Center for Disaster Management and Risk Reduction Technology

CEDIM Forensic Disaster Analysis Group (FDA)

June 2013 Flood in Central Europe - Focus Germany

Report 1 – Update 2: Preconditions, Meteorology, Hydrology[1]

(The report takes into account developments up to 20 June 2013 at 10:00 a.m.)

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Historical record water level of the Danube River of 12.75m in Passau on 03 June 2013, Source: www.passau.de

[1]The report was published on 4 June 2013; on 12 June 2013 it was first updated. This version (second update) takes into account the present hydrological development as well as new knowledge on the meteorological causes.

Contents

Basic Information Hydrometeorology June 2013 Flood	
Affected regions	Lower Saxony, Brandenburg, Saxony-Anhalt, Saxony, Thuringia, Hesse, Baden-Wuerttemberg, Bavaria; Austria, Czech Republic, Poland, Switzerland, Slovakia, Hungary, Croatia, Serbia
Affected catchment areas	Weser with Werra and Fulda; Danube with Regen, southern Danube tributaries, Inn and Salzach; Rhine with Main and tributaries, Neckar; Elbe with Pleiße, Saale, Mulde, Vltava among others
Areas most affected	Germany (Saxony-Anhalt, Saxony, Thuringia, Bavaria), Austria, Czech Republic; catchment areas of the Danube (with Regen, Lech, Inn) and Elbe (with Saale, Mulde)
Hydrological extent	Greatest spatial extent of all floods since 1950 (>46% of German river systems affected by at least 5-yearly floods). New record values for water levels and discharges at many gauging stations in the Danube and Elbe catchment areas Type of flood: large-scale river flooding with overflow and danger of levee breaches with large-area inundation of the hinterland
Preconditions and meteorological causes	Snow cover in Alpine regions until May. Very wet May (large positive precipitation anomalies), thus extensive oversaturation of the soil (greatest extent for 50 years), largely reduced infiltration capacity of the soil. Persistent meteorological conditions (TM), continuous advection of warm and moist airmasses from south-eastern Europe towards the North and from north-eastern Europe towards central Europe. Areas of heavy rain are intensified at the northern edge of the central uplands and the Alps: Repeated periods of heavy precipitation in the central uplands (Oremountains, Thuringian Forest, Bavarian Forest and the forest of the Upper Palatinate, Black Forest and Swabian Alb) and the fringe of the Alps.
Sources	Own analyses, German Weather Service (DWD), wettergefahren-fruehwarnung.de, hochwasserzentralen.de.

Summary

Repeated and long lasting periods of heavy rain in combination with extremely adverse preconditions led to a large scale flood event affecting various catchments. This flood event exceeded in its spatial extent and intensity the August flood of 2002 and the previous record summer flood of July 1954. Particularly affected are the catchment areas of Danube and Elbe; further affected are the catchment areas of the Weser (especially the Werra) and the Rhine. In these regions the situation has largely eased. The floodwaters from Tauber, Main and Neckar had no exceptional consequences for the flood water incidents at the middle and lower Rhine.

In the Danube catchment area the Danube, Lech, Regen, and the Inn,-Salzburg region were particularly affected. At the confluence of Danube and Inn in Passau the historical flood level of 12.75 m was observed (3 June). Apart from Passau the district of Deggendorf is affected at most, where from 5 June the dikes were not able to withstand the high water level and the constant pressure.

The flood waters coming from the Czech Republic to the Elbe, on 6 June passed Dresden, Torgau and Dessau and reached Magdeburg on 9 June. Due to the heavy inflows of the Saale, (where especially Halle was affected) and the Mulde, the Elbe section at Magdeburg and further downstream were particularly affected. The water level at the middle Elbe, Saale, and Mulde, exceed previous record values. In northern Saxony-Anhalt a levee breach near Fischbeck on 10 June resulted in the flooding of large areas at the Elbe-Havel bend.

1 Preconditions, Meteorology

1.1 Weather Situation, Soil Moisture

Several weeks before the heavy rainfalls began at the end of May 2013, Central Europe was already under the influence of a persistent low pressure system, that created very favourable conditions for flooding. The persistence of upper low pressure areas over central Europe in May 2013 and the beginning of June 2013 appears clearly in the deviation chart of the 500 hPa geopotential areas related to the long term average (Fig 1, the 500 hPa pressure level is located at an altitude of about 5.5 km; blue areas denote areas of low pressure and low temperatures, red colours denote areas of high pressure and high temperatures). Over large parts of Germany, France, Switzerland and northern Italy the deviation of the 30 day averaged period from 08.05.2013 to 07.06.2013 was between 80 and 100 gpm. This large and pronounced geopotential anomaly was created by the dominance of the continuous low pressure influence during the 4 weeks before the flood event. The quasi-stationary upper level low pressure area and its associated surface low pressure systems were responsible for the exceptionally wet weather conditions far ahead of the most intense rainfall by the end of May and beginning of June. On the contrary, large areas of Scandinavia and north-eastern Europe experienced unusually high pressure, drought and record high temperatures. This pressure configuration, low pressure across central Europe and high pressure over north-eastern Europe, proved to be very stable.

