JERICO

Application for Transnational Access

to Coastal Observatories

National Research Council of Italy
OGS
CNRS
IBW PAN
hcmr
NIVA
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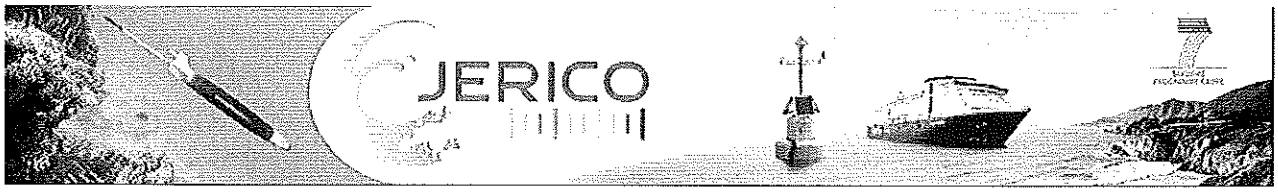
Helmholtz-Zentrum Geesthacht
CSIC
National Oceanography Centre



Description of the project

PART 1: User group details

Indicate if the proposal is submitted by

O an individual
X a user group

Information about the applicants (PI and project partners)

Principal Investigator (user group leader)

Title _ **Mr.** __ Name and Surname _____ **Roberto BOZZANO** _____

Gender **X** Male O Female

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Project partners
(repeat for each partner of the group)

Partner # 1

Title _ **Mrs.** __ Name and Surname ___ **Sara PENSIERI** _____

Gender O Male **X** Female

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PART 2: Additional information about the applicant(s) expertise

Expertise of the group in the domain of the application

The proposing Institute for Studying Intelligent Automation Systems (ISSIA), part of the National Research Council (CNR) of Italy, is active in the instrument and methodology sector focused on the study of the marine environment. It has a significant experience in **innovative technologies for the marine environment**, the development of suitable **monitoring methods**, and the integration of measuring equipment and processing systems.

CNR-ISSIA develops, manages and operates buoys and platforms (manned and unmanned) for the monitoring of the marine environment, accesses instrumented research vessels for dedicated oceanographic cruises and also develops technologies and instrumentation for marine research.

In particular, since 1991, it manages the large spar buoy "**ODAS Italia 1**" (**W1-M3A**) moored at the centre of the Ligurian sea, 80 Km southwards from Genoa on a 1200 m deep sea bottom: it is conceived as a measuring platform in the open sea fully equipped for measuring both meteorological and marine chemical-physical parameters in the surface layer. The buoy was involved in several CNR projects in the past and, after a partial refit during 2001, it is actually used for developing and testing meteorological and marine equipment. The buoy is currently configured as an off-shore observing system with a surface buoy and a subsurface mooring line. On the surface buoy, an acquisition and control system has been developed for processing acquired measurements onboard and transferring data in near real time ashore.

In recent years, CNR-ISSIA has confirmed its leading role in many national and international research projects for the development of activities within the marine-maritime sector.

Some of these projects are cited below:

- **MyOCEAN** (2009-2012) aimed at designing and developing a monitoring and forecasting service of the ocean at a regional and global scale in order to safely and effectively managing the marine resources.
- **EUROSITES** (2008-2011) was the European component of the global ocean observing system called OceanSITES. It aimed at integrating and enhancing the existing European open-ocean observational capacity to encompass the ocean interior, seafloor and sub-seafloor.
- Marine Environment and Security for the European Area (**MERSEA**, 2004-2008) aimed at developing an operational monitoring and forecasting capability of the ocean physics, biophysics and evolution at an European and global scale.
- Mediterranean Forecasting System: Toward Environmental Predictions (**MFSTEP**, 2003-2006) contributed to the development and the enhancement of a forecasting system at the Mediterranean scale.
- MEteo-tide Newtonian FORecasting (**MENFOR**, 2006) developed an innovative system based on gravitational metrology for the forecasting of the meteorological tides.

CNR-ISSIA is actually involved into the European project **PERSEUS** (2012-2015) and **MyOCEAN2** (2012-2016). The PERSUES project aims at identifying the interacting patterns of natural and human-derived pressures on the Mediterranean and Black Seas, assessing their impact of marine ecosystems and designing an effective and innovative research governance based on the achieved scientific knowledge.

