The flood event of July 1342

Beside numerous documented historical floods in Europe, the flood event of July 1342 attracts attention by its magnitude. Due to its dimension, distribution and extensive consequences it became famous and it referred to as millennium flood or hydrological worst-case scenario.

The chronology of flood events of the Rivers Main at Würzburg and the Rhine at Cologne (Fig. 1) document the extreme characteristic of the summer flood of 1342 in the historic framework as representative examples.

For this flood there are numerous written reports, which describe the exceptional water level, the distribution and destructions of the flood. The flood destroyed or damaged many bridges, mills and buildings in a wide range of several catchment areas in Central Europe. The intensive precipitation caused widespread soil erosion, with partly several meter deep gullies.

According to previous descriptions the precipitation began in Franconia and Thuringia and spread out north westward. The precipitation area should have reached from the Danube Valley to North Friesland and from the River Meuse to the River Oder and should have been caused by a Genoa low. In other descriptions a distribution which reached to the south French city Avignon, Austria, areas south of the mountain ridge of the Alps and eastwards towards Vistula Valley.

From some evidence attract attention, which explicitly point out that there are no reports about precipitation and inundations in some regions of the aforementioned distribution area. Worth mentioning are the catchment area of the Neckar, the entire region of Württemberg in south western Germany, the Bavarian foothills of the Alps, the Austrian Alps, Bohemia as well as Hungary and the surrounding Carpathian Basin, given that there are detailed reports about the flood otherwise. By means of the missing evidence of extensive precipitation in Bohemia and the distribution of floods between Avignon and Friesland, the atypical distribution of precipitation of a Genoa low stands out, which was only possible at the obviously exceptional precipitation area.

The approach of the estimation of peak discharges is presented for Frankfurt in detail. Intensive source analysis revealed that two roughness coefficients have to be considered: one for floodplain and one for riverbed.


Extension area

Defining the extension area is complicated, considering that there was more than one single flood event in 1342 and historic sources might have mixed them up. Generalizations lead to inaccurate transfers and deserve a careful review of the source texts. This can be illustrated by the example of the water level of the River Rhine at Cologne in July 1342. According to two reports the water level was sufficiently high that the city wall could be passed by boats. As a matter of fact this was only possible at the obviously higher water level of the winter flood of 1374.

The extension of the precipitation area (Fig. 2) is correlated to the catchment areas of flood-bearing rivers. Hence the extraordinary intensive precipitations could cause damages by floods down the valley, without being active there themselves.

The historical natural riverbed consisted of firmly embedded gravels, which cause the locally steep slope. At the city of Frankfurt the River Main forms a very slight curve, hence is meandering slightly.

With these information the roughness coefficient for the riverbed can be estimated. Due to range of values for several components of roughness coefficient this results in a minimal, maximal and plausible mean value for:

\[
n_{\text{main}} = 0.035
\]

\[
n_{\text{v}} = 0.042
\]

\[
n_{\text{h}} = 0.049
\]

Thus the roughness coefficient of the channel itself, the properties and condition of the channel in historic times have to be characterized.

The water level of the floodmark (Fig. 3) is correlated to the catchment areas of flood-bearing rivers. The extension area is quite complicated, considering that there was more than one single flood event in 1342 and historic sources might have mixed them up. Generalizations lead to inaccurate transfers and deserve a careful review of the source texts. This can be illustrated by the example of the water level of the River Rhine at Cologne in July 1342. According to two reports the water level was sufficiently high that the city wall could be passed by boats. As a matter of fact this was only possible at the obviously higher water level of the winter flood of 1374.

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The river side of Frankfurt the settlement density is very high and the city was surrounded by a fortification (Fig. 4). Therefore it might be assumed that the water does not flow outside of the city wall during a high water event. Consequently the component for obstructions \( n_b \) is supposed to be infinite, meaning flow velocity of the water is zero.

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On opposite site of the river in Sachsenhausen, building density was less and land use dominated by gardens (Fig. 4). Obstructions were less disturbing than in Frankfurt, so water was slowed down but still moving.

With given information the roughness coefficient for floodplain can be estimated:

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n_{\text{f}} = 0.08
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n_{\text{v}} = 0.096
\]

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n_{\text{h}} = 0.11
\]

The peak discharge of the July 1342 flood was 6 Fuss high in Nikolai Church (105.5 m a.s.l.) and the flood mark at the Eiserner Steg (99.28 m a.s.l.) reached area near the Dome (lowest point of the Dome 181.4 m a.s.l.) and the floodplain outside of the city wall.

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