How to get involved in ESO

An open meeting is being organized at the forthcoming AGU Meeting in San Francisco, on

Wednesday December 14, 16:00 in the MOMA Room, Zelos Hotel (former Palomar), 12 Fourth Street, Union Square, San Francisco. Please see the agenda for discussion below.

If you are not attending this meeting but wish to be (or remain) involved, please send an email to Guust Nolet (nolet@princeton.edu).

More information

Please contact any of the organizers of the Meeting if you need more information or if you cannot attend but wish to make your opinion heard:

Yongshun (John) Chen, johnyc@SUSTC.edu.cn
Guust Nolet, nolet@princeton.edu
Frederik Simons, fjsimons@princeton.edu
Karin Sigloch, karin.sigloch@earth.ox.ac.uk

For technical questions regarding Mermaids contact:

Yann Hello, yann.hello@geoazur.unice.fr

Agenda for the discussion at AGU (Wed Dec 14, 16:00, Zelos Hotel)

1. Introduction and welcome (Nolet)
2. The role of SUSTC in the launching of EarthScope-Oceans (Chen)
3. Discussion among all participants.
4. Formation of an EarthScope-Oceans international steering committee.

Mermaid presentations at AGU

S11D-2488 Y. Hello, et al., Mermaid floating seismometer: A versatile Oceanographic profiler dedicated to the Earthscope Ocean Program. Monday, 12 December 2016 08:00 - 12:20 Moscone South - Poster Hall

S11D-2495 J. Simon, et al., Global Seismology by Autonomous Mid-Column Oceanic Floats: A Quality Assessment of Four Years of MERMAID Data. Monday, 12 December 2016 08:00 - 12:20 Moscone South - Poster Hall

D22C-02 G. Nolet, et al., Seismometry in the Oceans: First Observations from an Array of Mermaids near Galapagos. Tuesday, 13 December 2016 13:55 - 14:10 Moscone South - 303

S31D-07 Y. Chen and G. Nolet, A complete tomography of the Earth’s interior with floating seismometers in the oceans: the EarthScope-Oceans. Wednesday, 14 December 2016 09:30 - 09:45 Moscone South - 305 years.

EarthScope-Oceans

The oceans cover 2/3 of the Earth’s surface and play an important role in maintaining the health of the Earth’s biosphere, but exploring this role systematically meets with many practical problems. The exploration of deeper regions is even more difficult. Floating sensors that communicate by satellite have proven their worth in the Argo project that explores ocean temperature and salinity worldwide. EarthScope-Oceans extends this to other domains. The Mermaid float is designed to observe and transmit data from seismic, electromagnetic and acoustic activity, in addition to chemical measurements. As the project develops, it will eventually be able to accommodate any type of sensor.

Who are we?

Originally designed by researchers in the US at Princeton and UCSD/Scripps, the latest version of the Mermaid has been developed by Geoazur (University of Nice), with financing from the European Research Council (ERC) and is built by Oséan, both in the south of France. Continued development towards a user-programmable instrument is done by i3s and Geoazur. SUSTC in Shenzhen (China) is leading international efforts to launch the first instruments in a worldwide, international network, EarthScope-Oceans, of at least 1000 sensors.

Current Mermaid technology and further development

The current spherical version of the Mermaid float is designed to remain operational for six years with a full battery load. It is equipped with a hydrophone, depth sensor, thermometer and, optionally, a CTD sensor to measure salinity. Two-way communication via Iridium allows for the Mermaid scientists to change observational directives, or to let it remain at the surface towards the end of its lifetime and be picked up by ships of opportunity. The hardware already allows for the accommodation of more and different sensors, and we expect to have a fully programmable version ready by 2019 that can serve biologists, geochemists, oceanographers, meteorologists as well as geophysicists.
Geoazur is currently running an experiment near Galapagos with 9 first generation (cylindrical) Mermaids, which have so far yielded more than five hundred useful seismograms (in two years, three have not yet run out of battery power). The experience with these prototypes has led to the development of the current (spherical) generation Mermaids, capable to function three times as long with today's battery technology, and recording data in a buffer such that events can still be requested by the user if the trigger missed them. The figure shows the data coverage obtained after 18 months.

EarthScope Oceans (ESO)

Formerly called MariScope, ESO is a group of geoscientists interested in creating a global network of sensors to monitor the oceanic environment. A first informal discussion meeting, hosted by IRIS, was held at the AGU Fall Meeting in San Francisco, 2013. The group intends to coordinate national projects and provides a forum where the characteristics of a future ESO data center can be discussed. As Mermaid technology develops, ESO is expected to quickly become multidisciplinary and comprise biologists, geochemists, meteorologists, oceanographers and others.

ESO’s potential

The current Mermaid records temperature, salinity (optional), and acoustic seismograms and rises to the surface whenever a strong seismic signal is observed. It locates itself by GPS and transmits data (typically 100 Kb/surfacing) via the Iridium satellite system. The future multidisciplinary version will be programmable and able to handle sensors for geochemistry, a high-frequency hydrophone to detect the presence of whales and dolphins, to monitor acoustic noise levels, or even to estimate rainfall at the surface, a magnetometer, a pinger, or any other instrument that has a low enough power consumption that the lifetime of the batteries (6 years for a typical user) is not seriously affected.

A simulation of the ray coverage for seismic tomography at three depths, as expected for five years of data, from land stations reporting to the International Seismological Center (left), or with 300 (center) or 1000 Mermaids (right column). Top: red dots are stations/Mermaid locations, green dots observable earthquakes. Below: a logarithmic colour scale indicates ray coverage (from dark blue zero to red for highest coverage). From Sukhovich et al., Nature Comm., 2015.

Coverage of rays for seismic tomography after 9 mermaids operated for 18 months near the Galapagos Islands.