Using Argo floats to characterize altimetry products

A study of eddy-induced subsurface oxygen anomalies in the Black Sea

A. Capet[1], G. Taburet[2], E. Mason[3], I. Pujol[2], M. Grégoire[1], M. Rio[4]

[1] FOCUS-Liège University, Belgium
[2] CLS, France
[3] IMEDEA, Spain
[4] ESA/ESRIN, Italy

Context

Context
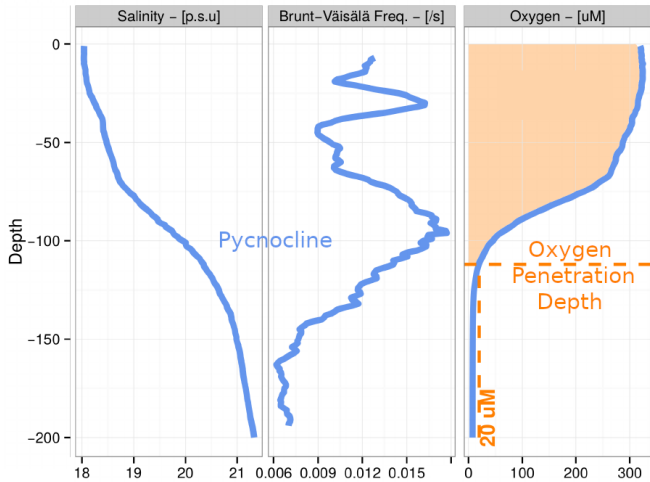
Context

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Oxygen penetration depth - annual mean
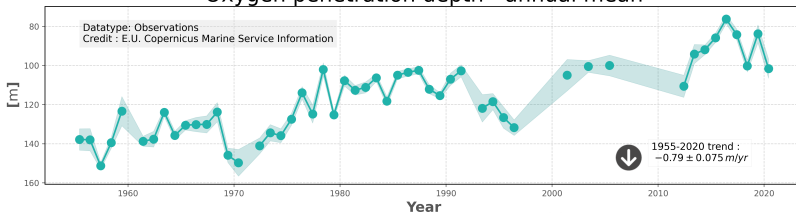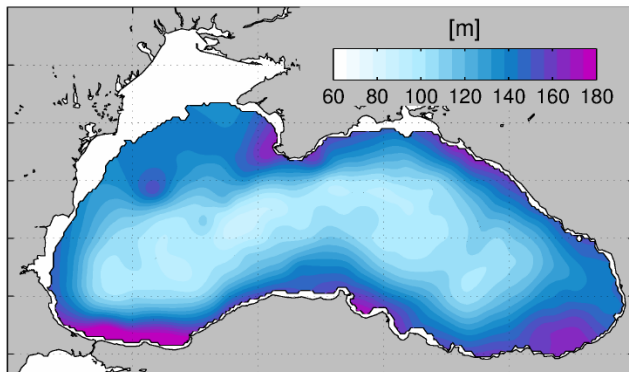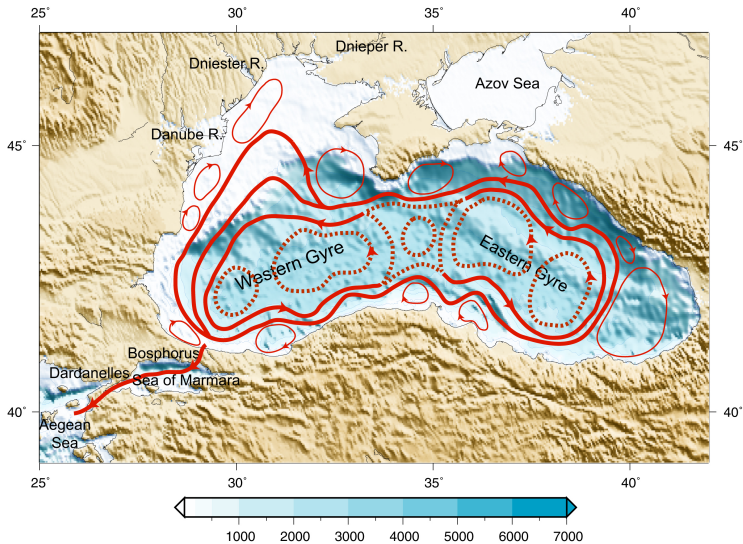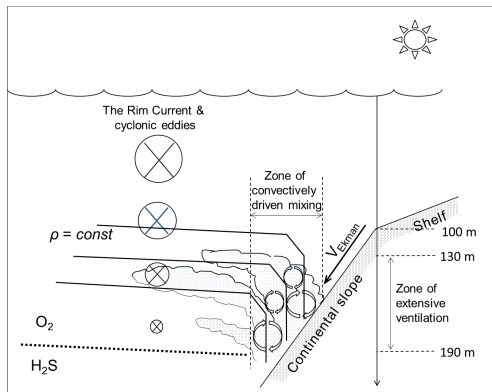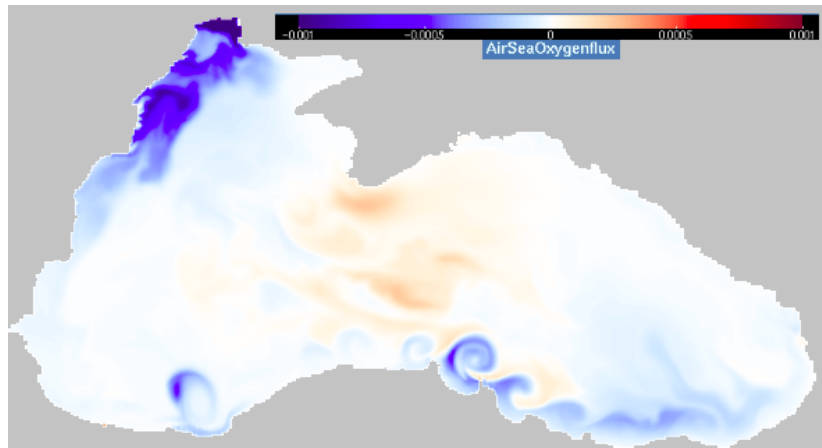
Datatype: Observations
Credit : E.U. Copernicus Marine Service Information

