EGU22-11253
https://doi.org/10.5194/egusphere-egu22-11253
EGU General Assembly 2022


# Massive morphological changes during the 2021 summer flood in the River Meuse

**Hermjan Barneveld**[1,2], Roy Frings[3], and Ton Hoitink[4]
[1]Wageningen University & Research, Department of Environmental Sciences, Hydrology and Quantitative Water Management Group , the Netherlands (hermjan.barneveld@wur.nl)
[2]HKV, Lelystad, the Netherlands (barneveld@hkv.nl)
[3]Rijkswaterstaat, Ministry of Infrastructure and Water Management, Maastricht, the Netherlands (roy.frings@rws.nl)
[4]Wageningen University & Research, Department of Environmental Sciences, Hydrology and Quantitative Water Management Group , the Netherlands (ton.hoitink@wur.nl)

In July 2021, an exceptional flood developed in the River Meuse and its tributaries. The high rainfall intensity lasted for several days in a number of sub-catchments in Belgium, Germany and the Netherlands, causing devastating floods. In the River Meuse itself, the peak discharge was highest since measurements started in 1911. The flood was particularly exceptional because floods normally occur in winter. During this flood, which lasted for 5 days only, flow velocities exceeded 5 m/s and unprecedented morphological changes occurred, especially in the permanently free flowing river section, referred to as the Common Meuse. In a section of 15 km long, more than 20 deep scour holes developed in the riverbed, some exceeding depths of 15 m. Morphological changes of this intensity and magnitude during extreme events are only sparsely reported in literature.

The objective of the study is to improve understanding of the processes causing high river morphodynamics under extreme floods, by focusing on the Common Meuse. Here, the riverbed surface is composed of gravel and the bed slope is five times steeper than the downstream channelized river. Post event field data were collected revealing the morphological changes in the riverbed from multibeam measurements, and floodplains deposition patterns from field surveys. We analyzed the volumes and composition of the floodplain deposits in relation to the riverbed material and morphological changes in the main riverbed.

Our analysis shows that breaching of the thin gravel layer on the riverbed caused the massive morphological changes. Analysis of historical data suggest that the main ingredients for thinning of the gravel layer on the riverbed are gradual channel incision up to 2 cm/yr, the vertical composition of the riverbed and altered flow conditions. Previous river training works, weirs and sediment mining created a supply-limited river system and an eroding trend. In the Meuse valley, several tectonic faults are found. In uplifting areas, known as horsts, the gravel layer on the riverbed is relatively thin, as the river continuously erodes the rising riverbed. Room for the River measures carried out since the 1995 flood event lowered flood levels, but also increased flow velocities in river reaches that were not or only marginally widened. A large portion of fine

sediments released from the riverbed underneath the gravel layer was deposited in comparatively wide floodplains located further downstream. The curvature of the river, height of the banks and concentrated flow directed towards the floodplains appear to determine locations of the main sand deposits. The unprecendented morphological changes may have a decisive impact on the morphological trends as well as on stability of infrastructure and flood safety. With respect to the latter, the impact of the scour holes on the overall hydraulic resistance and thus peak water levels will be assessed. These morphological processes may occur more frequently in future, also in other river sections, requiring new river management strategies to avoid a catastrophe.