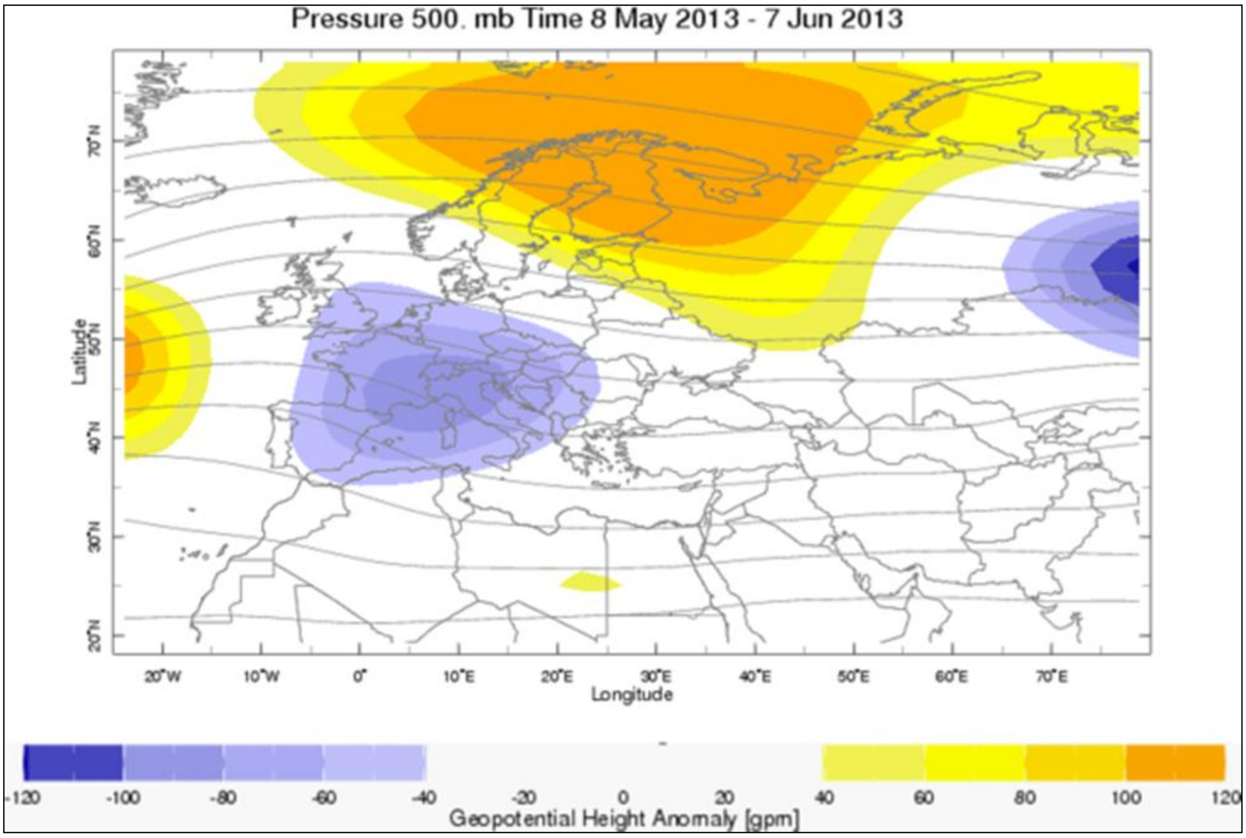


Fig. 1: Deviation of the 500 hPa geopotential level (30 day average 08.05.-07.06.2013) from the long term mean 1981-2010

Source: http://iridl.ldeo.columbia.edu

May in Germany was too wet in the whole of the country, the deviation of the precipitation was 178% of the long term mean. May 2013 was the countries second wettest since 1881. Thuringia even recorded a new monthly precipitation record with a total of 180 mm. As a result of the frequent and intense precipitation the soil was largely saturated. Due to this saturation of the soil the water infiltration capacity was reduced by up to 95% (instead of about 30% as in long term average for this time of year). Further precipitation under these conditions resulted in surface run-off.

The general weather pattern which finally caused the flood is classified as "Trough Central Europe" (TrM) or „Low Central Europe“ (TM) and not as the classical Vb weather pattern, when low pressure systems travel from the Liguria Sea towards the eastern Alps and continue into the Baltic.

Responsible for the heavy precipitation at the end of May 2013 was a cut-off upper depression moving slowly eastwards over the European continent; the result was a steady transport of unstable damp air of subtropical origin in a wide sweep over north-east Europe to central Europe (see Figs. 2.1 and 2.2). Several short wave troughs circulating around the quasi-stationary upper level trough caused the formation of new surface depressions over nearby south-east and eastern Europe. In interaction with a high pressure area coming from the west, a northern flow formed over central Europe in which stormy gusts occurred in certain areas.

