Deltares

FAQ

Why is it so difficult to predict the discharge and water level on the Meuse precisely?

Update: 31-8-2021

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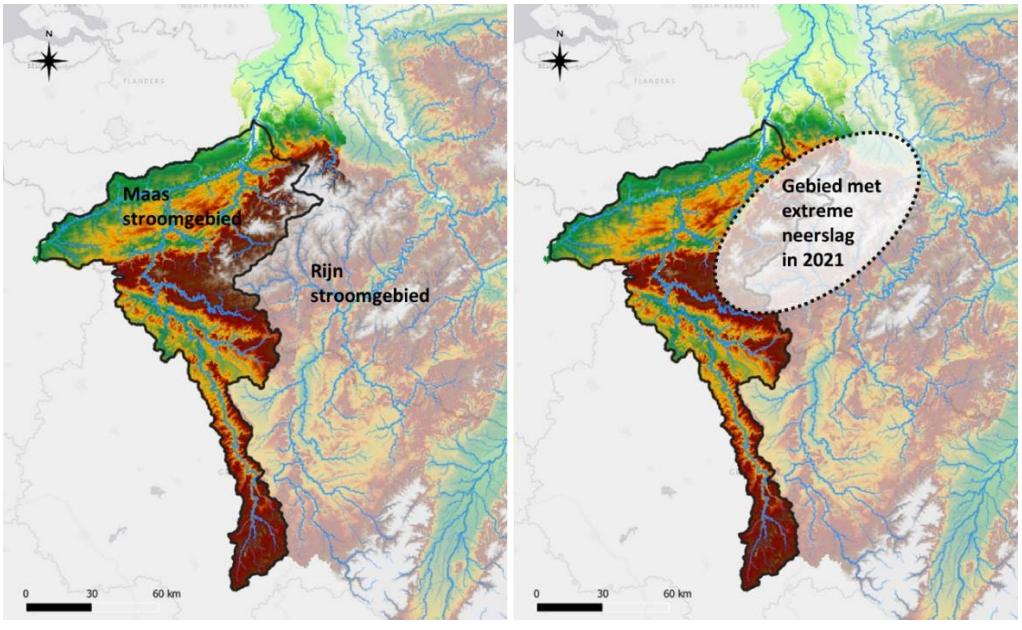
Monitoring data in Belgium and France

Predicting the discharge and water level for the Meuse during a period of high water is extremely important in terms of informing people living near the river in good time and organising the right response. The discharge of the Meuse is determined by the amount of precipitation in the catchment, most of which is located in France and Belgium. Weather models are used to predict how much precipitation may fall in the catchment. The Meuse catchment is quite elongated and it is parallel to the Moselle catchment (a tributary of the Rhine). Its elongated shape means that accurate predictions with weather models of where precipitation will be located are far from straightforward. If a band of rain passes twenty kilometres to the east or west of where it has been forecast, it will fall in the Ardennes (Meuse) or the Eiffel (Moselle). So an accurate prediction of where the rain may fall is very important.

Another complication is that the tributaries in the Ardennes, such as the Ourthe, Vesdre and the Lesse, are very responsive systems. These tributaries are relatively close to the Belgian-Dutch border and so the time it takes for the water from these tributaries to reach the border via the Meuse is less than twelve hours. This means that an inaccurate forecast can also easily result in errors in the prediction of the discharge of the Meuse in the Netherlands (by comparison: the interval in the Rhine is much longer, allowing for incorrect predictions to be corrected in time by monitoring the river discharge in Germany).

This consideration also played a role in the run-up to the discharge peak during the high water of 2021. In the initial forecasts, most rainfall was still expected in the Moselle catchment and it was only on Tuesday, 13 July and later that weather forecasts predicted heavy rainfall in the Meuse catchment. From then on, the weather models consistently forecast a large discharge peak on the night of Thursday (15) to Friday (16). That proved to be accurate.



