

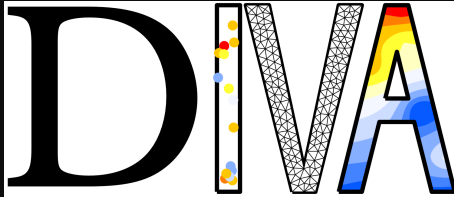
Recent methods for Data interpolation

DINEOF and DIVA

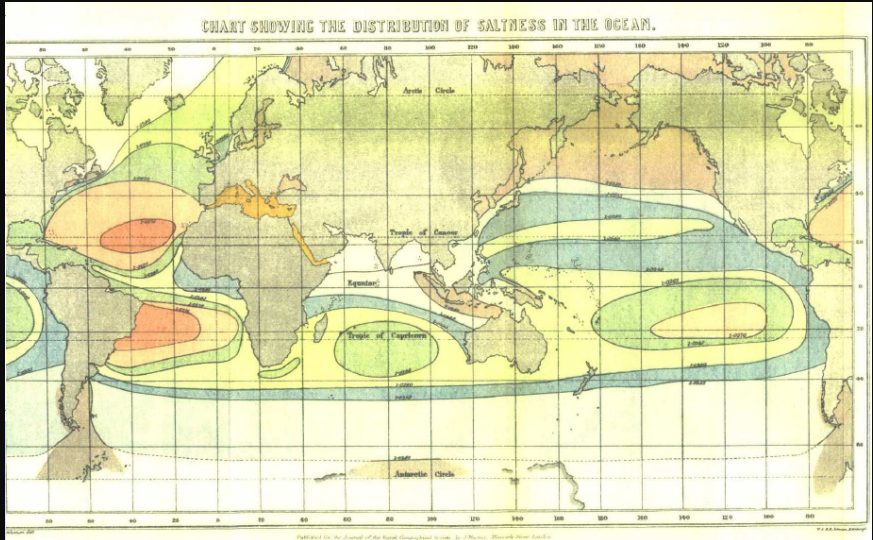
Charles TROUPIN

January 31, 2013

DIVA

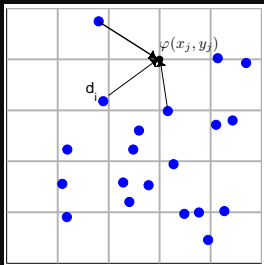
The image displays the word "DIVA" in a stylized font against a black background. Each letter is uniquely designed: the 'D' is a solid black serif letter; the 'I' is a vertical white bar containing several small colored dots (yellow, red, blue, orange); the 'V' is a white wireframe structure; and the 'A' is filled with a vertical rainbow gradient from red at the top to blue at the bottom.

The Diva tool: spatial interpolation of observations



DIVA = Data-Interpolating Variational Analysis

From sparse data points,
construct gridded field =
analysis

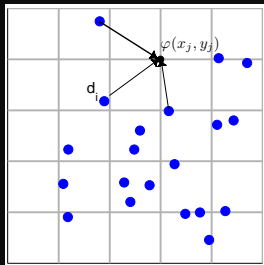


Formulation: minimize cost function that penalizes:

- 1 data-analysis misfit
- 2 smoothness of the field
- 3 physical constraint (advection, sources, ...)

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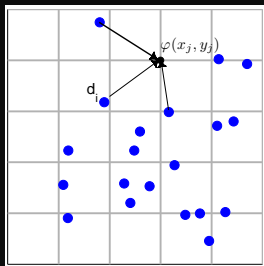


