

Was the drought of 2015 on the River Vistula in Warsaw the lowest ever observed?

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The River Vistula has a hydrological regime controlled by rainfall and snowmelt. The flood of 22 V 2010 r. had the highest discharge ever measured in Warsaw ($Q=5898$ m³/s). After this flood extreme low flows occurred in 12 IX 2012 ($Q=172$ m³/s) and in 28 VIII 2015 (157 m³/s). The low flow of 2015 set the lowest stage record ($H=42$ cm). The conditions during the low flow were favourable for archaeologists working on the River Vistula channel and banks. A group of archaeologists from the University of Warsaw discovered in the middle of the channel at 517 km a treasury of 17 century marbles and other finds. In 1656 Poland was in the state of war with Sweden. Marble sculptures were stolen and evacuated by the Swedish army from Warsaw to Gdansk harbor down the River Vistula. The barge transporting marbles sunk, leaving the treasure in the channel of the River Vistula. Since that time until now, the water levels in the river were too high to discover the treasures. The question is whether the drought of 2015 was the lowest in history and to what extent the lowest ever observed stage is related to the process of channel erosion in a regulated reach of the river. The specific conditions at the archaeological site have been studied using both long term hydrological data and hydrodynamic the 2D model CCHE2D, to the estimate erosion rate and velocities. The results show that the bottom erosion is quite strong and has caused lowering of the river bottom by 205 cm since 1919 (first rating curve published). The River Vistula reach in Warsaw forms a narrowing, called a "corset" which is controlled by the geological structures (river over flood terraces and glacial sills). Additionally the channel has been regulated by hydrotechnical structures and dredging work. The sequence of the 2010 year flood that increased the erosion rate in the reach and two deep low flows in 2012 and 2015 were favourable for archaeologists working in Warsaw on the River Vistula. The hydraulic conditions from the hydrodynamic model show that the archaeological site had a unique position which explains why the treasures have been preserved to our times.

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