

PROPOSITION DE SUJET DE THESE

Formulaire demande de financement : ARED - ISblue – Etablissement(s) - ...

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NB : ce dossier ne vous dispense pas de déposer en parallèle votre dossier sur l'extranet de la Région

Acronyme : BARACOBA

Présentation de l'établissement porteur (bénéficiaire de l'aide régionale)

Établissement porteur du projet : UBO UBS Institut Agro Rennes

IMTA ENSTA ENIB

Ecole Doctorale : EDSML

SPI BZH SPIN MATHSTIC Bretagne Océane pour les projets ISblue

Identification du projet

| | |
|--------------------|---|
| Intitulé du projet | Dams in land-sea continuum: which impact on estuarine biogeochemistry and matter transfer? |
| Nom | Waeles |
| Prénom | Matthieu |

Demande d'ARED

Se reporter à la notice ARED Région Bretagne et préciser :

| | |
|------------------------------|--|
| Priorité régionale | Atténuation et/ou adaptation au changement climatique |
| DIS | Economie maritime pour une croissance bleue |
| Levier thématique | Environnement, santé des océans et gestion du littoral |
| DIS secondaire | |
| Levier thématique secondaire | |
| Axe transversal | Transitions sociales et citoyennes |

Organisme de tutelle : encadrement et unité de recherche

Porteur du projet HDR

| | |
|-------------------------|------|
| Date obtention de l'HDR | 2014 |
|-------------------------|------|

| | |
|--------------------------|---|
| Nom | Waeles |
| Prénom | Matthieu |
| Mail | waeles@univ-brest.fr |
| Tel | 02 98 49 86 96 |
| Expérience d'encadrement | <ul style="list-style-type: none"> Jennifer Vandenhecke (2006-2009) : taux d'encadrement 50%, 4 publications de rang A, adjointe administrative, Université de Sherbrooke (Canada). Virginie Tanguy (2007-2011) : taux d'encadrement 50%, 5 publications de rang A, Enseignante groupe scolaire Javouhey Virginie Aumond (2010-2013) : taux d'encadrement 33%, 1 publication de rang A, Responsable métrologie NKE instrumentation Lauriane Marie (2013-2016) : taux d'encadrement 33%, 2 publications de rang A, Enseignante collège de St Renan Laura Cotte (2014-2017) : taux d'encadrement 50%, encadrant HDR, 5 publications de rang A, ingénieure projet au CEDRE Johann Breitenstein (2016-2019) : Taux d'encadrement 25%, 2 publications de rang A, postdoctorant- Univ. Umeå - Suède Lucie Toussaint (depuis oct. 2021): Thèse en cotutelle avec l'Université Laval, Québec, Canada, Taux d'encadrement 20% Tristan Gobert (depuis Oct. 2021) : Taux d'encadrement 50% (encadrant HDR) |

Unité de recherche

| | |
|---|--|
| Nom de l'unité | LEMAR |
| Acronyme de l'Unité (umr xx, ...) | UMR 6539 |
| Nom et prénom du responsable | Géraldine Sarthou |
| Le cas échéant, nom de l'équipe de recherche | Chibido |
| Le cas échéant, nom du responsable de l'équipe de recherche | Brivaela Moriceau et Matthieu Waeles (Chibido) |

Co-directeur de thèse – si nécessaire

| | |
|--------------------------|--|
| Nom | |
| Prénom | |
| Unité de recherche | |
| Etablissement de tutelle | |
| Expérience d'encadrement | |

