week training school was organised in collaboration with EUMETSAT. Topics covered were, among others:

→ Learning what data and products the Copernicus Marine Data Stream provides.
→ Accessing and downloading data and products provided in the Copernicus Marine Data Stream (CODA, EUMETSAT Data archive, EUMETCast).
→ Reconstructing missing data in satellite datasets using DINEOF.
→ Use of CMEMS reanalysis products.

16 students, 4 teachers paid by EOS-COST (4 more students and 6 teachers by Eumetsat)

4. Training school ("Crash course") in data assimilation (Bergen, Norway, 22 to 25 May 2018)

→ 4-day school
→ aimed at PhD-level students and early stage scientists with beginner or no notions of data assimilation intending to apply data assimilation as part of their research.
→ It will cover the basic notions of data assimilation, focusing on ensemble methods, illustrated with real-scale / operational applications and with the aid of practical exercises.