



EQECAT preliminary report into the flooding of the Elbe and Donau, August 2002

Report by J Toothill, 22nd August 2002

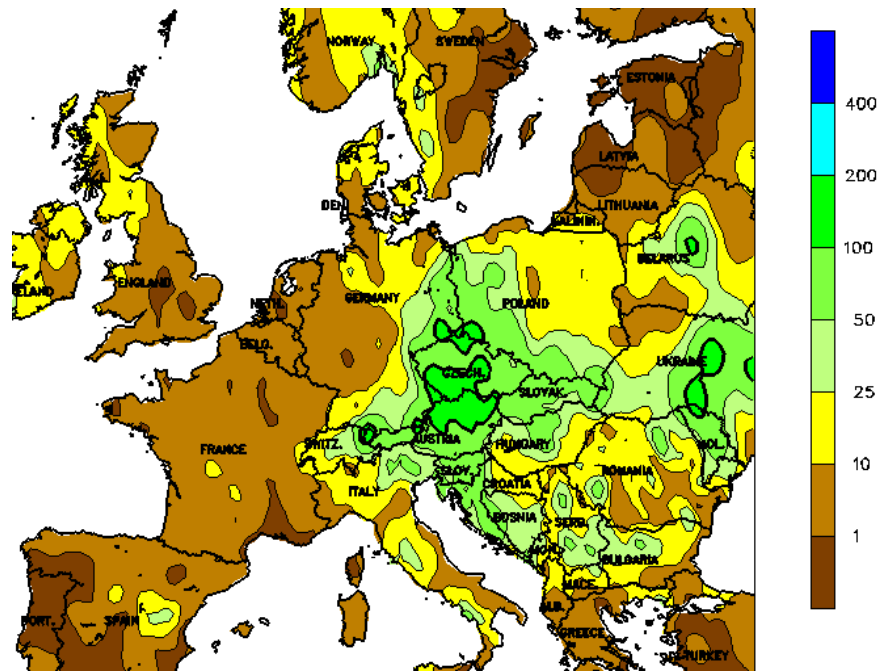
Widespread flooding in Austria, Bulgaria, the Czech Republic, Germany, Hungary, Romania, and Slovakia during August 2002 has caused extensive devastation and so far has resulted in over 100 flood-related deaths during August 2002. Much of the damage is located along the banks of two of Europe's largest rivers, the Danube and the Elbe. In Dresden, one of the worst hit cities, over a quarter of the population were evacuated at the height of the flood. Prague has also been badly affected, with severe damage occurring to much of the city's historic center. This preliminary report describes the meteorological conditions that led to flooding and resulting water levels in rivers and contains a brief description of damage in the affected area.