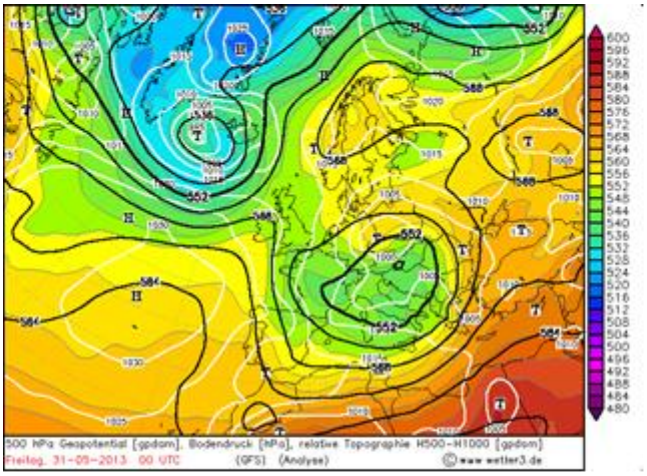


Fig. 2.1: 500 hPa-geopotential and sea level pressure, 31.05.2013, 00 UTC

Source: wetter3.de

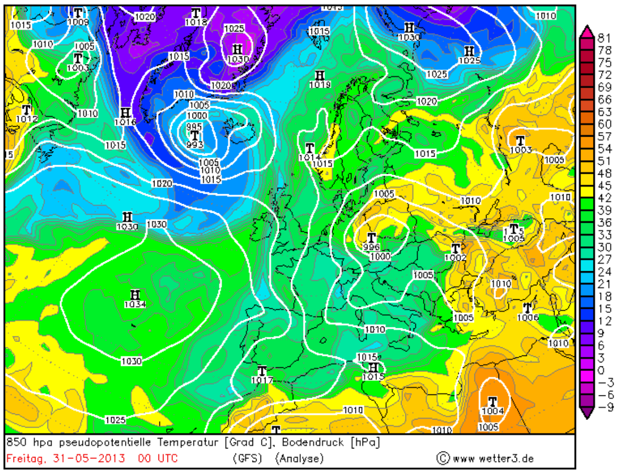


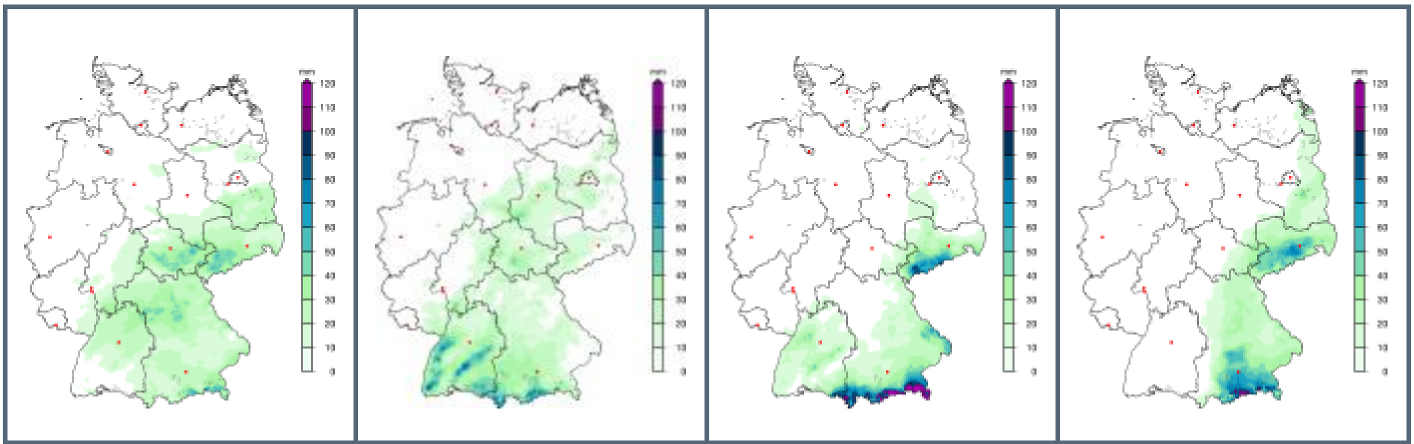
Fig. 2.2: 850 hPa-temperature and 850 hPa-pseudo-potential temperature, 31.05.2013, 00 UTC

Source: wetter3.de

Fig 2.1 shows the quasi-stationary extensive upper low pressure area over central Europe, which repeatedly triggered the development of surface depressions. With these surface depressions a flow of warm and very damp air from south-eastern Europe (Black Sea) was established, indicated by the yellow and orange colours in Fig. 2.2. In the strong northerly flow over central Europe, the luv sides (northern edges) of the Central Uplands and the Alps got the most intense precipitation.

1.2 Precipitation and Event Comparison

Due to the pronounced relief and the strong and steady northerly flow heavy precipitation developed particularly in the windward areas of the Central Uplands and the northern Alps; this was the case particularly in the Oremountains, in the Thuringia Forest, in the Fichtelgebirge, at the Franconia and Swabian Alb, in the Black Forest and the northern Alps (see Fig.3). Additionally, precipitation in the unstable wet air masses was convectively strengthened and accompanied by thunderstorms, particularly in eastern Germany.



