Central Europe Floods of September 2024

Event Update as of September 16

Summary

Central Europe has been impacted by significant flooding since September 12. While waters have not yet fully receded and the event is still ongoing as of September 16, initial assessments in the most affected countries and the extent of damage seen in disaster areas suggest a potentially significant economic loss.

What are the causes?

The flooding resulted from an extreme amount of rain that fell over a large area of Central Europe in a 5-day period from September 12 to 16. Primary synoptic feature associated with the event was a low-pressure system Boris (alternatively Anett), which developed in central Mediterranean (Genoa low) and stalled over the region, bringing rounds of torrential rain for several days.

What areas were impacted the most?

Significant damage occurred in parts of the Czech Republic, Poland and Austria. In the **Czech Republic**, the most affected areas were in the Opava, Odra and upper Morava catchments, with instances of catastrophic damage in Jeseníky region, where rainfall accumulations exceeded 500 mm. In southwest **Poland**, dramatic situation occurred in the Nysa Kłodzka basin and in **Austria**, widespread flooding occurred particularly in Lower Austria. Additional impacts were reported from other countries - western and northwestern **Slovakia**, as well as in parts of **Romania**. In total, at least 15 people were killed, while eight people were missing in the Czech Republic at the time of this writing.

How does the event compare to historical events?

The event was widely compared to the historic flood event of 1997 in the Czech Republic and Poland. In some basins, 2024 water levels exceeded those reached in 1997 (including Opava River), but in other cases, particularly along middle Morava and Bečva Rivers, situation was less difficult. Flood protection measures built over the last 2 decades, as well as much more effective warning systems and forecasts made before the event significantly helped to mitigate material and human impacts.

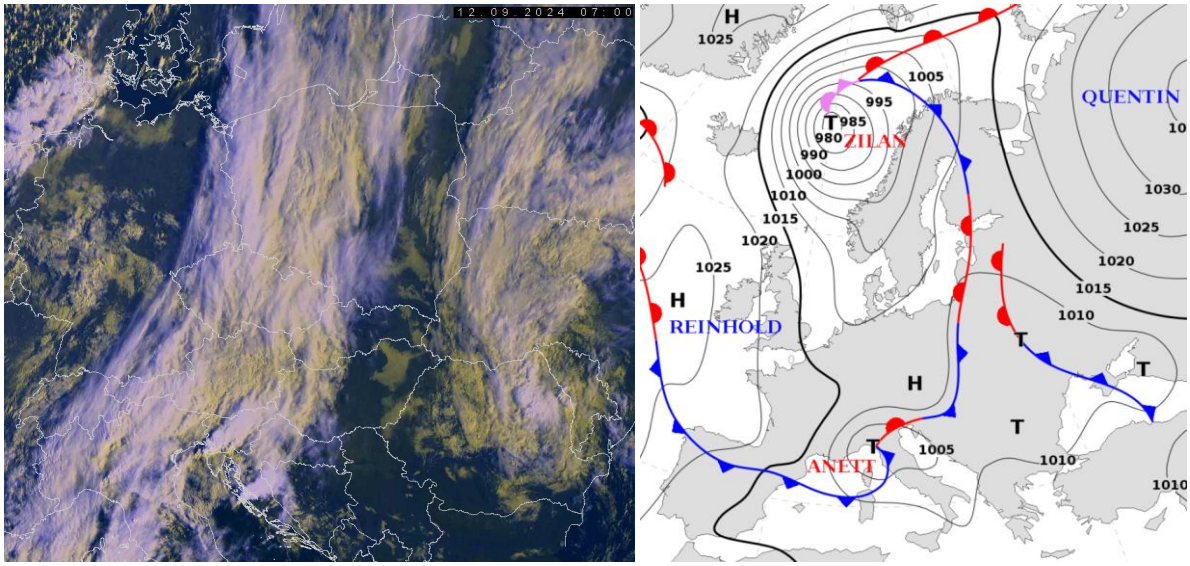
What is the outlook?