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- controlled by the data

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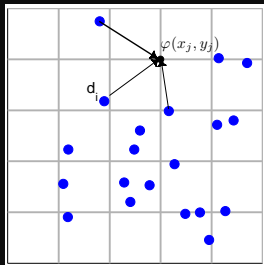
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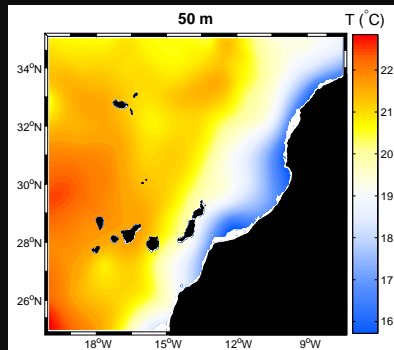
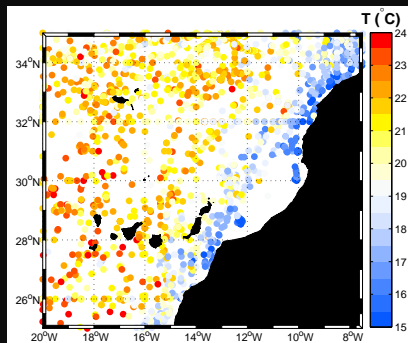
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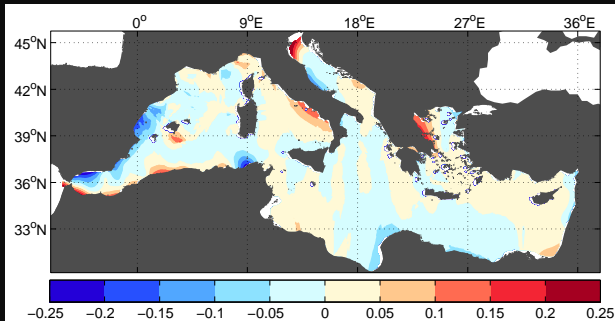
From in situ data to gridded fields



Measurements (left) and analysed field of temperature at 50 m in the Canary Island area.

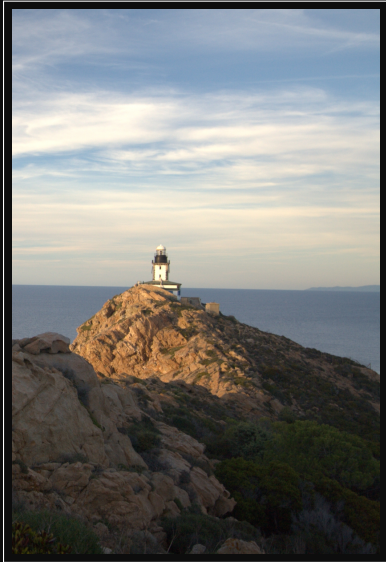
Why is better than other methods?

- Topographic constraints
- Optimized computation (finite-elements)
- Free software, user-driven developments



Difference between Optimal interpolation and DIVA for salinity in September at 30 m.

Diva user workshop



Where? STARESO station
(2007-2010),
Roumaillac (2012)

When? 1/year, Autumn

Public: beginners,
intermediate and
expert users

How? Contact me

More information:

<http://modb.oce.ulg.ac.be/mediawiki/index.php/DIVA>

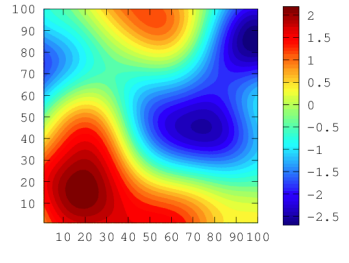
Test and play:

http://data-assimilation.net/Tools/divand_demo/html

DIVA demo help

Reference field

Field:



100
90
80
70
60
50
40
30
20
10

10 20 30 40 50 60 70 80 90 100

2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5

Location of observations

Your name:

Correlation length-scale:

Choose the location of your observation (maximum 10)

x y

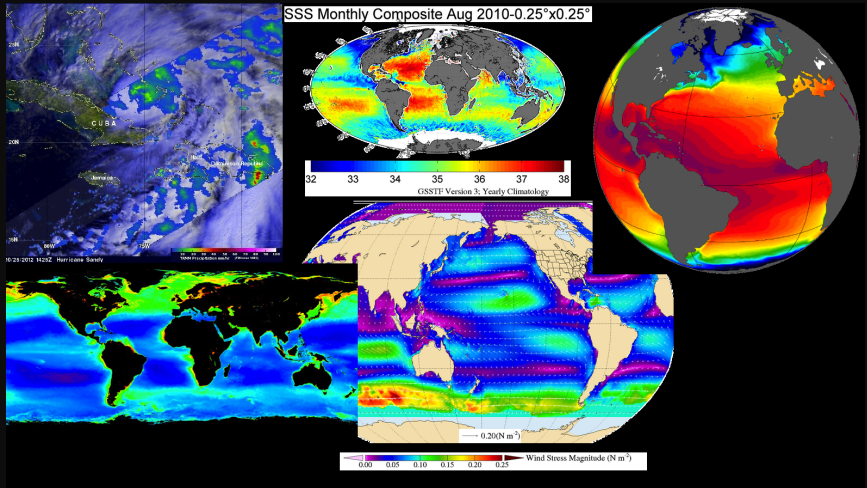
Top 5

Name	RMS
Chunksaah	0.165223169
bbl	0.1818438045
NicoG	0.1841920279
Charef	0.2056911308
fd	0.2111580456

Contact: Alexander Barth, a.barth at ulg.ac.be, 2012.