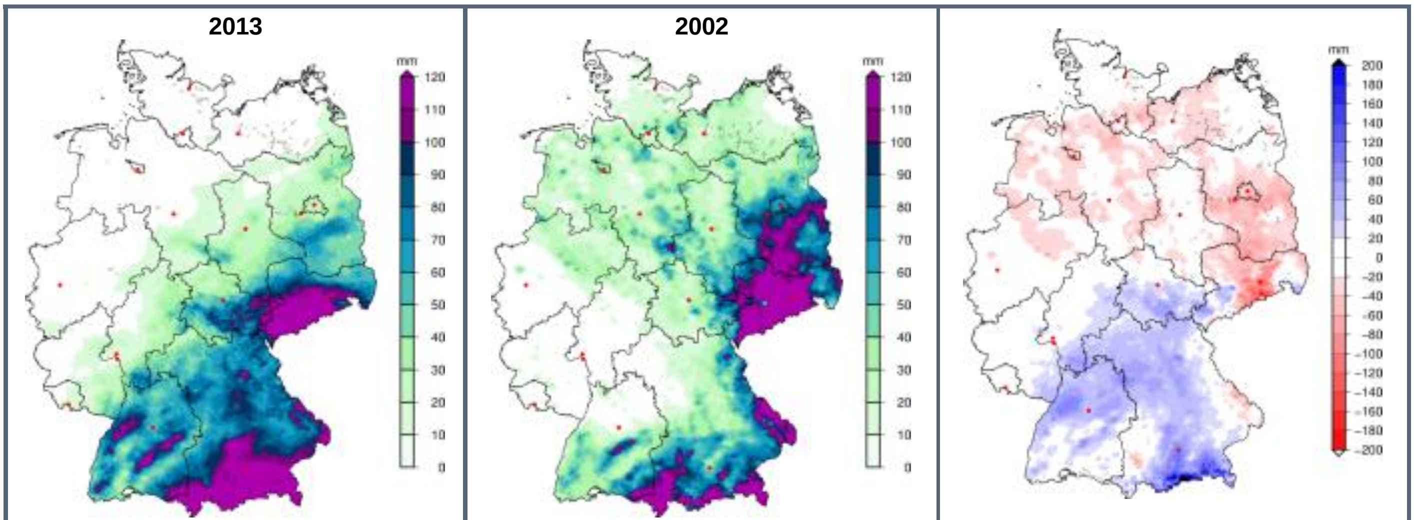
30.-31.05.2013, 06 UTC	31.-01.06.2013, 06 UTC	01.-02.06.2013, 06 UTC	02.-03.06.2013, 06 UTC

Fig 3: 24-hours total precipitation; interpolation (1x1 km) based on station measurements; period: 30.05.2013, 06 UTC, until 03.06.2013, 06 UTC

Data source: REGNIE data sets of the German Weather Service (DWD)

The maps of the 96-hour precipitation from 30.05.20132, 06 UTC, until 03.06.2013, 06 UTC, show for the flood event 2013 (Fig. 4, left) extensive areas in which precipitation of more than 120 mm was reached (violet). Particularly noticeable are the south of Saxony, smaller areas in the east of Thuringia as well as southern Bavaria. In Baden-Wuerttemberg the heaviest precipitation was concentrated in an area of the northern Black Forest, approximately between Baden-Baden and Pforzheim as well as in the Swabian Alb. South-east of a line Frankfurt/Oder - Leipzig - Kassel - Darmstadt - Karlsruhe over 60 mm rain fell widespread.

The present June flood of 2013 affected in particular the catchment areas of Elbe and Danube. In the past, similar weather conditions have already caused remarkable flood events, e.g. in August 2002 and in August 2005. These flood events resulted from a Vb weather pattern. Comparison of the rain patterns and rain amounts that caused the floods in 2002 and 2013 show clear differences (Fig. 4).



30.05.-03.06.2013, 06 UTC	10.08.-14.08.2002, 06 UTC	Difference 2013-2002

Fig 4: 96-hours total precipitation; interpolation (1x1 km) based on station measurements; period (2013): 30.05.2013, each at 06 UTC; period (2002): 10.08.-14.08.2002, each at 06 UTC

Data source: REGNIE data sets of the German Weather service (DWD)

In August 2002 over 120 mm of rain covered almost all of Saxony and spread over south-west Brandenburg up to Berlin (Fig. 4, centre). Furthermore the absolute quantities clearly exceeded those of 2013 (see Table 1). Conversely only comparatively small areas adjacent to the foot of the Bavarian Alps were subjected to heavy rainfall, whereas the Bavarian and Bohemian Forests received more rain in 2002. In the greater part of Baden-Wuerttemberg and Thuringia as well as in northern and western Bavaria the insignificant amount of rain did not cause any flooding.

Fig 4 (right) shows the difference of the heavy rain events in 2013 and 2002. Red areas indicate greater rainfall in 2002; in the blue areas it rained in 2013 more than in 2002. In spite of clearly less precipitation in 2013, particularly in north-east Germany and the Oremountains in many cases higher water levels were recorded than in 2002. Conversely considerably more rain than in 2002 fell in the western Oremountains, southern Thuringia and almost all of Baden-Wuerttemberg and Bavaria. The precipitation excess compared to 2002 was in certain parts over 100 mm, which ultimately was responsible for the enormous water intake into the Danube feeding rivers. The table below compares the 96-hours total rain amounts at various observation stations in the Danube and Elbe catchment areas with their historical values of the flood events of 2005 and 1954 in the Danube and 2002 in the Elbe

Table 1: Comparison of the 96-hours total rain amounts (RR) in 2013 with the flood events in 2002 (Elbe) as well as in the years 2005 and 1954 (Alps/Danube) at selected measuring stations.

Ort	Year/Period	RR	Comparison	RR	Comparison	RR
Danube Catchment area:	**2013**		**2005**		**1954**	
Aschau-Stein (Bavaria)	30.05.-03.06., 6 UTC	**405 mm**	20.08.-24.08., 6 UTC	**120 mm**	07.07.-11.07., 6 UTC	**487 mm**
Kreuth-Glashütte (Bavaria)	30.05.-03.06., 6 UTC	**373 mm**	20.08.-24.08., 6 UTC	**221 mm**	07.07.-11.07., 6 UTC	**258 mm**
Balderschwang (Bavaria)	30.05.-03.06., 6 UTC	**203 mm**	20.08.-24.08., 6 UTC	**260 mm**	07.07.-11.07., 6 UTC	**136 mm**
Elbe Catchment Area:	**2013**		**2002**			
Zinnwald-Georgenfeld (Saxony)	30.05.-03.06., 6 UTC	**154 mm**	11.08.-15.08., 6 UTC	**407 mm**		
Dippoldiswalde-Reinberg (Sax.)	30.05.-03.06., 6 UTC	**145 mm**	11.08.-15.08., 6 UTC	**240 mm**		
Stützengrün-Hundshübel (Sax.)	30.05.-03.06., 6 UTC	**224 mm**	10.08.-14.08., 6 UTC	**175 mm**		

