



Marine Monitoring



Implemented by



Apport des données Argo pour le Copernicus Marine Service

P.Y. Le Traon avec les contributions des
équipes Mercator Ocean International



Marine
Monitoring

Ocean Information

Le Service Marin de l'UE

OCEAN PRODUCTS

Ocean product catalogue, to download or visualize data across more than 10 variables, including historic, current and forecasted data.

DATA



OCEAN MONITORING INDICATORS

Essential variables monitoring the health of the ocean

TRENDS



OCEAN STATE REPORT

Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events

EXPERTISE



The screenshot shows the homepage of the Copernicus Marine Environment Monitoring Service. At the top, there's a navigation bar with links like 'ABOUT US', 'CASE STUDIES & PAPERS', 'SERVICES', 'SCIENCE & MONITORING', 'TRAINING & EDUCATION', 'SERVICE PORTFOLIO', 'SHORT-CUT TO SERVICES', 'REGISTER NOW!', 'SCIENTIFIC QUALITY', 'CITE & TUTORIALS', 'COLLABORATIVE FORUM', and 'LATEST NEWS FLASH'. Below the navigation, there's a large central image of the Earth with various data overlays. To the left, there are three main sections: 'OCEAN PRODUCTS' (with a sub-section for 'Data products'), 'OCEAN MONITORING INDICATORS' (described as 'monitoring the health of the ocean'), and 'OCEAN STATE REPORT' (described as 'extensive annual analysis on the state of the ocean'). On the right side, there's a sidebar with sections for 'EMERGENCY', 'PREDICTORS AND STORM RISKS', 'FOCUS AREA', 'TRAINING AGENCY', and 'SITE MAP - ALL REPORTS'. At the bottom, there's a footer with links for 'ABOUT US', 'PRIVACY & COMMUNITY', 'MARKETS', 'CONTACT US', and 'ANY QUESTIONS? Ask the Science Team'.