Despite additional rain in most of the Czech Republic, water levels are **mostly decreasing** across the country. The situation will continue to evolve in Southern Bohemia and elsewhere with more rain forecast. Flood waves continue to travel along the main water courses in **Austria**, as well as in **Poland** – where Wrocław expects the culmination of Odra with much lower severity than in 1997. The event will thus continue for several days until the waters fully recede. The situation also remains tense near Bratislava in Slovakia, as the Danube is expected to crest at around 950 cm on Tuesday (compared to a record level of 10.34 m in 2013).

Meteorological Recap

The catastrophic flooding in Central Europe occurred as a result of relatively complex synoptic situation, with a period of nearly **continuous rainfall** from September 12 to 15, with additional precipitation currently ongoing. Torrential rainfall occurred primarily in the Czech Republic (particularly Moravia and Silesia), Austria, southwest Poland and western Slovakia. The amount of rainfall was locally enhanced by **orography** on the windward side of mountain ranges and eventually exceeded 400 mm in Jeseníky and Krkonoše Mountains. This amount of rainfall is not typically experienced at this time of year. Another factor that contributed to the severity of the event was the substantial decrease of temperatures caused by an ingression of very **cold air** of polar origin - this limited evaporation and resulted in retention of water in the catchments.

The rainfall started on September 12 with a passage of a sharp **cold front**, bringing the first round of precipitation. Concurrently, temperatures plunged well below their seasonal means. Below is a satellite image of the cold front bringing initial precipitation on September 12 (left) and the synoptic situation with the low-pressure system developing in the Gulf of Genoa (right).