1955-2020 trend :
$-0.79 \pm 0.075 \, m/yr$

CMEMS, Ocean Monitoring Index, 2021

Context

Oxygen Penetration Depth (>20μM)

Capet et al., Biogeoscience, 2016

Context

Korotaev et al., JGR, 2003

Context

The Rim Current & cyclonic eddies

Zone of convectively driven mixing

$\rho = const$

V_{Ekman}

Shelf

Continental slope

100 m
130 m

Zone of extensive ventilation

190 m

O_2

H_2S

Ostrovskii and Zatsepin, Deep-Sea Research, 2016

Context

Objectives

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- Characterize eddy dynamics in Black Sea periphery.

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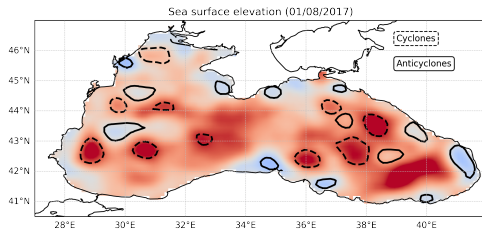- Evidence associated subsurface oxygen anomalies.

Methods

Methods

Objective 1: Characterize Mesoscale activity in the Black Sea periphery

► Altimetry products

Sea surface elevation (01/08/2017)

Methods

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► Challenged nearshore

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- → EO4SIBS altimetry

Eddy Kinetic Energy - Relative changes w.r.t CMEMS [%]

−100 −80 −60 −40 −20 0 20 40 60 80 100

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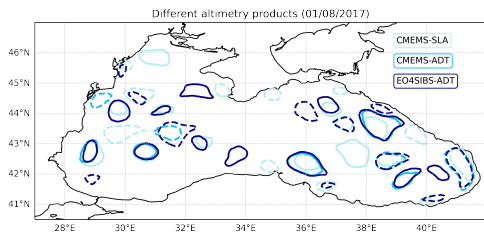- → EO4SIBS altimetry
- ▶ Comparison with previous products

Eddy Kinetic Energy - Relative changes w.r.t CMEMS [%]

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Sets of Altimetry	CMEMS-SLA	CMEMS-ADT	EO4SIBS-ADT	Model
Along-track	1 Hz	1 Hz	5 Hz	-
MDT	- (SLA)	CLS (ADT)	CLS (ADT)	- (ADT)
Interp.	OI	OI	OI + Bathy	None
Spatial res.	∼ 12 km	∼ 12 km	∼ 6 km	3km

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Different altimetry products (01/08/2017)

CMEMS-SLA
CMEMS-ADT
EO4SIBS-ADT

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Methods
How to compare altimetry products?

