

POST-DOCTORANT (H/F); Postdoc (female/male) Temps 100 %; full time ASSET: Advanced modelling of Spatio-temporal Sea-state ExTremes

Job Description

Employer

Université Côte d'Azur is committed to pursue transformation and excellence in its teaching, research and organizational practices with the aim of ranking among the top universities and of maintaining strong regional roots at the same time as an international outreach. More information at <https://univ-cotedazur.eu/working-for-universite-cote-dazur>.

The Inria Center of Sophia Antipolis (<https://www.inria.fr/fr/centre-inria-universite-cote-azur>) and the Observatoire de la Côte d'Azur (<https://www.oca.eu/fr/>) are members of Université Côte d'Azur.

General context of the project

The proposed work is part of a vast project entitled *Intelligent_Mapping*, itself part of the PEPR IRIMA project funded in 2024 by the Agence Nationale de la Recherche (ANR) as part of the National PIA4 France 2030 program. IRIMA is led by CNRS, Grenoble Alpes University and BRGM, and aims to structure and strengthen hazard and risk science in France. *Intelligent_Mapping* is a component of IRIMA, and is supported and hosted by Université Côte d'Azur (PIs: Isabelle Manighetti and Elena Di Bernardino). More specifically, *Intelligent_Mapping* is integrated into the IRIMA Plateformes Consortium, supported by BRGM (PI: J. Langlois). The primary aim of *Intelligent_Mapping* is to develop Artificial Intelligence (AI) algorithms able to identify, map, and measure in airborne and satellite images of the Earth, the natural and socio-environmental hazards and risks studied in IRIMA (earthquakes, tsunamis, volcanic eruptions, landslides, avalanches, floods, forest fires, destroyed vegetated areas, erosion and changes of littoral areas, etc.). The ASSET postdoctoral research project, "Advanced modelling of Spatio-temporal Sea-state ExTremes," is part of the modeling component and aims to develop statistical models of extreme events such as cyclones and marine submersion. The project is being carried out in collaboration with the ROM Consortium (Risques en Outre-Mer) of the PEPR IRIMA, which focuses specifically on telluric, environmental, and hydrometeorological risks in overseas territories.

Overall topic: Improve the spatio temporal modelling of compound extreme events (sea states)

The postdoc will focus on the development of a stochastic generator of extreme sea states with accounts for the spatio-temporal evolution. The project combines methodological innovation in statistics with applications to real coastal and marine processes. The objective is to improve the spatio temporal modelling of compound extreme events (sea states) in order to reproduce such episodes while controlling the extremal level and the possible knowledge of covariate values.

General approach

The work will rely on recent developments in extreme value statistics with explicit treatment of dependence. Particular attention will be given to the compound nature of sea states, typically described by the triplet [significant wave height, peak period, direction], together with additional variables such as wind or surge. These quantities must be treated jointly, their multivariate structure being central to the proposed developments. Sea states also fluctuate in time (seasonality, long term trend) and space, and present temporal and spatial dependence. The project will explore generative approaches, enabling the simulation of realistic extreme episodes from numerical model outputs and allowing scenario-based exploration under modified or amplified conditions. Parameter inference may also involve machine learning tools, allowing hybrid stochastic modelling and AI based inference while retaining interpretability and explicit control of dependence structures. The theoretical part of the project is central to the Intelligent_Mapping project (Platforms Consortium).

Real case applications

Real-world applications will be carried out in collaboration with BRGM and IRIMA's ROM consortium. The work will consist of studying sea conditions either in a Mediterranean context or in a cyclonic context in the French Antilles (or both, time permitting), where these processes are key drivers in coastal flooding. In the cyclonic case, the project will exploit a BRGM database with an equivalent duration of 1000 years described by Sando et al., (2024). These studies are directly linked to coastal risk assessment and to the characterisation of extreme marine hazards, which are central challenges for coastal communities.

Keywords

Statistical modelling, Extreme, Spatio-temporal modelling, Artificial intelligence, Waves

References

Sando, K., Wada, R., Rohmer, J., & Jonathan, P. (2024). Multivariate spatial and spatio-temporal models for extreme tropical cyclone seas. *Ocean Engineering*, 309, 118365.

Candidate's main activities

The selected postdoctoral candidate is expected to:

- Become familiar with state-of-the-art methods for multivariate and spatio-temporal extreme value analysis
- Develop and implement statistical models incorporating multivariate and spatio-temporal dependence structures
- Design generative approaches for the simulation of extreme sea states, possibly conditioned on covariates
- Adapt/develop neural estimators for model inference
- Disseminate the results through scientific publications (in English) in leading international journals in statistics and geosciences
- Present the work at international conferences
- Make the algorithms easy and practical to use for all users (the algorithms will be shared on an open platform).

Profile

The candidate should have a PhD in statistics with a strong interest in environmental sciences.

Required skills:

Top candidates would also have a strong command of:

- Statistical modelling.
- Extreme value modelling.
- AI skills.
- Proficiency in R and/or Python.
- Scientific writing.
- Oral communication.

Desirable optional skills:

- Experience in processing or manipulating very large data sets.
- Motivation for working on real cases.

Work location

The postdoc work will be supervised by a team including experts in statistical modelling, extreme value analysis, data science applied to coastal environments, oceanography, coastal engineering. The postdoctoral candidate will be hired at Université Côte d'Azur but will work in a partner of the Intelligence Mapping project, namely Inria-Montpellier, and more specifically the LEMON team, which is a joint project team involving two laboratories of the University of Montpellier: Hydrosiences (HSM) and Institut Montpellieran Alexander Grothendieck (IMAG). The team's research themes include coastal risk assessment, flood risk, extreme events, and the behavior of coupled physical and environmental systems.

The work will be conducted in strong collaboration with BRGM, which is also partner of the Intelligence Mapping project. BRGM is a public institute (EPIC) in applied Earth Sciences with widely recognized expertise in natural hazard and risk assessments. The work is part of the activities of the BRGM direction named Risks, and more particularly of the team (about 20 researchers) focused on coastal risks and climate change impact. These activities cover monitoring, field surveys, numerical and statistical modeling and support to decision making for risk planning.

Teleworking possible 2 days/week maximum

Application conditions

Recruitment type: CDD 24 months

Requirements: to have a PhD diploma or official equivalent

Complementary information

Applications, including a curriculum vitae, a letter of motivation, and the names and contacts of 3 referees, should be sent to isabelle.manighetti@univ-cotedazur.fr, gwlady.toulemonde@umontpellier.fr, and j.rohmer@brgm.fr with a copy to recrutement@univ-cotedazur.fr, by 01/03/2025.