Euro-Argo ERIC - European Research Infrastructure Consortium

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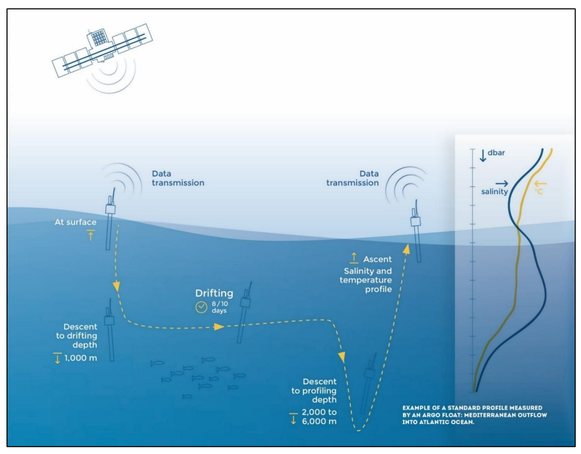
Argo evolution in Europe for the next decade

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.

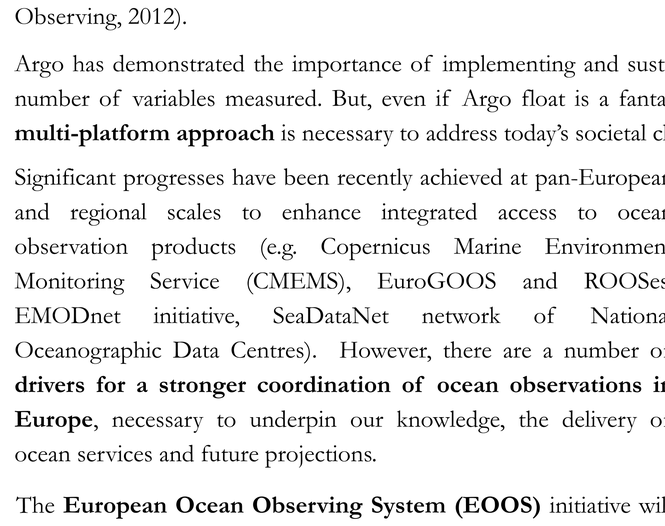


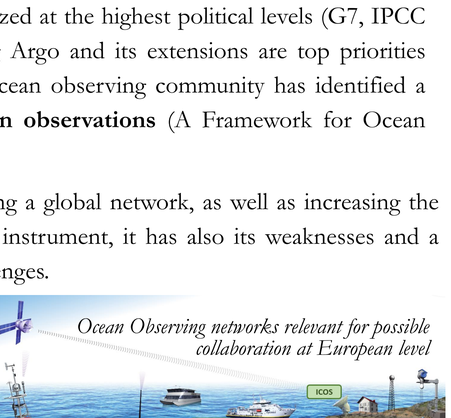
Typical cycle of an Argo float. The cycle is repeated during the float's lifespan, 4 year in average

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: **11 members, 1 observer 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 network in terms of active floats.

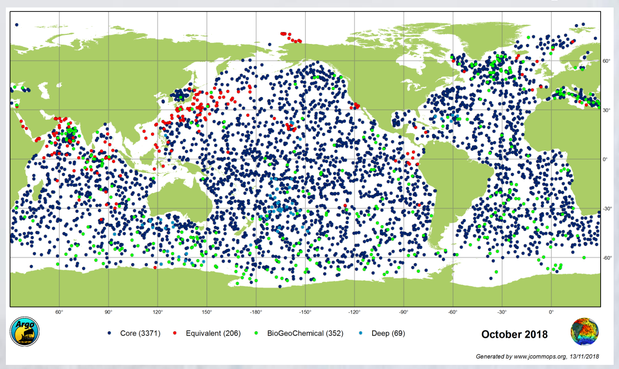
The strategy for Argo floats deployments in Europe

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 European 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 float 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, 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**

Targets in number of operational European floats per region and float type



Argo international operational floats, per float type

Many recent studies have highlighted the crucial contribution of the intermediate, deep and abyssal oceanic layers to the global energy and sea level budgets. Pilot experiments have demonstrated the capability of floats to make **measurements down to 4000m and 6000m depth**.