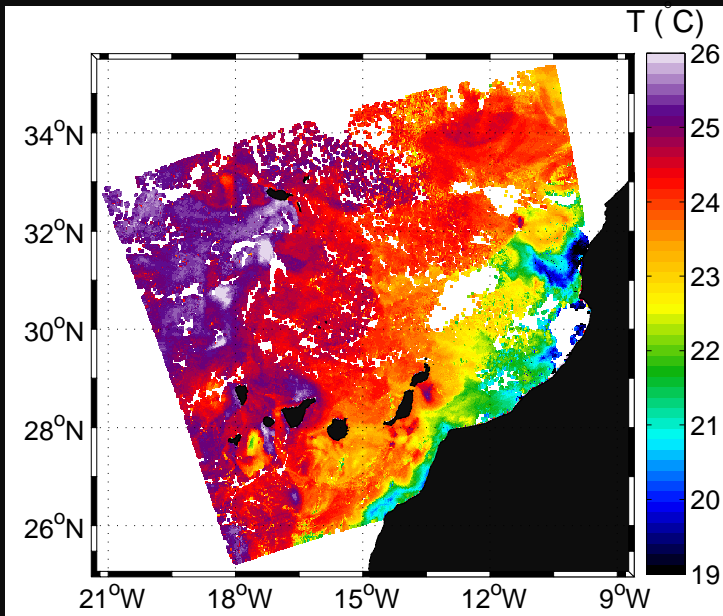
Satellites measure a lot of parameters, but ...



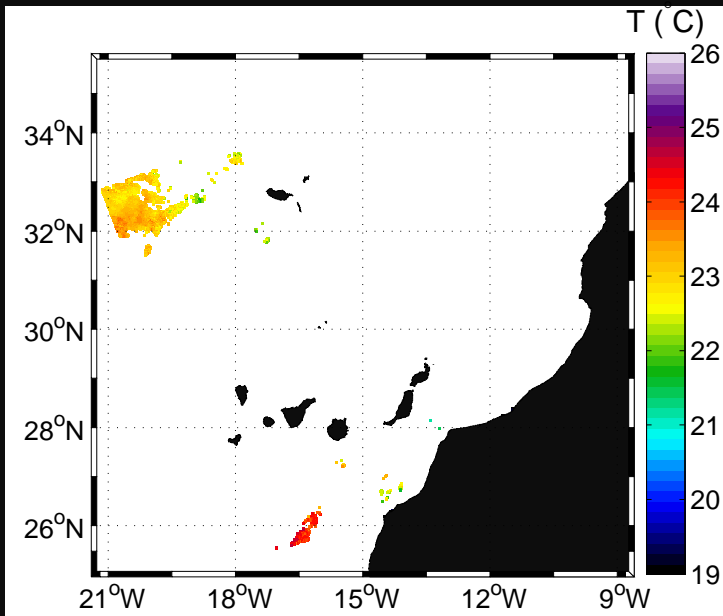
... they are limitations:

- 1 Spatial/temporal resolutions
- 2 Measurements limited to surface
- 3 Cannot view through clouds, dust, smoke, ...