Co-encadrant (s) de thèse – si nécessaire

| | |
|--------------------------|---|
| Nom | Raimonet |
| Prénom | Mélanie |
| Unité de recherche | LEMAR |
| Etablissement de tutelle | CNRS |
| Expérience d'encadrement | Roxelane Cakir (2017-2019), "Les fonctions écologiques de régulation des nitrates au sein des bassins versants : des cours d'eau aux territoires". 9 octobre 2020. Situation actuelle : Fondatrice et |

| | |
|--|---|
| | <p>présidente de la start-up HETWA (Harmonized Environmental Territory and Water Assessment; https://www.hetwa.fr/).</p> <p>Amina Mami (2017-2019), "Impact des changements climatiques sur la disponibilité et la gestion des ressources en eau : cas du bassin versant de la Tafna". 15 novembre 2020. Situation actuelle : Enseignante à l'Université des Sciences et de la Technologie d'Oran Mohamed Boudiaf.</p> <p>Thibaud Cazier (2012-2015), "Rôle des Procaryotes dans la dynamique du nitrite dans la Seine". 16 octobre 2015. Situation actuelle : Consultant Zifo RnD.</p> |
|--|---|

| | |
|--------------------------|--|
| Nom | |
| Prénom | |
| Unité de recherche | |
| Etablissement de tutelle | |
| Expérience d'encadrement | |

Description du projet : complément

Main location of the project in Brittany: The thesis will take place in Plouzané. A stay of 2 to 3 months in the Netherlands is also planned during the thesis in order to develop the modeling with Karline Soetaert (NIOZ, Yerseke, Netherlands).

Lieu principal de déroulement du projet si hors Bretagne :

Libellé (attention veiller à respecter le nombre de caractères imposés par le serveur de la Région)

Résumé synthétique du projet
(2 000 caractères maximum)

If estuarine dams allow to prevent floods/submersions and/or to have a harbor permanently filled with water, they can also induce significant modifications for estuaries by acting on nutrient fluxes, primary production, sediment transport, oxygenation, salinization, with important consequences for the structure and functioning of ecosystems. Despite these risks (already identified for river dams), studies on the impacts of estuarine dams are rare. In the context of climate change (i.e. intensification and lengthening of low water levels), it is essential to better understand the impact of these dams on water quality and ecosystems in order to adapt their management and avoid further degradation of coastal systems influenced by estuarine inputs. In the Bay of Brest, subject to significant nutrient inputs, tidal mixing and oxygenation of water masses are vital to mitigate eutrophication. However, estuarine dams can lead to hyper-eutrophication and anoxia and alter matter fluxes to the coastal zone. By studying two estuaries of the Bay of Brest, our objectives are to improve the knowledge on (1) the functioning of reservoirs upstream of estuarine dams, (2) the associated matter fluxes and (3) the downstream impacts, in particular during opening after confinement of water masses. As the key processes are strongly linked to the circulation of water and therefore to the operation of the gates of the dams, this work will be carried out in collaboration with the managers (Brest Métropole, Brittany Region) in order to (4) experiment alternative management methods and assess their impact.

Hypothèses, questions posées, points de blocage, approche méthodologique, technique
(4 000 caractères maximum)

In estuaries, dams are built to control floods/submersions and/or to keep a harbor in water. However, the fragmentation of the land-sea continuum by these structures can induce significant changes in estuaries by affecting nutrient fluxes, primary production, sediment transport, oxygenation, salinization, with important consequences for living organisms and changes in structure and ecological functions. Although studied in rivers [1-7], the impact of dams built in estuarine areas is very little addressed with the exception of rare and old studies (Vilaine estuary [8]). In the context of climate change (i.e. intensification and lengthening of low water levels), it is essential to better understand the impact of these dams on water quality and ecosystems to adapt their management and avoid further degradation of coastal systems under the influence of estuarine inputs.

In the Bay of Brest, subject to significant nutrient inputs, vertical mixing and oxygenation of water masses by tides are vital to mitigate eutrophication [9]. However, estuarine dams can induce hyper-eutrophication and anoxia (Penfeld estuary [10]) and alter matter fluxes to the coastal zone.

Our objectives are to improve our knowledge of (1) the functioning of reservoirs upstream of estuarine dams, (2) the associated matter fluxes and (3) the downstream impacts, in particular during the opening after confinement of water masses. As the key processes are strongly linked to the circulation of water and therefore to the operation of the gates of the dams [11], this work will be carried out in close collaboration with the managers (Brest Métropole, Brittany Region) in order to (4) experiment with alternative management methods and assess their impact.

