# Integrating profiling floats with extended capabilities in future education and outreach activities

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## General context

The Argo program is a remarkable example of international collaboration to setup a system delivering oceanographic data in real-time. Launched in 1999, one decade later, this program is now mature with more than 3000 floats operationally delivering temperature and salinity data world-ocean wide.

Based on the Argo program, outreach activities have been developed (e.g. SEREAD: Scientific Educational Resources and Experience Associated with the Deployment of Argo profiling floats in the South Pacific Ocean). These activities have been essentially focusing on the "physical ocean" and on climate-related topics.

During the last decade, a variety of miniature sensors have also been developed to obtain key measurements required for a better understanding of the ocean functioning. These sensors begin now to be implemented on a new generation of "multidisciplinary floats" thus allowing to measure biogeochemically-relevant data together with temperature and salinity. Oxygen, nitrate, Chlorophyll or the amount of light penetrating the ocean are the first variables that are going to be obtained by these floats. Sooner or later, pH, partial pressure of $CO_2$ or biomass of zooplankton will be also measured. Floats equipped with passive acoustic sensors are being prototyped to observe seismic waves in marine areas. Such waves traverse deep regions inside the Earth and are instrumental to image temperature variations in the mantle ("seismic tomography"). Only floats allow us to obtain such data over large areas in the southern hemisphere and in the North Atlantic and Pacific oceans.

We are thus entering an era where biological, biogeochemical as well as geophysical properties will be delivered in real-time for many oceanic areas at high temporal resolution and over the long-term. While this will obviously represent a revolutionary step in observational oceanography and geophysics, these new types of observation could also become a keystone for developing new outreach and educational activities.

**Future education and outreach activities**

COSEE will provide a direct link from the science teams to a broad education community (the COSEE NOW network currently has 291 registered users). COSEE NOW will benefit from using floats to expand COSEE NOW users and by entraining a larger base spanning the international community. Finally, the COSEE network and its community-based approach could take advantage from this new generation of floats and their characteristics, described hereafter.

- Real-time: This is particularly interesting to develop “reactive” and attractive web-based outreach contents.
- Exploration: Floats can be deployed in remote (e.g. central zones of the ocean) and harsh areas (e.g. North Atlantic Ocean in winter) where ships cannot sustain observations. Therefore exciting data measurements and totally new datasets for science and outreach are and will be available.
- Float arrays: “multidisciplinary floats” as part of arrays allow addressing scientific questions at various scales.
    - Global perspective. Research on global-change related hot-issues, like ocean desoxygenation and acidification, will take benefit from such types of measurements. These will contribute to the already existing outreach activities.
    - Regional perspective. Fundamental principles and concepts related to marine life in specific oceanic regions (e.g. the phytoplankton bloom in temperate areas) may be more easily outreached.
- Floats and basic concepts: Before addressing complex issues like climate change, students need to well understand the fundamental concepts in oceanography (e.g. stratification and mixing, seasonality of surface temperature and salinity and the relationship between $O_2$ at the surface, the atmosphere and primary productivity). Floats are great tools as students can compare and contrast profiles from different places and/or seasons.
- Floats and satellites: Float data together with satellite ocean color such as Giovanni (by Goddard Earth Sciences and Data and Information Services Center) data will be combined to provide a 3D/4D view of the global ocean for the first time, which can be adapted to become an attractive Web-based outreach support.
- “Adopt a float”: Originally initialized by SEREAD, the concept can be further developed to become even more attractive thanks to the diversity of topics that will be addressed. One can even think of a float that is simultaneously “co-adopted” by classes of different countries allowing exchanges between them to be developed.