Position Description

1. General Information

Name of the position	**Understanding and predicting seagrass decline in lagoonal environment**
Foreseen enrolment date	1 November 2024
Position is funded by	• COFUND, Marie Skłodowska-Curie Actions (MSCA), Horizon Europe, European Union • Institut Français pour l'Exploitation de la Mer (IFREMER) • Queensland University of Technology (QUT)
Research Host	Institut Français pour l'Exploitation de la Mer (IFREMER)
PhD awarding institutions	Université de Bretagne Occidentale (UBO) & Queensland University of Technology (QUT)
Locations	Primary: Brest, France Secondary: Brisbane, Australia
Supervisors	Dr Héloïse Muller (IFREMER) Ass. Prof. Paul Wu (QUT)
Group of discipline	Coastal physical oceanography; Modelling; Data science (machine learning, bayesian networks); Coastal hydro-sediment and ecological processes; Programming

2. Research topics (only one of these projects will be funded)

Project 1: *Understanding and predicting the causes and the consequences of seagrass fragmentation in the lagoonal environment of Reunion Island*
Seagrasses form coastal habitats of high ecological value as they are ecosystem engineers, supporting high levels of biodiversity, improving water quality, protecting coastlines from erosion, storms and floods, and trapping carbon. They have been declining for nearly one century with an estimated annual global loss of 7% (United Nations Environment Programme 2020). In tropical regions, anthropogenic pressures are very high, seagrass decline is high and biodiversity is greatly threatened. On Reunion Island, seagrass beds are distributed patchily throughout the lagoon. Seagrass coverage was maintained between 1951 and 2016: although phases of decline and regeneration occurred, the meadow was

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highly resilient. But in 2017, seagrasses began to decline and have almost disappeared today, suggesting that beyond a certain threshold of fragmentation, the meadow can no longer regenerate.

The project aims to analyse the seagrass fragmentation dynamics over decades in a tropical environment and explore the causes of meadow fragmentation using an existing time and space seagrass dynamics model coupling a process-based hydrodynamic-sediment transport model at 10-m resolution with a probabilistic seagrass growth model. This modelling approach will enable interrogation of the effect of the environmental forcings on the seagrass growth, and also to model the effect of seagrass obstruction on the hydrodynamics and sediment dynamics. Fragmentation thresholds beyond which the meadow is no longer resilient could be identified in this highly anthropogenic tropical system experiencing climate change. Both an applied and methodological process will be used to better understand fragmentation processes and their uncertainty in real world systems, make predictions to provide risk-informed decision support, and form the toolsets to address many other social, biological, ecological and complex systems fragmentation processes.

Supervisors: Dr Héloïse Muller (IFREMER), Ass Prof Paul Wu (QUT), Tévamie Rungassamy (GIP Réserve Naturelle Nationale Marine de la Réunion)

Research Fields: Physical coastal oceanography, data sciences applied to ecology, numerical modelling

Project 2: *Understanding and predicting the natural and anthropogenic causes of seagrass decline in the lagoonal environment of Reunion Island*

As lagoonal systems are relatively protected from strong currents and waves, they are suitable areas for seagrass development, however growing anthropogenic pressures and climate change are causing seagrass decline. This is the case on Reunion Island where seagrasses have been disappearing since 2017, well below the cover documented between 1951 and 2016.

The aim of the project is to identify and evaluate the processes impacting seagrass decline on Reunion Island. The study will be based on satellite and hyperspectral data and photographic analysis of the seagrass cover since 1951 combined with identification and quantification of environmental and anthropogenic processes that could be linked to the seagrass decline. This dataset will enable different hypotheses explaining the seagrass dynamics on Reunion Island to be tested using a modelling approach. The research will involve improving and modifying an existing time and space seagrass dynamics model which is a probabilistic seagrass growth model coupled with a process-based hydrodynamic-sediment transport model.

The work will focus on the probabilistic seagrass growth model including local processes acting on the seagrass dynamics such as mechanical destruction from austral and cyclonic waves, overgrazing by megaherbivores, chemical contaminants, protection from the coral reef, freshwater resurgences, etc. For this probabilistic modelling, particular attention will be paid to the evaluation of thresholds on the different pressures acting on the seagrass dynamics. Field campaigns will be organized to experimentally develop some of these thresholds and model the identified processes in the probabilistic seagrass growth model. For example, thresholds associated with grazing pressure will be deduced from field experiments to assess the impact of grazing on seagrass dynamics.

The output of the study will be a conceptual model describing the seagrass dynamics on Reunion Island highlighting the processes initiating and maintaining the ongoing decline of seagrass. This will help to inform the rehabilitation of seagrass beds in the lagoon.

