



Soil buffer limits flash flood response to extraordinary rainfall in a Dutch lowland catchment

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On 26 August 2010 the eastern part of The Netherlands and the bordering part of Germany were struck by a series of very heavy rainfall events lasting for more than a day. Over an area of 740 km² more than 120 mm of rainfall was observed in 24 hours. This extreme event resulted in local flooding of city centres, highways and agricultural fields, and considerable financial loss.

We report on the unprecedented flash flood triggered by this exceptionally heavy rainfall event in the 6.5 km² Hupsel Brook catchment, which has been the experimental watershed employed by Wageningen University since the 1960s. This study aims to improve our understanding of the dynamics of such lowland flash floods.

We present a detailed hydrometeorological analysis of this extreme event, focusing on its synoptic meteorological characteristics, its space-time rainfall dynamics as observed with rain gauges, weather radar and a microwave link, as well as the measured soil moisture, groundwater and discharge response of the catchment.

At the Hupsel Brook catchment 159.5 mm of rainfall was observed in 24 h, corresponding to an estimated return period in the order of 6000 years. As a result, discharge at the catchment outlet increased from 4.4 s⁻¹ to nearly 5 m³ s⁻¹ (i.e. a specific discharge of 0.77 m³ s⁻¹ km⁻², or 2.8 mm h⁻¹). Within 7 hours discharge rose from 50 to 4.5 m³ s⁻¹.

The catchment response can be divided into four phases: (1) soil moisture reservoir filling, (2) groundwater response, (3) surface depression filling and surface runoff and (4) backwater feedback. The first 35 mm of rainfall were stored in the soil without a significant increase in discharge. Relatively dry initial conditions (in comparison to those for past discharge extremes) prevented an even faster and more vigorous hydrological response.