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Nowcasting Flood Impacts of Convective storms in the Sahel

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Flash flooding from intense rainfall frequently results in major damage and loss of life across Africa. Over the Sahel, intense rainfall from Mesoscale Convective Systems (MCSs) is the main driver of flash floods, with recent research showing that these have tripled in frequency over the last 35 years. This climate-change signal, combined with rapid urban expansion in the region, suggests that the socio-economic impacts of flash flooding will become more frequent and severe. Appropriate disaster preparedness, response, and resilience measures are required to manage this increasing risk.

The NFLICS (Nowcasting FLood Impacts of Convective storms in the Sahel) project has co-developed a prototype early warning system for Senegal, incorporating nowcasting of heavy rainfall likelihood and flood risk from MCSs at city and sub-national scales. This system uses remote sensed satellite data and has been developed in partnership with the national meteorological agency (ANACIM) to operate quickly in real-time. To identify convective activity, wavelet analysis is applied to Meteosat data on cloud-top temperature for historical periods (2004 to 2019) and for the start-time of a nowcast. Data on historical convective activity, conditioned on the present location and timing of observed convection, are used to produce probabilistic forecasts of convective activity out to six hours ahead. Verification against the convective activity analysis and the 24-hour raingauge accumulations over Dakar suggests that these probabilistic nowcasts provide useful information on the occurrence of convective activity. The highest skill (compared to nowcasts based solely on climatology) is obtained when the probability of convection is estimated over spatial scales between 100 and 200km, depending on the forecast lead-time considered. Furthermore, recent advances have included incorporation of land surface temperature anomalies to modify nowcast probabilities – this recognises that MCS evolution favour drier land.

A flood knowledge database, compiled with local partners, allows estimation of the flood risk over Dakar given the identified probability of convective activity. The flood hazard is estimated from the probabilistic convective-activity nowcast when combined with information on the historical relationship between convective activity and precipitation totals. Information on the antecedent conditions can also be included, with a higher level of hazard associated with recent rainfall and already-wet conditions. Flood vulnerability is

estimated at the local scale from post-event analysis of the 2009 flood events along with information from recent modelling studies and flood-alleviation measures. The combined information from nowcasts of convective-activity and flood-risk is visualised through an interactive desktop GUI and an online portal. Operational trials over the 2020 and 2021 rainy seasons, and during intensive nowcasting testbeds with researchers and forecasters, has shown the utility of these new nowcast products to support Impact-based Forecasting.

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