<https://marine.copernicus.eu/>



#CMEMSTraining

WORKSHOPS

OUTREACH

SERVICE DESK



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Commission

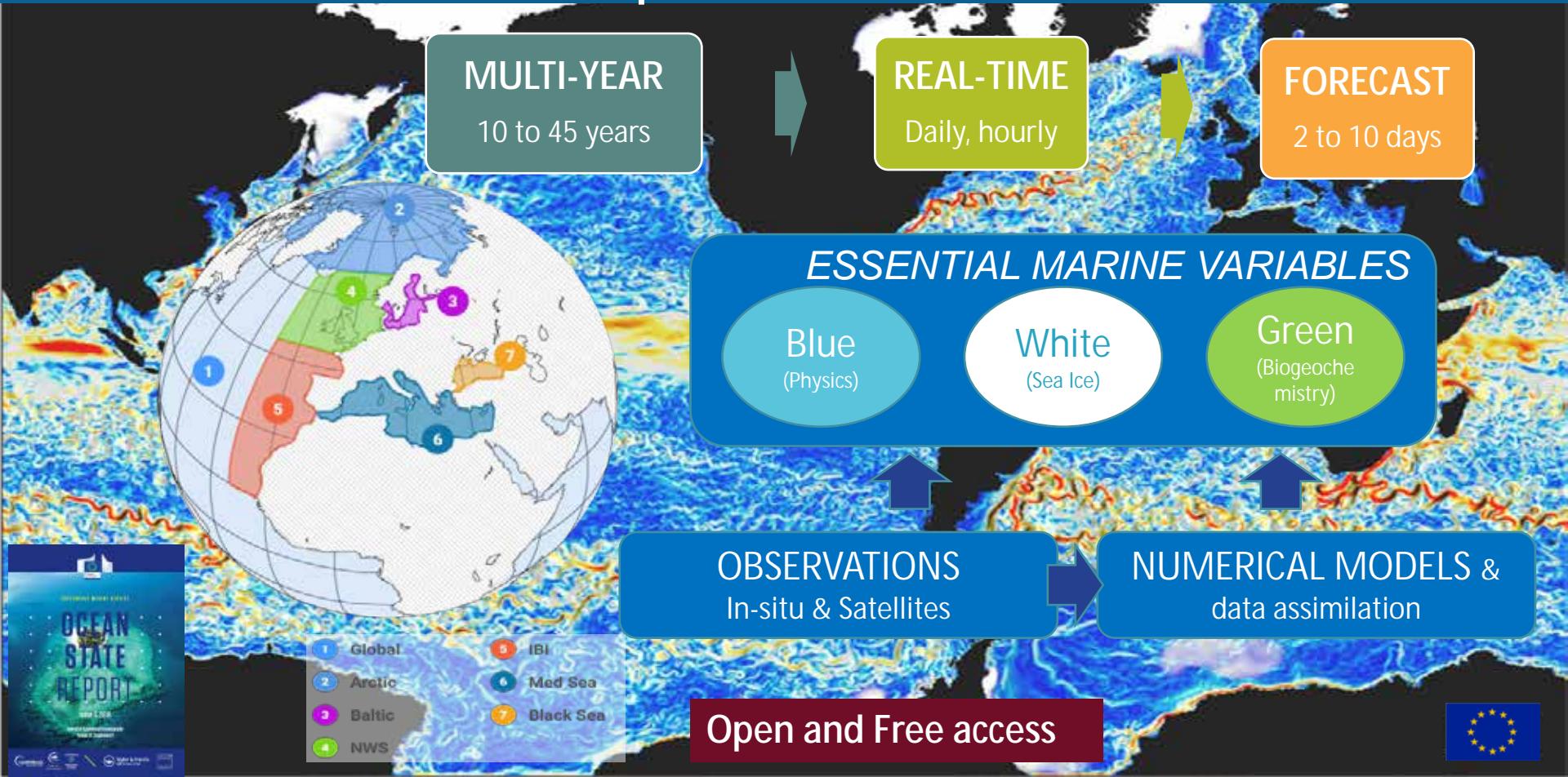
Copernicus
Horizon 2020

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User Support

Le Service Marine de l'UE (CMEMS)

Suivi et prévision de l'océan





Marine
Monitoring

Des producteurs aux utilisateurs...

Une centaine de
producteurs en Europe



ENVIRONMENT



SOCIETY



ECONOMY



pour un ensemble varié d'applications
et en support aux politiques
environnementales et climatiques

> 24 000 abonnés (+ 30% par an)



Copernicus
Europe's space for Earth Observation





Utilisateurs – société/ environnement /économie

MARKETS

Copernicus Marine Service supports all sectors of the blue economy

<http://marine.copernicus.eu/markets/>

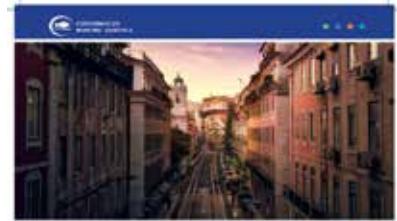


- | | |
|----------------------------------|-----------------------|
| 1 SEA ICE MONITORING | 6 COASTAL MONITORING |
| 2 MARINE CONSERVATION & POLICIES | 7 SOCIETY & EDUCATION |
| 3 SCIENCE & CLIMATE | 8 MARINE FOOD |
| 4 NATURAL RESOURCES & ENERGY | 9 MARINE NAVIGATION |
| 5 WATER QUALITY | 10 SAFETY & DISASTER |

USE CASES

Management Area Data of interest User login Cleaning Delete application

JOTUN	DRIMEN	AVALEN	PolarView	MARINA	EU
AHPA	PolarView	HIGROMOD	HYSOLAN	CLS	
CGG	gretel	Scenav	PolarView	GRSSCO	
ReefNet	Links	Links	Links	Links	
TAGS	MARIN	Links	Links	Links	



COPERNICUS MARINE SERVICE IN SUPPORT TO PORTUGAL

USE CASE EXAMPLES



COPERNICUS MARINE SERVICE IN SUPPORT TO

MARINE RENEWABLE ENERGY

USE CASE EXAMPLES



Les utilisations du Copernicus Marine Service

Use cases page (200 use cases)

Use cases books

Use cases demo page

<https://marine.copernicus.eu/markets/use-cases/>



Copernicus Marine Service : Le rôle essentiel des observations

Dépendance très forte vis-à-vis des systèmes amont d'observations (validation, assimilation).

Besoins définis à la fois pour l'in-situ et le satellite (Sentinel et ses extensions):
1/ continuité et 2/ améliorations importantes.

Argo et ses extensions (BGC, Deep, zones polaires) = besoin prioritaire.



