**3-years PHD – Position at Météo France**

Team :
**CNRM – UMR 3589**
**42, av G. Coriolis**
**31057 TOULOUSE Cedex**
**FRANCE**

Title :
**Predictability of Mediterranean Heavy Precipitating Events, strategies for early warning diagnosis.**

**Contact** :
Bruno Joly bruno.joly@meteo.fr , tél : +335.61.07.99.09
Philippe Arbogast philippe.arbogast@meteo.fr, tel : +335.61.07.96.39

Deadline to apply : 13 May 2016
Starting date : 01 October 2016

Summary :

Episodes of intense rainfall in the Mediterranean are part of the climate phenomena affecting western Europe whose societal impact is the most important. During these events, rainfall daily amounts can reach values equivalent to annual total within a single day. Associated torrential floods are responsible for considerable human and material damage (Aude 1999 Gard 2002 Riviera 2015). If long term territory adaptations are necessary, a more reliable and anticipating alert would benefit in a short term. Weather forecasting coupled with hydrological impact forecast is the main source of information for warnings. Experience shows that major sources of uncertainty in weather forecasting still remain, lowering the quality of the forecast, from the first 24 hour, namely the national “vigilance” procedure, to the entire warning forecast. On another hand, even at 24h term, the forecast process is based on a model analysis well before that date, between 4 to 2 days prior the issuance of the vigilance. A better understanding of sources of model uncertainty at such time-range may represent a major source of improvement for early warning. Quantitative precipitation forecast have improved dramatically in the last 10 years to produce realistic accumulated rainfall estimation. Nevertheless, reducing uncertainties of initial conditions analysis and physical processes modeling remain challenging issues. Going forward a probabilistic approach is first an effective method to estimate errors in numerical modeling as well as a fully adapted methodology to address extreme events issues. However the contribution of ensemble forecasting in the management of the alert is not shown today.

In addition, systematic studies of large-scale weather environments favoring the Mediterranean rainy episodes occurrence shows a climatological determinism between some atmospheric large scale patterns and intense rains events (Nuissier 2011). Experimentally, an index based on this latter study applied to the operational ensemble forecast at Météo France, showed that we could reliably detect these environments regardless of forecast term. Similar results were obtained with the model of the European Center for Medium Range Weather Forecasts (ECMWF) at lead-times up to 10 days. Significant potential predictability appears to exist beyond the deadlines where quantitative forecasting rainfall is of greater quality. The subject of this thesis would be to assess and validate this potential.

First, we will build on the results of a recent study in the team, which helped define new large-scale structures linked with heavy rains at a more regional scale (Pyrénées Orientales, Hérault, Cévennes mountain and plain, PACA). The subject will also benefit especially from a simulations database covering the last 30 years of a simplified version of the ensemble prediction at Météo-France PEARP (Descamps et al, 2015). This dataset will allow to examine the full distribution of ensemble forecasts heavy rainfall events of the last

35 years. The exceptional character of the rains provided by the system will then be estimated from the dissimilarity to the climate of the whole dataset. Intense events with lower predictability will be particularly addressed. The aim is to quantify the benefit of the large-scale indicators compared to the quantitative precipitation forecast as a function of the lead-time of the forecast range. Analysis of systematic errors, depending on the formulation of the model used in the ensemble forecasting will also be performed. The prospect that the intense nature of precipitating events could be robustly characterized several days in advance is a major issue for a meteorological service, as well as for its users. Therefore, we will undertake the possibility to extend the methodology implemented to 4 to 10 days forecasting and beyond, based on the TIGGE database including the main ensemble prediction systems. The aim is to highlight a lead-time range for which large-scale indicators would surpass the forecast rain systematically

Candidates are expected to have:
- a Master of Science degree or an equivalent qualification in atmospheric science, physical oceanography, environmental physics, or in climate physics when they start their Ph.D. project
- knowledge in atmospheric physics
- a good practice of English in writing and speaking for presenting scientific results
- good skills in data processing and programming (scripting languages: Shell, Python, R or similar)
- experience in numerical modelling.

About CNRM and the PhD Fundings
The French National Center for Meteorological Researches (CNRM, www.cnrm-game-meteo.fr), affiliated as a joint research Unit (UMR 3589) to Météo-France and CNRS, accounts eighty researchers and hundred and fifty engineers, technicians and administration staff. CNRM hosts between fifteen to twenty new doctoral students each year.
The candidate will compete for the three Météo-France PhD contracts and one or two university PhD grants. Short listed candidates will be invited to the doctoral selection seminar at Météo-France on 22, 23, 24 June 2016. The use of videoconferencing will be possible. The selected candidates will be then invited few days after to compete for a thesis scholarship Grant from the 'Universe, Environment and Space sciences' Doctoral Program of the Toulouse University.

Application:
Applicants should submit a cover letter with motivation, CV, degree certificates including transcripts of grades, abstract of the Master thesis, and the name of two academic referees including e-mail addresses and telephone numbers before the deadline.

Application deadline is May 16, 2016.

Bibliography :

Nuissier, O., Joly, B., Joly, A., Ducrocq, V., & Arbogast, P. (2011). A statistical downscaling to identify the large-scale circulation patterns associated with heavy precipitation events over southern France. *Quarterly Journal of the Royal Meteorological Society*, *137*(660), 1812-1827.

Descamps, L., Labadie, C., Joly, A., Bazile, E., Arbogast, P., & Cébron, P. (2015). PEARP, the Météo-France short-range ensemble prediction system. *Quarterly Journal of the Royal Meteorological Society*, *141*(690), 1671-1685.

Boisserie, M., Descamps, L., & Arbogast, P. (2015). Calibrated forecasts of extreme windstorms using Extreme Forecast Index (EFI) and Shift Of Tails (SOT). *Weather and Forecasting*, (2015).