The two sites chosen are the reservoirs upstream of the Guily-Glaz marine lock on the Aulne river-estuary and the Kervallon dam on the Penfeld river-estuary. During the first year, discrete samples and high frequency measurements (probes) will be taken at different seasons to understand the biogeochemical functioning of the reservoirs under normal management of the structures (water stratification and/or salinization dynamics, impacts on primary production, exchanges at the water-sediment interface and matter fluxes). Several elements will be studied in relation to the issues of eutrophication (N, P, Si, O, C) and historical metallic contamination (Pb, Zn, Cd, As).

In the second year, alternative management strategies for dams will be tested at key periods in consultation with the dam managers, in order to understand the associated benefits in terms of the ecological status of the reservoirs and the flow of nutrients and metals to downstream coastal systems.

Finally, the modeling of stocks and fluxes of matter will be developed and validated using data acquired during the periods of usual and alternative management of the structures. This model will allow testing the impact of different management scenarios on estuarine biogeochemistry in the short, medium and long term.

Références

- [1] Belletti et al. (2020) *Nature* 588, 7838
- [2] Vörösmarty et al. (2003) *Global and Planetary Change* 39, 169
- [3] Winton et al. (2019) *Biogeosciences*, 16 1657
- [4] Reid et al. (2019) *Biological Reviews* 94, 849
- [5] Pinay et al. (2017) *Restitution de l'ESCO Eutrophisation*. CNRS - Ifremer - INRA – Irstea
- [6] Van Cappellen & Maavara (2016) *Ecohydrology & Hydrobiology* 16, 106
- [7] Senneville et al. (2018) *Estuarine, Coastal and Shelf Science* 203, 29
- [8] Merceron, M. (1989). *Impact du barrage d'Arzal sur la qualité des eaux de...la Vilaine*.
- [9] Le Pape et al. (1996). *Continental Shelf Research* 16, 1885
- [10] Jaffrès et al. (2022) *LHB* 108.1, 2098069
- [11] Shin et al. (2019) *Anthropocene Coasts* 2, 145

Environnement scientifique, positionnement dans contexte régional/national/international (2 000 caractères maximum)

On a regional scale, this project will make a major contribution to the project TerraRade, new " Contrat de rade", 2022-2027) which is being set up in consultation with decision-makers, managers, local stakeholders and researchers in order to restore the quality of the waters and ecosystems in the Bay of Brest. The project also fits into theme 2 of the Brest-Iroise Workshop Area (ZABrI), co-led by the project's co-supervisor, which aims to stimulate interactions between managers and scientists around the issue of "water quality along the land-sea continuum", as well as into theme 3 of the ZABrI "sustainability between conservation, restoration, exploitation and uses", and into themes 3 (Sustainability of coastal systems) and 4 (Living ocean and ecosystem services) of the EUR project "ISblue". This project will thus provide an integrative and structuring dimension on a regional scale, due to the close links that will be pursued and stimulated between different observatories (IUEM, OSUR), between Brest and Rennes in the context of the CPER Glaz Environnement (which has just been financed for the next 6 years), as well as between different "Zones Ateliers" (the ZABrI and the ZA Armorique).

Because of its contribution to the ZABrI and the project TerraRade, this project will be very structuring on a national scale via the national network of Zones Ateliers (RZA) labelled by the Institut Ecologie et Environnement du CNRS. This Ph.D project will contribute to the "Interdisciplinarity" working group of the RZA, co-led by the co-supervisor of this thesis.

Beyond the European construction and the e-LTER (Long Term Ecological Research) network, the French network of Zones Ateliers is integrated in the international I-LTER network. The ZABrI is currently developing privileged links with coastal zones in several places on the planet, in particular in Canada (e.g. LIA BeBEST in collaboration with UCAR, collaborations with the University of Moncton for the Cocagne - Grande digue site of the ARTISTIC project), which is a major country in terms of collaboration priorities for the IUEM

Collaborations scientifiques (nature/partenariat/pays) et partenariat socio-économique envisagé

