

## “Climate analogs”: a data-science method to project spatial climate changes

### Application to wheat production areas

*Young scientist position (postdoc)*

The Laboratoire des Sciences du Climat et de l'Environnement – LSCE – is looking for a motivated postdoc / young scientist for a project focused on the **development of a machine learning method based on the climate analogs approach**, a data-driven methodology for statistical pattern recognition. This method will be applied to **adaptation of winter wheat to climate change in France**. Work will be performed in collaboration with researchers of the French agronomic institute (INRAE<sup>1</sup>) in Avignon, Grignon and Australia and with scientists of the ARVALIS Plant Institute<sup>2</sup>.

#### Background

Climate change is characterized not only by positive 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 growing and thus production. Projecting the potential impacts of climate change on production can be done using specific crop models but also agro-climatic indices that calculate the various meteorological stress crops experience during their different phenological stages throughout their growing cycle<sup>3</sup>.

To explore the potential future climate conditions, the funded project REGARD will rely on the “climate analogs” data-driven method. Based on appropriate distances (to be defined), climate analogs allow finding future situations the most similar to some present ones. This approach is thus to be properly defined, implemented and investigated. Then, when applied to agro-climatic indices characterizing wheat production conditions, it will project future locations with similar conditions. The application objective is then to illustrate and quantify the geographical displacements of the suitable areas of wheat production, as well as the potential for the appearance of new conditions in France. These new situations will be compared with the climates currently known in some reference present locations in other parts of the world.

#### Overall aim

The successful candidate will start implementing and investigating the “climate analogs” method. Then, s/he will compute the spatial and temporal evolutions of specific agro-climatic stress designed by INRAE for different wheat breeds, for historical climate and various global scenarios of future climate change. All scenarios have been bias-corrected and downscaled at about 50km resolution<sup>4</sup> and even 11km for some.

From today's distribution of the agro-climatic stages and climatic conditions during those stages, s/he will apply the “climate analogs” methodology, in order to characterize the spatial distribution of favorable wheat growing conditions in France.

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<sup>1</sup> <https://www.inrae.fr/>

<sup>2</sup> <https://www.arvalisinstitutduvegetal.fr/>

<sup>3</sup> Caubel, J., García de Cortázar-Atauri, I., Launay, M., de Noblet-Ducoudré, N., Huard, F., Bertuzzi, P., & Graux, A.-I. (2015). Broadening the scope for ecoclimatic indicators to assess crop climate suitability according to ecophysiological, technical and quality criteria. *Agricultural and Forest Meteorology*, 207, 94–106. <https://doi.org/10.1016/j.agrformet.2015.02.005> ; Caubel, J., Garcia de Cortazar-atauri, I., Vivant, A. C., Launay, M., & de Noblet-ducoudré, N. (2017). Assessing future meteorological stresses for grain maize in France. *Agricultural Systems*. <https://doi.org/10.1016/j.agsy.2017.02.010>

<sup>4</sup> Noël, T., Loukos, H., Defrance, D., Vrac, M., Levvasseur, G. (2021) High-resolution downscaled CMIP5 projections dataset of essential surface climate variables over the globe coherent with ERA5 reanalyses for climate change impact assessments. <https://doi.org/10.31223/X53W3F>

Analysis of future climate-based indicators will allow to identify the potential geographical displacement of areas suitable for growing wheat as well as how climatic conditions will evolve within today's areas. In case of significant changes in France, analogs of future growing conditions will be sought elsewhere in the world. This search for analogs is important as it can help breeders identify areas for selecting tomorrow's French breeds.

#### Requirements:

- Programming skills, preferably in R, although other languages are possible
- Skills in statistics and/or machine learning
- Interest and motivation in modeling, climate and impact sciences

#### Selection criteria:

- PhD
- Demonstrated experience working with complex codes and/or large datasets
- Demonstrated experience in the use of statistics and/or machine learning
- Autonomy, ability to work in a team and time management skills
- Ability to write in English
- Experienced in multidisciplinary team-based activities with the ability to effectively communicate with colleagues and with staff from the partners of a project

#### What LSCE can offer you:

LSCE<sup>5</sup> is an established, world-class research laboratory, representing a collaboration between CEA, CNRS and the University of Versailles Saint-Quentin (UVSQ), all three now being part of the new Paris-Saclay University. It is part of the Institute Pierre Simon Laplace (IPSL). LSCE hosts approximately 300 researchers, engineers and administrative staff including many PhD and master's students. This project will provide the employee with the opportunity to work directly on advanced methods with researchers from the LSCE and other institutions.

*Location:* Laboratoire des Science du Climat et de l'Environnement (<https://www.lsce.ipsl.fr>) located about 20 km from the heart of Paris in the Orme des Merisiers green area.

**Contract duration:** 18 months

**Starting date:** The position is available from June 2021 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.

#### Contacts:

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<sup>5</sup> <https://www.lsce.ipsl.fr>