

Global soil erosion and carbon transfers to inland waters during the Anthropocene: coupling model and paleolimnological approaches

CARRTEL Laboratory (INRAE, University of Savoie Mont Blanc, France) is offering the position of a PhD-Thesis in the field of Hydrology/ Soil Erosion/ Modelling

Accelerated soil erosion alters lateral exports of carbon (C) along the land to ocean aquatic continuum (LOAC) that needs to be accounted for closing the global C budget^{1,2}. However, monitoring data do not extend back as far as few decades, limiting our comprehension of the role of soil erosion and its dynamics in the global C budget on centennial timescale³. As such, we lack the ability to make predictions about the responses of soil erosion and C transfers to long-term climate and land cover changes.

To address this gap, the overall objective of this PhD project is to advance our understanding of the long-term dynamics of soil erosion and C exports from land to inland waters, by coupling data-driven and model approaches. Specifically, the research undertaken will focus on assessing the spatial-temporal variability of soil erosion (i.e. trends, regimes, transitions, hotspots) and on identifying main drivers of changes for the last 300 years, such as the effects of changes in precipitations, deforestation, agriculture and dams' settlement. The successful candidate will adapt semi-empirical models of soil erosion and C transfers constrained by paleo-data and hydro-climate scenarios to assess temporal trends, but also to quantify the global soil erosion and C exports to inland waters for the period 1700-2100 (i.e., mass of C exported, turnover or retention in watersheds). The model will be calibrated and validated for spatial variations against sedimentation rates and carbon fluxes data measured in French EDF reservoirs, c.f. EDF database including about 600 reservoirs. The model will be further validated for temporal variations against a paleo-data collection managed at CARRTEL of near-annual terrigenous and C signatures preserved in sediments from lakes around the world. In addition to the modelling approaches, the candidate will have the occasion to a lesser extent to participate in new field campaigns and lab analysis on lake sediments in order to implement the set of paleo-data.

With a new perspective on empirically constrained models of soil erosion and C-exports, the project will advance our understanding of the influence of land use and climate on the C cycle during the Anthropocene.

Team and Host institution

We offer a three-year funded PhD which is part of the C-ARCHIVES 2021-2024 program funded by the French National Research Agency (ANR). The PhD research will be realized at CARRTEL, Technolac Campus, Savoie Mont-Blanc University (USMB), Bourget du Lac, France ([URL](#)). The project involves scientists from CARRTEL, *Sol Agro et Hydrosystème* (INRAE, Rennes, France) and EDYTEM (CNRS, Technolac) laboratories, and the National company *Electricité de France* (EDF-CIH, Technolac) ([URL](#)). As such, you will be part of a dynamic team with logistical, financial, and staff support, including support for the modelling part of the project ([URL](#)).

CARTEL is a limnological research unit (UMR) of the French National Research Institute for Agriculture, Food, & Environment (INRAE) and of the USMB ([URL](#)). The unit includes about 40 permanent scientists dedicated to the study of aquatic systems (lakes mostly) in interaction with water and mass supplies from their catchments. The unit provides several academic and for-profit research, instrumental and field facilities, access to analytical platforms and computing facilities including a shared storage capacity raid and the MUST High Performance Computer cluster. The unit also offers courses and trainings, and an excellent potential for local and international scientific collaborations.

Start date : Open from now on

Required qualifications

- Completed master degree in hydrology, hydrogeology, geosciences, or a related field.
- Strong skills in scientific programming and experience in HPC environments.
- Motivation for modelling approaches
- demonstrate an interest in soil erosion, carbon cycle, paleo-environmental issues

Applications including a cover letter, CV, copies of degree certificates and detailed results (MSc), and the names of one referee should be submitted to the supervisors.

Thesis directors

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References

1. Regnier, P. *et al.* Anthropogenic perturbation of the carbon fluxes from land to ocean. *Nat. Geosci.* **6**, 597–607 (2013).
2. Naipal, V., Reick, C., Pongratz, J. & Van Oost, K. Improving the global applicability of the RUSLE model – adjustment of the topographical and rainfall erosivity factors. *Geosci Model Dev* **8**, 2893–2913 (2015).
3. Jenny, J.-P. *et al.* Human and climate global-scale imprint on sediment transfer during the Holocene. *Proc. Natl. Acad. Sci.* 201908179 (2019) doi:10.1073/pnas.1908179116.