?   Compare eddy properties

Methods

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X Compare eddy properties $\rightarrow$ Model $\neq$ reference!

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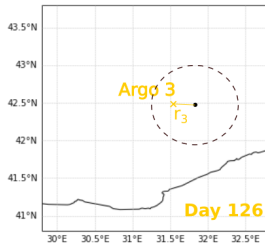
? Compare derived subsurface signatures...

Methods

Objective 2: Subsurface anomalies
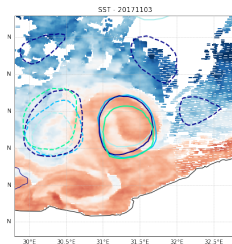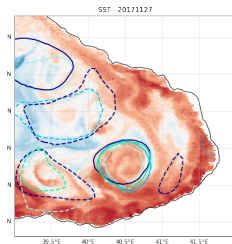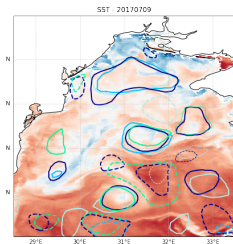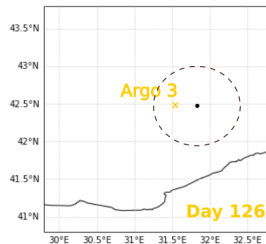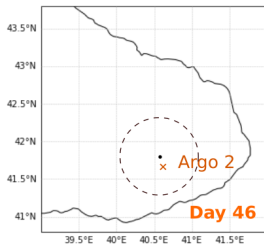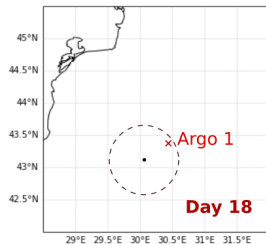
► Exploit Eddies/Argo Match-ups

Methods

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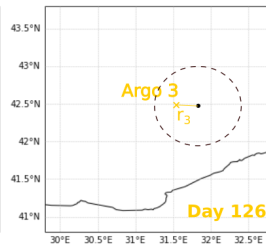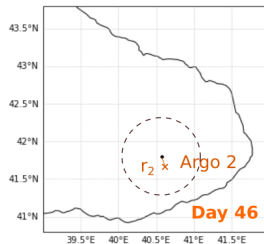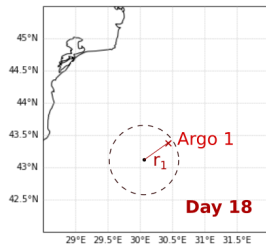
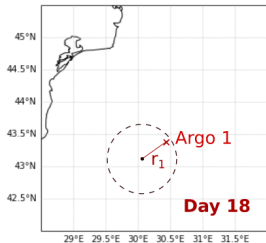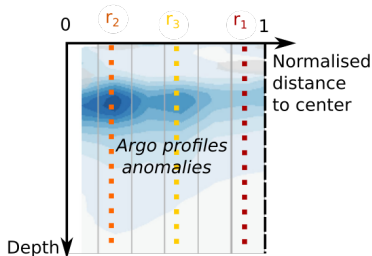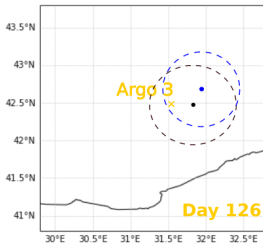► Exploit Eddies/Argo Match-ups

