Master 2 trainee offer:

Carbon budgets along the sediment-water and sediment-air interface in the intertidal zone of the Bay of Canche

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Background: Research Project CABESTAN:

Coastal wetlands, from the continuum of freshwater marshes to the intertidal zone, are widely represented on the French Atlantic-Channel coast (FACc). These highly productive environments are the receptacle of many continental inputs and can capture and sequester C for long term. The CABESTAN project aims to remove knowledge barriers on the processes and drivers that govern carbon fluxes in these environments. We have identified a large number of original questions centered on the behavior of C with respect to the different spatio-temporal gradients that characterize these environments: 1/ How do C uptake and recycling processes at tidal, diurnal and seasonal scales affect long-term C sequestration? 2/ How do C dynamics evolve in the saline gradient, from the intertidal zone to the backshore marshes? 3/ Do eutrophication gradients translate into a C sequestration gradient? 4/ Are the most productive substrates those that sequester the most C? 5/ How do climate and tidal forcing drivers along the FACc impact the C cycle? At the end of our project, the new scientific knowledge will allow us to answer the question: what will be the future evolution of C sequestration in coastal wetlands under the effect of climate and global changes?

To answer these questions we will study 9 areas located between the Arcachon lagoon (44.6°N) and the Canche estuary (50.5°N) with a comparative multi-site approach with multiple forcing drivers. For this, the CABESTAN project had to gather a set of complementary skills made of site experts, geochemists, sedimentologists, ecophysiologists, experts in C flux and assimilation measurements, organic matter (OM) analysis, remote sensing and modeling. Thus, the consortium brings together nearly 30 researchers from 9 laboratories.

The collaborative work will be organized in six tasks. The first is the coordination of the project which will include a compilation of knowledge on the biogeochemistry of each site and the comparison of methods. Task 2 will focus on benthic biogeochemical processes and will seek to understand those at work that control the C recycling/archiving balance by identifying and quantifying the diagenetic processes responsible for OM mineralization and alkalinity production.

Task 3 will aim to quantify C exchange at different sediment-air-water interfaces in the intertidal domain, including tidal pumping and sequestration rates. Task 4 will focus on the stocks and origin of sedimentary OM. Task 5 will focus on up-scaling and extrapolation of results using lidar methods and remote sensing. C flux maps will be established from a land use model compared to our observations at different scales. The last task will concern the dissemination, communication and exploitation of the results. At the end of the project, the expected results are a quantification of 1/ the stocks and sequestration rates of organic C in the sediments of the studied wetlands 2/ the carbon fluxes at the different interfaces. The processes and drivers responsible for these fluxes will be better known, which will use to feed models allowing to change scale, to propose scenarios of flux evolution according to global changes and to provide quantitative arguments for the preservation of coastal wetlands.

CABESTAN is in line with the FairCarboN call for proposals, and more precisely with axis 1.

Master trainee Research Project and specific objectives:

Within the frame of Tasks 2 & 3 of the research Project CABESTAN, the specific work performed during the Master trainee will focus on sediment-water and sediment-air exchanges of Carbon in the Canche estuary. This estuary is one of the sites chosen in the CABESTAN project. The aim will be to quantify global Carbon exchanges at the sediment-water interface and the sediment-air interface during the winter and spring periods, at three different typical sites of the Canche estuary, i.e. sandy channel, mudflat and salt marshes (Voltz et al, 2021, Meresse et al., 2023, in press). We will specifically study spatial and temporal variabilities, so that a protocol is fixed at the end of the trainee (how many replicates per station? Duration of the incubations? Daytime and daylight influence? Macrofauna and saltmarsh plants influence, including roots influence). As usually in the frame of such a large project, this Master work will benefit from the inputs of other collaborating teams on organic carbon stocks and quality in the sediments, as well as other biogeochemical measurements, such as DET gels, DIC in the interstitial waters, etc.

Methods and program:

Flux measurements of sediment-water exchanges will be performed by retrieving sediment cores (sampled at low tide), that will be incubated with overlying water in controlled conditions in the laboratory (Rauch & Denis, 2008; Janson et al., 2012; Tous-Rius et al., 2018). Dissolved Inorganic Carbon, Total alcalinity flux will be measured using an Apollo DIC analyzer, as well as sediment-water exchanges of Oxygen (Firesting sensors and Winkler titration) and Nutrients (Nutrients Autoanalyzer). Sediment-air exchanges of C will also be quantified by using clear and dark aerial benthic chambers coupled with and IRGA (InfraRed Gas Analyzer), that will be used in the field at low tide for direct estimates of fluxes (Migné et al., 2009; Spilmont et al., 2009). Moreover, the stock of Organic Carbon will be quantified by elemental analysis (Maxwell et al. 2023), as well as seagrasses (leaves and roots) and macrofaunal biomass. All methods are already routinely used in our team.

The first meeting of the Cabestan Project is already planned on 11-12 January 2024 (location to be finalized) but a meeting between the various participants from the LOG (8 permanent staff from the LOG involved in the Cabestan Project) is planned. After initial handling and bibliographical work in January, quantification of fluxes would begin in early February-March for the 'winter' sampling, while Spring sampling will be performed in April-May. Moreover, it is highly probable that inter-comparison experiments will be performed with others teams involved in the Project, maybe in different study sites during the first semester 2024, and the Master student will be involved in this process. The stations studied will also be integrated in the frame of the national BenthObs-Biogeo survey (long-term survey of sediment-water exchanges in different sites along the French coast).

References :

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Funding :

The research work is fully integrated in the PEPR Faircarbon Cabestan project, accepted in 2023, for a duration of 5 years, from 2024 to 2029. Moreover, in the frame of this 5-years long project, a PhD funding (Region/University for instance to be discussed) will be asked for in spring 2024.

Briefly:

Where? => Laboratory of Oceanology and Geosciences - LOG – Station Marine de Wimereux – 28, Avenue Foch, 62930 WIMEREUX – France – Research Team INTEREST (https://log.cnrs.fr/recherche/equipe-interest)

When? => From January to June 2024 (6 months) some flexibility (but not so much, due to the deadlines of the PhD grants applications).

Who? => Master Student with a serious background in coastal geochemistry, basic knowledge on estuarine systems (tidal coasts), blue carbon and carbon cycle (carbonate equilibrium), measurement methods for sediment-water and sediment-air exchanges using incubations. As this research work might be followed by a 3-years long PhD (application for a regional/university grant in spring 2024), only students interested in developing a PhD activity on that topic are welcome.

Grant? => A specific grant will be attributed during the 6-months long trainee, equivalent to about 600 €/month (specifically, 4.06 €/hour, full time work).

How? => The application is opened **until the 15th November 2023**. To apply, send CV and motivation letter to: lionel.denis@univ-lille.fr. Up to 2 recommendation letters (in the field of C cycling) are allowed, but not mandatory.

Selection of the applicants will be performed first of all by reading the CV and motivation letter, then through a visio-conference meeting.

Further information? => In case you need further information, please send an E-mail to lionel.denis@univ-lille.fr, mentioning 'Master trainee Offer' as Subject.