Sensor development is continuing as well as evaluation of the design of the Deep-Argo array proposed by Johnson et al. (2015). The European strategy for **Deep Argo** is to first focus **on areas where large deep signals are located**, that is where deep-water masses are formed, namely the **North-Atlantic Ocean** and the **Southern Ocean**.

The progressive addition of new bio-optical (oxygen, Chla fluorescence, backscattering, radiometry) and other chemical sensors (nitrate, pH) to the system starts to let **Biogeochemical-Argo** (BGC-Argo) become a reality (Johnson and Claustre, 2016). Euro-Argo aims at **contributing to ¼ of the global effort** (1000 fully equipped BGC-Argo floats with uniform regional distribution), with an additional effort put **on equipping half of the whole European fleet with oxygen** sensors.

Deep and BGC Argo floats deployed by Europe

The **Mediterranean and Black Seas** are strongly affected by human activities and climate change, and defined by variability scales much smaller than the global ocean. The aim is to **double the Argo sampling** in these southern Europe Seas compare to the core-Argo, with cycles of 5 to 10 days and parking depths adapted to the region. Argo activity in the **Baltic Sea** started in 2011 by Finland. The recommendation is to keep **7 active floats at all time**. With its seasonal sea ice cover, the Baltic Sea could serve as a test bed for the development of Argo floats operating in coastal and sea ice environments.

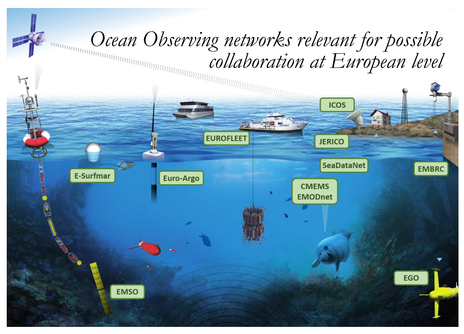
With the ongoing technological developments, a **further extension of the global Argo array in the ice-covered areas** of the Northern high latitudes - including Arctic - is envisioned (at about 5 years) and also coverage of the more severely ice-covered areas in the Nordic Seas (e.g. the East Greenland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

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 today's societal challenges.

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 (CMEMS), EuroGOOS and ROOSes, EMODnet initiative, SeaDataNet network of National Oceanographic Data Centres). However, 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.



Ocean Observing networks relevant for possible collaboration at European level

The **European Ocean Observing System (EOOS)** initiative 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.

Euro-Argo is taking part in this European effort take part and will **contribute to different aspects of EOOS**:

- **Optimization of the observing system design**
  - **Harmonize strategy** with other networks (Vessels, Drifters, Gliders, moorings, Satellite) to better fill the gaps in terms of coverage in time, space and parameters.
- **Collaboration in technology and sensor development**
  - Share knowledge in **common sensors used by various platforms**
- **Coordination in *at sea* operations**
  - Share best practices in terms of pre and post deployment tasks (e.g. **sensors calibration**)
  - Share **deployment opportunities**
- **Coordination in data quality both in Real-Time and Delayed Mode**
  - Share **best practices in terms of data management**
  - Develop **harmonized data distribution means and interfaces** with Operational Oceanography and Research communities
- **Improve the overall network data quality**
  - **Inter-comparison with data** acquired by other platforms
  - Share best practices in data **Quality Control**

Euro-Argo is engaging with 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. This effort of tightening with other observing networks will be enhanced and broaden to other collaborative aspects (as listed above) within the EU H2020 Euro-Argo RISE project starting in 2019. Euro-Argo is also involved in ENVRIplus [2015-2019] and ENVRI-FAIR [2019-2022] H2020 projects which gather all domains of Earth system science (Atmospheric, Marine, Biosphere and Solid Earth) to work together, capitalize the progress made in various disciplines and strengthen interoperability amongst Research Infrastructures and domains. In addition to cross domain activities, these project also contribute to organize the different domains, including the Marine domain.

References

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- Johnson, G. C., J. M. Lyman and S. G. Purkey (2015): Informing Deep Argo Array Design Using Argo and Full-Depth Hydrographic Section Data, JAOT 32, DOI: 10.1175/JTECH-D-15-0139.1