MyOCEAN2 is the prosecution of the MyOCEAN aiming at defining and setting up a concerted and integrated pan European capacity for ocean monitoring and forecasting as a GMES Marine Core Service.

CNR-ISSIA is also a member of the Mediterranean Operational Oceanography Network (MOON) and the Italian National Operational Oceanographic Group (GNOO).

Short CV of the PI

R. Bozzano is a researcher with more than 15 years of experience in the field of marine technology.

Since 2000, he is in charge of the development and the management of the large monitoring facilities based on the spar buoy ODAS Italia 1, constituting the so-called W1-M3A off-shore observing system.

His expertise originally focused on signal and image processing turned also to underwater acoustics, marine technology, and oceanography.

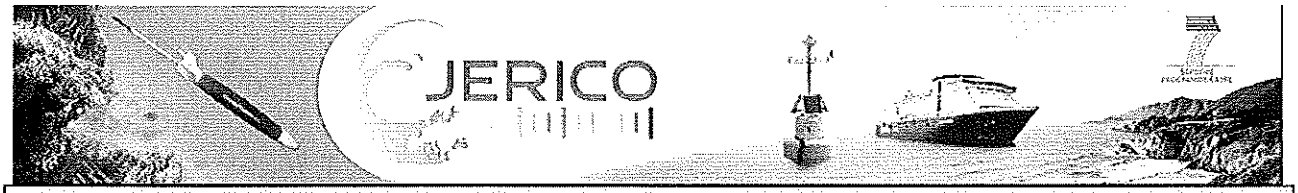
He was involved in several EU-funded research projects (i.e., MFSTEP, MERSEA, MyOCEAN, EuroSITES) and he is currently the CNR-ISSIA scientific responsible in the PERSEUS and MyOCEAN2 European projects.

In the mentioned projects, he was involved in several tasks related to the upgrade and increasing of the monitoring capability of the W1-M3A observatory especially in terms of innovative bio-geochemical sensors and to the further development of monitoring systems useful for the operational oceanography purposes.

He is the national point of contact in charge of the Data Buoy Cooperation Panel of the World Meteorological Organization and he is a member of the Steering Scientific Committee of the National Group for Operational Oceanography.

A list of 5 recent, relevant publications of the participant(s) in the field of the project

- S. Pensieri, R. Bozzano, M.E. Schiano, S. Sparnocchia, "Studies on the Interaction of the Ocean Upper Layer with the Atmosphere in the Mediterranean Sea Using the CNR-ODAS Italia1 Buoy and the R-V Urania", National Research Council of Italy - Department of Earth and Environment, Marine Research at CNR, E. Brugnoli, G. Cavarretta, S. Mazzola, F. Trincardi, M. Ravaioli, R. Santoleri Eds., Volume DTA/06-2011, Novembre 2011, ISSN: 2239-5172, pp. 1551-1560.
- S. Pensieri, R. Bozzano, M.E. Schiano, E. Canepa, S. Sparnocchia, P. Picco, "An Integrated Marine Observing System in the Ligurian Sea", National Research Council of Italy - Department of Earth and Environment, Marine Research at CNR, E. Brugnoli, G. Cavarretta, S. Mazzola, F. Trincardi, M. Ravaioli, R. Santoleri Eds., Volume DTA/06-2011, Novembre 2011, ISSN: 2239-5172, pp. 2287-2999.
- P. Picco, A. Cappelletti, S. Sparnocchia, M.E. Schiano, S. Pensieri, and R. Bozzano, "Upper layer current variability in the Central Ligurian Sea," Ocean Sci., 6, 825-836, doi:10.5194/os-6-825-2010, 2010.
- M. Tonani, N. Pinardi, C. Fratianni, J. Pistoia, S. Dobricic, S. Pensieri, M. de Alfonso, and K. Nittis, "Mediterranean Forecasting System: forecast and analysis assessment through skill scores, Ocean Science, 5, 649–660, 2009.
- K. Nittis, C. Tziavos, R. Bozzano, V. Cardin, Y. Thanos, G. Petihakis, M.E. Schiano, F. Zanon, "The M3A multi-sensor buoy network of the Mediterranean Sea," Ocean Science, Vol. 3, 229-243, 2007.