SYSTEMATIC REVIEW ARTICLE
Environ Monit Assess (2018) 224:166
DOI 10.1007/s10661-018-6664-6

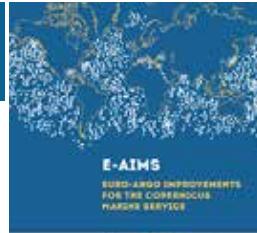
From Observation to Information and Users: The Copernicus Marine Service Perspective

■ Pierre-Yves Le Traouët*, ■ Antonio Rapaport, ■ Enrique Alvarez-Faraj, ■ Léonard Bocchi, ■ Anna Bohrmann, ■ Maria Belviso, ■ Alberthorsten Berndsen, ■ Laurent Berthon, ■ Vitojana Cesarini Brandoli, ■ Malte Breitfuss, ■ Michael Brügel, ■ Fabrice Brunet, ■ Gregory Carval, ■ Stephan Cramm, ■ Helmut Cramm, ■ Emanuele Crotti, ■ Christian Czaja, ■ Gertjan Dierckx, ■ Hans De Adnat, ■ Ralf-Dieter Dethloff, ■ Anne Dethlefsen, ■ Gerd-Dieter Döös, ■ Frieder Fiedler, ■ Hans-Günther Fleissner, ■ Yann Gobin, ■ Haroun Gómez, ■ Yann Guiguer, ■ Vincenzo Iervolino, ■ Andreas Flemming, ■ M. Isabel García-Herranz, ■ Marcos García-Solís, ■ Odile Garnier, ■ Florent Gasparin, ■ Cedric Giordan, ■ Marion Gentier, ■ Mathieu L. Gregoire, ■ Stéphanie Guineau, ■ Mathieu Hanneur, ■ Clara Harris, ■ Fabrice Ineichen, ■ Jürgen B. Höller, ■ Jacob Hoyle, ■ Julia Kavvouni, ■ Sushil Kati, ■ Robert King, ■ Thomas Langevin, ■ Benedicto Lemire-Dubois, ■ Leonardo Lima, ■ Chongming Mao, ■ Matthias J. Martin, ■ Simone Massina, ■ Angelique Meister, ■ Bruno Baudouin, ■ Hervé Nozette, ■ Armand Pescat, ■ Jonny Paterson, ■ Janusz Pawlak, ■ Jean-Pierre Peltier, ■ Marie Isabelle Pujol, ■ Anne Christine Pergaud, ■ Elisabeth Perner, ■ Bogna Rzepka-Comeau, ■ Luis Peña de Villegas, ■ Nadia Piat, ■ Andréa Probst, ■ Ariane Pouliquen, ■ Ad Stoffelen, ■ Marina Tsonis, ■ Lucia Vandendriessche, ■ Karine von Schuckmann, ■ Gianluca Volpi, ■ Cecilia Walker and ■ Anna Zucharska*

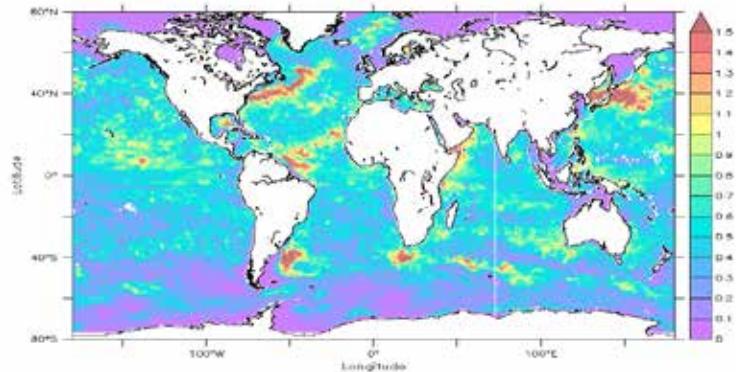




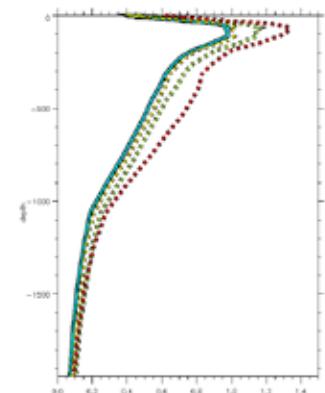
Impact des données Argo pour le Copernicus Marine Service



OSEs with the Mercator Ocean global ocean analysis and forecasting system
(Turpin et al., 2016). Impact of the assimilation of Argo floats and their density.



