

**Analysis of precipitation leading to the flooding of the Wisla river in July 2001
in comparison to the flooding of the Odra river 1997**

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Large areas around the Wisla river in Poland were flooded during July 2001. The GPCC (Rudolf, 1995) analysed all SYNOP data, which were received at the DWD in Germany via GTS (Fig. 1). Based on these data, the precipitation totals of July 2001 were compared to climate normals 1961-1990 as well as to the precipitation totals observed during the Odra river flooding of July 1997.

In the catchment area of the Wisla river, especially in the upper area, large precipitation amounts of more than 200 mm (with maxima of more than 300 mm) were measured (Fig. 2) in July 2001. The monthly totals reached 2-3 times of the climate normals 1961-1990 (Fig. 3). Fig. 4 and 5 present a similar precipitation analysis regarding the Odra river flooding of July 1997. A comparison shows, that the area of high precipitation was larger in July 1997 than in July 2001 and that the totals in 1997 were nearly twice as much as in 2001. But in 1997 the region of maximal precipitation occurred more westward than in 2001, which lead to heavy flooding in the upper and middle part of the Odra river catchment area (see Fuchs and Rapp, 1998; Wozniak and Otop, 2001).

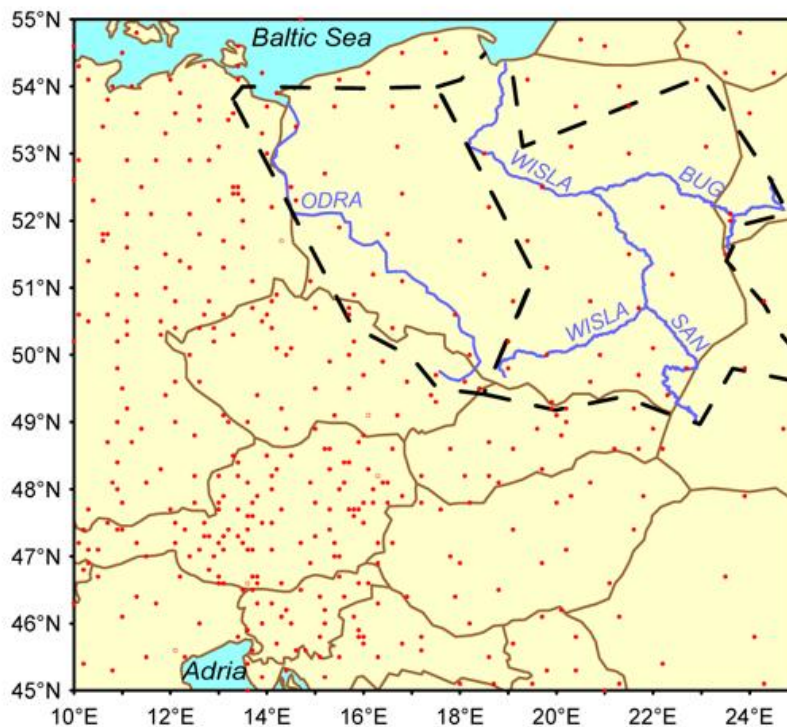


Fig. 1: Position of all SYNOP-stations (red dots) used in the GPCC analysis. The rough outline of the hydrological catchment areas of Odra and Wisla is surrounded with dashed lines.



