Modelling the frequency of extreme event forecasts for the management of funds for humanitarian action

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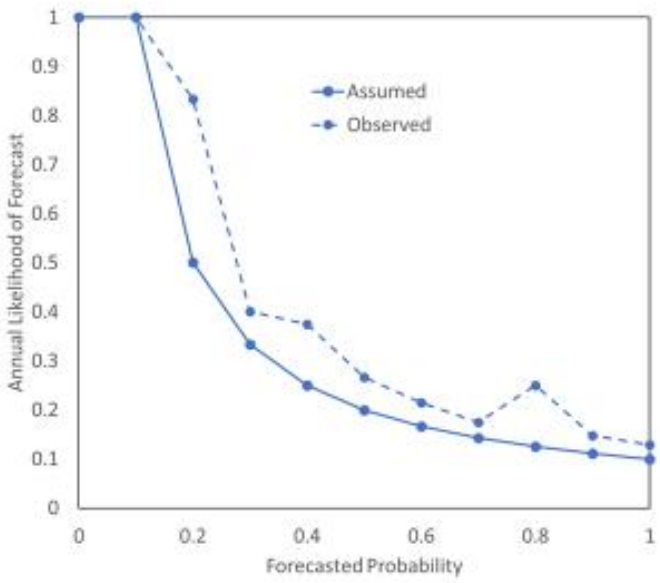
This studentship provides a unique opportunity for cutting-edge research that addresses real world forecasting challenges and applications within humanitarian forecast-based fund management. It includes highly sought-after placements with both the Red Cross Red Crescent Climate Centre and the European Centre for Medium-Range Weather Forecasts.

Forecast-based Financing (FbF) is a humanitarian initiative which releases funds on the basis of a forecast to support humanitarian actions before a disaster strikes, rather than relying on disaster response. The initiative has grown rapidly and now consists of several systematic financing mechanisms, such as the International Federation of Red Cross and Red Crescent Societies' (IFRC) Disaster Relief Emergency Fund (DREF). The recent expansion in donor-investments in FbF has necessitated the exploration of options for managing the risk of insolvency of such funds (e.g. insurance products or catastrophe bonds), and one such risk relates to how often the forecast triggers are met.



Left: A plot of the assumed and a hypothetical observed relationship between forecasted probability and annual likelihood of a forecast for a 1 in 10 year return period event. In this situation a fund like 'Forecast-based Action by the DREF' would draw down more frequently than expected, and if this was the case across all Early Action Protocols within the fund it would cause problems for its effective management. Right: flooding on the Brahmaputra River in Bangladesh.

Successful management of this FbF financing mechanism and similar funds requires knowledge of the expected drawdown (i.e. how frequently the conditions specified in the forecast triggers will be met and funding released).

Currently, the expected drawdown is based on the assumption that (for example) the condition of a 50% probability of a 1 in 10 year return period event would be met on average once in every 5 years. This assumption overlooks the following issues:

- There is a limited sample from which the 1 in 10 year return period is defined, and so it could occur more or less frequently than expected
- Events will be clustered in both space and time, leading to unexpectedly low or high drawdowns from the fund
- Probabilistic forecasts are not perfect and will overpredict or underpredict the likelihood of an event occurring, and any bias or noise will also vary by forecast variable, lead time and severity of event

Therefore research is required to explore how often the forecasts will trigger a payout, and how much uncertainty there is in the frequency of payouts.

The project will use archives of forecasts produced by the European Centre of Medium-Range Weather Forecasts such as re-forecasts, focusing on specific forecast products including the Global Flood Awareness System (www.globalfloods.eu) to explore some of the forecast triggers currently in place (such as for flood events in Uganda and Bangladesh), and also the Extreme Forecast Index.

The student will have the opportunity to undertake a 3-month placement at the European Centre for Medium Range Weather Forecasting – a world-leading forecast centre - to develop metrics for identifying and characterizing biases in event forecast frequency. By shadowing ECMWF staff on operational 'daily report' duty the student will gain a deep understanding of the circumstances where biases in event forecast frequency might be problematic. They will work together with leading researchers in the Forecast Department to develop a strategy for diagnosing the causes of such biases to support model development, applying this approach to selected case studies.

Working with the IFRC and the Red Cross Red Crescent Climate Centre, the student will offer information about the frequency of triggers, which will be incorporated into the development of Early Action Protocols for the 'FbA by the DREF', thereby having a valuable real-world impact.

Training opportunities:

The studentship would include an internship Junior Researcher with the Red Cross Red Crescent Climate Centre to develop an understanding of the context for humanitarian use of forecasts. This would be undertaken virtually, but would also include funded visits to colleagues from the IFRC in Geneva (COVID permitting).

The studentship would also involve Visiting Scientist status at ECMWF, including a 3-month placement where the student would work directly with Dr Jonathan Day. This will be virtual should COVID restrictions persist.

Student profile:
This project would be suitable for students with quantitative skills or knowledge from undergraduate degrees in Meteorology, Hydrology, Climatology, Mathematics, Environmental Science or a related field. Experience of coding in R, python, MATLAB or similar is desirable.

Funding particulars:
This project has CASE sponsorship from the Red Cross Red Crescent Climate Centre.

References:

https://www.ecmwf.int/en/forecasts/documentation-and-support/extended-range/re-forecast-medium-and-extended-forecast-range - ECMWF Reforecasts

https://www.ecmwf.int/assets/elearning/efi/efi1/story_html5.html - Extreme Forecast Index

https://media.ifrc.org/ifrc/fba/ - Forecast-based Action by the DREF

https://www.globalfloods.eu – Global Flood Awareness System

Coughlan de Perez, E., van den Hurk, B. J. J. M., Van Aalst, M. K., Jongman, B., Klose, T., & Suarez, P. (2015). Forecast-based financing: an approach for catalyzing humanitarian action based on extreme weather and climate forecasts. *Natural Hazards and Earth System Sciences*, *15*(4), 895-904.

https://research.reading.ac.uk/scenario/