RMS of 0-300 m temperature differences
between Run-Ref and Run-NoArgo



Absolute (left) and normalized (right) RMS of temperature innovations for Run-Ref(blue), Run-Argo/2(yellow), Run-NoArgo (green) and Free Run (red)

Temperature and Salinity forecast errors reduced by 20% to 60% when Argo data are assimilated. Keeping only half of the Argo floats degrades significantly the analysis



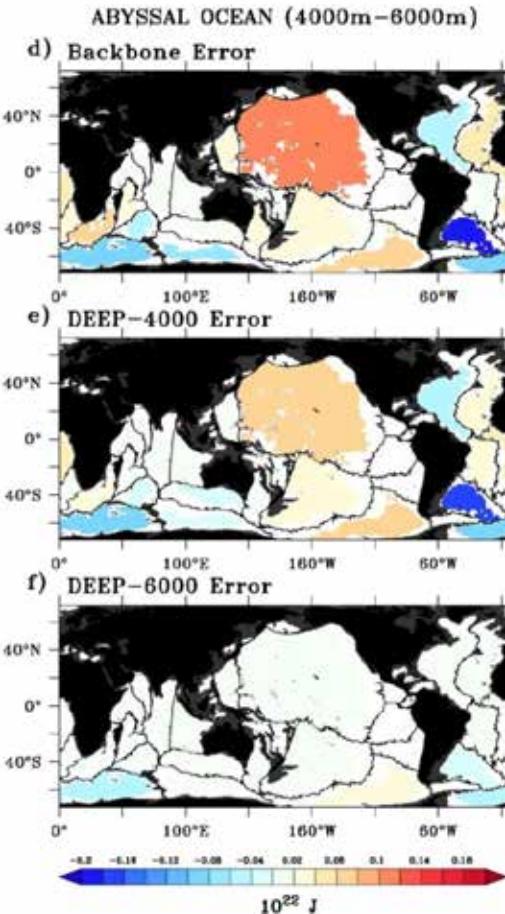
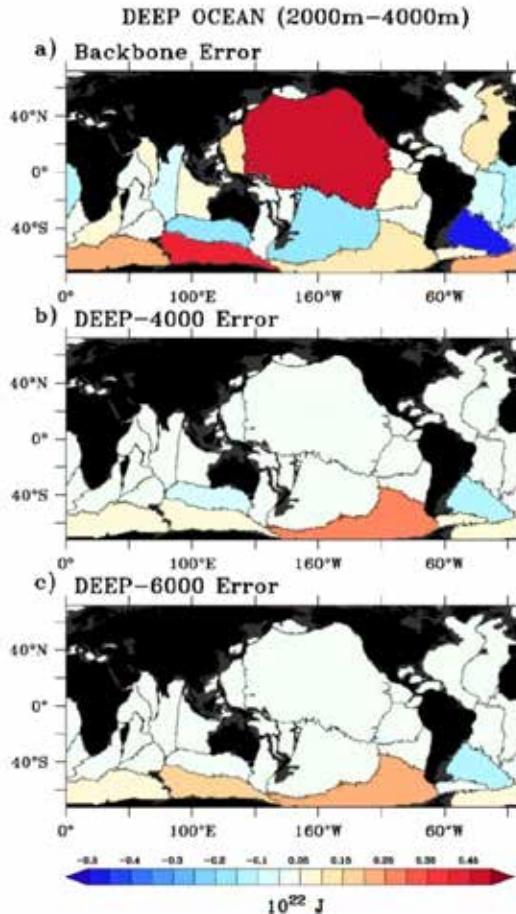
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IMPACT DE DEEP ARGO - OSSEs



Erreurs sur le contenu de chaleur moyen annuel pour les simulations backbone (core Argo), Deep Argo (4000 m) et Deep Argo (6000 m)