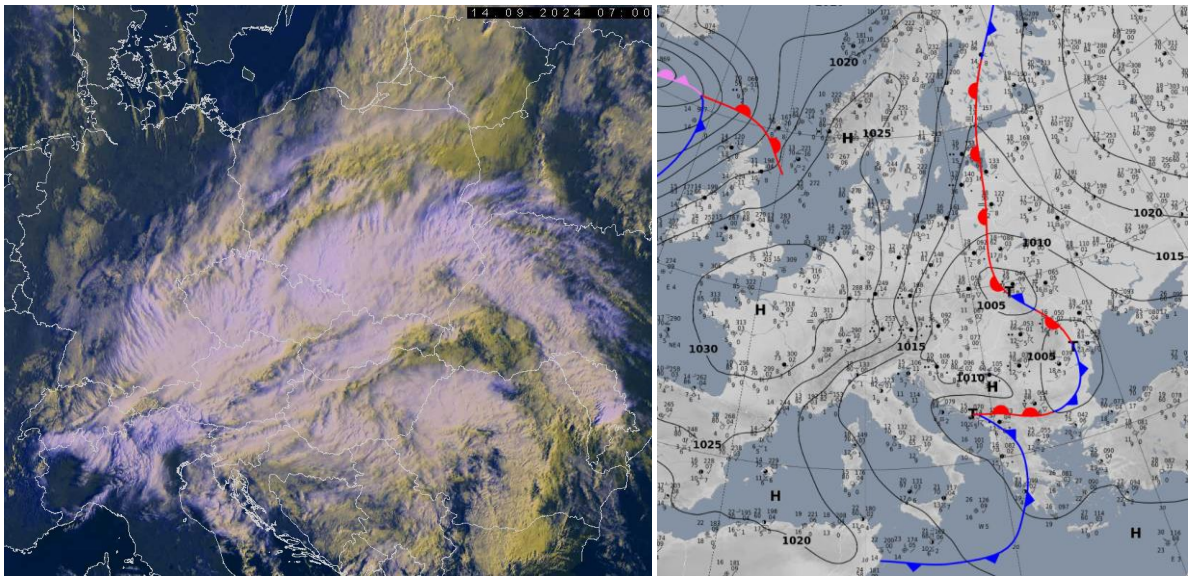


Situation in the morning of September 12. Source: CHMI, EUMETSAT, DWD

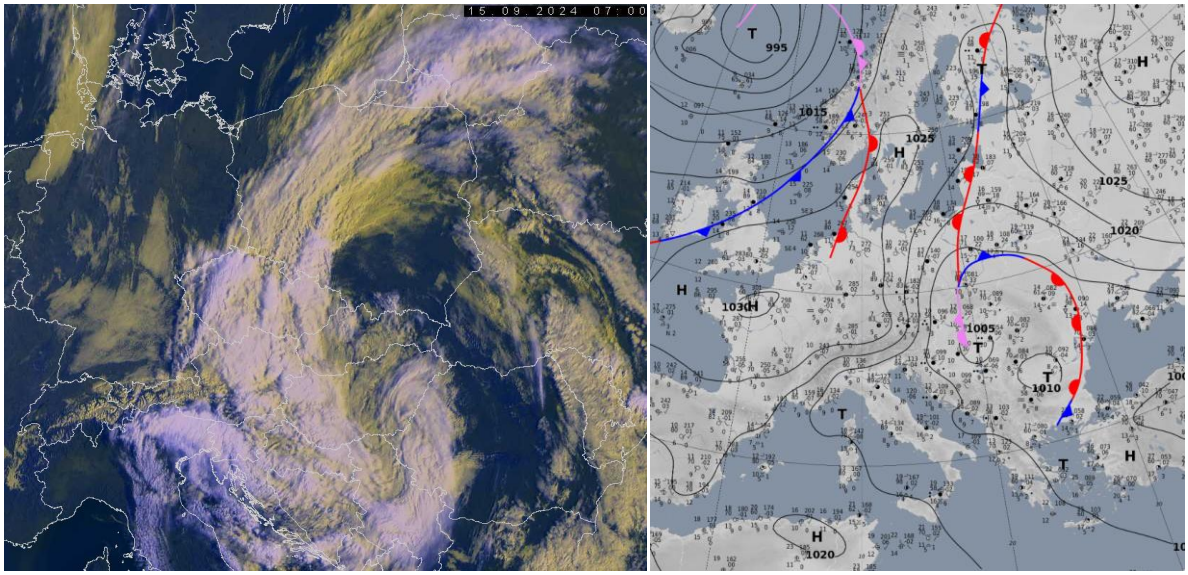
An area of low pressure developed south of the Alps and move to the Balkan region, bringing more heavy precipitation to Central Europe on September 13.

This low was described by Deutscher Wetterdienst as a **Vb-like cyclone** (Vb is also called a Genoa low), which typically brings high amounts of moisture from Central Mediterranean towards Central Europe and has generated several significant flooding events in the region in the past (such as the floods of 2002). This low has been named Anett by the DWD, and also has an international name **Boris**. This low stalled in the area through September 15, bringing rounds of torrential rain.

Rainfall continued as the low Boris stalled over the region on September 15 (see below). Eventually, rainfall subsided in the eastern parts of the Czech Republic and in Slovakia but continued in parts of Bohemia and Austria.



