JOB OFFER

2 years postdoctoral position : Accounting for forest dynamics in the calculation of the carbon substitution of wood products

The Risk Foundation (FDR) of the Institut Louis Bachelier was created in 2007 on the initiative of four academic institutions (the Centre Economique des Actuaires, Ecole Polytechnique, ENSAE and Université Paris-Dauphine) and four financial institutions (Allianz (formerly AGF), Axa, Groupama and Société Générale) with the aim of making a lasting contribution to the development of French research potential in all areas of risk.

The French National Research Institute for Agriculture, Food, and the Environment (INRAE) is a public research establishment. It is a community of 12,000 people with more than 200 research units and 42 experimental units located throughout France. The institute is among the world leaders in agricultural and food sciences, in plant and animal sciences, and is 11th in the world in ecology and environment. INRAE's main goal is to be a key player in the transitions necessary to address major global challenges. In the face of the increase in population, climate change, scarcity of resources and decline in biodiversity, the institute develops solutions for multiperformance agriculture, high quality food and sustainable management of resources and ecosystems.

WORK ENVIRONMENT & MISSIONS

▪ General scientific context

In the field of forest science, "carbon substitution" consists in replacing a product with a substitute that provides the same service for human activities but whose life cycle emits less greenhouse gases (GHGs). Carbon substitution by wood products thus contributes significantly to mitigation strategies based on forest socio-ecosystems[1]. Carbon substitution is generally calculated as the difference between the carbon emissions of a reference trajectory without additional wood consumption and those of an alternative trajectory with additional wood consumption. For this purpose, current studies are based on the comparison of a Life Cycle Assessment (LCA) of the two trajectories in a "cradle to grave" perspective.

The full LCA-based calculations of substitution can be condensed in substitution coefficients[2] by dividing the difference in GHG emissions by the difference in wood used (CS, generally in $MtCO_2$ or MtC per tonne of wood or m^3 of wood). Substitution reflect the variation in GHG emissions resulting from the use of one extra unit of wood. These easy-to-use coefficients allow including substitution estimates in fields other than LCA but the literature shows a wide range of CS values, even when the scenarios being compared are similar. A meta-analysis of this literature shows that CS for long- and medium-life wood products are in the range of - 2.3 to 15 tC avoided per tC contained in the wood products[2]. This variability stems from differences in the definition of the system boundaries for the two trajectories compared and in the inventory of associated emissions. In particular, few LCAs today take into account the dynamics of biogenic forest carbon in situ (i.e. in the forest) in the calculation of substitution.

Sustainable harvesting of forest biomass has traditionally been considered carbon neutral in the LCA literature, based on the hypothesis that carbon released during combustion or decomposition of the biomass is sequestered back into the growing biomass[5]. Since 2010, however, dynamic LCA methodologies[6] have emerged and consider in particular the evolution of the "carbon debt" over time with the publication of several studies highlighting the need to extend LCA methodologies in this direction[5,7,8]. However, the lack of coupling between forest growth models and LCA still prevents a systematic and detailed consideration of carbon flows and stocks in forest ecosystems. As a consequence, most substitution studies and the resulting CS calculations do not take this into account.

■ Research Project

This research project starts from the general research hypothesis that the dynamic consideration of forest carbon fluxes and stocks affects the value of substitution. In order to test this hypothesis, we propose first to couple a growth and harvest simulator developed in a previous project (BiCaFF, funded by ADEME) by Aude Valade and Valentin Bellassen[7] with a forest sector bio-economic model (FFSM, French Forest Sector Model) developed at BETA[9,10]. Based on this coupling, the project will then provide a LCA of wood products that will take carbon dynamics upstream into account. Two tasks are distinguished and will be the subject of two publications:

Task 1: The BiCaFF project showed that increased harvesting in French forests leads to an increase in GHG emissions during the first 30 to 40 years, and showed that the "payback times" or "payback" of the carbon debt varied according to the origin of wood the wood[7]. Task 1 will build on existing simulations to:

- Analyse regional differences in carbon balance as a response to different harvest scenarios.
- Identify regions or species for which a shorter payback time is possible given their forest growth characteristics and the type of wood product produced.

This work will be the subject of a paper that will identify in which regions or for which species an increase in harvest levels would be least damaging to the carbon balance of the sector.

Task 2: This task aims at coupling the BiCaFF model and the FFSM bio-economic model in order to simulate the full effect of a policy encouraging the consumption of wood products (e.g. a wood consumption subsidy) on:
- The forest structure: harvested species, location of the harvest, age structure of the harvest
- The dynamics of resulting carbon flows in the wood supply chain.

In a second step, fossil emissions in each scenario will be added and potential substitution will be calculated by an LCA. This step will require careful definition of the baseline scenario in order to specify which materials are replaced by wood products. This second task will also be the subject of a scientific paper.