2 Hydrology

The flooding of June 2013 has largely receded in the meanwhile. Throughout Germany above all the Danube and the Elbe catchments and at least parts of the of Weser and Rhine catchments were affected. The situations in the affected areas are quite different. In the following, the evolution of the flood and the situation until 20 June 2013 are detailed for the various catchments affected

2.1 Weser

Flooding of the Weser, Aller and Leine was caused by continuous, heavy rain from 25 May in the Weser uplands and the Harz. The flood peaks at the Weser, Aller and Leine were already exceeded from 28 May (Hoxter, Weser) until 31 May (Herrenhausen, Leine) and 1 June (Celle, Aller) respectively. Particularly, flood damage occurred in the Hildesheim and Hanover areas.

2.2 Rhine

In the Rhine catchment the Main (with Aitzsch and Schwarzach) und Neckar (with Tauber) were particularly affected. Especially on the Main the situation in the first days of the event (1 - 3 June) were tense. The Neckar also reached the highest flow rates already on 01.06.2013. However, the Middle and Lower Rhine did not experience significant flooding. The shipping traffic on the Rhine was interrupted for one week (1 to 7 June); the flood peak at the Maxau gauge was reached on 02 June.

2.3 Danube

Causes of the Danube flooding are firstly the long lasting precipitation with high total precipitation totals, up to 407 mm in 96 hours at the Aschau Stein rain gauge. In interaction with the extremely high soil moisture, specific discharges (the quotient of the dischargeand the catchment area) of over 250 l/s per km² occurred, e.g. from the catchment area of the Inn. The development to extreme flooding of the Danube was favoured by the timely coincidence of the flood peak of the tributaries of the Danube in the very elongated flood wave in the Danube. The peak of flooding in the upper southern intakes of the Danube (Iller and Lech, 160 l/s per km²) occurred already on 2 June and contributed to the flood peak in Donauwörth and Kehlheim on 3 June. The intakes from the northern catchment areas of the Naab (75 l/s per km²) and Regen (170l/s per km²) as well as the southern conflux of the Isar (170 l/s per km²) reached their maximum on 5 June and added to the existing flood of the Danube. The inflow peak from the Inn (approx. 7000 m³/s or 260 l/s per km²) reached the Danube already on 3 June. This inflow exceeded the highest ever recorded value of 6,700 m³/s of July 1954. At this time the water level of the Danube itself had already exceeded the highest alert level 4.

Focal points of the adverse effects of the Danube flooding were Passau and Deggendorf. In Passau on 4 June the water level of 12.75 m was observed. This is a new record level and is about 2 metres above the water level of July 2002 and also clearly above the value of 1954 (12.20 m). Deggendorf was badly affected particularly as a result of the levee breach at the Danube on 5 June. The maximum water level of about 8 m at the gauge Deggendorf is approx. 50 cm above the previous record values of Mai 1999 and August 2002.

2.4 Elbe

In the Elbe catchment area basically the same general meteorological situation and preconditions (high soil moisture) caused the flood as in other flooded areas. The spatial and temporal distribution of precipitation in the region of the Thuringian Forest, Fichtelgebirge and western Oremountains first led to principle flooding locations in the areas of the Elbe's eastern tributaries as well as at the Saale and Mulde and their catchment areas.

At the Mulde conflux maximum outflows were measured (maximal daily mean discharges) which, for example at gauge Golzern 1 on 3 June of 1.938 m³/s (about 365 l/s per km²) were higher than the previous record flood in August 2002 (1880 m³/s), which in the catchment area of the Mulde caused particularly severe damage.

On the Saale the flood peak occurred between 5 and 9 June; the city of Halle was affected severely (highest level 5 June). The water levels of the Saale receded only slowly due to the extended inundations. The peak flow at the Calbe station, just before the inflow to the Elbe, was not recorded until 7 June. The pressure on the dikes therefore remained high for a long time.

On 4 June the peak outflow of the Moldova reached the city of Prague in the Czech Republic. The flood peak from Moldova and Labe (Elbe) reached Germany on 6 June. In Dresden and Torgau the highest level was also reached on 6 June. In the further course the flood wave of the Elbe superimposed with the outflow of the Mulde and Saale tributaries which had already led to considerably increased flow in the Elbe river below Barby. The flood peak in Barby was exceeded on 9 June. Due to the overlapping of flood waves from the Elbe, Mulde and Saale the impact at the Middle Elbe was considerably more severe than in the Upper Elbe between Schöna and Aken where the discharges of the August 2002 flood event were not reached. On the other hand, below the inflow of Mulde and Saale rivers the flood peak considerably exceeded the values of August 2002. In this part the water levels reached new record values – particularly Magdeburg (highest value on 9 June) was severely affected. As at the Danube, along the Elbe a very long flood wave developed which endangered the Middle Elbe, especially in Saxony-Anhalt, and further downstream. In the district of Stendal the Havel polders in the Altmark were flooded. On 10 June a levee breached in the district of Stendal near Fischbeck. As a consequence large areas of ~200km² were flooded in the Elbe-Havel bend. Extensive evacuation was carried out. Meanwhile, the levee breaches were mostly repaired by means of sunken barges. The inflow in the affected area could thus be clearly reduced. In the meantime the water levels in the Elbe receded to the alert level 1. The flood water drains from the inundated areas and the evacuation measures are cancelled.