Situation in the morning of September 14. Source: CHMI, EUMETSAT, DWD



Situation in the morning of September 15. Source: CHMI, EUMETSAT, DWD

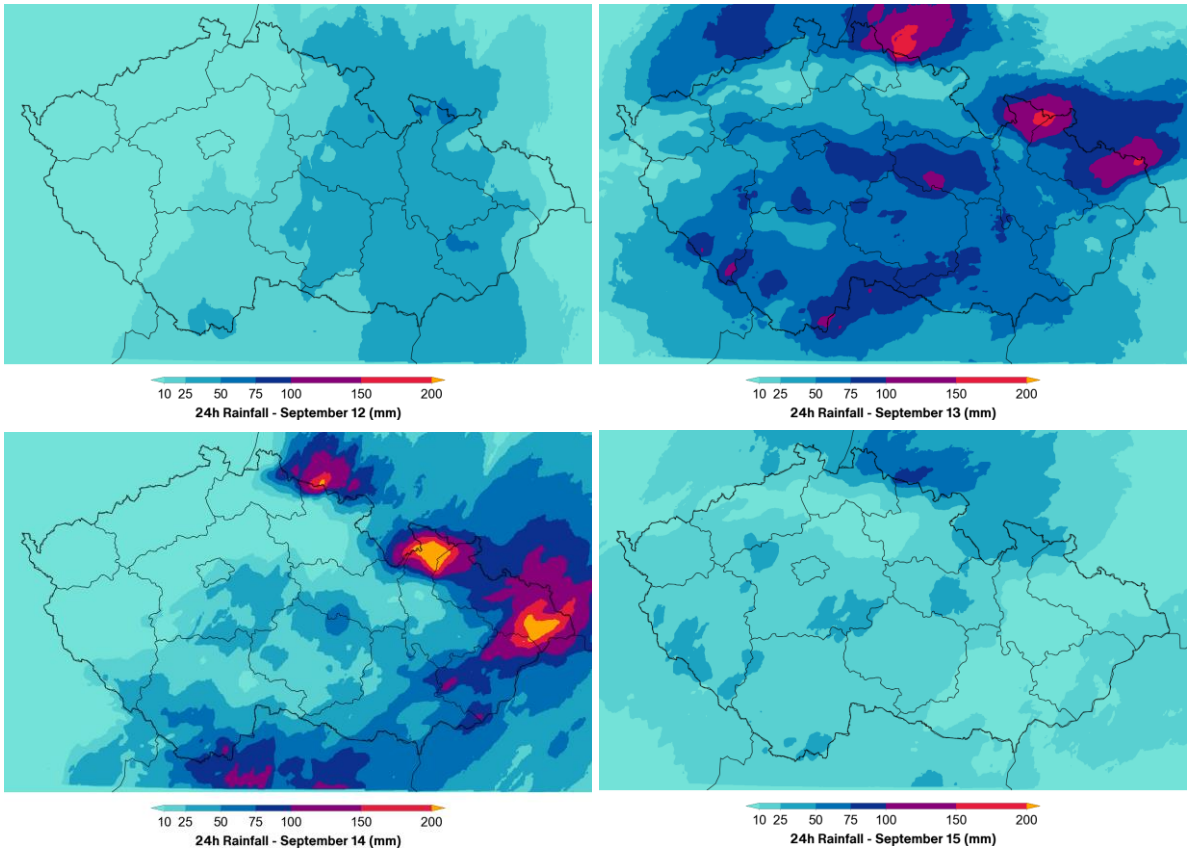
Strong winds posed an additional hazard during the period. Coupled with saturated soils and the fact that trees have not yet defoliated, falling trees resulted in additional damage and disruption. In the Czech Republic, intense gusts peaked with 131 kph at the exposed Milesovka station.

Additionally, **heavy snowfall** was observed in elevated locations of the Alps and other mountain ranges, with the snow line largely between 1,000 and 1,500 m a.s.l. This also means that much of the precipitation forecast for Austria will fall in a solid state.

Severity of the event was **forecast well in advance** as multiple models agreed on the spatial extent and volume of precipitation, as well as the orographic effect of mountain ranges.

Czech Republic

Since the start of the episode, windward locations of Jeseníky Mountains recorded **accumulations of more than 500 mm**, representing roughly half of the average annual precipitation totals. Extreme rainfall was also recorded in mountain ranges of Krkonoše (450+ mm), Beskydy (300+ mm), Novohradské Hory (250+ mm). Below is a summary of daily precipitation totals as provided by the CHMI, based on radar and rain gauge data:



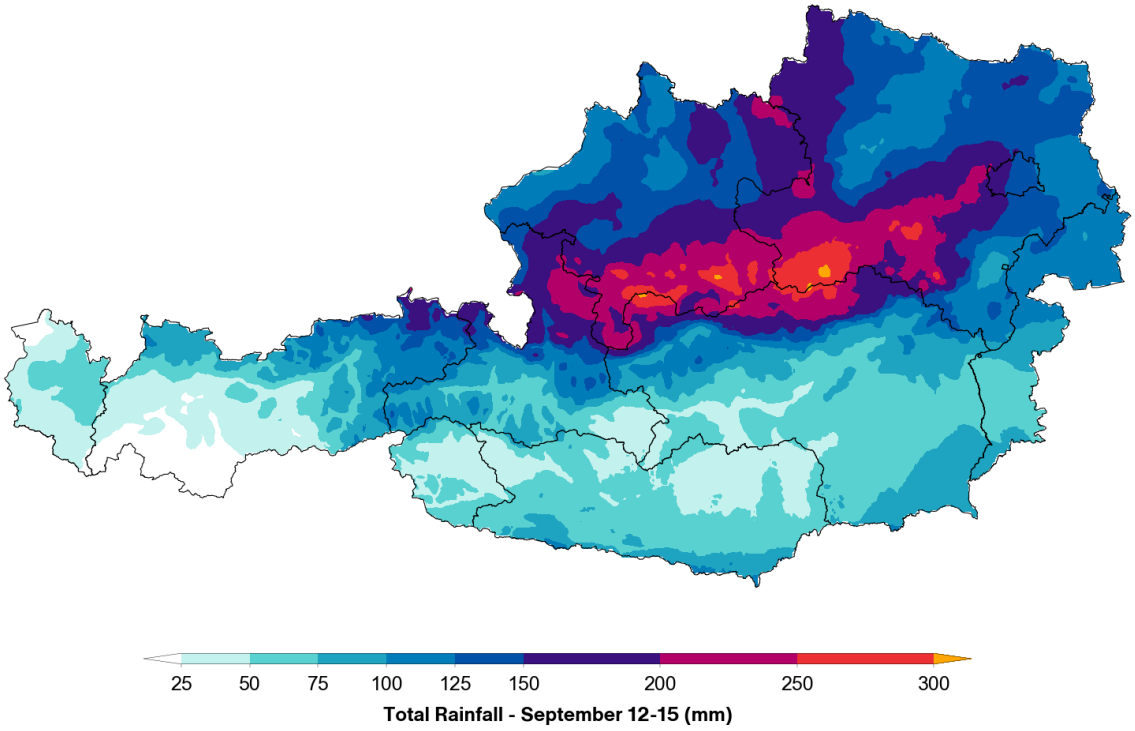
Austria

Extreme amounts of rain affected northern windward side of the Alps, particularly southern parts of **Lower and Upper Austria**, as well as the region west of **Vienna**. Till Monday, September 16, the highest storm accumulation was recorded in Lilienfeld and reached **371 mm**.

Multiple other locations in Lower Austria recorded more than 300 mm (see the table on right). Below is the total rainfall from September 12 to 15, as provided by ZAMG via the SPARTACUS dataset.

