The proposal for external users application to SOCIB Glider Facility will have to follow the enclosed template. SOCIB strongly encourages potential users to contact the SOCIB glider facility (glider.access@socib.es) to discuss details of existing glider fleet, sensors, feasibility of the proposed mission, etc…

SOCIB Gliders

Application Form for External Scientific Users

SOCIB Balearic Islands Coastal Observing and Forecasting System

PART 1: User group details
Indicate if the proposing user group is best described as X An individual user ☐ A team of two or more users

Information about the applicants (PI and project partners)

Principal Investigator (user group leader)

Title:	**Dr**
Name and Surname	**Ananda Pascual**
Gender:	**Female**
Institution:	**IMEDEA CSIC-UIB)**
Department / Group:	**Oceanography and Global Change**
Address:	**Miquel Marquès, 21**
Country:	**Spain**
Email:	**ananda,pascual@imedea.uib-csic.es**
Telephone:	**+34971611732**
Website	**www.imedea.uib-csic.es**

Project partners
(repeat for each partner of the group)

Title, Name and Surname:	**Dr. Antonio Sánchez-Román**
Gender:	**Male**
Institution:	**INSTITUTO MEDITERRANEO DE ESTUDIOS AVANZADOS**
Department / Research Group:	**OCEANOGRAPHY AND GLOBAL CHANGE**
Address:	**C/MIQUEL MARQUÉS, 21 07190 ESPORLES**
Country:	**SPAIN**
Email:	**asanchez@imedea.uib-csic.es**
Telephone:	**+34 97161 1408**

Project partners
(repeat for each partner of the group)

Title, Name and Surname:	**Dr. Bàrbara Sánchez-Román**
Gender:	**Female**
Institution:	**INSTITUTO MEDITERRANEO DE ESTUDIOS AVANZADOS**

Department / Research Group:	**OCEANOGRAPHY AND GLOBAL CHANGE**
Address:	**C/MIQUEL MARQUÉS, 21 07190 ESPORLES**
Country:	**SPAIN**
Email:	**bbarcelo@imedea.uib-csic.es**
Telephone:	**+34 97161 1408**

Project partners
(repeat for each partner of the group)

Title, Name and Surname:	**Mr. Daniel Rodríguez-Tarry**
Gender:	**Male**
Institution:	**INSTITUTO MEDITERRANEO DE ESTUDIOS AVANZADOS**
Department / Research Group:	**OCEANOGRAPHY AND GLOBAL CHANGE**
Address:	**C/MIQUEL MARQUÉS, 21 07190 ESPORLES**
Country:	**SPAIN**
Email:	**drtarry@imedea.uib-csic.es**
Telephone:	**+34 97161 1408**