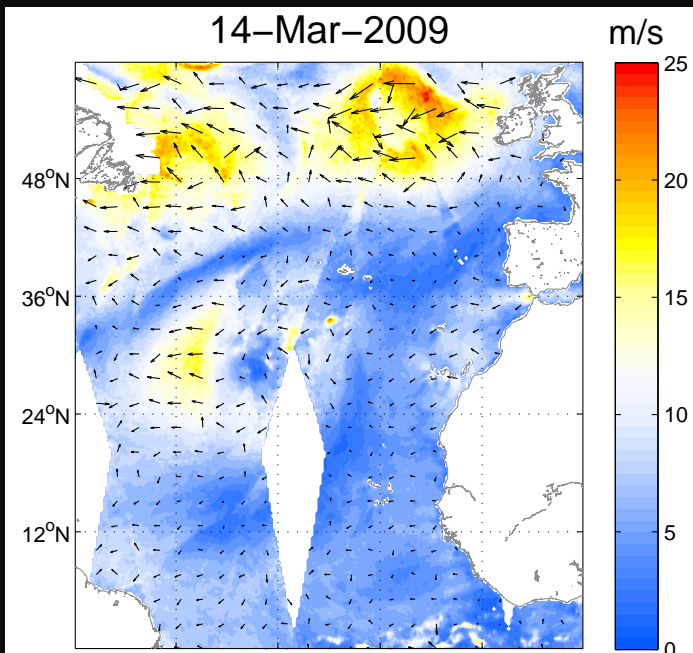
Examples



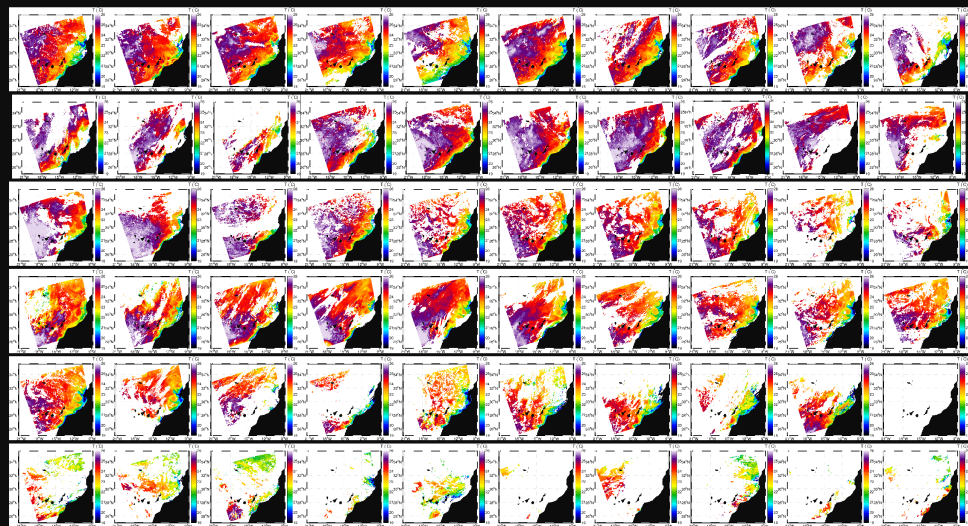
Examples



Examples



Solution: Use information from other images



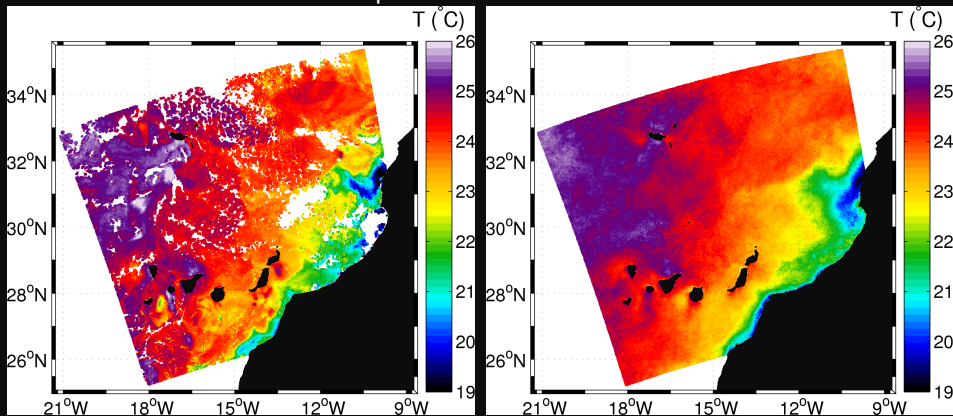
DINEOF = Data INterpolating Empirical Orthogonal Functions

Iterative method

- 1 Start with $N = 1$ mode
 - Compute new values at missing pixels
 - Repeat until **convergence**
 - Estimate reconstruction error
- 2 Increase number of modes and repeat procedure
- 3 ...
- 4 Final reconstruction: number of modes that minimises error

