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An Operational Global System for forecasting Point rainfall and Flash flood risk

Tim Hewson, Fatima Pillosu, and Ervin Zsoter
ECMWF, Reading, United Kingdom (tim.hewson@ecmwf.int)

At the EMS meeting in Sofia in 2015, in the final of the Harry Otten Prize for Innovation in Meteorology, a concept of how one could post-process global ensemble output to predict flash floods was presented. In the intervening period the idea has been developed into an operational system at ECMWF. The first real-time predictions were delivered to two countries in South America, in trial mode, in April 2017. This presentation will show (i) how the system was developed, (ii) how it now operates, (iii) verification scores indicating how the post-processing delivers much more accurate predictions of point rainfall, (iv) a case study of a flash flood event, (v) options for further improving the predictions.

The post-processing technique employed is one of downscaling, from a raw ensemble member prediction of average gridbox rainfall (e.g. for 12h), to a probabilistic representation, for that member's solution, of point rainfall for sites within each gridbox. The full point rainfall prediction is then the sum of the probabilistic point rainfall realisations from each ensemble member – i.e. an "ensemble of ensembles". The post-processing (for each member) relies on one being able to predict, a priori, using simple parameters, how the relationships between gridbox and point rainfall will vary. By relationships we mean sub-grid variability and mean bias. There is clear-cut physical and statistical evidence that these aspects depend strongly on the meteorological setting (e.g. is the rainfall convective), on the geographical setting (e.g. how complex is the topography), and on the time of day and year. This will be explained with examples. Clearly if there is a relatively high probability of extreme point rainfall, then the risk of flash floods is elevated. The raw global ensemble cannot provide this information. Moreover the post-processing relationships developed can also advise on key weaknesses to address when developing future model formulations. And the post-processed output may prove competitive alongside or at least complementary to post-processed output of limited area ensembles.

One key feature of the operational system is that a training period of only ∼1 year was required. Because of the methodology employed this equates to using a period of order hundreds or thousands of years in a traditional site-based post-processing approach. Furthermore the predictions are not confined to sites where we have observational data, but are for every land location. These advantages will be explained and discussed.