PART 2: Additional information about the applicant(s) expertise
Relevant expertise of the user group (max. 200 words) The participants in this proposal belong to the Marine Technologies, Operational and Coastal Oceanography (TMOOC) which develops its activities within the research line of Physics and Technology of the Coastal Ocean System: Observation, Prediction and Interactions. Its objective is to study the physical mechanisms that explain the dynamics of the coastal ocean system and its interactions with the coast and the open ocean in a context of global change. The variability of scales involved, from meters to thousands of kilometers and from seconds to years, and their nonlinear interactions, makes the understanding of these mechanisms a real internationally established challenge. We address this challenge combining -using a physical and mathematical background- theoretical, observational (in situ and remote) and numerical modeling approaches, particularly (but not exclusively) on the Mediterranean Sea, that becomes an ocean laboratory on a small scale, ideal to understand physical processes, to try new ideas and to support various activities in the maritime environment. It is an interdisciplinary group that holds significant external relationships with other groups, organizations and companies. The members of the TMOOC group participating in this proposal have a wide experience in the analysis of in-situ, remote sensing and modelling data to understand the dynamics of the upper ocean.
Short CV of the PI (max. 200 words) Ananda Pascual is a senior scientist of the Spanish National Research Council (CSIC) at IMEDEA (Mallorca, Spain). She obtained her Ph.D. in Physical Oceanography in the University of the Balearic Islands (2003), following with positions at CLS Space Oceanography Division in Toulouse as Marie Skłodowska-Curie postdoctoral fellow, and at IMEDEA as a Ramon y Cajal tenure-track fellow. Her research focuses on physical oceanography, with special interest of meso- and submesoscale dynamics. She uses integrated remote-sensing, multi-platform in-situ data in synergy with numerical simulations and theory. She has published over 120 peer-reviewed international articles and book chapters and has supervised 7 PhD students and 9 postdocs in the last 10 years. She has been a member of the Scientific and Technical Advisory Committee of the Copernicus Marine Service (European Commission) from 2016 to 2022, having been co-chair from 2018 to 2021. Ananda has been a in the organizing and scientific committees of numerous international conferences, meetings and workshops. From 2012 to 2016 she served as Science Officer of the European Geoscience Union (EGU, Ocean Science Division). She presently serves in various international steering committees (external expert advisory board of the H2020 IMMERSE project, steering committee and executive board of the H2020 EuroSea project, Expert Panel Member ESA World Ocean Circulation project, CALYPSO program). She leads the only Spanish group of the present NASA/CNES Surface Water Ocean Topography (SWOT) Science Team. She is the coordinator of the strategic theme ‘Oceans’ of CSIC and has led the development of the book ‘Ocean Science Challenges for 2030’, which, with the contribution of 150 authors from 23 CSIC research centers, reassumes the major ocean research challenges over the next decade, on the basis of their scientific impact and social importance. Ananda is also strongly engaged in public outreach and ocean literacy activities.

A list of 5 recent, relevant publications of the user group

1. Mason, E., Barceló-Llull, B., Sánchez-Román, A., Rodríguez-Tarry, D., Cutolo, E., Delepoulle, A., Ruiz, S. and Pascual, A. (2022). Chapter 8: Fronts, eddies and mesoscale circulation in the Mediterranean Sea. Book title: Oceanography of the Mediterranean Sea. An Introductory Guide. Editors: Schroeder, K. and Chiggiato, J. Publisher: Elsevier. ISBN: 978-0-12-823692-5
2. Cutolo, E., Pascual, A., Ruiz, S., Shaun Johnston, T. M., Freilich, M., Mahadevan, A., Shcherbina, A., Poulain, P., Ozgokmen, T., Centurioni, L. R., Rudnick, D. L., & D'Asaro, E. (2022). Diagnosing Frontal Dynamics From Observations Using a Variational Approach. Journal of Geophysical Research: Oceans, 127(11). https://doi.org/10.1029/2021JC018336
3. Tarry, D. R., Ruiz, S., Johnston, T. M. S., Poulain, P., Özgökmen, T., Centurioni, L. R., Berta, M., Esposito, G., Farrar, J. T., Mahadevan, A., & Pascual, A. (2022). Drifter Observations Reveal Intense Vertical Velocity in a Surface Ocean Front. Geophysical Research Letters, 49(18). https://doi.org/10.1029/2022GL098969
4. Barceló-Llull B, Pascual A, Sánchez-Román A, Cutolo E, d'Ovidio F, Fifani G, Ser-Giacomi E, Ruiz S, Mason E, Cyr F, Doglioli A, Mourre B, Allen JT, Alou-Font E, Casas B, Díaz-Barroso L, Dumas F, Gómez-Navarro L and Muñoz C (2021) Fine-Scale Ocean Currents Derived From in situ Observations in Anticipation of the Upcoming SWOT Altimetric Mission. Front. Mar. Sci. 8:679844. doi: 10.3389/fmars.2021.679844
5. Pascual, A. and D. Macías, Ocean Science Challenges for 2030, CSIC Scientific Challenges: Towards 2030, ISBN Vol. 13: 978-84-00-10762-8, http://libros.csic.es/product_info.php?products_id=1491, 2021

PART 3: Detailed scientific description of the project

List the main objectives of the proposed research

(max. 300 words)

The **general scientific objective** of this project is to quantify and improve our understanding of 4D horizontal and vertical exchanges associated with fine-scale (10-100 km) features (e.g., fronts, meanders, eddies and filaments) through the combined use of in-situ and satellite data in synergy with numerical models.

