Open position at Météo-France (CNRM) in Artificial Intelligence for Numerical Weather Prediction

Position

This Post-doctoral position on probabilistic prediction of extreme weather events based on AI/physics synergy is part of the POESY project funded by the French National Research Agency.
Application deadline: 15 october 2021
Duration of contract : 27 months
Expected starting date : 1 January 2022

Context

High-Impact Weather (HIW) events have devastating effects on society, causing human losses, degradation of infrastructures and large economic impacts. Severe precipitating events, damaging thunderstorms and strong winds are among the most impacting events from a meteorological point of view, with various severe indirect effects such as flooding, landslides and marine submersion. Being rare, HIW events lie in the tail of climatological distribution of weather events. Although meteorological services such as Météo-France have done significant progress in predicting weather for the last decades, accurately predicting the occurrence, intensity, location and timing of HIW still remains challenging.

Currently operational weather forecasts rely on physically-based modelling approaches, and Numerical Weather Prediction (NWP) models are operated daily to determine the future atmospheric states and the risk of HIW. In particular, Ensemble prediction systems (EPSs) aim at sampling the probability distribution of future atmospheric states. They consist in running several NWP forecasts in order to account for the different sources of uncertainty. At Météo-France, the operational AROME-EPS, which runs 16 perturbed forecasts with a spatial resolution of 1.3km, is used to anticipate the risk of HIW. However, properly capturing the associated uncertainty requires very high resolution (few hundred meters) large-size (few hundred members) ensembles. Nonetheless, such enhanced systems are currently unfeasible for operational NWP because of the associated computational cost.

In this context, the main objective of the POESY project is to explore the scientific feasibility and relevance of an **innovative hybrid EPS design, combining standard physical modelling with computationally-efficient Artificial Intelligence (AI) techniques,** in order to produce disruptive probabilistic forecasts for high-impact weather.

Objectives

The goal of this 27-month post-doctoral position is to **improve the representation of forecast probability distributions** by increasing the AROME-EPS sampling from O(10) to 0(1000) forecasts thanks to complementary **AI-generated forecasts.** For that purpose, physically-constrained deep generative models such as GANs and Variational AutoEncoders will be developed and evaluated. Besombes et al. (2021) provides a first example of GAN-based weather scenario. A crucial part of the work will be to adapt off-the-shelf learning architectures to the particularities of this geophysical problem. A specific attention will be paid to the following points : the learning of extremes, ensuring spatial, temporal and physical consistencies in the generated forecasts, mode collapse problem.

Required skills

The ideal candidate would have the following qualifications :

- a strong background in deep learning algorithms, in particular convolutional neural networks and deep generative models
- experience in geophysical problems would be appreciated, at least a strong interest for applied research in atmopsheric physics is highly recommended
- Proficiency with Python programming and AI librairies
- Experience with processing large volumes of data
- Experience of working in a Linux-based environment
- Aptitude for scientific work, written and oral communication in English, meetings abroad possible
- A scientific curiosity, autonomy, rigor in the interpretation of the results

Practical aspects

This work will be carried on in the Assimilation and Forecasting group of the Météo-France research department (CNRM), in Toulouse, France. The postdoc will benefit from the Meteo-France/CNRM computational facilities and will have access to the Météo-France archive of forecasts.

The net monthly salary will be around 2400 euros. This includes French social security (health insurance).

Application procedure

Interested candidates should send the following documents by e-mail to laure.raynaud@meteo.fr, olivier.pannekoucke@meteo.fr and ronan.fablet@imt-atlantique.fr **:**

- A curriculum vitae detailing experience and technical skills
- Motivation letter explaining interests for the job
- Recommendation letters will be appreciated

References

Besombes et al., 2021 : Producing realistic climate data with Generative Adversarial Networks, Nonlin. Processes Geophys., 28, 347–370, https://doi.org/10.5194/npg-28-347-2021.