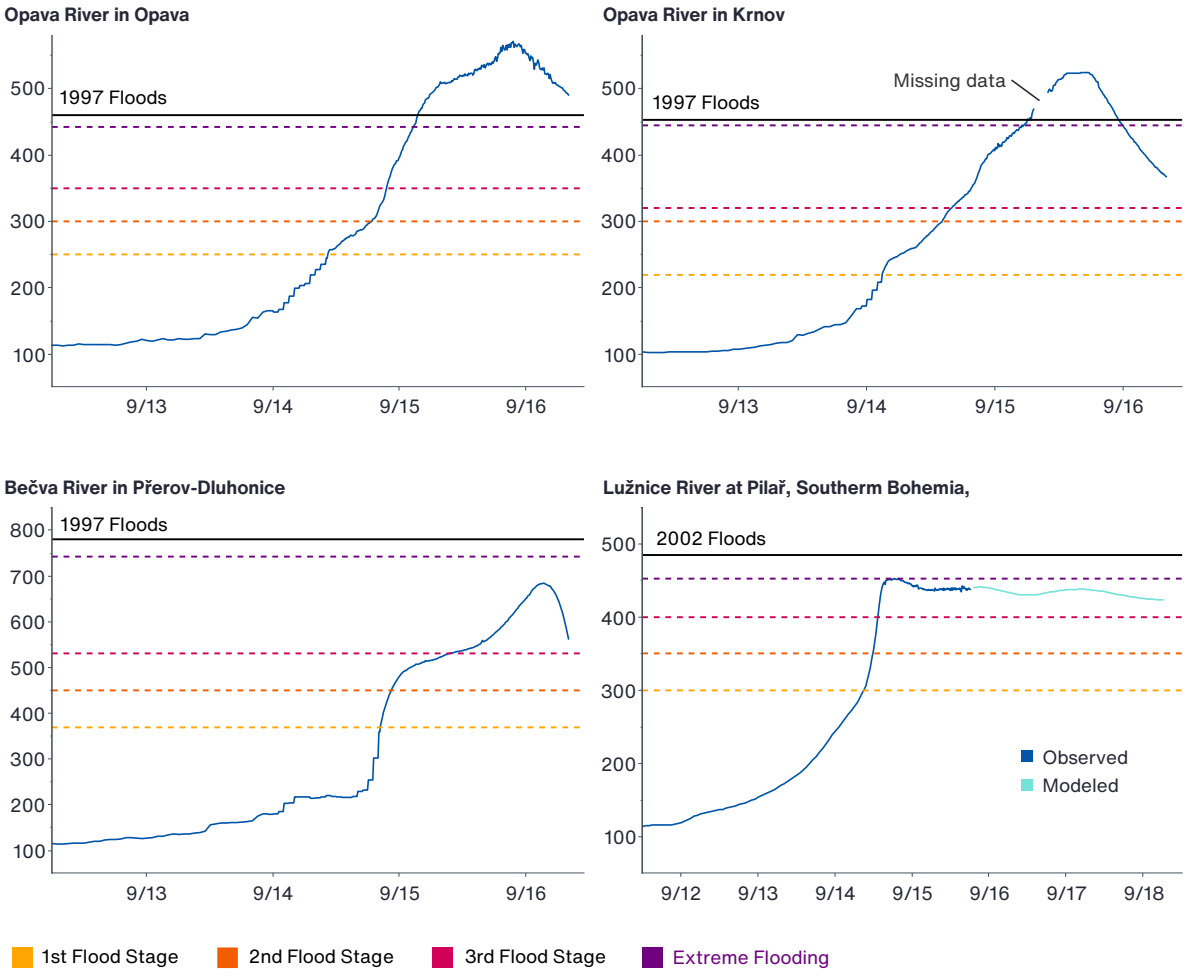
Location	4-day Rainfall Total (mm)	Previous Maximum (mm)	Year of Occurrence
Lilienfeld	**371**	**273**	**1997**
St. Pölten	361	179	2009
Tulln	358	142	1967
Buchbergwarte	354	106	2014
Lunz am See	343	297	2007

Source: ZAMG



Hydrological Recap

In comparison with the historic July 1997 flood event, some rivers exceeded the level reached 27 years ago. This was the case of the Opava River in particular, for example in the towns of Krnov or Opava. In contrast, the water level on the middle reaches of Morava River near Přerov in Central Moravia peaked at around 685 cm, almost 100 cm below the record set in 1997. Note that only stations for which data from both events are available are compared (below). At least 20 profiles, particularly across southern Moravia, exceeded 50-year flood discharge, several rivers exceeded 100-year flood. The situation in Southern Bohemia is expected to evolve in the following days.

