Euro-Argo ERIC - European Research Infrastructure Consortium

EURO-ARGO.EU
euroargo@ifremer.fr
@EuroArgoERIC

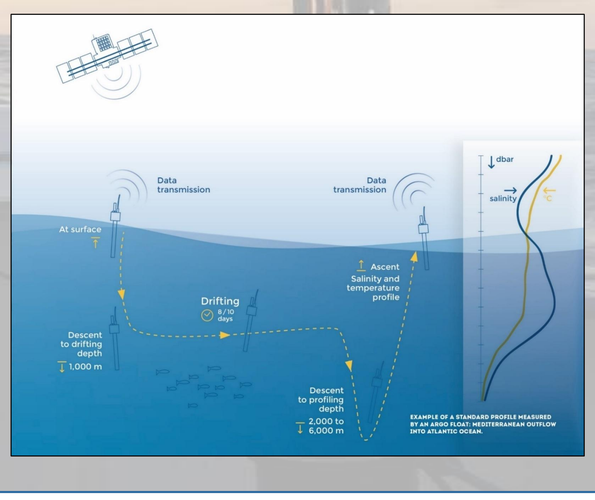
Argo evolution in Europe for the next decade

Argo: a global ocean observing system

The ocean has a fundamental influence on our climate and weather. It stores, transports and exchanges large amounts of heat, water and gases with the atmosphere. These exchanges dramatically affect global and regional climates in time-scales ranging from days to centuries.

Long-term high quality global ocean observations are needed to understand the role of the ocean on the earth's climate and to predict the evolution of our weather and climate.

Nearly 4000 autonomous profiling floats drifting at set depths all over the world's ocean are taking measurements of temperature and salinity from the sea surface down to a depth of 2000m. Observations are delivered via satellites to data centres where the data are processed and provided to users within a few hours of acquisition. Argo provides a free and open-data access policy.

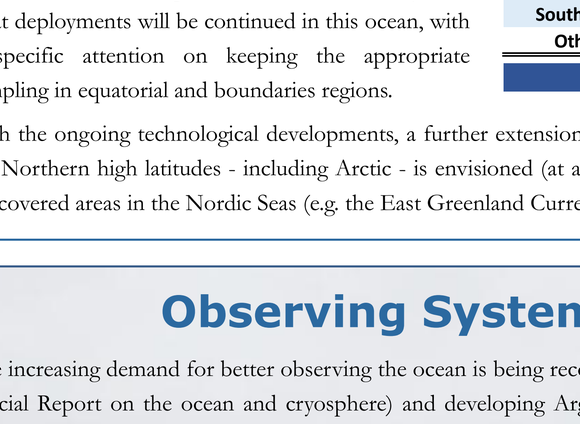


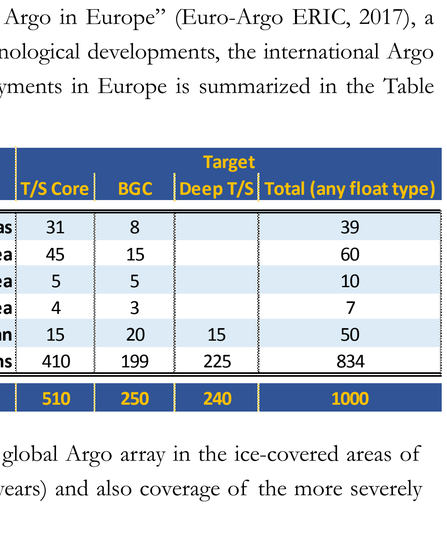
Typical cycle of an Argo float. The cycle is repeated during the float's lifespan, 4 year in average

The Euro-Argo Research Infrastructure

The objectives of the Euro-Argo ERIC (European Research Infrastructure Consortium) are to coordinate and sustain the European contribution to the global Argo network, with around 1000 European Argo floats operational at any time (1/4 of the network), through both national and European funds.

Euro-Argo involves 13 countries: 10 members, 2 observers and 1 candidate. In 2014, Euro-Argo gained the status of a European Research Infrastructure Consortium (ERIC), a legal entity that ensures its funding in the medium-term through commitments of its members and observers at state level.





Euro-Argo ERIC in 2018: 13 countries involved

Today, the European contribution represents more than 21% of the global Argo networks in terms of active floats.