A team of collaborators has been built to study the land-sea interface in an interdisciplinary and integrated way. This team is composed of researchers from the Discovery team at LEMAR (Cécile Klein, MCF, UBO, phytoplankton ecology), from the UMR GEO-OCEAN (Jérôme Goslin, IFREMER, geophysics, sedimentology) and from the DYNeco unit at IFREMER in Brest (Claire Labry, Françoise Andrieux-Loyer, IFREMER, phosphorus cycle), as well as from the UMR ECOBIO in Rennes (Annie Laverman, CNRS, nitrogen cycle) and from the NIOZ in Yerseke in the Netherlands (Karline Soetaert, NIOZ, modelling of aquatic ecosystems). This work will therefore rely on the expertise of the different partners for the logistic support for research at sea, the analysis of parameters, experimentation and modeling: in-situ sensors and instrumentation (OSU IUEM), sediment sampling/analysis tools (J Goslin, Geo-Ocean), mobile laboratory (CPER Glaz), analysis of physico-chemical parameters and nutrients (Pachiderm-Lemar platform), analysis of toxic metals (Pôle Spectrométrie Océan, IUEM), speciation of phosphorus (C Labry and F Andrieux, Dyneco, Ifremer), determination of phytoplankton species (C Klein, Lemar), denitrification process and experimentation (A Laverman, Ecobio, Univ Rennes), modelling (K Soetaert, NIOZ, Netherlands).

Close collaborations will be carried out with the managers of dams at the land-sea interface (SAGE coordinators, Brest Metropole, Brittany Region). Close links with the first two managers have already been established within the framework of various projects, including the current Contrat de Rade project aiming at restoring water quality and ecosystems in the Bay of Brest and its catchment areas.

Interventions, field days as well as days of restitution organized at the European University Institute of the Sea (IUEM) are also planned with high school students of agricultural high schools and Rural Family Houses (MFR) within the framework of the ECOFLUX-Bretagne program (CPER GLAZ financed, FEDER request in progress), project of participative observatory of water quality and biodiversity in Brittany. Note that the Aulne river-estuary is one of the pilot sites of this observatory.

Pour les demandes Région Bretagne

Adéquation du projet avec le DIS de Rattachement
 Pour les demandes Région Bretagne (3 000 caractères maximum)

This project is part of the DIS1 "Maritime economy for a blue growth", and in particular in the thematic lever "Environment, ocean health and coastal management". Indeed, this project aims to (1) develop our knowledge on the biogeochemical functioning of water reservoirs located upstream of dams built in estuarine areas and on their impacts in terms of eutrophication, salinization, trapping and/or retention of elements, etc., and (2) co-construct alternative management scenarios of these structures, in close collaboration with dam managers, in a context of climate change. These advances will provide knowledge and tools to facilitate decision-making and planning in terms of dam management in estuarine areas, with a view to restoring water quality in Brittany under a changing climate.

The project is related to the "Social and citizen transitions" and in particular to the strategic objective "Strengthen and renew the dialogue between science and society", since close links will be strengthened between scientists and managers (i.e. SAGE coordinator, Brest Metropole, Region): co-construction of research questions, constitution of database, interpretation of results, co-construction of alternative management scenarios. Links will also be strengthened with the civil society (e.g. associations, high school students, teachers, citizens) through participative observations (in particular ECOFLUX-Bretagne within the framework of the CPER GLAZ financed and a current FEDER request).

Si priorité régionale, préciser (200 caractères maximum)

Regional priority "Mitigation and/or adaptation to climate change": co-construction of management scenarios reconciling uses and water quality in a climate change context

Demande de (co)financement ISblue

Vous sollicitez un financement ISblue,

Précisez le lien du sujet avec les thèmes ISblue

| Thème ISblue | Thème principal | Thème secondaire (si nécessaire) | Autre (si nécessaire) |
|---|-----------------|----------------------------------|-----------------------|
| la régulation du climat par l'océan | | | |
| les interactions entre la Terre et l'océan | | | |
| la durabilité des systèmes côtiers | x | | |
| l'océan vivant et les services écosystémiques | | x | |
| les systèmes d'observation à long terme | | | x |

Expliquez/précisez en quelques lignes dans quelle mesure votre demande correspond à l'un ou plusieurs des critères ISblue ci-dessous :

1- Originalité, impact potentiel du projet (4 lignes maxi)

The originality of this work is to study of the impact of estuary dams on the symptoms of eutrophication and metallic pollutants fluxes, by adopting an original transdisciplinary approach of work in close collaboration with dam managers. This will allow to better understand the risks associated with these dams and to adapt the management in order to reconcile uses and water quality.