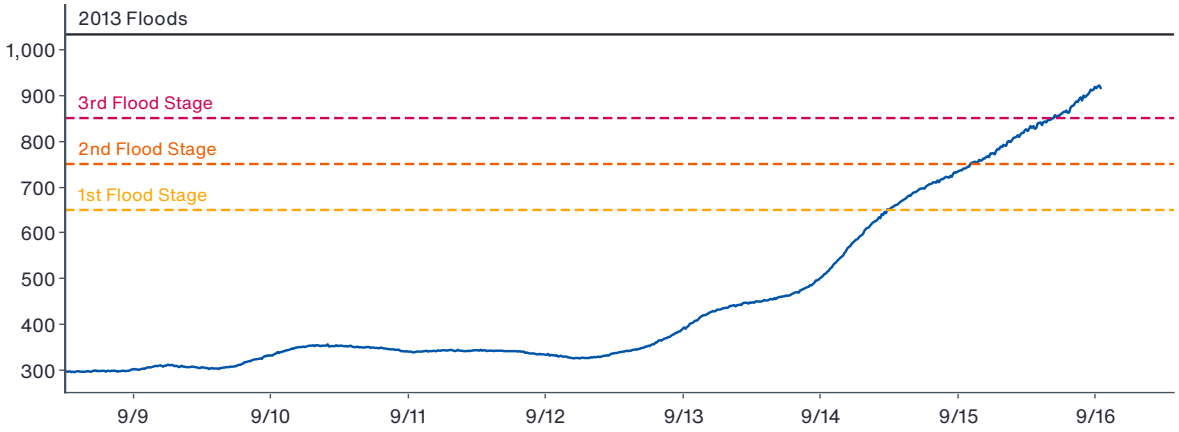


Source: CHMI | Graphic: Aon's Catastrophe Insight

Parameter		July 1997	September 2024
Max Water Level (cm)	Krnov (CZ)	453	525
	Opava (CZ)	460	572
	Ostrava (CZ)	650	641
	Přerov (CZ)	780	685
	Kłodzko (PL)	655	798
Countries Affected		CZ, PL, DE, AT, SK, RO, MD, HU	CZ, PL, DE, AT, SK, RO, HU
Casualties		137	15

In Slovakia, localized flooding occurred mainly in Zahorie (extreme west) and around the capital of Bratislava. The Danube is expected to crest at around 950 cm on Tuesday, below the record level reached in 2013:

Danube River in Bratislava, Slovakia (cm)



Data: SHMU

Historical Context and Flood Protection

In the **Czech Republic**, the catastrophic 1997 flood in Moravia was caused by a rainfall event of similar intensity. Flood protection has also come a long way since – **flood defenses** have been constructed in many cities and municipalities partly as a reaction to the 1997 event. According to Ministry of Agriculture, investments in flood protection measures has reached almost $1.4 billion since 2002, when another major flood event struck in Central Europe. This resulted in additional protection of property of around 1 million people living in Czechia.

The 1997 flood, known in **Poland** as *Powódź tysiąclecia* (Millenium Flood) similarly led to further investments into flood protection in the region. One of the examples is the Racibórz Dolny polder with a capacity of 185 million cubic meters (image on the right), constructed in 2020, the largest water management structure in Poland. On September 15-16, 2024, it started taking in water from the Odra catchment and protecting exposure downstream, including Wroclaw.

Furthermore, warning system, civil defense mechanisms and **public awareness** is on a higher level compared to historical event and collective memory seems to play a role in mitigating the flood impacts. The situation has been widely covered by local and national media, resulting in faster dissemination of critical information among the population in the affected areas.

Event Impacts

Czechia

The situation gradually deteriorated over the weekend following the continuous rain and on September 15, 250 locations reported flood stage, of which 120 exceeded the third, highest level. The worst situation was in Olomouc and Moravian-Silesian regions, particularly in Jeseníky, Opava and Ostrava areas, where **Opava River** reached 1-in-100-year discharges and **exceeded levels recorded during the catastrophic flood of 1997**. Multiple towns and municipalities were partly or completely flooded – notably, roughly 80% of the town of Krnov, or residential neighbourhoods on the left-bank parts of Opava were under water. **Odra River** culminated and flooded parts of the city of Ostrava.

Town of Krnov (left) and Kateřinky neighborhood of left-bank Opava (right), both flooded by the Opava River.
Source: Fire Rescue Service of CR

Catastrophic flooding occurred in **Jeseník** and the surrounding municipalities, where the most extreme rainfall took place. Multiple structures were destroyed by raging floodwaters, multiple bridges were swept away, and the region was essentially cut off. Rivers Bělá, Desná, Vidnava and upper Morava all caused significant damage. Many other locations across the country experienced flooding and some areas are still expecting the culmination of water courses, notably downstream of the Morava River and several rivers across southern Bohemia.

On September 15, the number of power outages peaked at 260,000 due to disruption on the grid, most of which were located in Moravian-Silesian and Olomouc regions. **Widespread disruption** occurred on the railway network, with essentially all travel cancelled in the Moravian-Silesian region, as well as in many other locations. Damage on railway network alone will run at least into the hundreds of millions CZK, as per the initial assessment of authorities.