PART 3: Detailed scientific description of the project

List the main objectives of the proposed research

The proposed project addresses the main scope of performing a calibration and inter-calibration exercise of bio-geochemical sensors to be operationally and routinely deployed on off-shore marine observatories making part on a continuous basis of the marine monitoring network of the Mediterranean Sea.

In particular, the first objective consists in enhancing the accuracy of the in-situ observations on a long term basis of dissolved oxygen, chlorophyll-a and turbidity in the Ligurian basin collected by a multiparametric probes installed on the W1-M3A offshore observing system. This observatory is constituted by the only spar buoy in the Mediterranean Sea called ODAS Italia 1 and by a close subsurface mooring and it has the capability to monitor meteorological condition, as well as physical and biogeochemical properties of the ocean also with rough sea and bad weather for long-term analysis.

The opportunity to install on this platform carefully calibrated probes not only for acquiring temperature ad conductivity data, nowadays quite common, but also for collecting ocean colour, on one hand could improve the knowledge about the biogeochemical processes in the upper thermocline and on the other hand could support with real-time quality controlled observations the developing biogeochemical forecast models for both the phases of assimilation and calibration/validation.

The need for a precise and geographically-consistent calibration is especially true for what concern the chlorophyll-a measurements, since the original calibration factors are usually representative of a specific phytoplankton culture (such as the *Thalassiosira weissflogii* for the Wet-Lab instruments) that often is not typical of the basin in which the instruments have to be deployed or is present in very low concentration.

Furthermore, the W1-M3A observatory, together with the E1-M3A buoy moored in the south Aegean Sea and the E2-M3A buoy positioned in the South Adriatic, is part of the M3A network, developed within the framework of the MFSTEP project in order to answer to the needs of the Mediterranean Forecasting System of real-time physical and biogeochemical observations of the upper thermocline. After the end of the MFSTEP, the network took an important role also in MERSEA project and more recently in the EuroSITES initiative aiming at create a fully integrated system of deep ocean observatories. In this perspective, it is extremely important by the scientific point of view to give continuity to the work done and to pursue in the sensors intercalibration between the M3A sites, that represents the second objective of this proposal.

Indeed, the possibility to use sensors calibrated with the same procedures installed on the different sites belonging to the M3A network makes feasible a comparison between the involved sites thanks to an homogenous database in order to verify at a quantitative level the observed differences and to enhance the quality of the in-situ observations.

A further aim consists in the exchange of expertise for the configuration of instruments to be deployed in oceanic observatories with respect to the most valuable and efficient anti-fouling techniques.

Moreover, the proposed research will contribute to the improvement of overall quality of the Mediterranean Sea observations by sharing the collected calibrated in-situ data from the W1-M3A observing system through several data centers, such as Coriolis (IFREMER, France) and the In-Situ Thematic Assembly Center of the MyOCEAN GMES Core Marine Service managed by the Hellenic Centre for Marine Research.

Give a brief description of the scientific background and rationale of your project

Long term in-situ monitoring of bio-geo-chemical properties of the ocean is challenging, not only due to marine environmental condition that often are consistent with remote sites, corrosion issues and biologically active basins, but also due to the instruments accuracy and precision needed to obtain useful data for processes analysis as well as for assimilation into models (Claustre et al., 2009). Indeed, the complexity of the ocean seawater comprehensive of several chemical compounds makes difficult to use measurements techniques very common in laboratory (Mowlem et al., 2008).

Nonetheless, the growing interest in the knowledge of ocean interior (Cronin et al., 2012) together with the increasing sophistication of autonomous analyzers promote the investigation of processes such as oxygen consumption, primary productivity and ocean acidity that have not been possible to be autonomously measured in the past.

Apart from their undoubted scientific relevance (for process analysis as well as for modeling requirements) some biogeochemical variables can be nowadays measured through non-intrusive and automatic, partially miniaturized, low-power, in-situ sensors (Nittis et al., 2007). The variability of these processes due to geographical position, seasonal behaviour and concentrations, that sometimes are very low, requires a close attention to the maintenance procedures of the used instrumentations, especially in terms of calibration.

