PHD #2

Use of marine drone (USV) for a better characterization of coastal ocean processes and validation of SWOT observation

This 3 years PhD position will take place at LIENSs laboratory in La Rochelle, France (https://lienss.univ-larochelle.fr). LIENSs is an Interdisciplinary Joint Research Unit (UMR 7266 La Rochelle University and CNRS). It integrates expertise in many scientific fields across environmental sciences and social sciences to address issues on the **sustainable development of the littoral zone**. Part of its research activities focuses on the functioning of the coastal ocean and its response to climate change. LIENSs presently hosts 80 researchers, 29 permanent engineers and technicians, 24 post-doctoral researchers and invited researchers, and 40 PhD students. The PhD student will be host by the Ocean Coastal Dynamic team of the LIENSs where he/she will interact with a group of scientist's experts in the sea level analysis and observation, satellite geodesy and marine geodesy, high resolution numerical modeling of the coastal ocean.

Subject:

Part of the coastal dynamics, and in particular the part governing the transfer of elements (pollutants, nutrients, sediments ...) is very poorly known in coastal areas and yet this dynamic plays a major role in the evolution of ecosystems and coastal morphology (erosion processes, siltation, etc...). On December 16, the SWOT (Surface Water Ocean Topography) satellite was launched into orbit from the American base of Vandenberg (https://swot.cnes.fr/fr). This satellite will observe the water on the Earth's surface with a definition improved by a factor of 10 compared to previous altimetry missions. This mission, which follows a series of conventional altimetry missions (Topex/Poseidon and Jason), is dedicated to both continental hydrology, offshore and coastal oceanography. This is made possible by a technological breakthrough related to a new instrument: a wide-swath interferometric radar. The satellite will observe the topography of the oceans and surface waters on both sides of its trajectory on bands of 50 km wide. For the first time, this new instrument will provide near-global observations of offshore and coastal ocean water masses with a resolution never reached before. The "coastal" products will be distributed with a pixel resolution of 250 m. This mission will also allow for the first time to monitor more than 95% of terrestrial water reservoirs by providing height, width, slope and flow information on rivers over 100 m wide and on almost all lakes. This mission will provide a better understanding of fine-scale ocean dynamics and will allow a global monitoring of the water cycle on Earth. The SWOT mission will start with a 1-day phase repetitive orbit on a reduced number of tracks in order to allow the validation and interpretation of this new type of data.

The core of the PhD student's work will be to use the PAMELi marine drone developed at LIENSs (https://pameli.recherche.univ-lr.fr/) in order to design and conduct field campaigns to map the 2D Sea Surface Height of the coastal ocean for multipurpose application: in situ validation of the new SWOT observations on the coastal zone and river mouth, cartography of the marine geoid at the coast and validation of numerical ocean simulations. The student will capitalize on the @sea campaign programming tools optimized for Unmanned Surface Vehicles which have also allowed for a better characterization of tidal model errors in the macro-tidal zone of the Charentais Pertuis (Tranchant et al., 2021). The student will also have the opportunity to develop with the LIENSs technical team a participatory science project aiming at equipping sailboats or tourism ships with low-cost sea level measurement means.

