

Climate-induced changes in suitable areas for wheat production: crop modelling approach with a focus on high temperatures and atmospheric CO₂ concentration effects.

Young scientist position

INRAE is looking for a motivated postdoc / young scientist for a project focused on the **adaptation of winter wheat to climate change in France** via the use of climate analog methods and **crop modelling**. Work will be performed in collaboration with researchers of the French agronomic institute (INRAE¹) in Grignon (near Paris) and Avignon (southern France), of the University of Queensland² (Australia) and with scientists of the ARVALIS Plant Institute³.

Background

Climate change is characterized not only by increasing trends in temperature, changes in key climate variables such as precipitation and radiation, but more importantly by changes in their seasonality, variability and extremes. This challenges crop growth and thus production. Projecting the potential impacts of climate change on production can be done using crop models that simulate the impact of various abiotic stress (and their interactions) on crops during their growing cycle.

Our recently funded project, REGARD, has chosen to explore the potential future conditions for growing winter wheat in France and Australia. The objective is to identify and quantify geographical displacements of current wheat production environments, as well as characterize projected conditions that will be compared with current climates from wheat breeding stations in other parts of the world.

Overall aim

The successful candidate will work on modelling the effects of high temperatures and atmospheric CO₂ concentration effects on wheat physiology.

Firstly he/she will review the state of the art of the relative formalisms implemented in the crop models⁴, and then propose possible improvements of these formalisms for the 2 models of the project: APSIM⁵ and STICS⁶. He/she will test these models on their ability to account for these climatic effects, using ad hoc data sets (e.g. FACE experiments). He/she will propose a critical analysis of the results obtained by modelling, including potential acclimation of processes such as photosynthesis.

Second, the post-doc will use the project's models to study the evolution of climate risks in ecoclimatic niches (established by a collaborator post-doc from the LSCE - Laboratoire des Sciences du Climat et

¹ <https://www.inrae.fr/>

² <https://qaafi.uq.edu.au/>

³ <https://www.arvalisinstitutduvegetal.fr/>

⁴ Toreti, A., Deryng, D., Tubiello, F. N., Muller, C., Kimball, B. A., Moser, G., . . . Rosenzweig, C. (2020). Narrowing uncertainties in the effects of elevated CO₂ on crops. *Nature Food*, 1(12), 775-782. doi:10.1038/s43016-020-00195-4.

Vanuytrecht, E., & Thorburn, P. J. (2017). Responses to atmospheric CO₂ concentrations in crop simulation models: a review of current simple and semicomplex representations and options for model development. *Global Change Biology*, 23(5), 1806-1820. doi:10.1111/gcb.13600

⁵ Holzworth, D. P., Huth, N. I., Devoil, P. G., Zurcher, E. J., Herrmann, N. I., McLean, G., . . . Keating, B. A. (2014). APSIM - Evolution towards a new generation of agricultural systems simulation. *Environmental Modelling & Software*, 62, 327-350. doi:10.1016/j.envsoft.2014.07.009

⁶ Brisson, N., Mary, B., Ripoche, D., Jeuffroy, M. H., Ruget, F., Nicoulaud, B., . . . Delecolle, R. (1998). STICS: a generic model for the simulation of crops and their water and nitrogen balances. I. Theory and parameterization applied to wheat and corn. *Agronomie*, 18(5-6), 311-346. doi:10.1051/agro:19980501

de l'Environnement)⁷ in mainland France and Australia. He/she will attempt to distinguish the projected evolutions, and in particular the way in which wheat growth and development will be impacted by the interactions between drought, thermal stresses and the effects of CO₂ in projected *climates*.

Last, he/she will achieve *in silico* experiments to propose local adaptations of wheat management to climate change.

Short trips to Avignon (1 week several times) and Australia (2-3 months) will be necessary to interact with the other partners of the REGARD project.

Skills and selection criteria:

- Good knowledge in agronomy and/or plant physiology, understanding of climate and impact sciences, interest and motivation in programming, demonstrated experience working with models, skills in core statistics.
- Dynamic and collaborative team player, autonomous, proactive and rigorous.
- Ability to effectively communicate with colleagues and with staff from the partners of a project
- Time management skills
- Good English oral and written communication

What INRAE can offer you:

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.

By joining our team, you benefit from:

- up to 30 days of annual leave + 15 days "Reduction of Working Time" (for a full time);
- parenting support: CESU childcare, leisure services;
- skills development systems: training, career advise;
- social support: advice and listening, social assistance and loans;
- collective catering.

Location: Université Paris-Saclay, located about 30 km from the heart of Paris

Contract duration: 24 months with possible extension

Starting date: The position is available from March 2022 and will remain open until filled

Salary: Competitive salary with full social and health benefits, commensurate with work experience

How to apply: Applicants should submit a complete application package by email. The application package should include (1) a curriculum vitae including the publications, (2) statement of motivation, (3) names, addresses, phone numbers, and email addresses of at least two references.

⁷ <https://www.lsce.ipsl.fr>



REGARD

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Search for climate analogs to select tomorrow

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