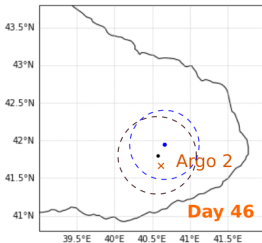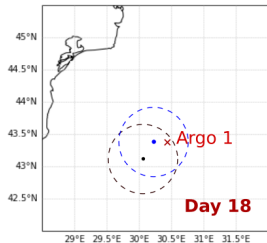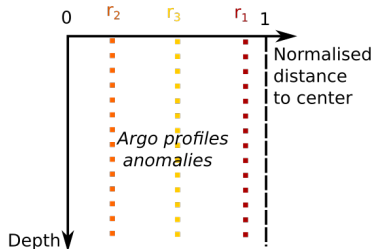**Eddy-centric composite framework**
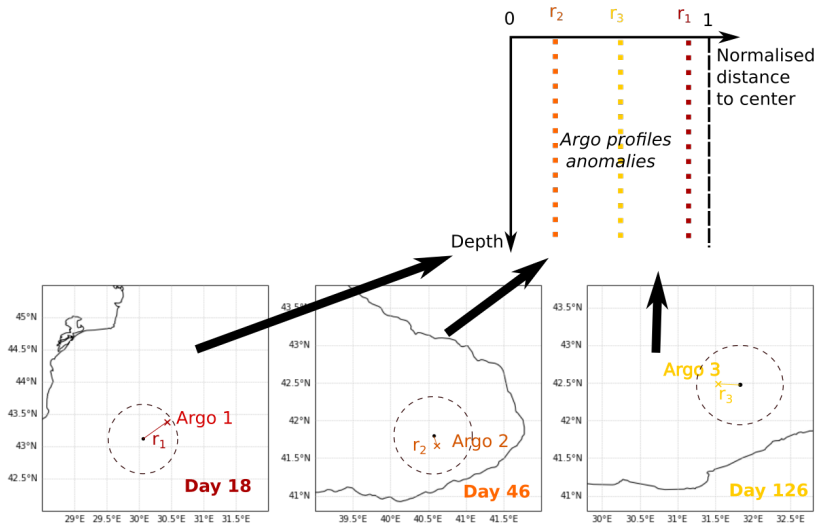
Methods

Objective 2: Subsurface anomalies

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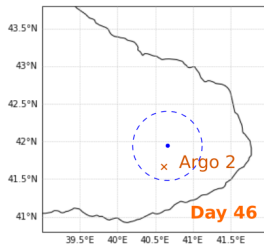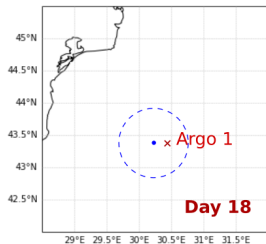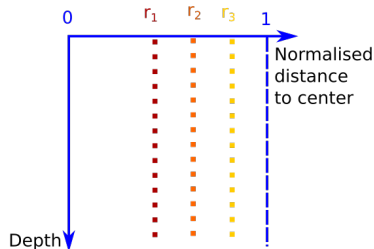- ▶ Composite mean of anomalies
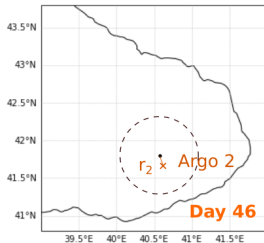
Eddy-centric composite framework

Methods

Objective 2: Subsurface anomalies

► Exploit Eddies/Argo Match-ups

► Composite mean of anomalies

Eddy-centric composite framework

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► Exploit Eddies/Argo Match-ups

► Composite mean of anomalies

► $\neq$ Set

  $\rightarrow \neq$ radial coordinates

  $\rightarrow \neq$ mean picture

  $\rightarrow \neq$ error on the mean

Eddy-centric composite framework
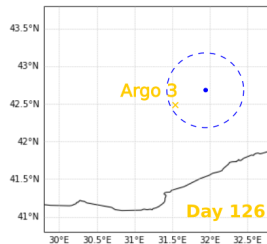
Results