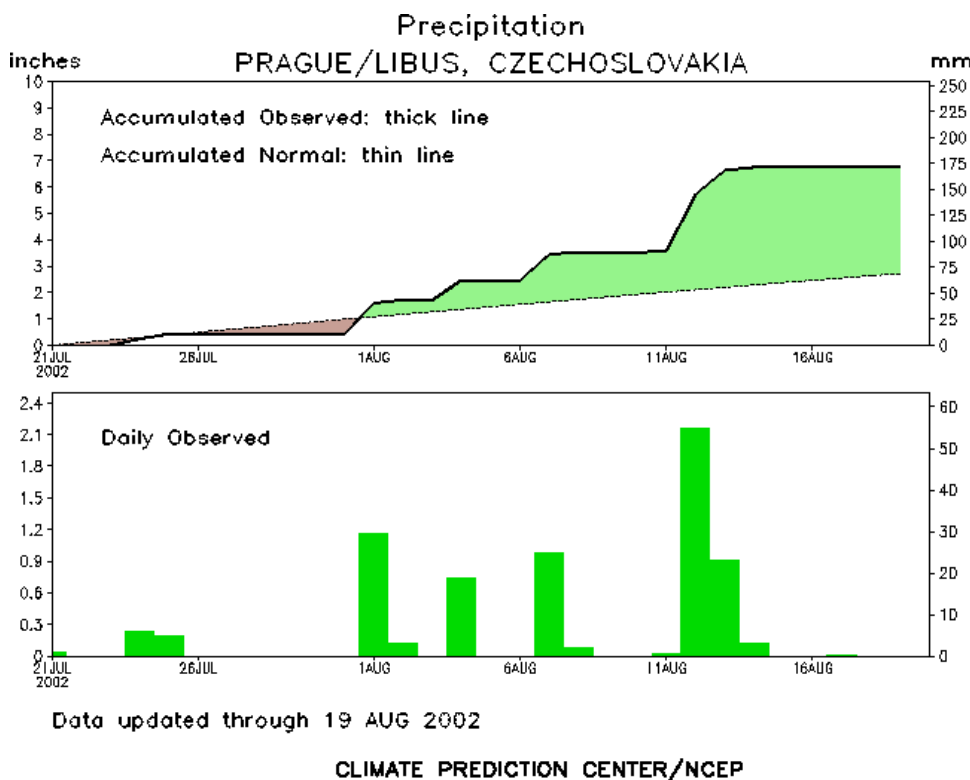
Street scene in Dresden

Meteorological Background

The August 2002 flooding was a result of heavy prolonged rain in the catchment area of the Danube and Elbe river basins. The meteorological conditions giving rise to the rain were unusual, although not extraordinary. The weather system causing the rainfall passed across Europe further to the south than is normal for such fronts. This path caused the event to cross warmer waters than is passed by most fronts crossing Europe, allowing it to pick up more moisture. This, coupled with the fact that the front was relatively slow moving, enabled the protracted precipitation of heavy rain.



Precipitation in Europe, August 11-17. *Source NOAA.*



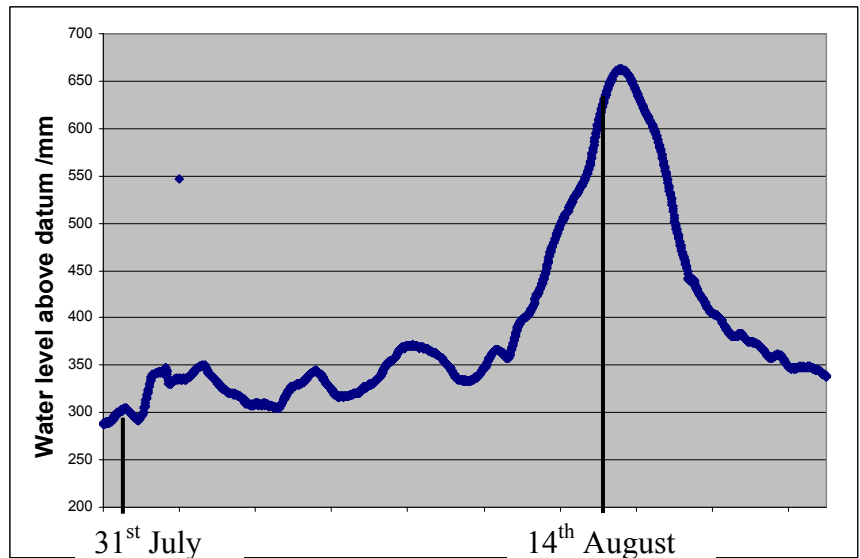
Comparisons between the normal and observed rainfall for this period for many locations in Central Europe reveal that rainfall in the first two weeks of August was two to three times the normal level for this time of year. The example for Prague (*left*) shows four periods of heavy rain, cumulating in two days of exceptional rainfall on the 12th and 13th of August. This pattern was repeated throughout the catchments of the Elbe and Danube rivers.

Daily observed rainfall and accumulated observed rainfall compared to normal in Prague for the period 21st to 17th August.