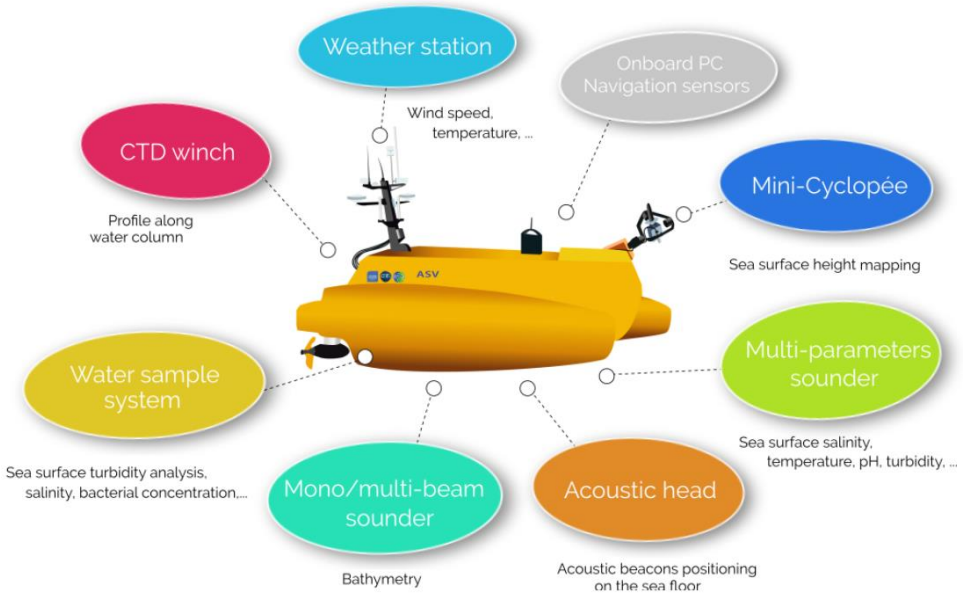

Figure 1: Panel of sensors to be mounted onboard the drone

The two supervisors of this thesis (Laurent Testut and Valérie Ballu) have been working for many years with conventional altimetry data, which they have applied to topics as varied as the study of ocean tides (Testut et al., 2016), the validation of coastal hydrodynamic models (Testut et al., 2012), long-term variations in sea level (Testut et al., 2016) or marine geodesy (Ballu et al., 2013). Over time, we have built at LIENSs a solid experience in satellite-based altimetry, which we have developed in recent years to the coastal regions of the Pertuis Charentais and New Caledonia. The proposed thesis will be in the continuity of the of two previous PhD students : Tranchant Yann-Treden (2018-2022) and Chupin Clémence (2018-2022) who have developed innovative research based on the use of the USV PAMELi, GNSS buoys and the development of digital tools (kinematic GNSS data processing chain, high resolution numerical modeling of the Pertuis, Python toolbox…) which now allow us to better understand the physics of the radar measurement and its behavior in coastal areas (role of foreshores in the radar footprint, improvement of geophysical corrections using wave models or GNSS data, ...) (Chupin et al., 2020, Tranchant et al., 2021).

The salary will be aligned with the CNRS PhD funding (~2100 € Brut /Year)

How to apply:

Your application files must include :

- a curriculum vitae
- a covering letter
- reference letters (optional)
- an academic transcript (Bachelor + Master 1 and first semester Master 2 if available)
- a copy of the last scientific report (article, Master 1 report, python notebook)

Deadline for submitting your files is before 2 of June 2023

All the documents should be included in zip file YOURNAME.zip and sent to :

laurent.testut@univ-lr.fr, valerie.ballu@univ-lr.fr

via email or filesender system if zip file is too large

Required knowledge and skills

- Master in Geoscience with background in geodesy.
- Aptitude and interest for data analysis, instrumentation, field trip … and programming
- Strong programming skills in Python (numpy, pandas, xarray, …) and good background in statistics

Références :

Ballu, V., P. Bonnefond, S. Calmant, M. -N. Bouin, B. Pelletier, O. Laurain, W. C. Crawford, C. Baillard, et O. de Viron. 2013. « Using Altimetry and Seafloor Pressure Data to Estimate Vertical Deformation Offshore: Vanuatu Case Study ». *Advances in Space Research, Satellite Altimetry Calibration and Deformation Monitoring using GNSS*, 51 (8): 1335-51. https://doi.org/10.1016/j.asr.2012.06.009.

Chupin, Clémence, Valérie Ballu, Laurent Testut, Yann-Treden Tranchant, Michel Calzas, Etienne Poirier, Thibault Coulombier, Olivier Laurain, Pascal Bonnefond, et Team FOAM Project. 2020. « Mapping Sea Surface Height Using New Concepts of Kinematic GNSS Instruments ». *Remote Sensing 12 (16).* https://doi.org/10.3390/rs12162656.

Chupin, Clémence, Valérie Ballu, Laurent Testut, Yann-Treden Tranchant, et Jérôme Aucan. 2022. « Noumea: A New Multi-Mission Cal/Val Site for Past and Future Altimetry Missions? » EGUsphere, juillet, 1-37. https://doi.org/10.5194/egusphere-2022-514.

Testut, L., F. Birol, et C. Delebecque. 2012. « Regional Tidal Modeling and Evaluation of Jason-2 Tidal Geophysical Correction ». *Marine Geodesy 35 (SUPPL. 1)*: 299-313. https://doi.org/10.1080/01490419.2012.718642.

Testut, L., V. Duvat, V. Ballu, R.M.S. Fernandes, F. Pouget, C. Salmon, et J. Dyment. 2016. « Shoreline changes in a rising sea level context: The example of Grande Glorieuse, Scattered Islands, Western Indian Ocean ». *Acta Oecologica 72: 110-19*. https://doi.org/10.1016/j.actao.2015.10.002.

Testut, L., et A.S. Unnikrishnan. 2016. « Improving modeling of tides on the continental shelf off the west coast of India ». *Journal of Coastal Research 32 (1):* 105-15. https://doi.org/10.2112/JCOASTRES-D-14-00019.1.

Tranchant, Yann-Treden, Clémence Chupin, Laurent Testut, et Valérie Ballu. 2021. « Assessing Tide Correction under Altimetry Tracks: An Innovative Validation Methodology Using USV (Unmanned Surface Vehicle) in-Situ Measurements ». *EGU21-16339. Copernicus Meetings.* https://doi.org/10.5194/egusphere-egu21-16339.

Tranchant, Yann-Treden, Laurent Testut, Clémence Chupin, Valérie Ballu, et Pascal Bonnefond. 2021. « Near-Coast Tide Model Validation Using GNSS Unmanned Surface Vehicle (USV), a Case Study in the Pertuis Charentais (France) ». *Remote Sensing 13 (15)*: 2886. https://doi.org/10.3390/rs13152886 .