Results

Different altimetry products
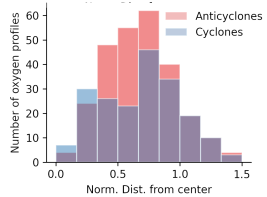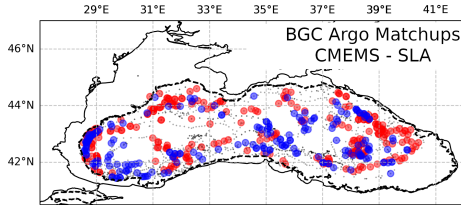
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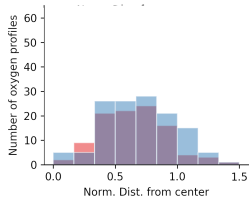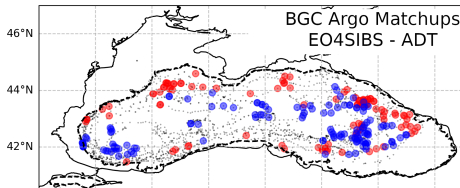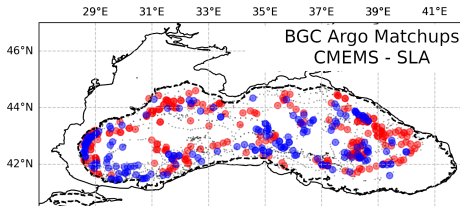
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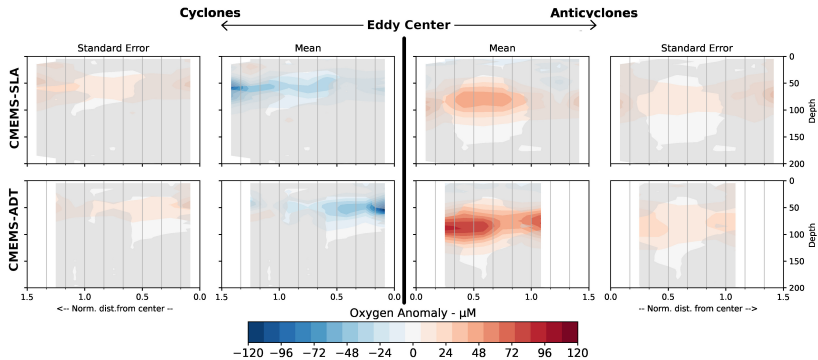
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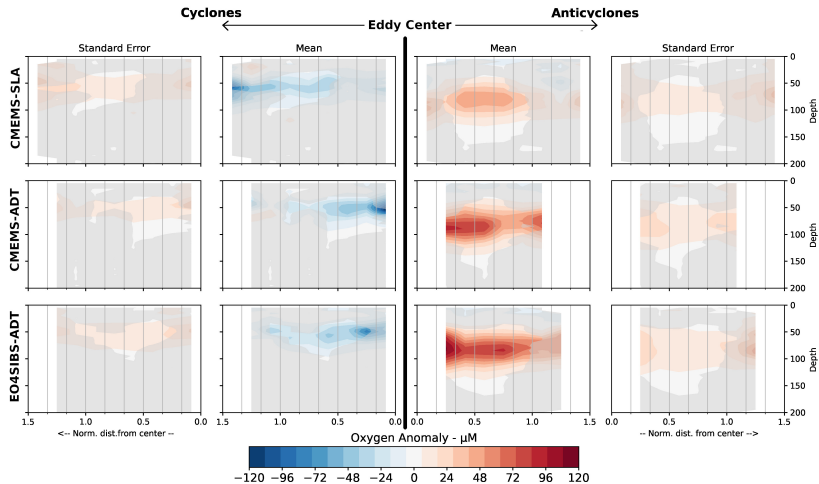
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Subsurface oxygen anomalies
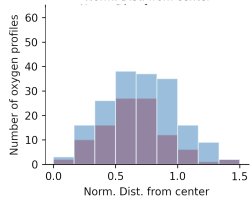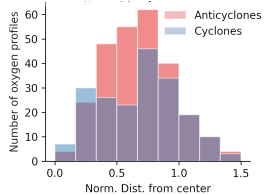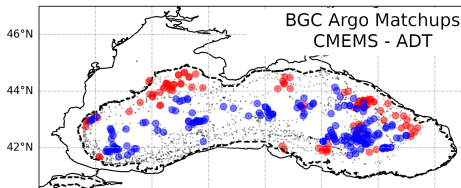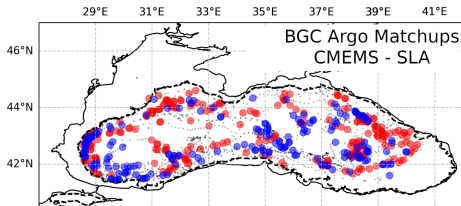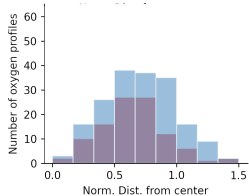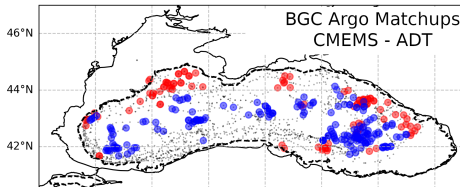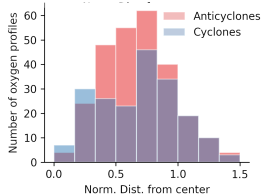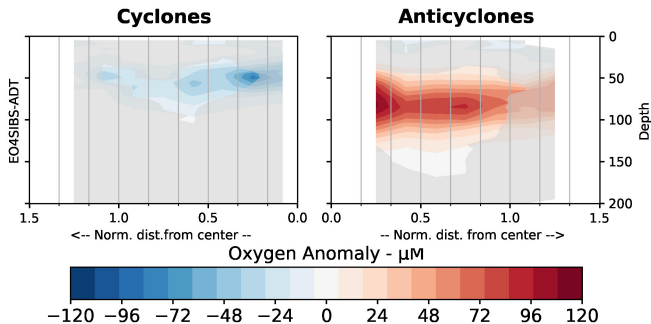
Take home messages