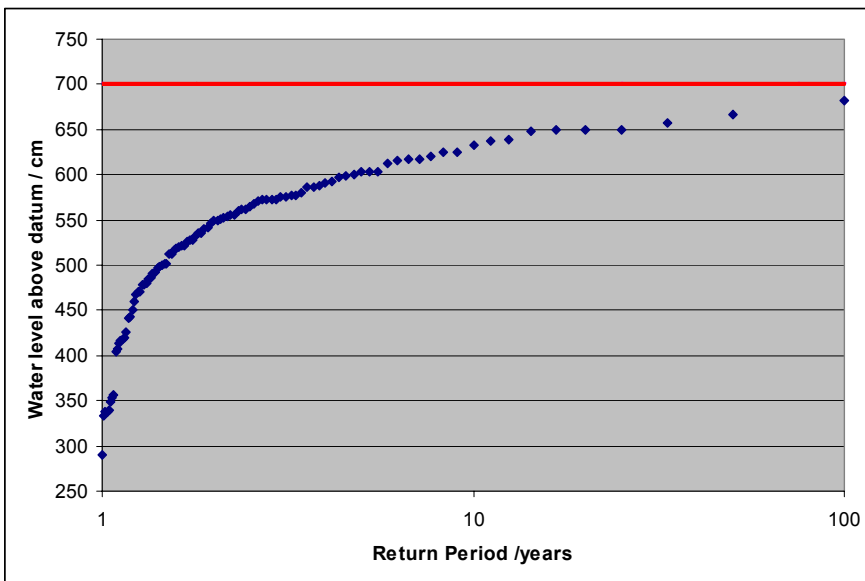
Flood water in the Danube and Elbe

A flood hydrograph of the event is shown for Schwabelweis on the Danube. The flood is seen as a single distinct peak in the hydrograph.

The resulting water depths on the Elbe and Danube rivers have exceeded previously recorded levels in many places.

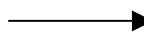


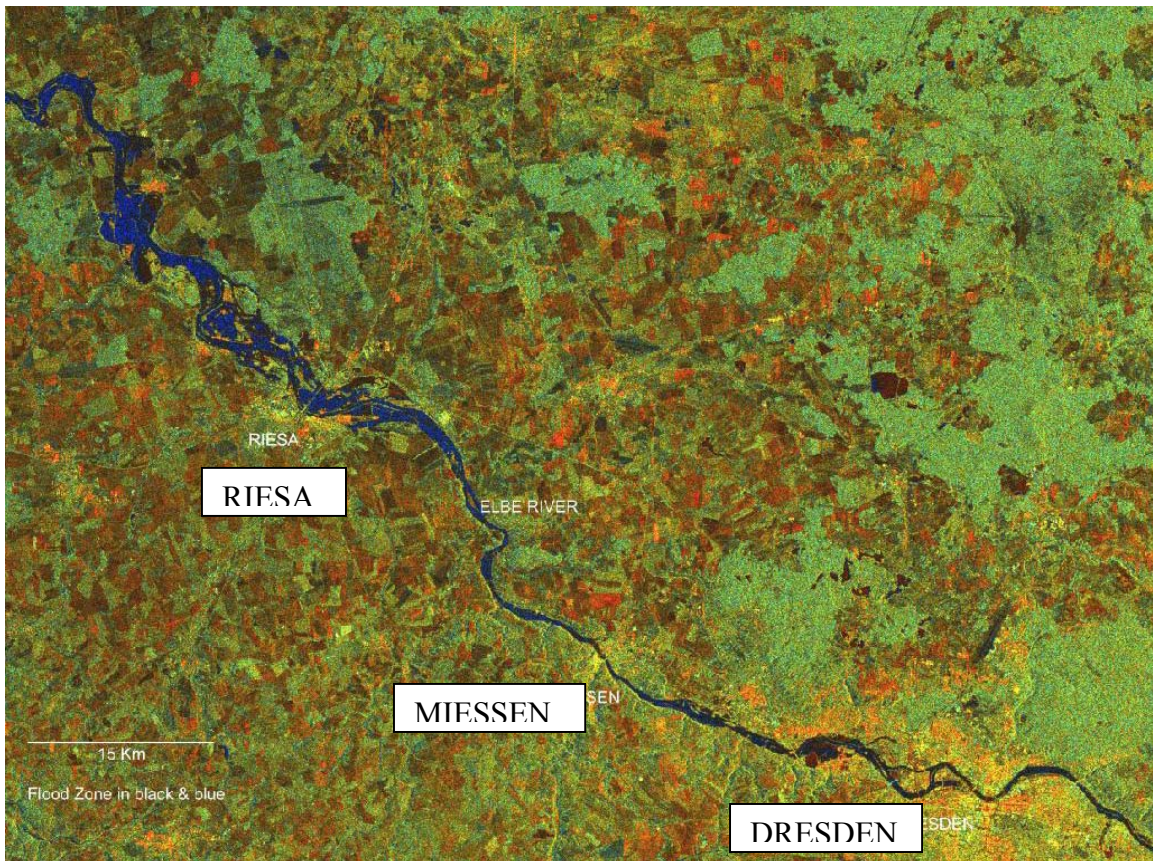
An example is given for Barby, near Dresden. The water level – return period relationship for annual maxima data recorded prior to 2002 is shown in blue and the level of the August 2002 flood is shown by the red horizontal line. The water level in the current event exceeds any previously recorded data.