Fig. 2: Precipitation totals (mm) in July 2001



Fig. 3: Precipitation totals in July 2001 in % of the normals 1961-1990

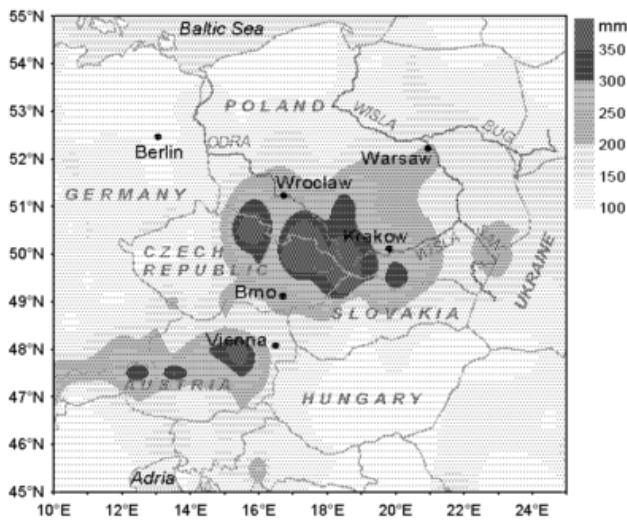


Fig. 4: Precipitation totals (mm) in July 1997

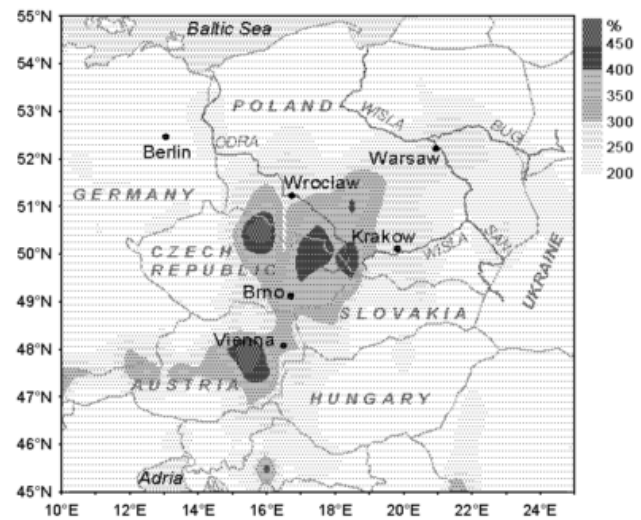


Fig. 5: Precipitation anomaly in July 1997 in % of normals 1961-1990

WMO	Name	Stations above sea level	Precipitation 1. - 31.7.2001	Anomaly (%)
12650	Kasprowy-Wirch	1989 m	610 mm	292
12625	Zakopane	855 m	435 mm	265
12660	Nowy Sacz	292 m	314 mm	293
12570	Kielce	260 m	290 mm	337
12600	Bielsko-Biala	398 m	246 mm	186
12566	Krakow-Balice	237 m	156 mm	184
12690	Lesko	420 m	211 mm	179

Table 1: Precipitation totals in July 2001 and anomalies in % of the normals 1961-1990 at several stations of the hydrological catchment area of the upper reaches of the Wisla river

The time series of daily precipitation during July 2001 at the mountain stations "Kasprowy Wirch" and Zakopane" (Upper Tatra) show (Fig. 6 and 7), that the period of high precipitation started in the catchment area of the Wisla river around July 16th and continued - with a short weakening - 12 days until 27th July. The synoptic cause of the main precipitation activity (some larger precipitation amounts were also measured during the first days of the month) was a nearly stationary upper low above South East Europe.

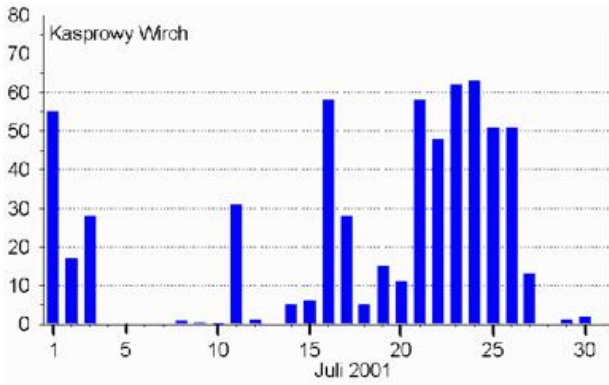


Fig. 6: Daily precipitation totals (mm) in July 2001 at the station Kasprowy Wierch

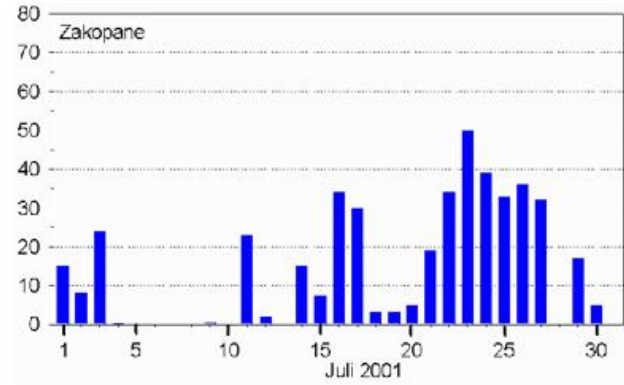


Fig. 7: Daily precipitation totals (mm) in July 2001 at the station Zakopane

The four maps on Fig. 8 show the large area distribution of the daily precipitation totals in Europe during the period with heaviest precipitation (23rd – 26th of July 2001). GPCC analyses daily precipitation totals on $1^\circ \times 1^\circ$ grids for Europe ($31^\circ - 72^\circ$ N, 11° W - 44° E) on a routine basis beginning with January 1st 2001 (<http://gpcc.dwd.de/Dailyprecip-Euro2001>).