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- ► Argo floats are usefull to characterize altimetric products (and eddy detection methods).

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- ► Argo floats are usefull to characterize altimetric products (and eddy detection methods).
- ► Structure of oxygen subsurface anomlies suggest BGC terms in the mesoscale contribution to Black Sea oxygen dynamics.
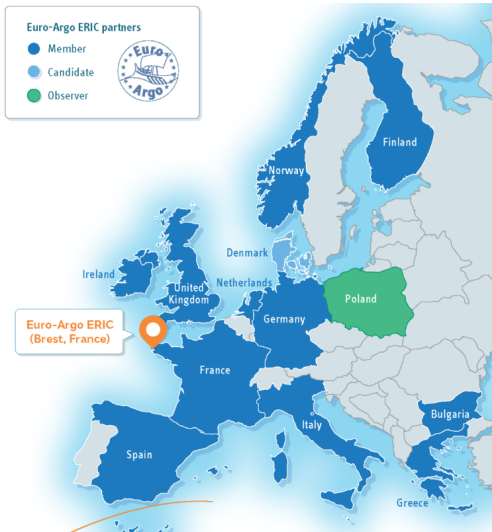
Argo

Argo

1. In the Black Sea : unique BGC vertical structure.
   - H_2S horizon.
   - Coupled phototrophic and chemotrophic loops.
   - $\rightarrow$ Challenging testing ground for BGC-Argos.

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   - H_2S horizon.
   - Coupled phototrophic and chemotrophic loops.
   - $\rightarrow$ Challenging testing ground for BGC-Argos.
2. Everywhere: enforce BGC-Argo/model interface.
   - Organic matter: dissolved, particulate, lability,...
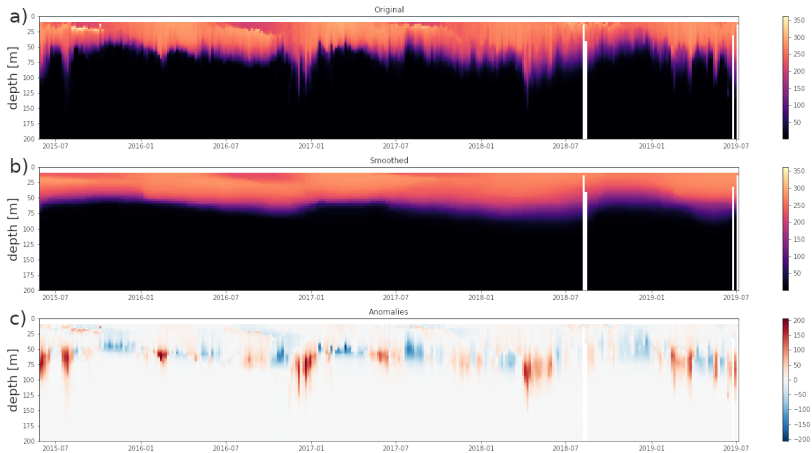   - Characterize error distribution for all BGC-Argo variables.

Argo

Thank you!

frontiers

Using Argo floats to characterize altimetry products: a study of eddy-induced subsurface oxygen anomalies in the Black Sea

Arthur Capet [1,*], Guillaume Taburet [2], Evan Mason [1,3], Isabelle Pujol [2], Marilaure Grégoire [1], Marie-Hélène Rio [4]

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