Inria Chair of Junior Professor

Supporting institution / organization
Head of the institution / organization: Bruno Sportisse
Site concerned: Centre Inria de Sorbonne Université
Academic Region: Paris

Partner institution organization
Sorbonne Université

Project name
AI Research for Climate Change and Environmental Sustainability

Acronyme
ARCHE (AI Research for Climate Change and Environmental Sustainability)

Thématique scientifique
Climate simulation and modeling, data assimilation, and machine learning

Mots-clés
Statistical learning, machine learning, mathematical modeling, data assimilation

Target duration
3 to 6 years

Profile required
A PhD or equivalent is mandatory to apply. A successful postdoc experience of 3+ years is expected to benefit from the possibility to become a senior permanent researcher within a 3-to-6-year time after hiring.

Financial overview
200,000€ for the duration of the project financed by ANR and which may be supplemented by Inria via incentive ressources.

Section (s) CNU/CoNRS
26, 27, 37 / 07, 19, 41

Contacts
- Eric Fleury, Director of the Inria center at Sorbonne University: Eric.Fleury@inria.fr
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- Solène Turquety, Head of EUR IPSL Climate Graduate School: solene.turquety@latmos.ipsl.fr

- Gérard Biau, Director of SCAI (Sorbonne Centre for Artificial Intelligence): <u>gerard.biau@sorbonne-universite.fr</u>
- Claire Montéléoni, leader of ARCHE project, claire.monteleoni@inria.fr

Context
As stated in the Inria COP 2019-2023, in order to retrospectively demonstrate major contributions in a few scientific priorities, Inria has made choices and considers the theme of "Responsible AI", which encompasses a set of scientific themes on mastering algorithms and data processing chains, as a priority. Inria also considers major application sectors such as "sustainable development and energy" in its priorities. Inria must promote the renewal of scientific themes and the emergence of new disciplines with a key role of digital technology as a lever for interdisciplinarity. Inria wishes to establish a new project team in Paris, with the core focus on the major challenge of research in artificial intelligence for climate change and environmental sustainability.

In this context, the Inria center at Sorbonne University wishes, in collaboration with the LATMOS laboratory (Laboratoire Atmosphères, Observations Spatiale), a member of the Institut Pierre Simon Laplace (IPSL), and in connection with the SCAI institute (Sorbonne Center for Artificial Intelligence), whose theme "Climate, Environment & the Universe" is a key axis of its strategy, to co-build a new joint project team ARCHES with the core focus on the major challenge of research in artificial intelligence for climate change and environmental sustainability.

This creation strengthens the actions taken by SU. Indeed, SCAI promotes a transdisciplinary program of "minor in AI and Data Science". This option fully relies on SU's pedagogical structure of "minor", which allows students to obtain a degree in a major discipline while developing solid foundations in a minor discipline on complementary or related themes. The AI and Data Science minor is accessible to all students enrolled in the Faculty of Science and Engineering.

The recruitment of an INRIA junior professorship chair complements Claire Monteleoni's recruitment in 2023 through the Chose France program and will strengthen the creation of a "minor in AI and Data Science". This recruitment will also enable the creation of a hub with critical mass, capable of conducting cutting-edge research.

Summary of the scientific project
The field of climate science is incredibly rich in data, encompassing not only in-situ and remote-sensed observational data but also vast amounts of simulation results from physics-driven climate models. The potential of machine learning (AI algorithms for extracting insights from large datasets) is immense in improving and developing more sophisticated climate models and simulations to provide a more comprehensive picture of how climate change affects the planet. The objective is to develop an Inria project team focused on integrating machine learning to address climate change along three major axes:

1. AI for climate change adaptation: Forecasting Extreme Weather Events. Extreme weather events, such as heatwaves and severe storms, can have significant impacts on society, including hazards such as droughts, wildfires, and floods. Machine learning can help improve the prediction of such extreme events, which will be essential in aiding communities to adapt to a changing climate in the short term by adapting new "fundamental weather models" to be effective for extremes rather than averages.
2. AI for climate change mitigation: Reducing carbon emissions through renewable energy and land use changes. There are clear benefits of machine learning in renewable energy forecasting, significantly outperforming traditional weather prediction models. A joint challenge with EDF is launched, focusing on renewable energy forecasting problems for long-term energy planning. Land use changes also have the potential to reduce CO_2 emissions; however, the possible impacts of land use changes on CO_2 emissions and their relevant uncertainties are not well understood. Machine learning can contribute to solving this problem in various ways.
3. AI for long-term climate change prediction and its impacts. In collaboration with climatologists, the goal is to develop machine learning approaches to better understand the impact of a changing climate on sea levels. By utilizing both climate model simulations and satellite measurements of sea surface height, we aim to forecast global and regional sea level trends under various carbon emission scenarios. Machine learning can also be employed to refine data from coarse-resolution model simulations to the fine resolutions necessary to study polar ice melt and its effects on sea level.

Summary of the teaching project

The junior professor will significantly contribute to the pedagogical initiatives launched and supported by SCAI within the framework of the national strategy in Artificial Intelligence and the France 2030 program, both through the trans-disciplinary program of "minor in AI and Data Science" and through continuing education programs.

The junior professor will carry out a mission as a teacher-researcher in the field of machine learning, statistics, artificial intelligence (AI) and data science, broadly defined. He or she will be assigned to the Mathematics Department or the Engineering Department of the Faculty of Science and Engineering at Sorbonne University.

The holder of the position will be responsible for teaching undergraduate and graduate students. He or she may teach in one or more of the following programs:
- Research workshops on data science in L1,
- Data Science and AI tracks in Mathematics and Computer Science Bachelor's programs,
- "AI and Data Science" minor offered in L2 and L3 to students in Chemistry, Mechanics, Physics, Earth Sciences, and Life Sciences programs,
- Optimization, statistics, and AI courses offered in Sorbonne University's Master's programs,
- EUR-IPSL Climate Graduate School.

In addition to teaching, the holder of the position will participate with other teacher-researchers in the relevant disciplines in the pedagogical design of courses in the field of data science, optimization, statistics, and AI at Sorbonne University, and in the reflection on their evolution. He or she will have the opportunity to get involved and participate in continuing education programs offered by the Faculty of Science and Engineering at Sorbonne University in these different fields.

Skills

- Scientific excellence,
- Supervision/management skills,
- Teaching skills,
- Participation in the scientific direction of the project,
- Project management and fundraising abilities.