A complete hydrological classification and analysis can only take place when confirmed measurements are available. The evaluations here are based on (raw) data provided by the © Bayerischen Landesamtes für Umwelt (Bavarian State Office of Environment, Agriculture and Geology), www.lfu.bayern.de, from the

Sächsischen Landesamtes für Umwelt, Landwirtschaft und Geologie (Saxony State Office of Environment and Geology), the Landesbetrieb für Hochwasserschutz und Wasserwirtschaft Sachsen-Anhalt (State Office of Flood Protection and Water Management Sachsen-Anhalt), the Thüringer Landesanstalt für Umwelt und Geologie (Thürigen State office for Environment and Geology (TLUG)) and the Wasser- und Schifffahrtsverwaltung des Bundes via the Bundesanstalt für Gewässerkunde (Water and Shipping Management of the Federal Office via the Federal Institute for Hydrology.

3 Comparison with Historical Floods

The flood of June 2013 ranks among large scale flood events affecting several river catchments.. Comparison with historic events provides a basis for quick ranking and estimation of the magnitude of possible negative effects already at a time at which detailed analyses are not yet possible. Due to uncertain and incomplete information, In terms of seasonality, prevailing meteorological conditions and triggering causes, the present flood can be compared to the past floods of July 19, June 1999 August 2002 and August 2005. In the table below the present flood is compared to these historical large-scale flood events which had considerable consequences for Germany with regard to the severity and economic losses.

Table 2: Comparison of significant flooding incidents – causes, intensities, consequences

Year - Name	Cause of flood	River and gauging station with maximal return period (years)	Severity index[1]: S: Severe L: spatial extent	Deaths	Economic losses / Financial losses
1954 Summer flood	Heavy rain	>200 Weiße Elster, gauge Greiz (TH)	S = 42.4 L = 28,2%	n/a	n/a.
1999 Whitsun flood	Heavy rain	~200 Ammer, gauge Stege, (BY)	S = 24,4 L = 18,7%	7 (Em-Dat) [2]	412 Mio. € (Kron 2004) [3]*
2005 August flood („Alpine flood“)	Heavy rain	< 75 Lech, Pegel Landsberg/Lech (BY)	S = 19.2 L = 16,9 %	k.A.	190 Mio € (LfU 2006) [4]
2002 August flood	Heavy rain	>500 Freiberger Mulde, gauge Nossen (SN)	S = 35,9 L = 22,4 %	27 (Em-Dat)	11,8 billion. € (Kron 2004) [3]
2013 June flood	**Heavy rain with high initial soil moisture**	**~500 Zwickauer Mulde, gauge Wechselburg (SN)**	**S = 75 L =46%**	**8 (Status 20.06.2013)**	**~12 billion. (Fitch Rating – first estimate)**

[1] S: Return period of peak flow relative to HQ5 multiplied by relative water system length (L: percentage share of the water system section with tributaries > HQ5 at the river network considered, modified according to Uhlemann et al. 2010 (DOI: 10.5194/hess-14-1277-2010)
[2] EM-DAT (http://www.emdat.be/database) enquiry June 2012
[3] Kron 2004: Increasing flood damage: Danger for the insurance business? ATV-DVWK Fed. German conference, Würzburg
[4] LfU 2006: August floods 2005 in southern Bavaria, Augsburg

The floods in June 2013 considerably exceed the previous record floods of July 1954 and August 2002 in terms of spatial extent and severity. The spatial extent and intensity of the incident is compared to the historical incidents of July 1954 and August 2002 for the status of the data collection of 20 June 2013 in the maps of Fig. 3. The maximal daily mean discharges recorded in the course of the flood events are evaluated with regard to the statistical recurrence intervals in years. The statistical analyses are based on periods of several years of daily mean flow. The peak discharges are summarised in the attachment in the Table: „Comparison and classification of maximal discharge flow values in m³/s (daily mean) of selected gauges in the German river network during the flood of July 1954, August 2002 and June 2013.