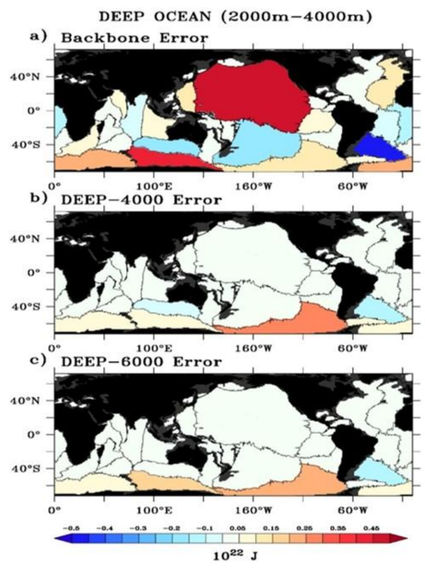
Users & applications

The Argo network provides fundamental ocean observations used both for operational services through the assimilation of data in forecasting systems and for progressing in ocean knowledge and better understand the marine ecosystem and the role of the Ocean on climate, through scientific analysis.

Argo is the single most important in situ observing system required for the Copernicus Marine Environment Monitoring Service (CMEMS).

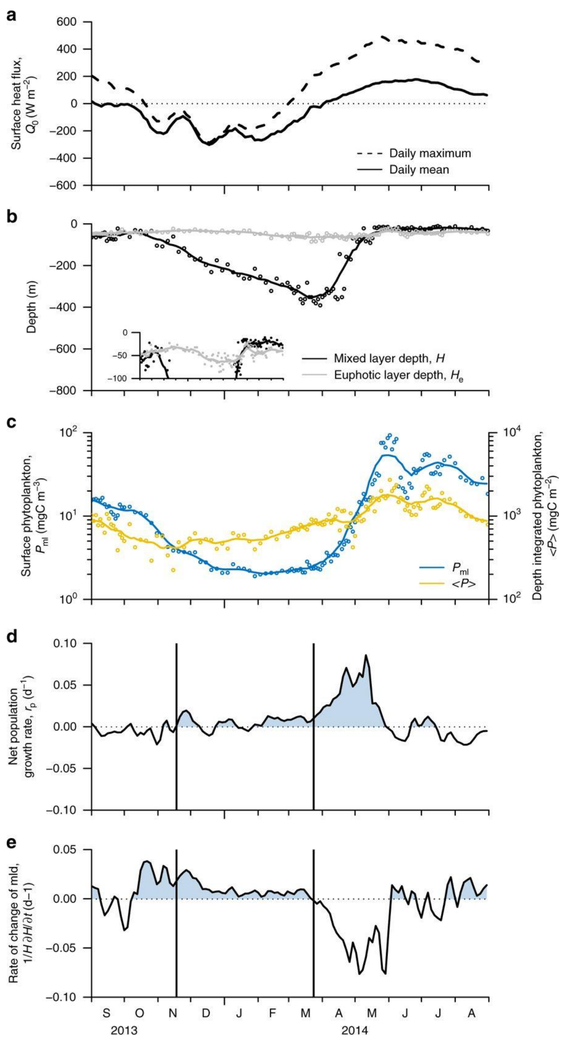
Argo and satellite data are assimilated into CMEMS models used to deliver regular and systematic reference information on the state of the seas, with applications in the domains of coastal and marine environment, maritime safety, resources management, weather and seasonal forecasting and climate.

Observing System Simulation Experiments are carried out to infer the importance of Argo and its extensions for operational systems. The Figure opposite shows the impact of deep Argo measurements [down to 4000m (b) and 6000m (c)] in reducing the error on the deep (2000-4000m) Ocean Heat Content, compared to when only classical Argo measurements (0-2000m) are used (a).

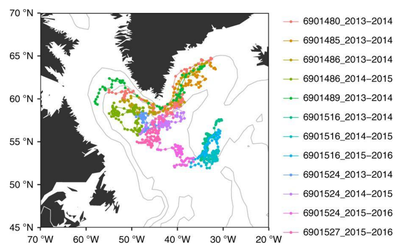


Gasparin et al (2018)

Floats with bio-optical sensors reveal what processes trigger the North Atlantic bloom
Mignot et al. (2018)



Profiles from 9 Biogeochemical-Argo floats drifting in the sub-polar North Atlantic for several years have been used to quantify the net population growth rates in winter and spring and provide a detailed description of the typical evolution of phytoplankton during these seasons.



The main conclusion of this recent study is that phytoplankton populations start increasing in winter, but at very weak rates, while the explosive acceleration in these rates, typical of blooms, is not observed until spring, when atmospheric cooling subsides and the mixed layer rapidly shoals. While the weak accumulation of phytoplankton in winter is crucial to maintaining a viable population, the spring bloom dominates the overall seasonal production of organic carbon.

