

Project Endorsement Form

1. PROJECT TITLE

Full title	Dinitrogen Fixation in the Indian Ocean: an interbasin and seasonal comparison
Acronym	DINDE
Website	www.oceanbridges.net (check under "projects")
Keywords (up to 10, describing the project research)	N ₂ fixation, diazotrophs, dissolved organic matter, OMZ
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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Institutional or personal website	https://www.mio.osupytheas.fr/ www.oceanbridges.net

Other key participants / research team leaders: (repeat as needed)

First name	Arvind
Last name	Singh
Role in the project	Co-PI
Affiliation	Geosciences Division Physical Research Laboratory (PRL) Navrangpura, Ahmedabad 380 009
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First name	Sophie
Last name	Bonnet
Role in the project	Collaborator
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N.B.: Please note that all these names and contact details will be added to the IIOE-2 membership database.

IIOE-2 Joint Project Office

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

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

Biological dinitrogen (N₂) fixation by specialized prokaryotes so-called diazotrophs is the main contributor to reactive nitrogen stocks in the ocean, fueling the marine food chain and promoting CO₂ sequestration. As compared to other oceanic basins, the magnitude and controls of N₂ fixation in the Indian Ocean remain unknown and excluded from global ocean nitrogen budgets.

The Indian Ocean is separated by the Indian subcontinent into the Arabian Sea (west) and the Bay of Bengal (east). The biogeochemistry of the region is controlled by the Asian monsoon system, which has different effects on the Arabian Sea than in the Bay of Bengal. Hence, marine biogeochemical studies in the Indian Ocean need to consider the inter-basin and the inter-season variability.

The goal of DINDE (Dinitrogen Fixation in the Indian Ocean: an interbasin and seasonal comparison) is to decipher the role of N₂ fixation in the two sub-basins of the Indian Ocean, focusing on the two most unknown seasons: winter monsoon and intermonsoon. DINDE will examine the magnitude of N₂ fixation rates according to environmental variability, untangling the diversity of local diazotroph assemblages and their metabolic controls. Moreover, DINDE will isolate strains with the aim of discovering diazotroph species unique to the Indian Ocean.

DINDE will integrate the second International Indian Ocean Expedition (IIOE-2), a novel international effort to study the oceanography of the Indian Ocean. The in situ work will be performed during four oceanographic cruises (two per basin in each target season,

two in German vessels and two in Indian vessels). The project will be carried out by the French and Indian collaborating PIs, a PhD student and an assistant. Sample analyses will be shared among the two labs according to their expertise and equipment.

As the Indian Ocean is warming faster than any other basin in the world's oceans, quantifying its N₂ fixation capacity and understanding its biogeochemical dynamics emerges as a priority in current oceanographic research. DINDE lays the ground for a new collaboration between Indian and France, opening new research avenues in the most unknown oceanic basin.

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.

Objectives of DINDE project matches well with theme 6 (Unique geological, physical, biogeochemical, and ecological features of the Indian Ocean). The northern Indian Ocean is a unique basin where nitrogen loss and gain processes co-occur. Expansion of oxygen minimum zones (OMZs) will most likely affect these nitrogen cycle processes in a complex way. Present research conducted in other oceanic regions highlights presence of diazotrophy in the OMZs. In this project, apart from studying the N₂ fixation in the intense OMZs of the northern Indian Ocean, the role of environmental variables on N₂ fixation will be addressed. DINDE will address imperative questions related to the role of Indian monsoon on the nitrogen cycling processes in general, and N₂ fixation in particular.

5. INTERNATIONAL COLLABORATION(S):

Is the project part of a related multi-national activity? **YES**

If No, would you welcome international collaboration in your project? **NA**

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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).

The goal of DINDE is to decipher the role of diazotrophy in the two sub-basins of the IO between seasons. Since the great majority of the previous N₂ fixation related oceanographic cruises were performed during the summer monsoon, we will focus on the northeast monsoon and intermonsoon seasons.

Sampling will take place in the frame of the IIOE-2 German oceanographic cruises complemented by cruises in Indian oceanographic vessels. The cruises are programmed to cover a winter monsoon and an intermonsoon seasons in both the Arabian Sea and the Bay of Bengal as follows:

- Cruise 1: Winter monsoon Arabian Sea cruise (German cruise BIOCAN-IIOE2)
- Cruise 2: Intermonsoon Arabian Sea cruise (Indian cruise tentatively on FORV *Sagar Sampada*)
- Cruise 3: Winter monsoon Bay of Bengal cruise (German cruise BIOCAT-IIOE2)
- Cruise 4: Intermonsoon Bay of Bengal cruise (Indian cruise tentatively on FORV *Sagar Sampada*)

Sample analyses will be shared between the Indian and French partner labs according to their expertise and equipment availability.

6. TIMETABLE OF THE PROJECT

Start date: September 2020	End date: August 2023
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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:

DINDE is funded by the Indo French Centre for the Promotion of Advanced Research ([CEFIPRA](#)), whose mandate is to promote collaborative research between India and France in cutting edge Science and Technology.

Two other proposals have been submitted to provide extra support including:

- IDEFIX I: InDIan ocEan and nitrogen FIXation: which will consist of an oceanographic cruise onboard the R/V Pourquoi Pas funded by the Société des Explorations de Monaco. The cruise will take place between Mauritius, Seychelles and La Réunion in summer 2021. This opportunity enlarges the geographical cover of our project to higher latitudes in the Indian Ocean.
- IDEFIX II: 50k Euro extra funding have been requested to the Pure Ocean initiative, whose goal is to support innovative applied research projects around the world, contributing to the protection of fragile marine ecosystems and biodiversity.

Is your project part of, or affiliated to, another SCOR, IOC or IOGOOS activity or project?

If “yes”, please indicate which activity or project:

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8. DATA MANAGEMENT AND SHARING

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

Yes, new data will be collected. General oceanographic data will be readily submitted to open databases as established by the German research groups leading the oceanographic cruises. Data collected on Indian ships will be submitted to IIOE-2 portal.

Specific diazotrophy data collected will be submitted, upon publication, to dedicated databases such as NCBI for sequences and the global database of diazotrophs (hosted by the [OCB N-fixation working group](#)).

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, Arvind Singh

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? **YES**

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.

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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 highly beneficial towards the overall goal of understanding biogeochemical cycling in the Indian Ocean. Importantly, it will set our students in a scientific environment

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to increase their networking and their future as the new generation of oceanographers specialized in the Indian Ocean.

11. OPTIONAL: OTHER COMMENTS/INFORMATION/MATERIAL (*length and detail may be at the discretion of 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.

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