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Reconstruction of the July 2021 European floods footprint – from field measurements to hydraulic model calibration

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Between 13th and 16th July 2021, low-pressure system Bernd caused heavy flooding in parts of eastern Belgium, western Germany, and north-eastern France. In many of these areas, the 24 hours rainfall amounts exceeded the mean monthly precipitation (T. Junghänel et al. 2021). With at least 220 reported fatalities and insured loss estimates ranging between 10 and 13 EUR billion, it is one of the most devastating natural catastrophes in the central-European region of the last decades (GDV 2021).

Given the relevance of this event, a detailed reconstruction of the flood footprint would be of interest for both earth scientists and the insurance industry. For this purpose, a reconnaissance field trip was organised between 1st and 3rd November 2021 to affected municipalities in the German states of North Rhine-Westphalia, Rhineland-Palatinate, and the Belgian province of Liège. Remaining flood marks in buildings and other infrastructure were measured for over 200 locations, and water depths were inferred from them. In addition, information was collected on the degree of damage to buildings, as well as on the stage of reconstruction and clean-up. The focus was on areas that did not get much media attention back in July 2021, smaller ungauged streams, and, in general, any location where the flood depths and damages could not be easily inferred from other sources. The information collected during this field trip, combined with updated E-OBS precipitation data, river discharge gauge data, satellite imagery, as well as media and authorities' reports was used to input, calibrate, and validate the different components of the RMS in-house flood model chain. In particular, the depth measurements from the reconnaissance trip were useful to calibrate the inundation model in municipalities affected by flash flooding from small to medium-sized ungauged streams, or by pluvial flooding. These point measurements allowed for a more detailed and comprehensive reconstruction of the flood depths over the entire affected area, beyond the better monitored larger river systems.

T. Junghänel, et al. (2021) Hydro-klimatologische Einordnung der Stark- und Dauerniederschläge in Teilen Deutschlands im Zusammenhang mit dem Tiefdruckgebiet „Bernd“ vom 12. bis 19. Juli 2021, DWD Geschäftsbereich Klima und Umwelt, https://www.dwd.de/DE/leistungen/besondereereignisse/niederschlag/20210721_bericht_starkniederschlaege_tief_bernd.pdf

GDV (2021) Hochwasserkatastrophe: Versicherer zahlen bereits über drei Milliarden Euro, <https://www.gdv.de/de/medien/aktuell/hochwasserkatastrophe-versicherer-zahlen-bereits-ueber-drei-milliarden-euro--73798>