



# **Project Endorsement Form**

## **1. PROJECT TITLE**

Full title	will nitrogEn fiXaTion offset nitrogen dePletion in expAnding oceaN Deserts?
Acronym	EXPAND
Website	NA
Keywords (up to 10, describing the project research)	Indian Ocean, nitrogen fixation, diazotrophs, primary productivity, oligotrophic gyre, climate change
New initiative or continuing programme?	New initiative

### 2. APPLICANTS

#### Lead applicant / Project Leader / key research contact person:

First name	Mar	
Last name	Benavides	
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	13288 Marseille	
Country	France	
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Email address	mar.benavides@ird.fr	
Institutional or personal website	https://www.mio.osupytheas.fr/ www.oceanbridges.net	

N.B.: Please note that all these names and contact details will be added to the IIOE-2 membership database.

# **3. ABSTRACT**– **Brief description of the project:** (1/4 page maximum)

#### This will be placed on the IIOE-2 Website after endorsement.

The warming and nutrient depleted conditions induced by climate change are bound to force changes in resource supply to fuel primary productivity. Biological nitrogen fixation provides the largest source of reactive nitrogen in oligotrophic regions and responds positively to experimental temperature and CO<sub>2</sub> increases expected towards the end of the 21st century.

A comparison of the two last generations of Earth system models indicates that the parametrisation of nitrogen fixation has a profound impact in net primary productivity predictions towards the end of the 21st century. Among the global ocean regions, this increased global uncertainty is significantly driven by the Indian Ocean. However, the Indian Ocean represents only ~1% of the nitrogen fixation data available to date. Hence, constraining nitrogen fixation in the Indian Ocean gyre is crucial to improve the predictability of net primary productivity and the future role of the ocean as a climate change regulator.

EXPAND will provide mechanistic and quantitative understanding on how nitrogen fixation changes with gyre expansion seasonally, and its impact on primary productivity and export. This information will provide precious data coverage in this severely undersampled region, feeding models for a better parametrisation of nitrogen fixation and improved predictability of biological productivity in the future ocean.

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# 4. LINKS TO IIOE-2 SCIENCE PLAN: (1/2 page maximum)

How do you anticipate your project to contribute to the IIOE-2 strategy and science delivery, with reference to which (either one or more) of the six IIOE-2 Science Plan themes that your project responds. Please state the specific issues and questions addressed by your project in the context of the IIOE-2 Science Plan themes and key issues.

EXPAND contributes to IIOE-2 Science Plan Theme 6: Unique geological, physical, biogeochemical, and ecological features of the Indian Ocean. Focusing on how physical characteristics of the southern Indian Ocean gyre system influence the biogeochemistry and ecology of the Indian Ocean.

The Indian Ocean gyre expands and contracts according to seasonal changes in sunlight irradiance and atmospheric circulation, affecting water column structure with biogeochemical and ecological impacts. Different studies have reported a sustained warming of the northern Indian Ocean over the past half century. However, models suggest that its gyre region has not warmed significantly and has a low signal-to-noise ratio in ocean colour data. Collectively, these uncertainties impede delineating the Indian Ocean gyre confidently and pose questions on its actual expansion, pleading for experimental evidence.

EXPAND will provide mechanistic understanding and quantitative information on how nitrogen fixation changes with gyre expansion seasonally, and its impact on primary productivity and export. This information will provide precious data coverage in this severely undersampled region, feeding models for a better parametrisation of nitrogen fixation and improved predictability of biological productivity in the future ocean.

### 5. INTERNATIONAL COLLABORATION(S):

Is the project part of a related multi-national activity? <u>YES/NO</u> If No, would you welcome international collaboration in your project? **YES/NO** 

#### 6. REGION(S) OF STUDY

Provide a description of 'where' the research is to be conducted (for field based activities) and/or the region or regions to which the research pertains (you are encouraged to consider providing either the coordinates of the area of studies or the coordinates of the planned cruise tracks, as well as a figure as an addendum to your proposal).

