Geophysical Research Abstracts
Vol. 17, EGU2015-5768, 2015
EGU General Assembly 2015

Improving the quantification of flash flood hydrographs and reducing their uncertainty using noncontact streamgauging methods

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Continuous river discharge data are crucial for the study and management of floods. In most river discharge monitoring networks, these data are obtained at gauging stations, where the stage-discharge relation is modelled with a rating curve to derive discharge from the measurement of water level in the river. Rating curves are usually established using individual ratings (or gaugings). However, using traditional gauging methods during flash floods is challenging for many reasons including hazardous flow conditions (for both equipment and people), short duration of the flood events, transient flows during the time needed to perform the gauging, etc. The lack of gaugings implies that the rating curve is often extrapolated well beyond the gauged range for the highest floods, inducing large uncertainties in the computed discharges.

We deployed two remote techniques for gauging floods and improving stage-discharge relations for high flow conditions at several hydrometric stations throughout the Ardèche river catchment in France : (1) permanent video-recording stations enabling the implementation of the image analysis LS-PIV technique (Large Scale Particle Image Velocimetry) ; (2) and mobile gaugings using handheld Surface Velocity Radars (SVR). These gaugings were used to estimate the rating curve and its uncertainty using the Bayesian method BaRatin (Le Coz et al., 2014). Importantly, this method explicitly accounts for the uncertainty of individual gaugings, which is especially relevant for remote gaugings since their uncertainty is generally much higher than that of standard intrusive gauging methods. Then, the uncertainty of streamflow records was derived by combining the uncertainty of the rating curve and the uncertainty of stage records. We assessed the impact of these methodological developments for peak flow estimation and for flood descriptors at various time steps.

The combination of field measurement innovation and statistical developments allows efficiently quantifying and reducing the uncertainties of flood peak estimates and flood descriptors at gauging stations. The noncontact streamgauging techniques used in our field campaign strategy have complementary interests. Permanent LSPIV stations, once installed and calibrated, can monitor floods automatically and perform many gaugings during a single event, thus documenting the rise, peak and recession of floods. SVR gaugings are more “one shot” gaugings but can be deployed quickly and at minimal cost over a large territory. Both of these noncontact techniques contribute to a significant reduction of uncertainty on peak hydrographs and flood descriptors at different time steps for a given catchment.

Le Coz, J.; Renard, B.; Bonnifait, L.; Branger, F. & Le Boursicaud, R. (2014), ’Combining hydraulic knowledge and uncertain gaugings in the estimation of hydrometric rating curves: A Bayesian approach’, Journal of Hydrology 509, 573-587.