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Moving towards Global Flash Flood Impact Forecasts using ECMWF's Medium Range Ensemble and Socio-Economic Information

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Flash flood forecasting represents a challenge. To implement an effective system forecasts should be enhanced by the understanding, not only of the natural hazard itself (in this case, localized heavy rainfall), but also by the understanding of vulnerability and exposure aspects. For this reason, ECMWF, JRC and the University of Reading are working together to build a forecasting system for global flash floods and their impacts.
Forecasts of flash floods can exhibit large errors in the event location and/or magnitude. Two ECMWF products have been used to estimate the hazard's likelihood: (a) the Extreme Forecast Index (EFI) that integrates the difference between forecast and climatology to provide an outlook of areas prone to heavier rainfall than usual up to day 5, and (b) a new test product (ecPoint-Rainfall) that provides probabilistic point-scale rainfall forecasts up to day 10 by correcting for weather-dependant bias and weather-dependant sub-grid variability in ECMWF ensemble forecasts of rainfall.
In fast evolving events, such as flash floods, impacts depend not only on magnitude of the natural hazard itself, but also on exposure information, and how these two factors evolve and intersect in space and time. For example, urban areas have higher vulnerability (e.g. increased runoff due to surface types) and also increased exposure (population as well as infrastructure), so the socio-economic impacts of extreme rainfall (and flooding) in urban areas will generally be much greater than if the same conditions occur in non-urban areas. Therefore, information about vulnerability and exposure can (a) help reduce losses by refining warning areas, and (b) help emergency responders improve preparedness by targetting their efforts in a more efficient way. For example, using Houston metropolitan area during Hurricane Harvey as a case study, different exposure information has been tested, such as floodplain inundation extent and the road network. As future work, to account for vulnerability and further refine warning areas, datasets such as gridded population density data (e.g. Global Human settlement layer at 1km scale) and critical infrastructure locations such as hospitals (e.g. OpenStreetMap API) could be considered.
Event-based verification has been performed using media reports of flash flooding from e.g. the European Severe Weather Database for Europe, National Weather Service reports for the USA, and FloodList.com entries for a global coverage. For a one-year verification period, the "area under the ROC curve" metric shows good skill scores using the EFI ($\sim$0.7 in Europe, $\sim$0.6 globally). Tests are currently under way for ecPoint-Rainfall.
The presentation will focus on (1) the setup of the global flash flood forecasting system using hazard/exposure information, (2) the verification challenges, (3) the outlook of future products, and (4) the work to move towards impact forecasting.