



Post-doc in ecophysiology / forest modelling:

Modeling of the functioning of oak and Douglas fir stands as a function of objective density

Start proposed: January-February 2025

Context and aim:

European forests are affected by climate change, which have been accelerated in recent decades, with uncertain consequences. Therefore, it becomes difficult to predict wood production. However, this projection is an historic issue for the forest-wood sector, allowing it to plan the harvest, sustainability and renewal of the resource. This is all the more true to reduce the water stress. Silvicultural practices with a lower objective density can be envisaged to reduce the evapotranspiration of stands and the interception of precipitation, reduce the use of soil water reserve and improve its recharge. These management scenarios with lower density (and reduced LAI) raise many questions: on their quantitative impact on water flows and on ecosystem functioning, or on their impact on wood quality. These low-density stands are currently very poorly accounted for in forest production models, whether dendrometric or process-based. It is becoming urgent to focus on this type of management to assess their relevance, their real potential and their limits.

Our project will focus on sessile and pedunculate oak stands (23% of the volume of standing timber in French forests, according to the IFN), two species representing major historical challenges for the timber industry, and Douglas fir (5% of the surface, 30% of sawn softwood production by 2040), used as a reforestation species for many years.

To estimate the relevance of these itineraries, we want to compare them with the silvicultural scenarios currently implemented in the forest in projections for the year 2100 under different climate scenarios. The model considered is an eco-physiological model at stand scale, CASTANEA.

Scientific questions and aims:

In this work, we want to answer the question:

Will low-density forest management allow better resilience to water stress in oak and Douglas-fir stands in the context of climate change compared to currently management?

Technical challenge underlies this problem resolution:

Is it possible to work on low-density forest stands with an eco-physiological stand model, such as CASTANEA? Under which conditions?

Planned tasks:

To do so, the post-doctoral fellow will have to deal with 3 distinct objectives:

1. Improve CASTANEA model
2. Know its limits when representing low-density stands
3. Make projections to test a management panel under different future conditions

1. Several avenues are envisaged to improve CASTANEA model, arising from previous work:

- Make the allocation coefficient depend on stand dendrometric metrics
- Update dendrometric laws to implement in model with the knowledge present in the literature and the work carried out within the framework of DENSPROFOR project



- Refine integration of thinning effect in the model and generalize it to all species.
- Integrate a hydraulic dimension into CASTANEA model for temperate species (Oaks and Douglas fir in priority) to better simulate water stress

2. The main objectives of this sub-task are to: test CASTANEA limits on extreme densities (in particular for very low densities), define the domain of validity of CASTANEA on density point and provide ideas for extending this domain.

3. Work on this sub-task benefits from work done on the first two sub-tasks. In addition, it is planned to work with the ONF-RDI on the design of management practices to be tested as part of future projections. Then a relevant simulation plan will have to be adopted to answer the question:

Will low-density forest management allow better resilience to water stress in oak and Douglas-fir stands in the context of climate change compared to currently management?

Working environment :

This post-doctoral contract is part of a project funded by ADEME (Call GRAINE 2022), DENSPROFOR.

The host laboratory is UMR ESE (<https://www.ese.universite-paris-saclay.fr/>). The post-doctoral fellow will work with researchers from EV (the plant ecophysiology team) and will be supervised by **Christophe François**, with the involvement of Nicolas Delpierre.

Other partners are associated to this post-doctoral project:

- Researchers from UMR SILVA (<https://www6.nancy.inrae.fr/silva/>), in particular mechanistic (**Marion Jourdan**, coordinator of DENSPROFOR project) and phenomenological (Julien Sainte-Marie) modellers and silvicultural experimenter (Ingrid Seynave). The post-doctoral researcher will be offered the opportunity to travel regularly to Nancy.
- The engineers of the ONF-RDI of Dôle, Salomé Fournier and Thomas Cordonnier.

Required skills:

- Master or PhD degree in plant ecology/ecophysiology and background in environmental physics;
- Demonstrated publication skills ;
- Working knowledge in programming and in one computer language at least;
- Strong interest in the modelling of complex systems;
- Working knowledge of the English language;

Work details:

- Post-doc grant 18 months duration, starting January-February 2025
- Net salary: following Université Paris-Saclay salary scales according to diploma and experience

How to apply:

Send a detailed CV, application letter and coordinates of 2 reference persons:

- Christophe François (ESE, Saclay): christophe.francois@universite-paris-saclay.fr
- Marion Jourdan (SILVA, Nancy): marion.jourdan@inrae.fr

Application deadline : December 31th, 2024