More specifically we plan to collect fit-for-purpose in-situ quasi-synoptic observations of open ocean fluid dynamics resolving the fine-scale in the unique area of the South-Western

Mediterranean that is to be sampled by SWOT during the 90-day fast phase, just 3 months after launch (1-day orbit).

We propose two multi-sensor experiments during the SWOT fast-sampling phase after launch in the same area of the previous PRE-SWOT project (Southern Balearic Sea). The field-work will combine gliders, drifter observations, ship data (including a new moving vessel profiler), HF radar, and mooring data together with satellite observations and numerical simulations. New tools based on Artificial Intelligence (AI) will be applied to the synergy of in-situ and SWOT data. Data-assimilative simulations will be used to both objectively optimize the sampling strategy and integrate satellite and in-situ observations through data assimilation to provide realistic estimates of the multi-variate ocean fields.

Give a brief description of the scientific and/or technical background to, and rationale for, your project

(max. 300 words)

Over the past 20 years, the scientific community has been developing a new measurement technique based on radar interferometry to enhance the remote sensing capability of the sea surface and obtain wide-swath measurements of water elevation at higher resolutions over both the ocean and land. The new Surface Water and Ocean Topography (SWOT) satellite mission (Morrow et al., 2019) was launched in December 2022 and is expected to provide a spatial resolution one order of magnitude higher than present altimeters, and thus representing the next big breakthrough in Earth observation. This will likely open a new era for the understanding of ocean dynamics at these fine-scales.

During the 90-day calibration fast-sampling phase after launch, SWOT will provide observations of SSH on a daily basis in specific areas of the world ocean for instrumental calibration/validation (d'Ovidio et al., 2019). The region around the Balearic Islands in the Western Mediterranean Sea is one of the selected areas for the SWOT fast-sampling phase (Figure 2), becoming a strategic region of study for SWOT calibration, and providing a unique opportunity to enhance our knowledge of fine-scale ocean dynamics in Spanish waters. The study of this region is of special interest given that the Mediterranean Sea is recognized as an ideal laboratory for studying ocean processes of global relevance, such as water mass formation, overturning circulation, boundary currents, meso/submesoscale eddies and instabilities, carbon export and associated ecosystem responses (Malanotte-Rizzoli et al., 2014; Tintoré et al., 2019).

Understanding the three-dimensional (3D) dynamics associated with fine-scale features and its impact on the large scale ocean circulation and climate system is one of the major international challenges for the next decade in oceanography (e.g., Young and Sikora, 2003; Kwon et al., 2010; Ma et al., 2016; Su et al., 2018; Bishop et al., 2020; Small et al., 2020). Integrated approaches combining multi-platform in-situ data with remote sensing observations and high-resolution model simulations constitute the innovative methodology proposed to evaluate and understand the 3D pathways associated with these structures (Mahadevan et al., 2020a, Pascual et al., 2017, Barceló-Llull et al., 2021).