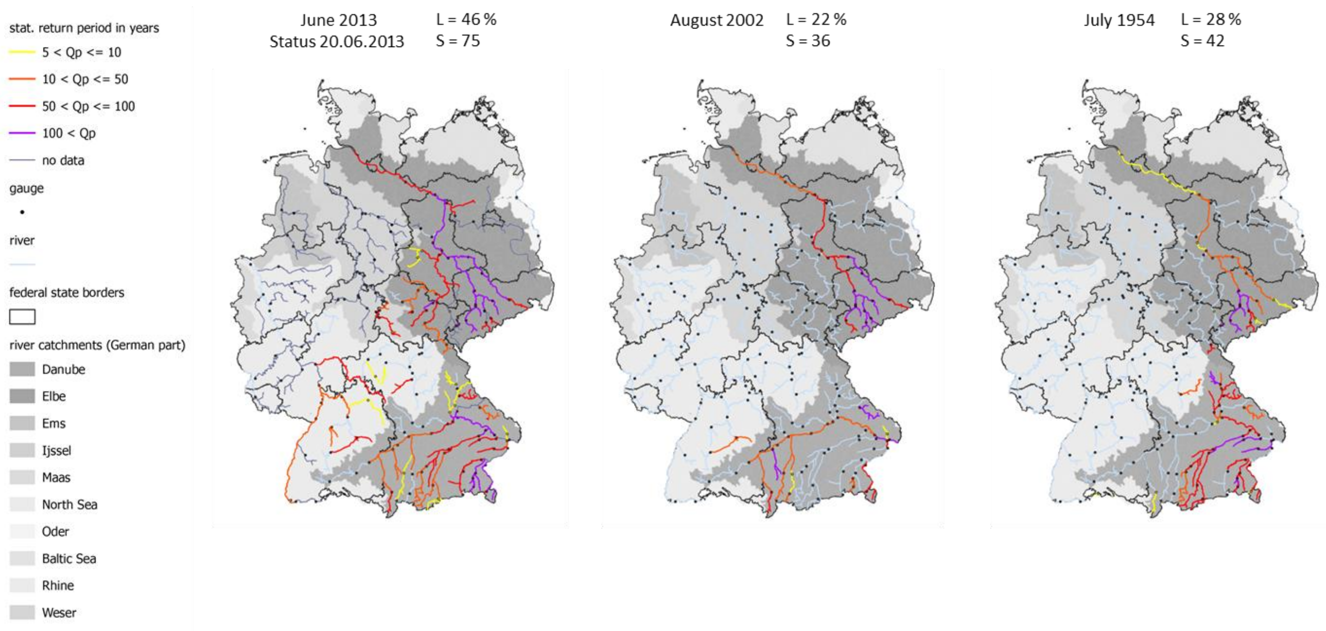


Fig 3: Comparison of the historic floods 1954 and 2002 with the present flood June 2013: Maximal return periods (flood probability as reoccurrence interval) at the rivers reporting flooding

It is clear that the present flood showed higher discharges than comparable historic events in the Danube catchment. Furthermore, additional tributaries of the Danube contributed to the current flood.In contrast to August 2002, Isar and Naab rivers contributed to the June 2013 flood. Contrary to July 1954 and similar to 2002 in June 2013, floods were seen in the upper Danube and its the southern tributaries Iller and lech In the Elbe catchment in June 2013 particularly the catchment area of the Saale was affected in addition. Due to the confluence of the flood discharges from the Elbe, Mulde and Saale rivers the section of the Elbe below the Saale inflow junction was more severely affected than in August 2002.

This report was prepared on the basis of gauge data (Hochwasserzentralen.de: BfG, Federal Measuring Service) Information of the German Weather Service (DWD), meteorological data and model calculations (DWD, wettergefahren-fruehwarnung.de (weather danger early warning)) and proprietary analyses of the Center for Disaster Management and Risk Reduction Technology (CEDIM).

A version with the original illustrations in the original resolution and further reports and press releases regarding the floods in June 2013 can be seen by visiting www.cedim.de.

For explanation of technical terminology CEDIM provides a glossary "Terms and Definitions of Risk Science" www.cedim.de/download/glossar-gesamt-20050624.pdf.

Center for Disaster Management and Risk Reduction Technology

Comparison of the maximal outflow values in m³/s (daily average values) of selected levels in the German waterway network during flooding incidents July 1954, August 2002 and Jun 2013 and classification in annuality classes (flooding probability)

				Jul 54		Aug 02		Jun 2013*	
	River	Location Name	Location Number	QP [m³/s]	Tn Classe	QP [m³/s]	Tn Class	QP [m³/s]	Tn Classe
Rhine	Neckar	HORB NECKAR	411	17	0	96	0	170	0
	Tauber	BAD MERGENTHEIM	212	7	0	5	0	175	3
	Tauber	TAUBERBISCHOF-SHEIM	44602	5	0	9	0	200	3
	Jagst	DOERZBACH	477	29	0	7	0	180	1
	Enz	PFORZHEIM ENZ	4422	14	0	27	0	240	2
	Main	SCHWUERBITZ	24006007	181	0	36	0	255	0
	Main	KEMMERN	24010004	0	0	34	0	375	0
	Main	SCHWEINFURT-NEUER HAFEN	24022003	522	0	119	0	845	0
	Rodach	UNTERLANGENSTADT	24143008	30	0	3	0	98	0
	Pegnitz	NUERNBERG	24225000	83	2	17	0	61	0
	Aisch	LAUFERMUEHLE	24263000	63	0	4	0	152	3
	Fränkische Saale	BAD KISSINGEN	24406005	9	0	8	0	80	0
	Fränkische Saale	WOLFSMUENSTER	24409003	7	0	10	0	98	0
Weser	Werra	MEININGEN	420020	23	0	7	0	134	1
	Werra	VACHA	420120	35	0	13	0	284	3
	Werra	GERSTUNGEN	420170	34	0	18	0	335	3
	Werra	FRANKENRODA	420190	56	0	30	0	354	2
Elbe	Elbe	DRESDEN	501060	2,300	1	4,500	3	4,359	3
	Elbe	TORGAU	501261	2,370	2	4,290	4	4,303	4
	Elbe	WITTENBERG	501420	2,470	2	3,990	4	4,939	4
	Elbe	AKEN	502010	3,420	2	3,960	3	5,000	4
	Elbe	BARBY	502070	3,939	2	3,950	2	5,100	4
	Elbe	MAGDEBURG-STROMBRUECKE	502180	2,389	1	4,010	3	5,000	4
	Elbe	WITTENBERGE	503050	3,174	2	3,670	3	4,287	4
	Mulde	GOLZERN 1	560021	1,400	4	1,880	4	1,938	4
	Zwickauer Mulde	ZWICKAU-POELBITZ	562070	547	4	369	3	439	4
	Zwickauer Mulde	WECHSELBURG 1	562115	746	4	871	4	1,003	4
	Chemnitz	GOERITZHAIN	564410	214	4	195	4	226	4
	Freiberger Mulde	NOSSEN 1	566040	122	2	383	4	275	4
	Zschopau	HOPFGARTEN	567420	139	3	267	4	200	3
	Flöha	BORSTENDORF	568160	123	1	353	4	222	3
Elbe	Saale	RUDOLSTADT	570270	32	0	12	0	251	2
	Saale	CAMBURG-STOEBEN	570330	40	0	28	0	270	3
	Saale	CALBE GRIZEHNE	570940	440	0	290	0	800	3
	Ilm	MELLINGEN	572910	7	0	4	0	70	3
	Ilm	NIEDERTREBRA	572920	8	0	6	0	122	4
	Unstrut	NAEGELSTEDT	573010	1	0	4	0	27	0
	Unstrut	OLDISLEBEN	573110	14	0	32	0	138	2
	Gera	ERFURT-MOEBISBURG	574210	10	0	8	0	138	3
	Weiße Elster	GREIZ	576470	418	4	96	0	288	4