This proposal focus its attention on three of the most significant parameters related to the ocean status of health: dissolved oxygen, fluorescence and turbidity. In particular, the proposed work aims at validating and cross-validating several sensors to be operationally used in off-shore and deep ocean observatories.

The amount of dissolved oxygen is a measure of the biological activity of the water masses (Joss et al., 2003). Phytoplankton and macroalgae present in the water mass produce oxygen by way of photosynthesis. Bacteria and eukaryotic organisms (zooplankton, algae, fish) consume this oxygen through cellular respiration. The result of these two processes determines the concentration of dissolved oxygen, which in turn indicates the production of biomass.

The use of fluorometers for long term deployments is widespread by providing useful information on growth rates of phytoplankton communities. Subsurface chlorophyll measurements can give additional information to satellites, especially in detecting deep chlorophyll maxima. Nonetheless, the practice of such sensors to estimate chlorophyll concentration for long term deployments is extremely inaccurate unless precise calibrations are made using chlorophyll extraction to account for site-specific species and the changes in environment, or phytoplankton community taxonomy, or physiology.

Turbidity can be quantified by the measurement of the backscattering coefficient (backscattering-meter) and jointly with transparency estimation made with transmissometer can lead to an estimation of the concentration of Particulate Organic Carbon (POC).

From this brief description, it is evident how the mentioned three parameters have a strong scientific relevance and being measurable with relatively innovative technology are the most important "bio" variables on which the implementation of ocean observation systems must rely on.

Claustre, H., Antoine, D., Boehme, L., Boss, E., D'Ortenzio, F., Fanton, D'Andon, O., Guinet, C., Gruber, N., Handegard, N.O., Hood, M., Johnson, K., Körtzinger, A., Lampitt, R., LeTraon, P.Y., Lequéré, C., Lewis, M., Perry, M.J., Platt, T., Roemmich, D., Sathyendranath, S., Send, U., Testor, P., Yoder, J., 2009. Guidelines towards an integrated ocean observation system for ecosystems and biogeochemical cycles. Proc. Of OceanObs'09: sustained ocean observations and information for society, J. Hall, D.E. Harrison, and D. Stammer (Eds.).

Cronin, M.F., Weller, R.A., Lampitt, R.S., Send, U., 2012. Ocean reference stations. In Earth Observation, R.B. Rustamov and S.E. Salahova (eds.), InTech, ISBN: 978-953-307-973-8.

Joos, F., Plattner, G.K., Stocker,T.F., Körtzinger, A., Wallace D.W.R., 2003. Trends in Marine Dissolved Oxygen: Implications for Ocean Circulation Changes and the Carbon Budget. EOS, Transactions, American Geophysical Union, 84(21), 197-201.

Nittis,K., Tziavos, C., Bozzano, R., Cardin, V., Thanos, Y., Petihakis, G., Schiano, M.E., Zanon, F., 2007. The M3A multi-sensor buoy network of the Mediterranean Sea. Ocean Science, 3, 229-243.

Mowlem, M., Hartman, S., Harrison, S., Larkin, K., 2008. Intercomparison of biogeochemical sensors at ocean observatories. Research & Consultancy Report No. 44, EurOceans 2008.

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Present the proposed experimental method and working plan

The proposed experimental method is based on analytical laboratory techniques to assess known concentrations of the parameters to be measured by the tested sensors.

For the calibration of the dissolved oxygen sensors samples are collected during the experiment and analyzed later using the Winkler methodology. Regarding the fluorometer and turbidity sensor, they are calibrated against known concentrations and particles dimensions of reference solutions.

Two separate experimental sessions will be carried out, one for dissolved oxygen sensors and the other for turbidity and fluorescence sensors.

Dissolved oxygen

Dissolved oxygen calibration will be performed for one SBE43 sensor cross-checked with an electronic calibrated probed and with Winkler titrated water samples.

The SBE43 sensor is a polarographic membrane oxygen sensor, an upgraded Clark cell, redesigned and optimized to reduce drift and hysteresis. SBE43 is an in-line sensor usually plumbed in to the CTD pump and Y-valve flow-thru system and lies down stream of the CT-cell. The sensor provides dissolved oxygen (DO) concentrations in milliliters per liter and % saturation.