Present the proposed experimental method and working plan with detailed information on the number of gliders requested, the sensors needed, mission plan, maximum depth (200 or 1.000 m). ***(max. 500 words)*** Two gliders will cross the front or small-scale feature along a transect parallel to the one followed by the R/V and ~10 km apart. Both gliders will be sampling the same transect one after the other and separated by ~25-30 km (which is equivalent to a temporal separation of about 1 day, i.e. same temporal resolution of SWOT data during the fast sampling phase). Gliders will collect high-resolution temperature, salinity, oxygen and fluorescence profiles down to 500 or 1000 m depth (to be determined based on the results from the OSSEs). During the experiment duration, we expect that each glider will repeat the transect several times with a navigation speed of ~25 km/day. The gliders will be deployed and recovered from the R/V SOCIB. The basic payload for the glider should include CTD, oxygen and FL3 sensors. This tentative sampling is not fully fixed, the exact waypoints of the glider missions will be defined a few weeks before the deployment based on the analysis of satellite data (altimetry, SST and ocean colour).
Indicate the type of access applied for ☐ remote *(the measuring programme is implemented by SOCIB and the presence of the user group is not required)* ☐ partially remote *(the presence of the user group is required at some stage)* 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 **(max. 200 words)** The tentative time schedule of the 2 glider mission is as follows: - Deployment: April 24, 2023 - Recovery: May 12, 2023
Add a jpeg or pdf diagram of the idealised glider deployment track

