2021-04062 - Post-Doctoral Research Visit F/M Inference of regional patterns affected by ENSO dynamics

Type de contrat : CDD
Niveau de diplôme exigé : Thèse ou équivalent
Fonction : Post-Doctorant
Niveau d'expérience souhaité : Jeune diplômé

A propos du centre ou de la direction fonctionnelle

GeoStat is an **INRIA** project located at **INRIA Bordeaux Sud-Ouest (INRIA BSO)**, inside the theme: *applied mathematical computation and simulation, optimization, learning and statistical methods.*

The team makes fundamental and applied research in the analysis of complex natural signals using paradigms and methods from Statistical Physics such as: **scale invariance**, **predictability**, **universality classes** We study the parameters related to common statistical organization in different complex signals and systems, we derive new types of **sparse** and **compact representations**, and **machine learning approaches**. We are also developing tools for the analysis of complex signals that better match the statistical and geometrical organisation inside these data: as a typical example, we cite the evaluation of *cascading properties of physical variables* inside complex signals.

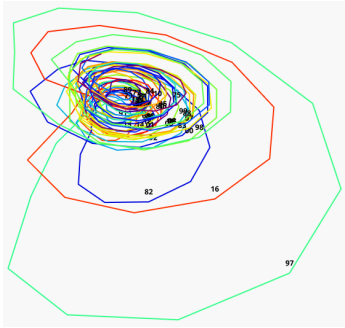
Contexte et atouts du poste

Climate in the Pacific areas, from Australia to the Americas coastline, is strongly influenced by the ENSO phenomenon (El Niño Southern Oscillation) corresponding to irregular oscillations of the sea surface temperature and winds. At the maxima of these oscillations, huge rainfall events create devastating floods on the Pacific South American coastline, while severe droughts and fires impact opposite regions (Australia, South East Asia, India). We focus especially on the area of the Pacific coast and slope (Andes) of Peru. We monitor the runoff of 49 river catchments, together with measured precipitations and temperatures over their watersheds, from the 1970s to the present [1]. We are then able to define regions with homogeneous hydroclimatology (e.g., wet or arid, coastal or montainous, etc) [2]. Four indices of sea surface temperature aggregate the influence of distinct zones of the Pacific Ocean on the ENSO phenomenon. Taken together, this approach allows to study the ENSO effects on separate regions. In particular, we aim at identifying the main influential factors that trigger extreme events in each region. We use a global approach in order to build an integrated model of the regionalized ENSO dynamics. Our goal is to produce reasonable predictions for each region, over the 3, 6 months to 1 year range, that the model states deviate from normal and may lead to an extreme event.

Mission confiée

You will join an active team of multi-disciplinary research and must be prepared to work both on the theoretical aspects of dynamical systems inference, as well as the hydro-climatological aspects of the ENSO effects we are trying to model and quantify. This work is part of an on-going collaboration described on this page : https://team.inria.fr/comcausa/el-nino-southern-oscillation/

Our approach is based on computational mechanics and more precisely the method detailed in [3]. It consists in identifying the internal states of the natural process, states with the same causal influence, and how they evolve through time. These dynamical states are embedded in a low-dimensional state space, corresponding to the main influential parameters. These should also correspond to some combination of environmental factors driving the ENSO dynamics. This allows us to reconstruct attractors and make predictions along their trajectories. The example on the right is such an attractor, showing both the seasonal cycles and the extreme events of 1982, 1997 and 2016.



You will use the regionalized data described in [1,2] and the method from [3] to build predictive models for the 3, 6 months and 1 year range, over each hydro-climatologically consistent region. In order to best build these models, you will explore how each environmental parameter influences the dynamical reconstruction and affects predictions. But each descriptive variable (sea surface temperature, precipitations, water runoff...) is also the result of multiple interacting natural processes (oceanic, atmospheric and continental cycles), each with their own characteristic time scales. Theoretically, these scales also impact the relative influence of how each variable is accounted with respect to each other. Expliciting these multi-scale links in relation to the system dynamics (possibly reconstructed at different scales) is a methodological challenge that will also be addressed as part of this post-doctoral research

References

[1] Rau P *et al.* (2018): Assessing multidecadal runoff (1970–2010) using regional hydrological modelling under data and water scarcity conditions in Peruvian Pacific catchments. Hydrological Processes 33 (1) 20-35.
[2] Rau P *et al.* (2017): Regionalization of rainfall over the Peruvian Pacific slope and coast. International Journal of Climatology 37(1): 143–158.
[3] N. Brodu, J.P. Crutchfield : Discovering Causal Structure with Reproducing-Kernel Hilbert Space ε-Machines. https://arxiv.org/abs/2011.14821

[4] : Bourrel L et al. (2015): Low-frequency modulation and trend of the relationship between ENSO and precipitation along the northern to centre Peruvian Pacific coast. Hydrological Processes 29(6): 1252-1266

Principales activités

Research, analyzing data, coding (Python), writing articles

Informations générales

- **Thème/Domaine :** Sciences de la planète, de l'environnement et de l'énergie
- **Ville :** Talence
- **Centre Inria :** CRI Bordeaux - Sud-Ouest
- **Date de prise de fonction souhaitée :** 2022-03-01
- **Durée de contrat :** 12 mois
- **Date limite pour postuler :** 2022-02-28

Contacts

- **Equipe Inria :** GEOSTAT
- **Recruteur :**
Brodu Nicolas / nicolas.brodu@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3500 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 180 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

A recently obtained PhD in either computational sciences or environmental sciences.

Candidates from either background are encouraged to apply, but must show a strong interest in both disciplines. A commitment to multidisciplinary and collaborative research is required.

Consignes pour postuler

For more information please contact:
- Nicolas Brodu = nicolas.brodu@inria.fr
- Luc Bourrel = luc.bourrel@ird.fr

Thank you to send:
- CV
- Cover letter
- Support letters (mandatory)
- List of publication

Sécurité défense :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement :
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention: Les candidatures doivent être déposées en ligne sur le site Inria. Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération

2653€ / month (before taxs)