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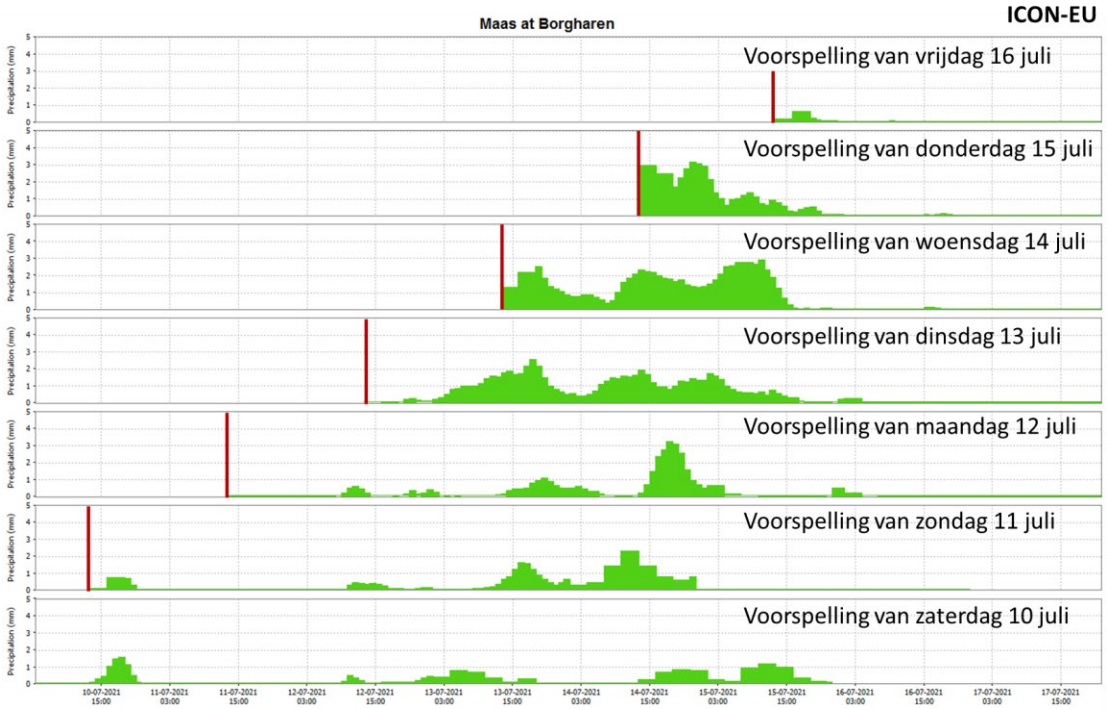
Rainfall intensity

In addition to the location, rainfall intensity is also important. If the intensity stays low, a lot of rain will enter the rivers via the groundwater and therefore flow less quickly into the Meuse. When rainfall is very intense, a larger percentage will run off via the surface and that process is relatively fast. Predicting intensity accurately is therefore important for the correct simulation of the rain run-off process.

During the high water of 2021, a significant increase in run-off was predicted for the first time quite early on Sunday, 11 July. During the course of the week, the amount and intensity of the forecast rainfall was continuously revised upwards, and the forecast of the discharge peak was therefore also revised in the same direction. This can be seen in the forecast from the ICON-EU weather model, which was used as the primary source for the discharge forecasts during the high-water period (see figure below).



Forecast from the ICON-EU weather model

Model uncertainties

To forecast discharges, simulation models are also used to predict how much precipitation will run off and how quickly. These models are generally developed and calibrated in line with previous observations of high water. This means that, when the models are used in an extreme high-water situation, they are not covered by the calibration range and so the results from the models are uncertain.

During the high water of July 2021, and particularly in the tributaries in Belgium, discharges far

exceeded the previously measured range. As a result, the margin of uncertainty is larger for discharges from these sub-catchments that are simulated by the models in conditions of this kind.

Measurements of discharge and water levels in the Meuse and its tributaries are used to reduce the model uncertainty in the operational systems. During the high water of 2021, however, the discharges in some tributaries, including the Vesdre in Belgium and the Roer in the Netherlands, were so high that the monitoring stations stopped functioning for a while.

In the Netherlands

Once the discharge peak has reached the Netherlands, there is still a margin of uncertainty with respect to the exact height and timing of the peak. This is partly a result of uncertainty relating to whether peaks from the tributaries in the Netherlands will coincide with the peak in the Meuse and uncertainty about the current condition of the river bed and floodplains. This uncertainty requires constant monitoring of the situation and revisions of the forecasts.