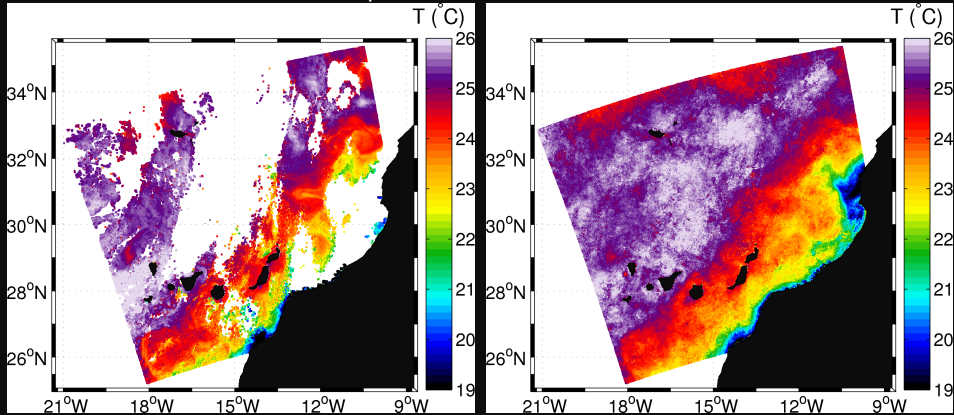
Results

September 5, 2012



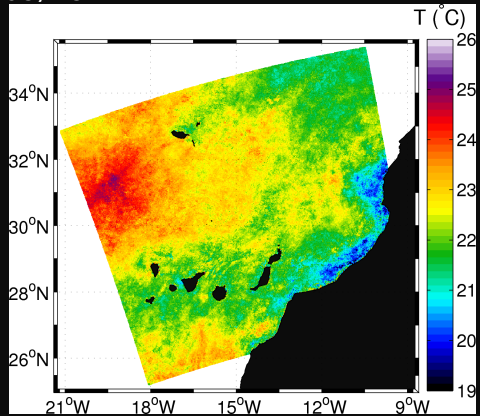
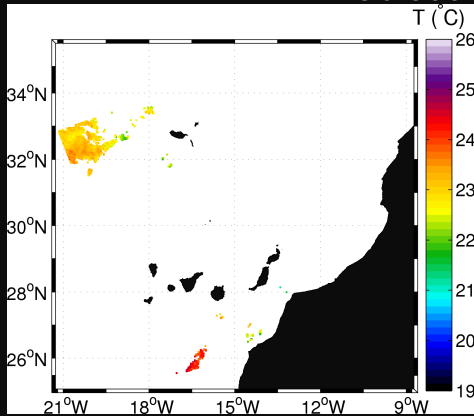
Results