Supervisors: Dr Héloïse Muller (IFREMER), Ass Prof Paul Wu (QUT), Tévamie Rungassamy (GIP Réserve Naturelle Nationale Marine de la Réunion)

Research Fields: Marine ecology, data sciences, coastal oceanography, numerical modelling

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Project 3: *Understanding and predicting the seagrass dynamics in the lagoonal environment of Reunion Island to inform seagrass restoration*
Seagrasses are classified as sentinel species because they clearly indicate marine environmental changes at local, regional and global scales. They are considered as an indicator of water quality in the Water Framework Directive and are a bioengineer species monitored in the Marine Strategy Framework Directive. Moreover, they are the subject of several conservation initiatives (Flora Fauna Habitat Directive, Nairobi Convention,…) and research projects whose purpose is to design tools that will help to prevent their degradation. Seagrass dynamics are complex, responding to a range of forcings over different time scales. Therefore, an integrated ecosystem approach is required to understand the drivers of seagrass decline and is there is a motivation to develop efficient models. Our teams have developed a time and space seagrass dynamics model coupling a process-based hydrodynamic-sediment transport model and a probabilistic seagrass growth model to simulate the evolution of seagrasses at regional scale over decades. Such a tool is useful for local authorities to set up the best management practices to protect seagrasses. On Reunion Island, seagrasses are declining at an alarming rate since 2017 with no clear causes identified. The project aims to model the effect of management scenarios to prevent the Reunion Island seagrass decline and to rehabilitate the seagrass in the lagoon in partnership with local authorities. It also aims to improve existing indicators for monitoring seagrass habitats and to make proposals for adapting current monitoring programs in the framework of the various European directives. This implies identifying and overcoming the limits of our model: taking into account anthropic pressures (different from temperature changes and light modifications), integrating a socio-economic dimension, defining management scenarios, etc. In this context, field monitoring will be considered to optimize the current monitoring networks. The developed model, which will feed the monitoring indicators, will help to discriminate the natural variability from the variability induced by humans in the seagrass dynamics. This scientific project will be in partnership with local authorities from the nature reserve whose mission is to monitor of the state of coastal ecosystems and which coordinates the various associated monitoring programs.
Supervisors: Dr Héloïse Muller (IFREMER), Ass Prof Paul Wu (QUT), Tévamie Rungassamy (GIP Réserve Naturelle Nationale Marine de la Réunion)
Research Fields: Marine ecology, data sciences applied to ecology, marine coastal ecosystems dynamics, numerical modelling

3. Employment Benefits and Conditions

IFREMER offers a 36-months full-time work contract (with the option to extend up to a maximum of 42 months). There is a no probation period and the total working hours per week is 38 hours.

The remuneration, in line with the European Commission rules for Marie Skłodowska-Curie grant holders, will consist of a gross annual salary EUR 27,900. Of this amount, the estimated net salary to be received by the PhD candidate is EUR 1,770 per month. However, the definite amount to be received is subject to national tax legislation and depends on the applicant's professional experience.

Benefits include

- Becoming a Marie Skłodowska-Curie fellow and be invited to join the Marie Curie Alumni Association.
- Access to all the necessary facilities and laboratories at IFREMER and QUT.
- Tuition fees exemption or sponsorship at both PhD awarding institutions.
- Yearly travel allowance to cover flights and accommodation for participating in AUFRANDE events.

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- 10,000 EUR allowance to cover flights and living expenses for 12 months in Australia.
- Same leave conditions as other IFREMER employees, including a minimum of 2.5 paid leave days per month and additional bank holidays and other leave days .
- Full health insurance, including maternity and parental leave .
- Access to social activities and help services.

4. PhD enrolment

Successful candidates for this position will be enrolled by the following institutions and must comply with their specific entry requirements, in addition to AUFRANDE's conditions.

Applicants must hold a master degree in ecological modelling or in data sciences applied to ecology or in coastal oceanography with an interest in physics/biology coupling, including:

- a significant research component, normally 25% or more of the credit point value;
- a minimum grade point average of 5 (on a 7 point scale) in that course; and
- present evidence of research experience and potential for approval.

Applicants must demonstrate a level of English proficiency equivalent to an overall IELTS Academic score above 6.5. Tests must be taken no more than 2 years prior to the course commencement.

More information on IFREMER - Université de Bretagne Occidentale (UBO)'s requirements

Visit the website: https://www-iuem.univ-brest.fr/training/edsml/?lang=en

More information on Queensland University of Technology (QUT)'s requirements

Applicants should check the course entry requirements, where they will find a specialised guide to countries and qualifications which meet the requirements.

QUT accepts English language proficiency scores from the following tests.

English Test	Overall	Listening	Reading	Writing	Speaking
PTE Academic/PTE Academic Online	58	50	50	50	50
Cambridge English Score	176	169	169	169	169
IELTS Academic / IELTS Online	6.5	6	6	6	6
TOEFL iBT / Home / Paper	79	16	16	21	18

Short-listed applicants will need to submit an online application at QUT.

For more information and details on how to apply to QUT:

How to apply: https://www.qut.edu.au/research/study-with-us/how-to-apply

Admission Criteria for the Doctor of Philosophy:

https://cms.qut.edu.au/__data/assets/pdf_file/0015/640320/qut-admission-criteria-doctor-philosophy.pdf

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