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Introducing a Nationwide High-Resolution Pluvial Flood Map: A New Tool for Risk Assessment and Emergency Management in Germany

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Abstract:

Heavy rainfall events have become more frequent in recent years and in many cases the large amount of precipitation within a very short period of time leads to severe flooding and damage. Recent studies on climate change support this observation and show increasing trends in the frequency of extreme weather events, which include these high-intensity precipitation events.

In Germany, the high intensity as well as the extent and damaging impacts of flooding gain increasing attention among the society and the federal and state governments. Attention focus shifts towards heavy rainfall risk management and prevention of catastrophic harm and damage to people and property.

Contributing to an optimal preparation for the consequences of heavy rainfall events the Federal Agency for Cartography and Geodesy (BKG) introduces a nationwide scenario-based high-resolution pluvial flood map showing simulated information. The map evolves in close partnership with federal and state authorities and is currently being successively made available to politicians, authorities and the general public as OpenData for damage prevention and civil protection (Wimmer et al. 2023).

The foundation of the hydronumerical two-dimensional modelling are high-resolution geoinformation provided by the federal and state governments. A one-meter resolution Digital Terrain Model (DTM) is modified with culverts, 3D buildings, land cover data and further geoinformation to achieve a hydrologically effective and realistic discharge.

The resulting map provides two flood scenarios in line with the heavy rainfall index by Schmitt et al. (2018) which classifies the hazardous character of heavy rainfall events based on the return period. It is increasingly used in risk communication towards the general public in Germany. Based on a dataset of regionalized precipitation heights as a function of precipitation duration and annularity (KOSTRA) by the German Meteorological Service (DWD), a 100-year event is simulated. Additionally, the result of a heavy rainfall event with a precipitation of 100 mm/h (Figure 1) is published. Both scenarios are visualized with flood depths, flow velocities and flow directions (e.g. *geoportal.de/map.html?map=tk_04-hinweiskarte-starkregengefahren-sn*).

The successively published data are used as initial assessment of risk potential. Combining the map with local expertise and government action guidelines simplifies the planning of measures. The map serves as an important and nationwide tool for identifying areas at risk of pluvial flooding. Local authorities, planners and emergency services are enabled to derive appropriate measures, both preventively and immediately before the event. The integration of more recent adaptation measures, local terrain features or the effects of secondary hazards (e.g. landslides or blocked drains) into the map is implemented as part of local follow-up surveys in the context of heavy rain risk management programs.

Building on the initial map, the BKG is currently developing a dynamic tool being part of the Digital Twin Germany project. It aims to provide event-related information on flooding caused by heavy rainfall. By simulating the effects of changes in infrastructure on the extent of pluvial flooding, users will be able to virtually test possible measures in advance in order to successfully minimize the impact.

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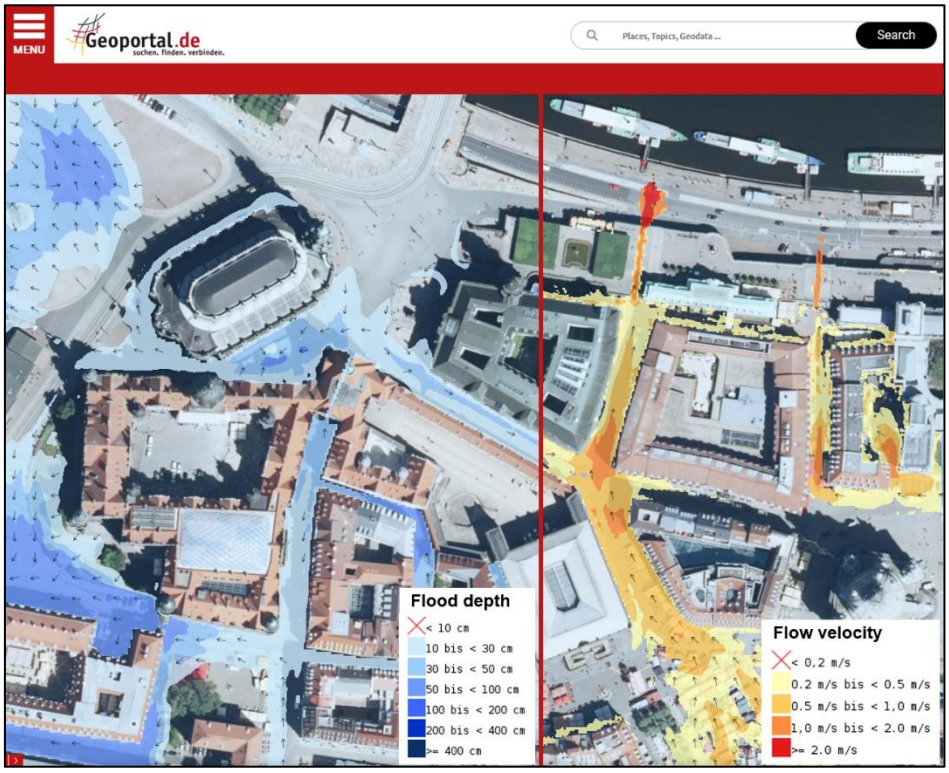

Figure 1. Flood depth, flow velocity and flow directions of a simulated heavy rainfall event (100mm/h) in Dresden, Saxony.

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