September 15, 2012



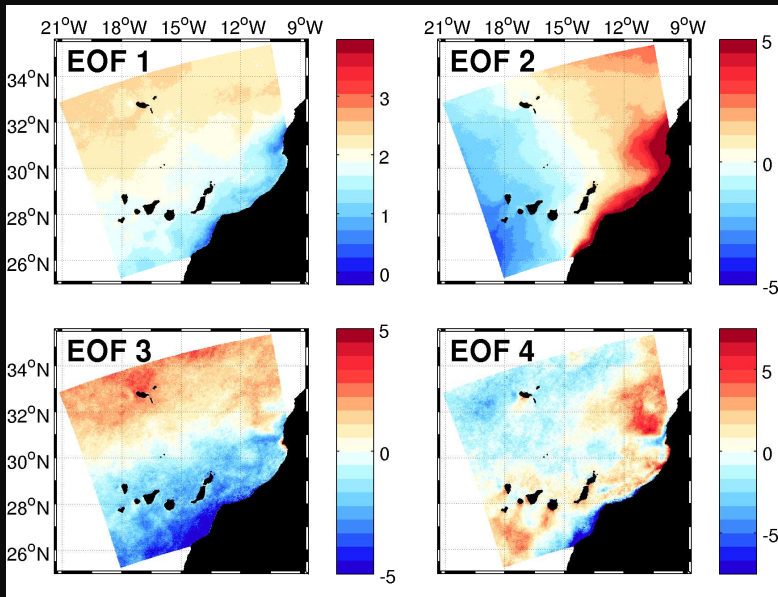
Results

October 30, 2012



Spatial modes

2008



Automatic processing

<http://gher-diva.phys.ulg.ac.be/DINEOF/dineof.html>



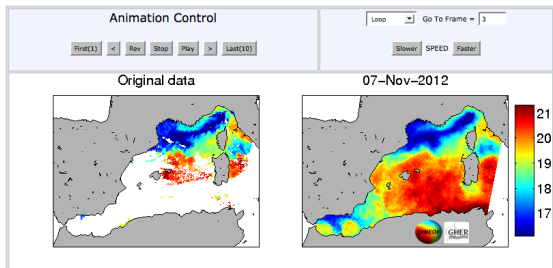
DINEOF daily cloud-free SST for the Western Mediterranean Sea

- [Reconstructed SST field](#)
- [Initial and Reconstructed SST fields](#)
- [Outliers field](#)
- [All fields](#)
- [DINEOF Wiki page](#)

See also:

- [Canary-Madeira SST](#)

DINEOF (Data Interpolating Empirical Orthogonal Functions) is an EOF-based technique to reconstruct missing data in satellite images. In this page the initial cloudy data set and the reconstruction for the last 10 days are shown. This product is updated daily with the latest SST data.



Note: Units are degrees Celsius

Here DINEOF is applied daily to NAR SST level 3 from the Ifremer Medspiration [ftp site](#).

Automatic processing

http:

//gher-diva.phys.ulg.ac.be/DINEOF/dineof_allCAN.htm



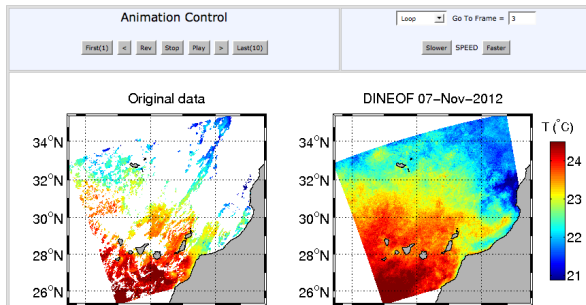
DINEOF daily cloud-free SST for the Canary-Madeira region

- [DINEOF Wiki page](#)
- [DINEOF google group](#)
- [GHER group](#)

See also:

- [Mediterranean SST](#)

DINEOF (Data INterpolating Empirical Orthogonal Functions) is an EOF-based technique to reconstruct missing data in satellite images. Initial cloudy data, reconstruction, outliers and error field (all calculated by DINEOF) for the last 10 days are shown. This product is updated daily with the latest SST data. The different steps used to produce the filled images are described [here](#)



What's more?

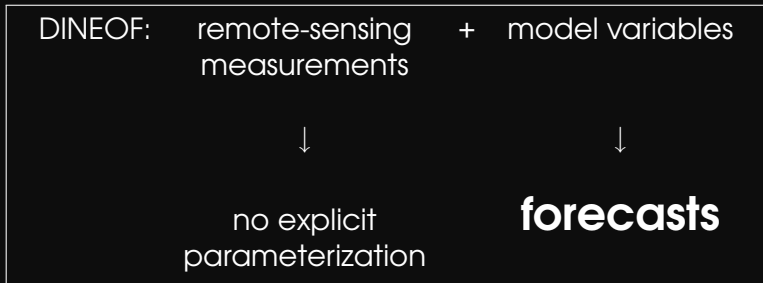
- Multivariate analysis
 - Merging: polar-orbiting + geostationary
 - Forecasts

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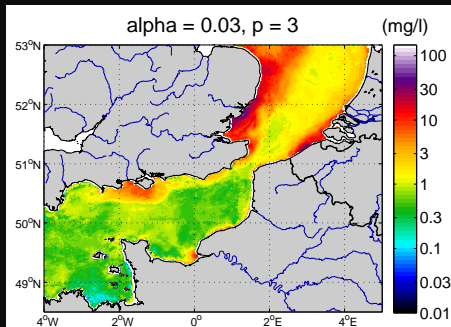
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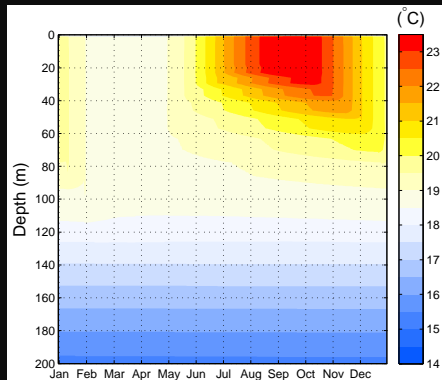
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"Forecast" of
Total Suspended
Matter