*Time series of key variables measured or derived from float 6901516 from Sept. 2013 to July 2014. The continuous lines in panels **a–c** represent 24-day running averages that remove short-term fluctuations. Panel **c** : P_{ml} (blue) is the mixed layer averaged phytoplankton carbon biomass concentration and <P> (yellow) is the depth-integrated phytoplankton carbon biomass. Panels **d-e** : the 1st vertical line marks the initiation of the weak winter accumulation phase and the 2nd one marks the initiation of the spring bloom. Panel **e** : mld stands for mixed layer depth*

The strategy for Argo in Europe

One of the main challenges for Euro-Argo is now to implement the **new phase** of Argo with an **extension towards biogeochemistry (BGC-Argo), the polar oceans, the marginal seas and the deep ocean** (down to 4000 and 6000m). Euro-Argo has recently published its "strategy for evolution of Argo in Europe" (Euro-Argo ERIC, 2017), a reference document that will be revised regularly taking into account technological developments, the international Argo strategy and the users needs. The current strategy for Argo floats deployments in Europe is summarized in the Table below, in numbers of operational European floats.

Euro-Argo will ensure that the European deployments fulfil the international core Argo programme requirements in terms of global geographical repartition. The Atlantic Ocean is a region of great interest for the European research community, and float deployments will be continued in this ocean, with a specific attention on keeping the appropriate sampling in equatorial and boundaries regions.

Area	Target			
	T/S Core	BGC	Deep T/S	Total (any float type)
Nordic Seas	31	8		39
Mediterranean Sea	45	15		60
Black Sea	5	5		10
Baltic Sea	4	3		7
Southern Ocean	15	20	15	50
Other regions	410	199	225	834
Total	510	250	240	1000

With the ongoing technological developments, a further extension of the global Argo array in the ice-covered areas of the Northern high latitudes - including Arctic - is envisioned (at about 5 years) and also coverage of the more severely ice-covered areas in the Nordic Seas (e.g. the East Greenland Current).

Observing System Framework

The increasing demand for better observing the ocean is being recognized at the highest political levels (G7, IPCC and its Special Report on the ocean and cryosphere) and developing Argo and its extensions are top priorities within the G7 Future of Oceans working group. The international ocean observing community has identified a need for integration and coordination of interdisciplinary ocean observations (A Framework for Ocean Observing 2012). Significant progresses have been recently achieved at pan-European and regional scales to enhance integrated access to ocean observation products (e.g. Copernicus Marine Environment Monitoring Service, EuroGOOS and ROOSes, EMODnet initiative, SeaDataNet network of National Oceanographic Data Centres).

There are a number of drivers for a stronger coordination of ocean observations in Europe, necessary to underpin our knowledge, the delivery of ocean services and future projections. The 2016 ESFRI roadmap report stresses that Europe urgently needs to develop an integrated and sustained European Ocean Observing System (EOOS). The EOOS framework will link the currently disparate components by an overarching strategy, maximizing the benefits of optimization, infrastructure use, standardization, open data exchange and capacity building, strengthening the European contribution to the GOOS.

Argo has demonstrated the importance of implementing and sustaining a global network, as well as increasing the number of variables measured. But, even if Argo float is a fantastic instrument, it has also its weaknesses and a multi-platform approach is necessary to address GOOS and EOOS societal challenges. Euro-Argo is engaging with the other ocean ERICs (EMSO, ICOS) and Research Infrastructures (Gliders, coastal networks, GOSHIP) to contribute to an integrated observing network and be able to fill gaps whenever possible through initiatives such as TPOS for the Pacific Tropical Ocean, or the Atlantic BluePrint.

Atlantic Ocean Observing BluePrint
EOOS European Ocean Observing System
The Global Ocean Observing System
plus ENVRI

References

- Euro-Argo ERIC (2017): *Strategy for evolution of Argo in Europe*, v3.2. DOI: 10.13155/48526
- Gasparin et al.. (2018): *Requirements for a deep Ocean Observing System from Observing System Simulation Experiments*, to be submittted in JTech.
- Mignot, A., R. Ferrari and H. Claustre (2018): *Floats with bio-optical sensors reveal what processes trigger the North Atlantic bloom*, Nature Communication 9, Article number 190. DOI: 10.1038/s41467-017-02143-6.

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