Impact important de Deep-Argo sur la réduction des erreurs entre 2000 à 4000 m

Apport spécifique du Deep-Argo 6000 m pour les couches abyssales

Gasparin et al., Journal of Climate, 2020

Gasparin et al., Frontiers Marine Science, 2019



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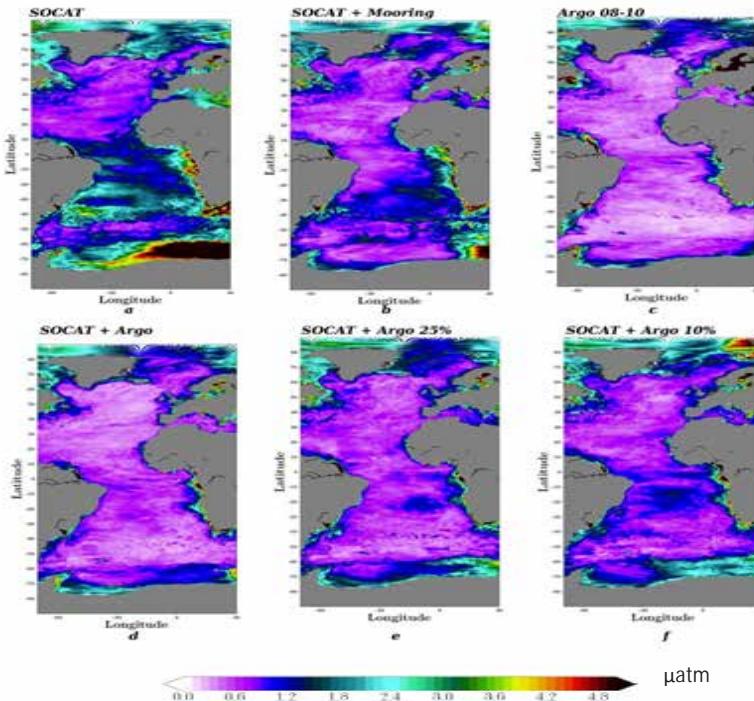


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Estimation des flux air/mer de CO₂ – Apport de BGC Argo (M. Gehlen, A. Sommer)

Utilisation d'un réseau de neurones pour reconstruire des champs 2D de pCO₂ de surface

Feed-forward neural network (FFNN) (Denvil-Sommer et al., 2019)



Ecart-type des différences entre les champs pCO₂ reconstruits et modélisés (NEMO-PISCES)

Pseudo-observations (Neural Network training):

- a) SOCAT (2001-2010)
- b) SOCAT + OceanSITES (2008-2010)
- c) Argo (2008-2010);
- d) SOCAT + Argo
- e) SOCAT et 25% of Argo
- f) SOCAT et 10% of Argo

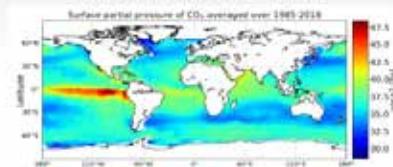
AtlantOS

Apport (potentiel) majeur d'Argo pour le suivi des flux air/mer de CO₂ dans le Copernicus Marine Service

GLOBAL OCEAN SURFACE CARBON

Metadata provided by CMEMS

Credits: E.U. Copernicus Marine Service Information



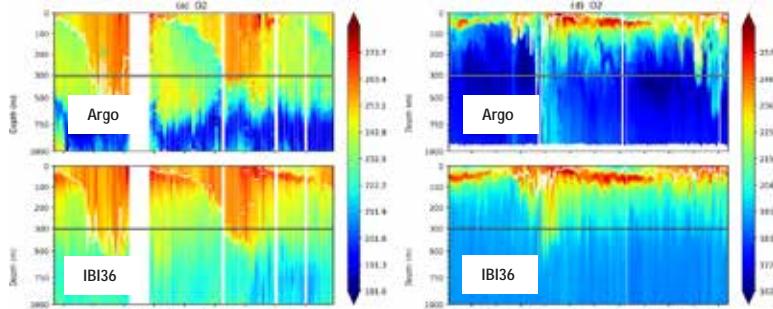


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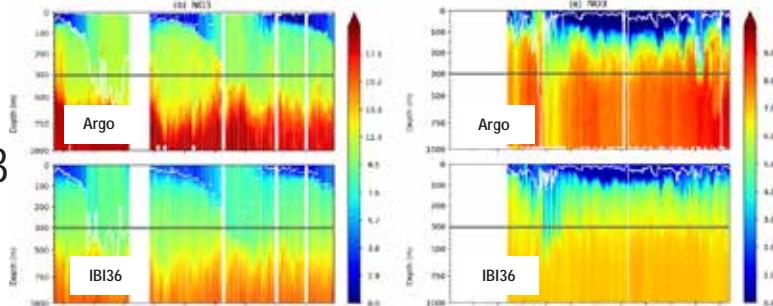
Atlantique