This sensor has an analogue output voltage signal proportional to the temperature-compensated current flow occurring when oxygen is reacted inside the membrane. The detected voltage is converted into the oxygen concentration by using a modified version of the algorithm by Owens and Millard (1985).

The method for calibrating the sensor consists in increasing and reducing the oxygen concentration in a volume of water. The tank water must be bubbled with air (usually at a depth <10 cm to prevent super-saturation) and mixed thoroughly for several hours prior to calibration. For low concentrations, the bubbler has to be turned off thus some of the dissolved oxygen content of the tank water is lost to the atmosphere and the DO % saturation of the tank drops after some hours. A fast drop of the dissolved oxygen saturation can be achieved by bubbling the tank with nitrogen gas.

Water samples has to be collected to perform Winkler titration.

Fluorescence

Fluorescence calibration will be performed for one WetLabs ECO-FLNTUS sensor, two other optical units developed by an Italian SME and cross-checked with an electronic calibrated probed and with measured concentrations extracted from water samples.

The WetLabs ECO FLNTU fluorometer and turbidity sensor detects inferred chlorophyll-a (theoretical range of 0.04-50 µgL-1) from fluorescence at a wavelength of 470 nm provided as an output voltage. The voltage is then converted to a fluorescence value (as µg L-1 chlorophyll-a) using a factory determined scale factor determined from a Dark Count and a Chlorophyll Equivalent Concentration (CEC). The CEC may be obtained from an equivalent unit voltage when the sensor was exposed to a 25µg L-1 culture of *Thalassiosira weisflogii*. However, this procedure originally used by the manufacturer should be replaced by in-vivo cultures of site-specific species and with concentration much lower with respect to the original ones.

For chlorophyll-a concentration determination, the working plan consists in progressive dilution of a known concentration that has to be consistent with the most common species present in the Mediterranean Sea.

Turbidity

For turbidity, the sensor detects back-scatter across an inferred range of 0-25 NTU at a wavelength of 700 nm. Calibration constants are used to convert the voltage to an equivalent Nephelometric Turbidity Unit (NTU) using a scale factor calculated from a Dark Count AND a known FORMAZIN concentration standard. However, FORMAZIN is a hazardous substance and its handling should be treated with caution (MSDS health-hazard rating of 2). Thus, it is proposed to employ other calibration standards available on the market, such as AMCO Clear.

Indicate the type of access applied for

O remote	*(the measuring system is implemented by the operator of the installation and the presence of the user group is not required)*
O partially remote	*(the presence of the user group is required at some stage e.g. installing and un-installing)*
X in person/hands on	*(the presence of the user group is required/recommended during the whole access period)*

Indicate the proposed time schedule including expected duration of access time

The requested access time is 5 days. This duration is thought to be sufficient to set-up the laboratory and to prepare the instruments for the measurements.

In particular, the following schedule is proposed:

- Day 1:laboratory and equipment preparation.
- Day 2: laboratory work for dissolved oxygen.
- Day 3: laboratory work for turbidity and fluorescence.
- Day 4: sample analysis for all the parameters.
- Day 5: result evaluation, discussion, draft report preparation to be submitted to host institution.

Two different periods for accessing the facility should be preferable.

The first period (September 17th - October 6th, 2012) might allow us to use/deploy calibrated sensors at the observatory during the cruise scheduled from October 15th-23rd, 2012 thus providing an immediate and practical outcome to the proposed project.

Other periods by the end of the year should allow the requesting team to use and deploy the calibrated instruments before the spring bloom in 2013.

Host infrastructure

Indicate the type(s) of JERICO host facility(s) you are interested in
(Tick more than one if it is useful for your project)

O ferrybox O fixed platform O glider **X** calibration laboratory

Indicate the specific JERICO host facility(ies) you wish to choose

The "POSEIDON CAL" host facility is selected.

Explain briefly why you think your project will be best carried out at the specified host facility(ies)

The "POSEIDON CAL" facility holds a unique experience in testing, evaluating, and calibrating oceanographic sensors for temperature, conductivity, oxygen, chlorophyll-a and turbidity to be used in oceanic observing systems.

These skills have been also achieved during the participation of European projects such as MFSTEP, MERSEA, EuroSITES as well as in national funded initiative such as POSEIDON.