2- Positionnement international du sujet, cotutelle ou co-encadrement international (4 lignes maxi)

Dams in estuarine zones are present all over the world and the results of this thesis will provide knowledge that can be transposed to many systems. Within the framework of this thesis, collaborations will be developed with Karline Soetaert, expert in physical-biogeochemical-ecological modelling of aquatic systems (NIOZ, Netherlands).

3- Effet intégrateur entre unités de recherche et / ou interdisciplinarités (4 lignes maxi)

This thesis presents integrating aspects (1) within LEMAR through an inter-team collaboration CHIBIDO-DISCOVERY, and (2) within ISblue through a collaboration between 3 laboratories: LEMAR, DYNECO (IFREMER) and GEO-OCEAN. These collaborations will allow a deep interdisciplinary work combining geophysics, hydrology, biology, biogeochemistry, chemistry, ecology.

4- Potentiel d'insertion à un haut niveau dans la communauté académique ou non académique du docteur (4 lignes maxi)

At the end of the thesis, the student will have interdisciplinary skills and a triple competence in observation, experimentation and modelling on pollution issues related to the land-sea socio-ecosystem, with numerous possibilities of insertion in the academic or non-academic community, in particular in environmental management and mediation.

Financement du projet de thèse

En cas de financement à 50 %, le cofinancement est-il déjà identifié (oui/non) : oui

Si oui, préciser la nature du cofinancement (ANR, partenaire privé, Ademe, etc.) :

ARED Région Bretagne

Si le cofinancement n'est pas encore confirmé, date prévue de réponse du cofinancier :

En cas de non-obtention du cofinancement demandé, une autre source de cofinancement est-elle identifiée (oui/non) : oui

Si oui, laquelle : ARED Brest Métropole

Sollicitez-vous un co-financement Is-Blue (oui/non) ? oui

Important : Veillez à bien compléter les différents co financements sollicités sur le serveur Thèses en Bretagne Loire lors du dépôt de votre dossier.

Projet de thèse en cotutelle internationale

S'agit-il d'un projet de thèse en cotutelle internationale dans le cadre d'une convention (oui/non) : **non**

Si oui, préciser l'établissement pressenti (et le pays de rattachement) :

Ce projet de thèse fera-t-il l'objet d'un cofinancement international (oui/non) : **non**

(Rémunération du doctorant par l'établissement implanté sur le territoire régional (18 mois sur 36 mois), et l'établissement étranger, qui s'engage également à rémunérer le doctorant dans le cadre de son séjour à l'étranger, soit durant 18 mois -a minima-)

En cas de cofinancement international, préciser -si vous en avez connaissance- l'organisation du calendrier des périodes de séjour :

Préciser quel est le stade du projet international (joindre une lettre d'engagement du partenaire)

Vous sollicitez un financement UBO EDSML qui sera porté à la décision du Conseil de l'ED

Indiquez le ici, oui non **et sur le serveur TEBL (indispensable)**

Le candidat

Profil souhaité du candidat (spécialité/discipline principale, compétences scientifiques et techniques requises) :

Master's degree in Marine Chemistry, Marine Biology, Marine Biogeochemistry or Coastal Environment Expertise and Management. Expertise in physical-chemical measurements in waters, with if possible experience in field work, experimentation and/or modeling. Knowledge of the functioning of coastal ecosystems. Attraction to interdisciplinary and transdisciplinary approaches (of work in collaboration with the actors of the territory).

ATTENTION : Tout dossier non déposé sur le serveur dans les délais indiqués, ne pourra être pris en compte notamment par les instances ISblue, conseil de l'EDSML.

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