Effect of weirs

In addition to the known uncertainties, there are also other circumstances during high water that complicate the situation. The Meuse, for example, has a large number of weirs that, under normal circumstances, raise the water level for shipping so that there is enough draught. During periods of high water, the weirs have to be opened because the water level has to be kept as low as possible. During the high water of 2021, this failed to happen the weir at Monsin near Liège. This weir was being serviced during the high water period, which meant that the weir could not be opened and that the water was backed up more than was assumed in the models. And more water was also discharged through the Albert Canal. This probably lowered the Meuse discharge that reached the Netherlands during and it may also explain why the discharge peak at Sint Pieter that was ultimately measured was lower than forecast.

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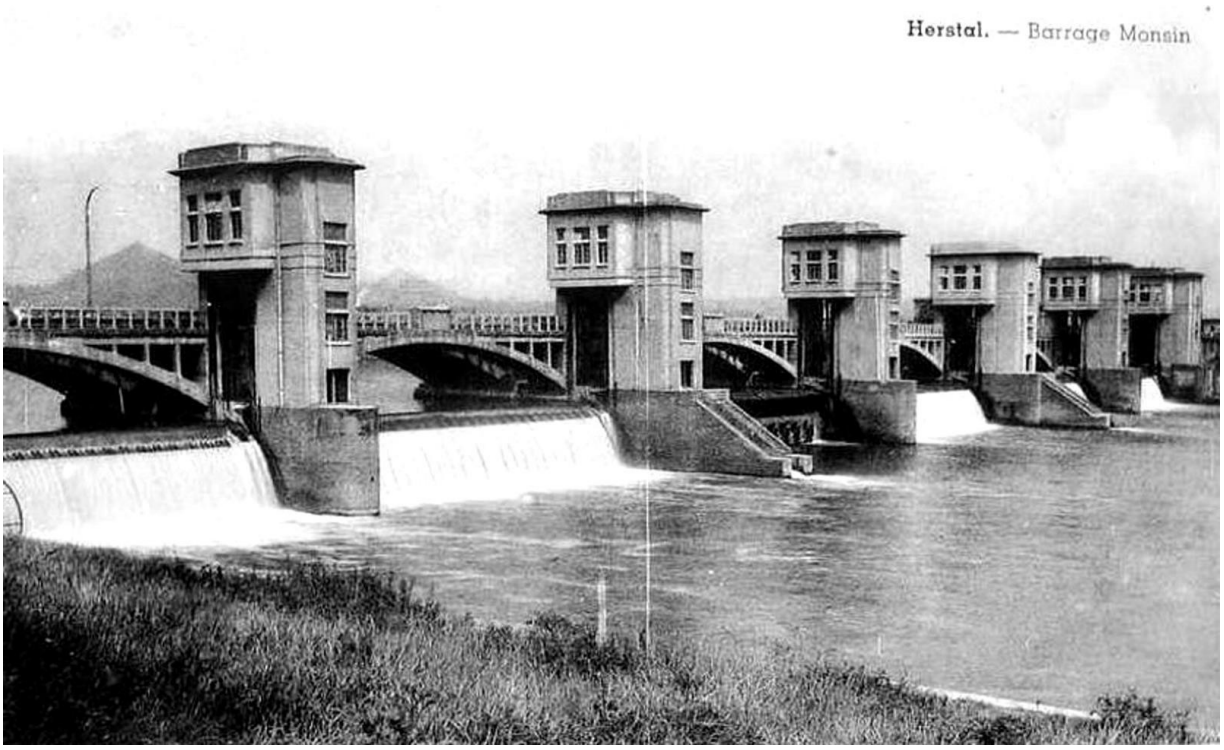

The weir at Monsin; Source: https://nl.geneanet.org/prentbriefkaarten/view/292182#0

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The weir at Monsin during the high water of July 2021

Source: https://www.rtbf.be/info/societe/detail_inondations-a-liege-situation-tendue-au-barrage-de- monsin-une-grue-menace-l-alimentation-des-stations-de-pompage?id=10804927

Forecast of the discharge peak in 2021

Ultimately, the most accurate forecast of the peak discharge was drawn up approximately 12 hours before the peak arrived at Sint Pieter. That was when most of the water contributing to the peak discharge had already fallen as rain and entered the smaller and larger rivers. The operational system can draw on this information during the production of the forecast. The uncertainty about the rain yet to fall was still the same but this rain had more of an effect on Meuse discharges that were due to reach the border of the Netherlands more than twelve hours later.