4.2 TOWARD IMPROVED FLASH FLOOD WARNINGS BASED ON HIGH-RESOLUTION PRECIPITATION NOWCASTS

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Flash flood events, which are typically triggered by intense precipitation and efficient runoff production, are difficult to monitor and predict due to large hydrometeorological uncertainties. The French national service in charge of flood forecasting (SCHAPI) has developed, in collaboration with Irstea and Mto-France, a national warning system, Vigicrues Flash, to provide flash flood warnings at ungauged locations based on high-resolution radar-gauge rainfall products. Operational since March 2017 for about 10,000 municipalities, this system complements flood warnings produced by the Vigicrues procedure for French monitored rivers. Compared to Mto-France APIC warnings for heavy precipitation events, Vigicrues Flash includes a simplified distributed rainfall-runoff model to forecast the basin response to rainfall inputs.

Vigicrues Flash is based on a discharge-threshold flood warning method called AIGA (Javelle et al. 2014) to characterize flood hazard in real time at any point along the river network. The operational radar-gauge Quantitative Precipitation Estimate (QPE) grids from Mto-France at a 1-km^2 resolution are ingested into the hourly distributed hydrologic model to produce real-time peak discharge estimates on any river cell. Every 15 minutes, these discharges are compared to reference flood quantiles, which were derived from long-term streamflow simulations. The automated system determines rivers exceeding the high flood and very high flood thresholds, as well as their associated municipalities. These flood hazard maps are published on a web platform and warning messages are automatically sent to registered users who might be impacted to help them mitigate flood damages.

The flash flood warning system is being enhanced to ingest high-resolution precipitation nowcasts from the AROME convection-permitting numerical weather prediction model and account for the input and hydrological uncertainties. Météo-France's AROME-NWC precipitation nowcasts are provided at a 1.3-km resolution for a 6-hr forecast horizon, and hourly updated (Auger et al. 2015). The deterministic AROME-NWC forecasts are ingested as time-lagged ensembles and combined with multiple sets of hydrological regionalized parameters. The resulting flow ensembles lead to define probabilistic flood warnings. The evaluation was carried out with hindcasting experiments for significant events from September 2014 to June 2017 for 750 French basins. Results indicate significant improvements in terms of flash flood event detection and effective warning lead time, compared to warnings from the current setup (without any future precipitation) and warnings based on

single-valued persistency benchmarks. We also discuss the impact of the QPE products used to derive hydrological model states and flow forecasts and the need to account for QPE uncertainty.

Planned enhancements include running the hydrologic model at a sub-hourly time step, accounting for and reducing hydrologic uncertainties via data assimilation, developing a comprehensive post-event damage database and characterizing flood vulnerability.

References

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