SOCIB Balearic Islands Coastal Observing and Forecasting System

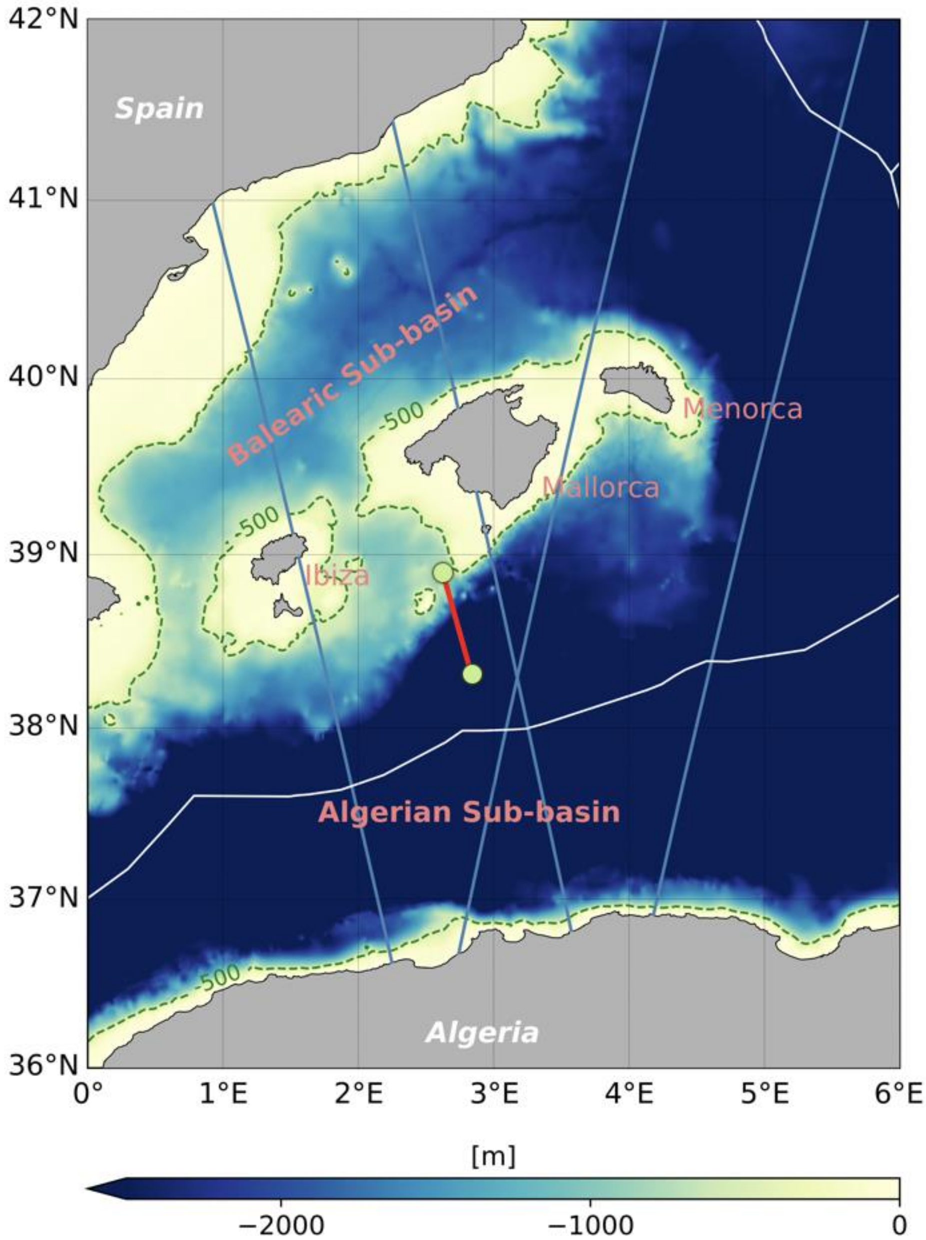

Figure 1: Area of study. Background colors represent bathymetry. Blue lines correspond to the SWOT swaths during the fast sampling phase and the white line limits the Spanish EEZ. Red line is the tentative track of the two gliders.

Additional information
Is there another facility in your country similar to the one you wish to utilize?
☐ Yes X No

If yes, please indicate your reasons for requesting access to the SOCIB glider (max. 150 words)
Is this a resubmission of a previously rejected proposal? ☐ Yes X No
If yes, please provide the reference number and submission date of the original proposal. Briefly describe the changes made in comparison to the rejected version (max. 200 words)
Is this a continuation of an earlier successful project? ☐ Yes X No
If yes, please provide the reference number and submission date of the earlier proposal. Briefly describe the principle achievements of the earlier project and any objectives that were not fully met. (max. 200 words)

PART 4: Technical information
List of the glider instrumentation of most importance to your proposal G3 Slocum glider with CTD, oxygen and FL3 sensors.
List of any additional instrumentation that you have discussed and agreed with the Glider Facility *N/A*
Provide details of your preferred sampling intervals, glider excursion depths and surfacing/communication intervals - Glider excursions depth between surface and 700 m. This target depth is tentative and could be modified after OSSEs and checking first hydrographic profiles. - Downcast and upcast sampling. - Communications every 12 hours.

Balearic Islands Coastal Observing and Forecasting System

Details of your Data Management specific needs - Standard data processing following the SOCIB glider toolbox.
Chose the data access and distribution (one option only) x Public *(open access through the public SOCIB thredds and Coriolis portal (GDAC))* ☐ Partially public *(public SOCIB thredds (only))* ☐ Restricted *(public SOCIB thredds with authentication required)* ☐ Temporally restricted *(restricted during predefined period. In that case, after this period, public or partially public distribution should be chosen by the client)*
DOI minting (highly recommended) X Yes *(Data Centre will be in contact for the metadata information)* ☐ No
Risk Evaluation (marine traffic, fishing grounds, etc.) and Contingency Plan *Before the glider deployment, an analysis of the marine traffic and fishing grounds will be done in order to minimize the risks.*
Emergency Logistics for immediate recovery (time to action, radius of action planed, etc.) *The study area will be near Mallorca island, so a fast and small boat (https://www.socib.es/index.php?seccion=detalle_noticia&id_noticia=149) can be used for recovery in case of emergency.*

SOCIB Balearic Islands Coastal Observing and Forecasting System

Date of compilation 03/02/2023

Signature of the PI Firmado por PASCUAL ASCASO ANANDA - DNI 78214365J el día 03/02/2023 con un certificado emitido por AC Sector Público

BASTERRECHEA OYARZABAL GOTZON - DNI 30596404X Firmado digitalmente por BASTERRECHEA OYARZABAL GOTZON - DNI 30596404X Fecha: 2023.02.05 10:32:58 +01'00'

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

This section reserved for the SOCIB Glider Facility

Date of proposal receipt by email ______________________________

Assigned reference number ______________________________

Signature of receiving officer ______________________________