REFERENCES

1. Gustavsson, L. *et al.* Using biomass for climate change mitigation and oil use reduction. *Energy Policy* **35**, 5671–5691 (2007).
2. Sathre, R. & O'Connor, J. Meta-analysis of greenhouse gas displacement factors of wood product substitution. *Environmental Science & Policy* **13**, 104–114 (2010).
3. Werner, F., Taverna, R., Hofer, P. & Richter, K. Carbon pool and substitution effects of an increased use of wood in buildings in Switzerland: first estimates. *Ann. For. Sci.* **62**, 889–902 (2005).
4. Suter, F., Steubing, B. & Hellweg, S. Life Cycle Impacts and Benefits of Wood along the Value Chain: The Case of Switzerland: Life Cycle Impacts and Benefits of Wood. *Journal of Industrial Ecology* **21**, 874–886 (2017).

5. Helin, T., Sokka, L., Soimakallio, S., Pingoud, K. & Pajula, T. Approaches for inclusion of forest carbon cycle in life cycle assessment - a review. *GCB Bioenergy* **5**, 475–486 (2013).
6. Levasseur, A., Lesage, P., Margni, M., Deschênes, L. & Samson, R. Considering Time in LCA: Dynamic LCA and Its Application to Global Warming Impact Assessments. *Environ. Sci. Technol.* **44**, 3169–3174 (2010).
7. Valade, A. *et al.* Carbon costs and benefits of France's biomass energy production targets. *Carbon Balance Manage* **13**, 26 (2018).
8. Valade, A., Bellassen, V., Magand, C. & Luyssaert, S. Sustaining the sequestration efficiency of the European forest sector. *Forest Ecology and Management* **405**, 44–55 (2017).
9. Caurla, S. Modélisation de la filière forêt-bois française : Évaluation des impacts des politiques climatiques. (AgroParisTech, 2012).
10. Caurla, S., Bertrand, V., Delacote, P. & Le Cadre, E. Heat or power: How to increase the use of energy wood at the lowest cost? *Energy Economics* **75**, 85–103 (2018).

PRACTICAL INFORMATIONS

Training & Skills

Degree required: Ph.D. in forestry, ecology, economics or environmental sciences.

The profile sought is that of a research modeler in ecology and/or forest sciences, with an appetence for economics **or** an economist with skills in forestry and/or ecological modelling. A good knowledge of forest dynamics models is required. Previous experience in model coupling would be appreciated. Knowledge of Life Cycle Assessment is a plus, but is not required.

Supervision, environment & life quality :

The postdoctoral researcher's missions are at the heart of a partnership between the Risk Foundation represented by the Energy and Prosperity Chair and INRAE through three of its UMRs: BETA, CESAER and ITAP. The position consists in a combination of two contracts. On the first year, the postdoctoral researcher will be recruited by the Risk Foundation of the Louis Bachelier Institute. On the second year, the researcher will be recruited by INRAE. During the two years, the researcher will be scientifically integrated at INRAE and supervised by INRAE scientists. Ideally the researcher will be located at BETA on the AgroParisTech-Nancy campus, in the premises of Sylvain Caurla who will supervise the scientific work. Other locations (Montpellier and Dijon) or teleworking are possible and will be studied on a case-by-case basis. A close collaboration is planned during the first year with Valentin Bellassen (CESAER, INRAE, Dijon) and Aude Valade (Eco&Sols, CIRAD, Montpellier), both of whom are at the origin of the BiCaFF model. In the second year, a collaboration with UMR ITAP is envisaged (Eleonore Loiseau, INRAE, Montpellier).

↘ Working conditions

- Location:

UMR BETA, Nancy, France, http://www.beta-umr7522.fr/

OR

UMR Eco&Sols, Montpellier, France, https://www.umr-ecosols.fr/

OR

↘ How to apply

Applications and inquiries should be sent to:

Sylvain Caurla, researcher
(sylvain.caurla@inrae.fr) 03 83 39 68 96
Aude Valade, researcher
(aude.valade@cirad.fr)
Valentin Bellassen, researcher
(valentin.bellassen@inrae.fr) 03.80.77.27.91

UMR CESAER, Dijon, France, https://www2.dijon.inrae.fr/cesaer/

- Time period : one-year renewable, starting as soon as possible

- Salary :
  - ~2600€ (gross, per month) + precariousness bonus at the end of the contract (10% of gross salary).
  - Travel expenses related to project work will be fully covered.

✖ Application deadline: April 15th 2021. Applications will be evaluated on a rolling basis, as soon they are received.

Please submit your application as a single PDF file. This file should contain a 1-page cover letter describing your motivation to apply, a CV including relevant degrees, a publication list, and the contact information of 2 current or former supervisors.