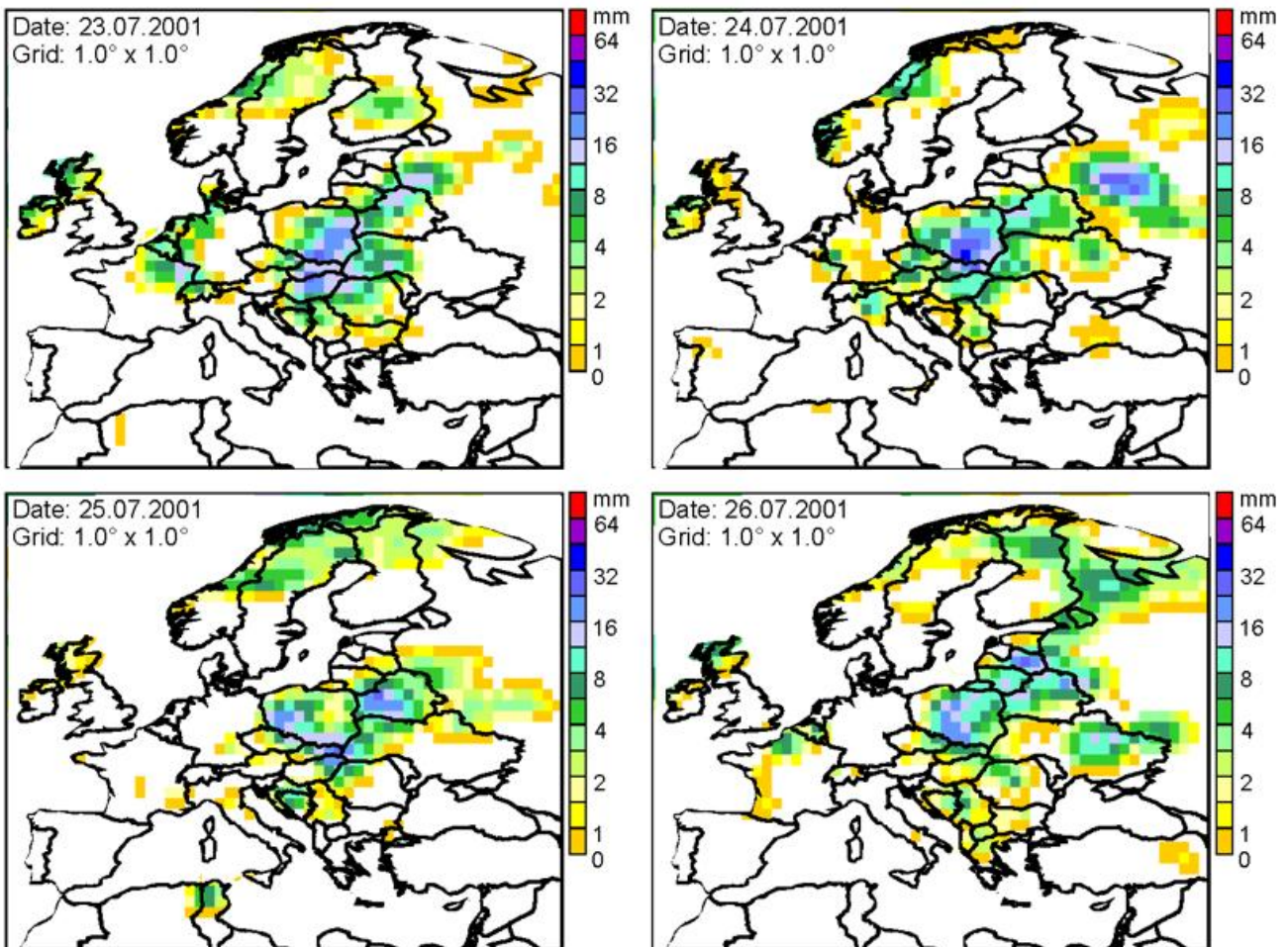


Fig. 8: Daily precipitation totals in Europe from 23rd until 26th of July 2001 (Database: GTS-SYNOP), corrected regarding systematic measurement errors (Fuchs et al., 2001). Grid: $1^\circ \times 1^\circ$.