EXPAND aims to quantitatively understand the impact of the Indian Ocean subtropical gyre (hereafter only 'gyre') expansion on biological nitrogen fixation and its subsequent impact on primary productivity.

The objectives are:

1) TRACK: Locating and measuring seasonal change in Indian Ocean gyre expansion

- 2) IMPACT: Understanding and quantifying the impact of gyre expansion on diazotrophic nitrogen inputs
- 3) LEGACY: Extending in situ measurements for nitrogen availability predictability in the future Ocean

To achieve these goals, two consecutive cruises and a recovery cruise are proposed covering seasonal gyre expansion variability. The Indian Ocean gyre size is minimum in July and maximum in January. Hence, two sampling cruises are proposed for July 2025 and January 2026, adding a short mooring recovery cruise in July 2026.

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The cruise strategy consists of a series of stations crossing the upper and lower boundaries of the gyre (see figure below), with underway sampling between them. During the first cruise (July 2025), three fixed moorings will be installed at three key locations chosen to cover the maximum latitudinal seasonal variability of the gyre boundaries, recovered on a shorter cruise after one year (July 2026).



#### 6. TIMETABLE OF THE PROJECT

Start date:	End date:
January 2025	December 2030

#### 7. LINKAGES WITH OTHER PROJECTS / PROGRAMMES / INITIATIVES

Is the project part of a related national or multi-national activity? If yes, provide the related activity title and website for reference, if available:

EXPAND will contribute to global oceanography/biogeochemistry programs IMBER, BioGeoSCAPES, GEOTRACES and IIOE-2 by providing precious data in the least explored basin of the world.

Is your project part of, or affiliated to, another SCOR, IOC or IOGOOS activity or project? If "yes", please indicate which activity or project:

NA

#### 8. DATA MANAGEMENT AND SHARING

1. Will new data be collected as part of this project (yes or no?)

Yes

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2. Contact information if any, of the person in charge of the data management from whom the metadata can be accessed by interested IIOE-2 stakeholders.

*Please note that for all IIOE-2-endorsed projects, IIOE-2 will have developed its own metadata portal. Once the project is endorsed, the project leader will be asked to provide the metadata information of the project.* 

Mar Benavides Mar.benavides@ird.fr

3. Recognizing the need for an initial period of exclusive data use, would you be willing to provide timely access to all data generated under this project and associated metadata in accordance with relevant national and funding agency data sharing policies? <u>YES</u>/NO

#### 9. FUNDING

*Please note that IIOE-2 strongly encourages funded/resourced projects. However, IIOE-2 may endorse projects yet to receive funding/resourcing if IIOE-2 endorsement can be clearly shown to significantly aid in prospects for funding/resourcing.* 

Has funding and resources to successfully achieve and undertake the project been obtained? Indicate the sources of funding and resources that have been approached and/or secured.

EXPAND is based on an ERC Consolidator Grant led by Benavides (IRD/MIO), which will be submitted in December 2023.

Ship time for cruises onboard the R/V Marion Dufresne has already been requested to the French Oceanographic Fleet.

#### **10. BENEFITS FROM IIOE-2 ENDORSEMENT** (1/4 page maximum)

Specify why you are seeking endorsement and how the activity would benefit from endorsement, and how the IIOE-2 SC could assist in the implementation of your project.

Being endorsed by IIOE-2 would immensely increase the visibility of our project with the IIOE-2 community, to promote future collaborations and interchanges. Indeed, international visibility will also be enhanced. Joining the IIOE-2 community will be highly beneficial towards the overall goal of understanding biogeochemical cycling in the Indian Ocean. Importantly, it will set our students in a scientific environment.

# **11. OPTIONAL: OTHER COMMENTS/INFORMATION/MATERIAL** (length and detail may be at the discretion of and as desared personny by the applicant)

and as deemed necessary by the applicant)

Please feel free to provide any other comments, information or materials that you feel relevant to your proposal for the IIOE-2 Steering Committee's information and benefit. You may provide this as general information or provide the additional comments/information/materials as relevant to any of the specific Sections above.

# IIOE-2 Joint Project Office (JPO)





(Signature of the PI)

Mar Benavides

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