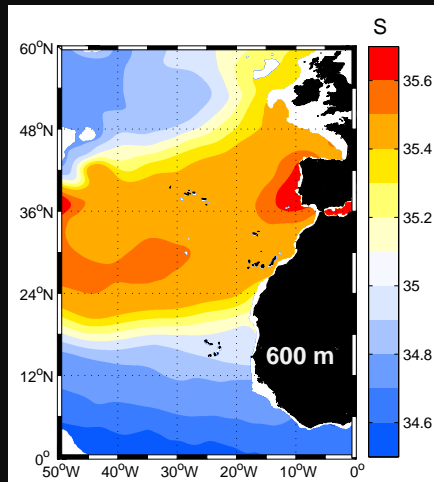
Previous work

- *Seasonal cycles in the Canary Island region, JMS (2010)*
- *Climatology of the North-East Atlantic, JGR (2010)*
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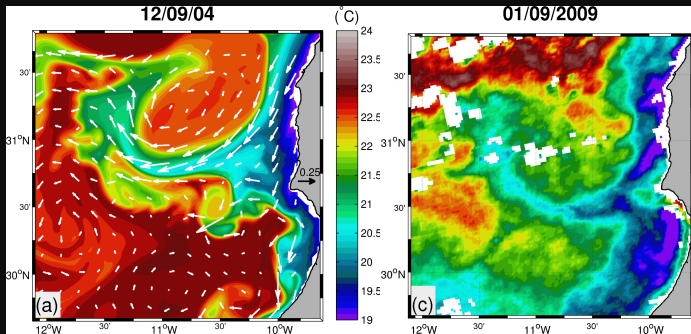
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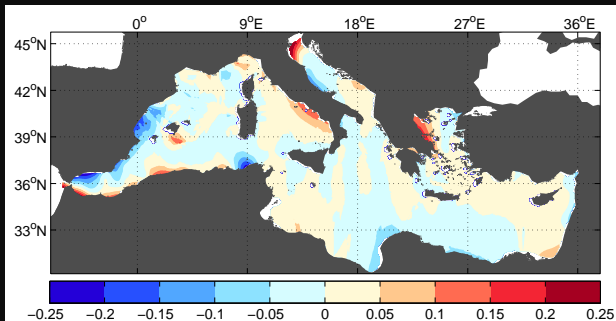
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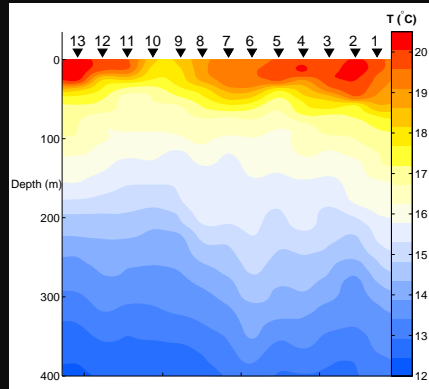
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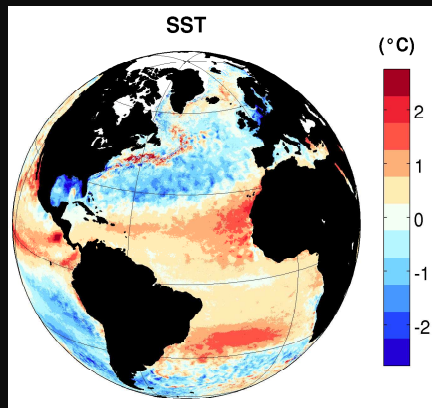
In preparation

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- *Anomalies in the tropical/subtropical North Atlantic in 2010*
- *Temporal trends of the Black Sea Cold Intermediate Layer*



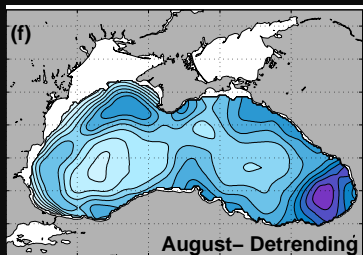
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Thanks for your attention