As of the evening of September 15, emergency services responded to nearly 8,000 incidents since the start of the event in total and more than **12,000 people were evacuated** nationwide. One person was confirmed dead and eight people were declared missing at the time of this writing. With additional rain forecast for the following days, although with far lower intensity, additional increases of water levels in the most affected areas cannot be ruled out.

Austria

Extreme amounts of rain that fell in Austria resulted in widespread flooding, particularly in **Lower Austria** (Niederösterreich), which was declared a disaster area (Katastrophengebiet) on September 15. Particularly difficult situation occurred in the St. Pölten district, where multiple water courses overflowed their banks and several dams broke. Notable property losses were initially reported also from districts of Tulln, Krems and other. Three people were killed in the disaster area, including one firefighter.

Notable damage and disruption were also reported from **Vienna**, as the local river Wien overflowed its banks. Metro system was significantly affected. Additional flooding incidents also occurred in Styria, Upper Austria and elsewhere. The event also resulted in widespread disruption on the grid (more than 12,000 power outages) and traffic (railways disrupted). Authorities evacuated at least 1,100 homes nationwide.

River Wien in western Vienna (left) and flood protection erected in Waidhofen on River Thaya (right)
Source: Stadt Wien, BFK Waidhofen

Poland

Widespread flooding occurred in southwestern and southern Poland. By the evening of September 15, the State Fire Service conducted more than 15,250 interventions related to the event, of which 6,200 occurred in **Silesian** (śląskie), 5,300 in **Lower Silesian** (dolnośląskie) and 1,200 in **Opole** (opolskie) voivodeships. As of September 16, five people were killed.

Critical situation occurred in Stronie Ślonskie, where a small reservoir collapsed on September 15, sending a large flood wave downstream and essentially flooding the entire town. Widespread damage occurred in the town of Głuchołazy, with a temporary bridge destroyed and large areas under water. The town was similarly affected during the Millenium flood of 1997. Further downstream, town of Nysa was notably affected. Critical situation also developed in the Kłodzko area, in Lądek-Zdrój and elsewhere.

Catastrophic flood in Głuchołazy (left) and Kłodzko (right)
Source: Army of the Czech Republic, IMGW

Slovakia

The most difficult situation in Slovakia ensued in **Záhorie, Myjava and Kysuce** regions (extreme west and northwest). In Čadca, a 50-year flood on the Kysuca river affected the town and adjacent municipalities. In western Slovakia, many local streams burst their banks, notably in the town of Stupava. This was also the region with the highest rainfall accumulations, as it was notably affected by the windward effect of the Little Carpathian Mountains. It is worth noting that the highest rainfall (over 350 mm in Pernek) was beyond the most pessimistic forecasts deemed as realistic prior to the episode. Notable amount of damage was caused by strong winds, particularly in the capital of Bratislava.

However, much of the focus still remains on the culmination of **Morava and Danube** rivers, expected to occur well above the third flood stage on Tuesday, September 17, as flood waves from the neighbouring countries will reach the area. The Danube is expected to crest in Bratislava at around 950 cm, which compares to the record level of 10.34 m recoded during the flood of 2013.

Flooding in Čadca (left), additional disruption caused by strong winds (right). Source: Slovak Fire and Rescue Corps

Elsewhere

Six people were killed in **Romania** as heavy rains and flooding related to the low-pressure system Boris affected parts of the country, notably the eastern counties. According to the initial assessment of the Ministry of Interior, at least 28 localities in 7 counties – particularly in Galati, additionally in Argeş, Bacău, Iaşi, Neamţ, Timiş and Vaslui - were affected, and roughly 5,000 homes were flooded in total. More than 320 were rescued by the emergency services.

Source Information

Deutscher Wetterdienst (DWD)
Czech Hydrometeorological Institute (CHMI)
Zentralanstalt für Meteorologie und Geodynamik (ZAMG)
Slovak Hydrometeorological Institute (SHMU)
Instytut Meteorologii i Gospodarki Wodnej (IMGW)
European Severe Weather Database (ESWD)
The Ministry of Agriculture of the Czech Republic
Fanta *et al.* 2019 How long do floods throughout the millennium remain in the collective memory? *Nat Commun* 10, 1105

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