Méditerranée

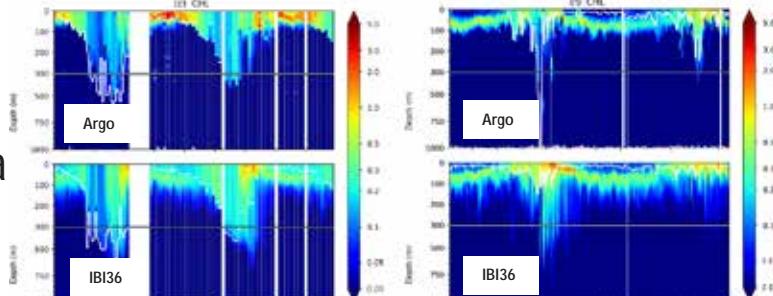
O2



NO3



Chla



Apport des données BGC Argo pour la validation des modèles

Comparaison des données BGC Argo (O2, NO3, Chla) avec le système régional IBI 1/36° du Copernicus Marine Service

Gutknecht et al., ocean science, 2019



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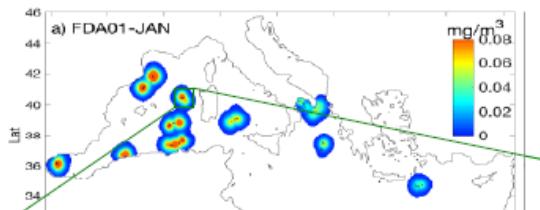
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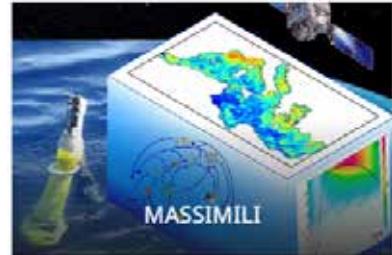
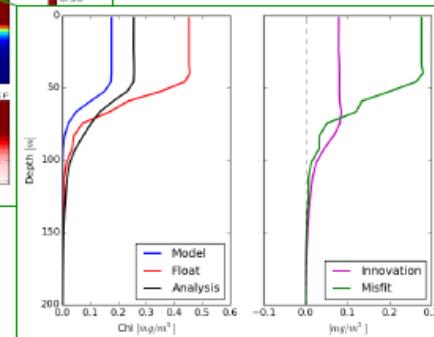
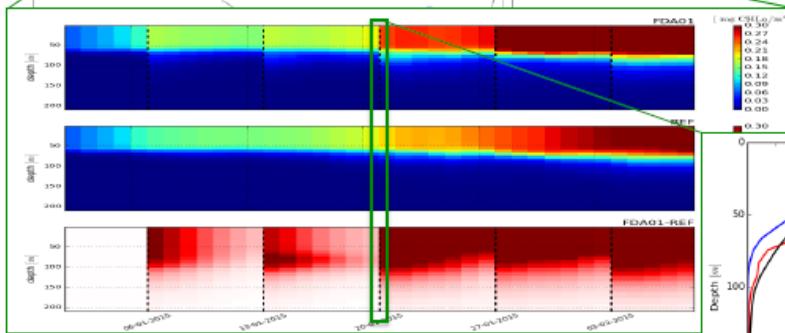


Impact des données BGC Argo NAOS pour le Copernicus Marine Service

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Assimilation des
données / modèles BGC



G. Cossarini, , L. Mariotti, L. Feudale, A. Mignot, S. Salon, V. Taillandier, A. Teruzzi, F. D'Ortenzio (2019). Towards operational 3D-Var assimilation of chlorophyll Biogeochemical-Argo float data into a biogeochemical model of the Mediterranean Sea. Ocean Modelling 133, 112-128. doi: [10.1016/j.ocemod.2018.11.005](https://doi.org/10.1016/j.ocemod.2018.11.005)



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Conclusions

- Ø Fort impact des données Argo (T&S) dans les systèmes d'analyse et de prévision océanique (et leurs applications) du Copernicus Marine Service. Très forte complémentarité avec l'altimétrie.
- Ø Impact (futur) important pour Deep Argo.
- Ø Rôle important et croissant de BGC Argo pour la validation des modèles, les flux air/mer de CO₂ et pH et l'assimilation des données conjointement aux observations satellites de couleur de l'océan. Un nouveau paradigme.
- Ø Importance d'une évaluation régulière de l'apport des flotteurs d'Argo (OSEs) et de travaux conjoints sur le design et impact du futur d'Argo (communautés observations et modèles) (OSSEs).