A first climatological assessment of the July 2001 precipitation in the upper reaches of the Wisla river is possible based on the time series of the July precipitation of the station Zakopane (Fig. 9). The data of the years 1951 – 1990 could be used out of the Global Historical Climatology Network (GHCN) of the NOAA (USA) (Vose et. Al., 1992), the data since 1991 are monthly precipitation totals routinely derived at GPCC from synoptical observation data. Very striking is the record value of July 2001 as well as an increased frequency of high July precipitation events during the last years of the 20th century.

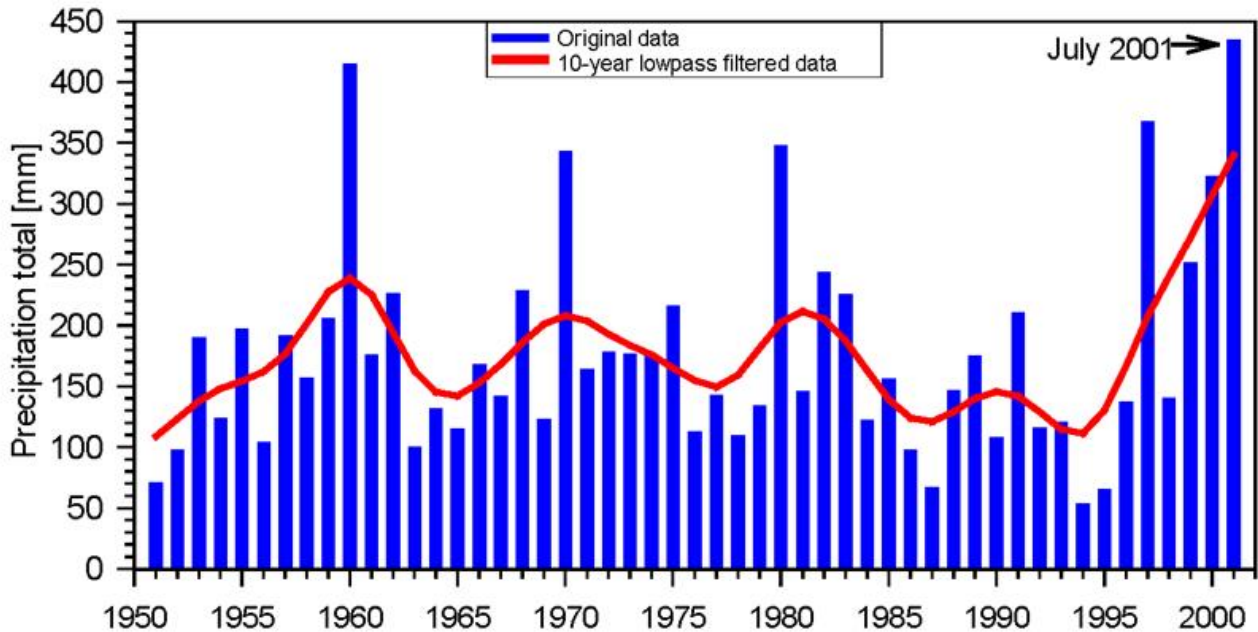


Fig. 9: Precipitation totals at the station Zakopane (Poland) during all July months since 1951. Database 1951-1990: GHCN Version 2 (<http://www.ncdc.noaa.gov/pub/data/ghcn/v2/ghcnftp.html>); since 1991: GTS-SYNOP-data, analyzed at GPCC.

The IPCC (Intergovernmental Panel on Climate Change) stated in his recent report (IPCC, 2001), that a temperature increase, based on the increase of the greenhouse gases, can be already observed in many regions of the earth. Climate models predict that this temperature rise will be enforced during the 21st century. This will most probably lead to a rise of evaporation, which will cause an precipitation increase in many areas. An increase of means, even with constant variability, will lead to a higher frequency of extrem events. Thus the IPCC expects for many regions of the earth an increase of intense precipitation events during the 21st century, which will trigger more frequent floodings, landslides and avalanches. The increased frequency of heavy precipitation and flooding events during the last years in Europe and other parts of the earth could be a sign, that beside temperature also the precipitation distribution is already changing.

Literature

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