	Bode	WEGELEBEN	579049	16	0	9	0	72	1
	Bode	HADMERSLEBEN	579070	24	0	24	0	72	1
	Sächsische Saale	HOF	56001502	91	3	12	0	82	2
	Danube	KIRCHEN-HAUSEN		11	0	19	0	60	0
	Danube	HUNDERSINGEN		42	0	61	0	180	0
	Danube	BERG	10024000	62	0	120	0	180	0
	Danube	DILLINGEN	10035801	584	0	948	2	917	2
	Danube	DONAUWOERTH	10039802	725	0	979	2	966	2
	Danube	KELHEIM	10053009	1,320	0	1,675	2	1,790	3
	Danube	OBERNDORF	10056302	1,509	1	1,660	2	1,923	3
	Danube	SCHWABELWEIS	10062000	2,113	2	119	0	2,734	4
	Danube	HOFKIRCHEN	10088003	3,286	3	2,858	2	3,362	4
	Iller	KEMPTEN	11402001	370	1	563	3	535	3
Danube	Mindel	OFFINGEN	11609000	69	0	116	4	89	2
	Wörnitz	HARBURG	11809009	92	0	16	0	108	0
	Lech	LECHBRUCK	12002009	272	0	520	2	334	0
	Lech	LANDSBERG	12003001	360	0	607	1	440	0
	Wertach	TUERKHEIM	12406008	109	0	200	2	181	1
	Altmühl	TREUCHTLINGEN	13406105	23	0	4	0	26	0
	Altmühl	EICHSTAETT	13407200	44	0	16	0	42	0
	Naab	UNTERKOEBLITZ	14002305	270	2	77	0	201	0
	Naab	MUENCHSHOFEN	14006000	570	3	148	0	381	1
	Naab	HEITZENHOFEN	14008006	680	3	154	0	435	1
	Schwarzach	WARNBACH	14408004	112	3	35	0	100	3
	Regen	CHAMERAU	15202300	318	2	462	4	291	2
	Isar	SYLVENSTEIN	16002500	360	3	145	0	219	1
	Isar	FREISING	16006500	884	3	364	0	624	2
	Isar without Mühlbäche	LANDAU	16008007	1,379	4	576	0	1,200	3
	Isar	PLATTLING	16008506	1,244	3	530	0	1,373	4
	Amper	STEGEN	16602303	86	2	63	0	82	2
	Amper	FUERSTENFELD-BRUCK	16605006	103	3	61	0	86	2
	Amper	INKOFEN	16607001	226	3	140	0	231	3
	Vils	ROTTERSDORF	17204204	221	4	39	0	135	3
Danube	Vils	GRAFENMUEHLE	17207508	411	4	108	0	256	3
	Ilz	KALTENECK	17406005	81	0	172	1	164	1
	Inn	OBERAUDORF	18000403	1,310	0	1,022	0	1,261	0
	Inn	WASSERBURG	18003004	0	0	1,427	0	2,219	3
	Inn	PASSAU INGLING	18008008	6,359	4	5,213	3	4,410	2
	Alz	SEEBRUCK	18403002	265	4	187	2	293	4
	Tiroler Achen	STAUDACH	18454003	504	3	435	2	797	4
	Salzach	BURGHAUSEN	18606000	2,414	3	2,534	3	4,046	4
	Saalach	UNTERJETTENBERG	18642003	364	1	552	3	593	3
	Rott	BIRNBACH	18806406	345	4	80	0	200	3

*** Data status 07.06.2013 16:00 CEST,**
present measured values are unchecked raw data

Tn Class:	Regional Annuality	Explanation		Data Sources:
0	Qp < HQ5			© Bavarian State Office of Environment, www.lfu.bayern.de
1	HQ5 < Qp < = HQ10	Tn:	Repetition interval in years	Saxony State Office of Environment, Agriculture and Geology
2	HQ10 < Qp <= HQ50	Qp:	Maximal annual outflow (daily average value) in m³/s	Sachsen-Anhalt Office of Flood Protection and Water Management
3	HQ50 < Qp <= HQ100	HQ5:	Outflow, statistical occurrence average every 5 years	Thüringen State Office of Environment and Geology(TLUG)

4	HQ100 < Qp	Flooding Forecast Centre Baden Württemberg Water and Shipping Management of the Fed. Rep. (WSV), prepared by the Federal Institute for Hydrology (BfG)