



## PhD Research Proposal Form China Scholarship Council (CSC) 2022

*A remplir en français ou en anglais en fonction de la langue qui sera utilisée pour la thèse*

### FIELD

--Géosciences--

Thesis subject title: Modeling regional cropland soil organic carbon dynamic from a century-long time span –case study of the Tuojiang river basin -

**Name of the French doctoral school/Ecole doctorale: STEP'UP**

**Name of the Research team/Equipe de recherche: Equipe "Surface et Réservoir", Laboratoire de Géologie de l'ENS**

Website: <http://www.geologie.ens.fr/recherche/equipes/surface-et-reservoir/>

**Name of the Supervisor/Directeur de thèse: Pierre Barré**

Email: [barre@geologie.ens.fr](mailto:barre@geologie.ens.fr)

Julia Le Noë, postdoctoral researcher at LG-ENS will also be involved.

**Lab Language/ Langue de travail: Anglais**

### **Research Proposal Abstract/Présentation du sujet:**

Cropland soil organic carbon (SOC) is a key property of soil quality for ensuring food security and agricultural sustainability, and also plays a central role in the global carbon cycle. Cropland SOC storage is mainly determined by the balance between C inputs in the form of residues and output from C mineralization. Much concern has been raised about how human and environmental factors has affected cropland SOC under long-term agricultural development trajectories<sup>1,2</sup>. By using a calibrated biogeochemical coupling model (GRAFS-AMG) based on cropland ecosystem perspective, in combination with spatially-explicit gridded environment and agricultural management data, the topic aims at quantifying the spatial and temporal patterns of cropland SOC storage from a century-long time span and investigating the underlying mechanisms<sup>3</sup>. To reach those goals, we will implement the following work plan: (i) Establish regional temporal and spatial cropland distribution dataset by using novel machine learning method, (ii) Calibrate a new AMG model<sup>4,5</sup> according to local pedo-climate conditions, (iii) Simulate the regional spatially-explicit dynamic of cropland SOC of 1 km gridded from a century-long time span, (iv) Quantitatively evaluate the relative impacts of temperature, precipitation, land cover change, fertilization, residue input on cropland SOC dynamic. This research will help to better understand the temporal and spatial pattern of cropland SOC and its driving mechanisms. This new scientific knowledge will allow to better inform the controlling

measures that can be implemented in order to improve cropland C sequestration for climate change mitigation and to ensure food security<sup>6</sup>.

**References** (people involved in the supervision underlined):

- [1] Le Noë, J., Billen, G., Mary, B., Garnier, J., 2019. Drivers of long-term carbon dynamics in cropland: a bio-political history (France, 1852–2014). *Environmental Science & Policy*, 93, 53-65.
- [2] Ren, W., Banger, K., Tao, B., Yang, J., Huang, Y., Tian, H., 2020. Global pattern and change of cropland soil organic carbon during 1901-2010: roles of climate, atmospheric chemistry, land use and management. *Geography and Sustainability*, 1(1), 59-69.
- [3] Billen, G., Lassaletta, L., Garnier, J., 2014. A biogeochemical view of the global agro-food system: Nitrogen flows associated with protein production, consumption and trade. *Global Food Security*, 3(3-4), 209-219.
- [4] Clivot, H., Mouny, J.C., Duparque, A., Dinh, J.L., Denoroy, P., Houot, S., Vertes F., Trochard R., Bouthier A., Sagot S., Mary, B., 2019. Modeling soil organic carbon evolution in long-term arable experiments with AMG model. *Environmental modelling & software*, 118, 99-113.
- [5] Kanari, E., Cécillon, L., Baudin, F., Clivot, H., Ferchaud, F., Houot, S., Levavasseur, F., Mary, B., Soucémarianadin, L., Chenu, C., Barré, P., 2021. A robust initialization method for accurate soil organic carbon simulations, *Biogeosciences Discuss.* [preprint], <https://doi.org/10.5194/bg-2021-246>, in review, 2021.
- [6] Launay C., Constantin J., Chlebowski F., et al, 2020. Estimating the carbon storage potential and greenhouse gas emissions of French arable cropland using high - resolution modeling. *Global Change Biology*, 27: 1645-1661.

**Type of PhD :**

1.Full PhD

- Joint PhD/cotutelle (leading to a double diploma) : NO
- Regular PhD (leading to a single French diploma) : NO

2. Visiting PhD (students enrolled at a Chinese institution who come to ENS for mobility period) :

YES

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