The proposed project is based on past links established during the mentioned projects and this opportunity will allow CNR and HCMR to sustain their scientific cooperation and to further contribute to develop, upgrade and integrate their ocean monitoring systems in a more coherent way in the framework of the M3A network.

If possible, list other JERICO facility(ies) where you think your experiment could alternatively be carried out

Apart from the temperature and conductivity calibration facilities "OGS-CTO" and "MPL CAL6" no other facilities are available in JERICO with oxygen, chlorophyll-a and turbidity calibration capabilities.

Additional information

Is there a facility similar to the one you wish to utilize in your country?

O Yes X No

If yes, please indicate your reasons for requesting access to the JERICO facility you have chosen

Have you already submitted an Access Proposal to any of the participating facilities under this or previous EU Programs?

O Yes X No

If yes, please indicate the name of the institution, submission date and reference number for each such proposal

Is this a resubmission of a previously rejected proposal? *(Select "yes" if this application is a revised version of a proposal submitted to JERICO before that was rejected by the Selection Panel)*

O Yes X No

If yes, please give the exact reference number and submission date. Kindly describe briefly the changes made in comparison to the rejected version.

Is this a continuation of an earlier project funded under a previous call for Transnational Access in JERICO at the same facility?

O Yes X No

If yes, please give the exact reference number and submission date. Kindly indicate also what has been achieved in the previous experiment and the reasons why the objectives have not been fully met.

PART 4: Technical information

Wherever possible, please specify your requests regarding the use of your chosen facility's equipment/instruments/sensors, including any additional services, data or other requirements.

The "POSEIDON CAL" facility is a fully-equipped laboratory for performing the proposed project.

Calibration standards (i.e., water samples with known concentrations of oxygen, chlorophyll-a and turbidity) should be prepared during the project. The preparation of initial chlorophyll-a culture should be likely initiated some days before the start of the project.

The proposers can supply turbidity standards, if necessary.

Some power supplies devices might be used to power up the instruments.

List all material/equipment you plan to bring to the JERICO facility (if any):

The following equipment will be shipped to the selected facilities:

- 1 dissolved oxygen sensor (SBE43) from Sea-Bird Electronics, Inc. (USA) and related spare parts.
- 1 turbidity/fluorescence sensor (ECO-FLNTUS) from WETLabs (USA) and related spare parts.
- 2 fibre-optics fluorescence sensors from Idromar Srl. (Italy) and related spare parts.
- 1 portable multiparameter water quality meter (HI9828) from Hanna Instruments (USA) and related spare parts.

All the mentioned material will be shipped in a proper case for scientific instrument handling.

Please provide a detailed and realistic budget for the expenses you expect to incur for travel/boarding and the shipment of equipment, if applicable in your case *(note that a maximum of two travel grants will be assigned to each user group, depending on the length of the requested period of stay).*

It is requested that two researchers can access the calibration facility. However, one of them can be self-funded by CNR-ISSIA.

For each researcher, the following costs should be taken into account:

- Travel: € 150,00
- Lodging: €120,00/day x 7 days (5 working days + 2 days for travel) = € 840,00

The total expenses, for two researchers, will amount to (150,00+840,00) x 2 = € 1.980,00.

Shipment of the equipment (two ways) should be valued to € 900,00

As a consequence, a total budget of € 2.880,00 should be sufficient to perform the described project.

Please tick the appropriate boxes and give detailed information for the kind of risks associated with your proposed activity

☐ Chemical :
☐ Biological :
☐ Radiological :
☐ Other :

It is expected not to have any particular risk to face during the performing of the proposed project.

A generic care should be used working in a bio-chemical laboratory. Host safety regulation will be followed during the hosting.

Since FORMAZIN will not be used as standards for the turbidity calibration, no dangerous material will be treated by the involved personnel.

Date of compilation April 2nd, 2012

Signature of the PI

[Roberto Bozzano]

Signature of an appropriate authorised person
(e.g. Head of Department, Research Office)

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[on behalf of Dr. A. Distante, director of CNR-ISSIA]

This section reserved to the JERICO TNA Office

Date of proposal receipt by email _____

Assigned reference number _____

Signature of receiving officer _____

National Research Council of Italy

Ifremer

Helmholtz-Zentrum Geesthacht

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National Oceanography Centre