Water level – frequency relationship at Barby, near Dresden. Annual maxima data for the 100-year period 1900 – 2000 are shown. The level of the August 2002 flood is indicated by the red horizontal line.

Clean-up operations in Dresden. The water level in this street, located over 0.5km from the Elbe, reached 2m above street level. The high water mark can clearly be seen on the wall of the building.





A satellite picture of Sachsen, Germany shows the extent of flooding on the Elbe downstream from Dresden. *Source: Earthnet Online (ESA)*

Coping with the floods

Prior to flooding, extensive emergency operations were undertaken in all the affected countries to improve existing flood defences, protect buildings and evacuate areas at risk. Water levels in the Danube



Preparation of sand bags in Magdeburg

and Elbe have exceeded all prior expectations as to the level of flooding possible on the two rivers, and existing defences were simply not high enough to withstand water levels in many places. In Germany, both the police and the military have been heavily involved with the effort to build emergency defences. The general public have also been involved in constructing both defences along riverbanks and in protecting their own home from flood waters.

Large dumps of sand and bags have been provided for public use in areas at risk from immediate flooding, along with emergency medical care facilities and communication centres.



Waiting for the flood: Sandbag and wooden board protection of property in an evacuated area of Magdeburg

River dyke heightened with polythene and sand bags outside Dessau, downstream from Dresden. This defence held, saving a residential district and part of the town centre behind the defence

An even larger effort is required once flooding has passed, although without the time pressure. Disposal of sand bags and damaged property creates a problem in addition to the clean-up of property and streets required. In many areas, the deposition of tens of centimetres of mud, sometimes polluted, has made streets impassable. This mud must be cleared away, and drains unblocked, before the water remaining in many basements can be pumped away and damage can be repaired. Considerable loss due to business interruption is inevitable, especially in badly hit areas where the services required for a quick clean-up of buildings are over-stretched.



Centre of Dresden: This street remains virtually impassable, being filled with ~10cm of mud.

Property damage

Extensive losses have occurred related to residential districts in floodplain areas. In many areas, more modern properties are especially badly affected since these have a higher tendency to be located on the flood plain. Losses to contents are particularly large, especially in single storey properties such as bungalows or ground floor apartments. In most areas, there is little evidence of significant structural damage to residential properties, although damage to electrics and other utilities located in basements is widespread.



Flooded houses on the Elbe flood plain north of Dresden



Collapse of glass-fronted office. The water level in this street reached ~1m above ground level.

Other than in areas directly adjacent to the river, where velocity of the water has been able to cause the collapse of some buildings, there is little evidence of structural failure. Minor damage may also occur where debris (e.g. trees and cars) are carried by flowing water. One major cause of direct structural damage is the presence of large panes of glass at ground level, notably in glass-fronted commercial properties at street level. Some collapses of weak retaining walls (e.g. garden walls) have also occurred where a wall has been sufficiently impermeable to allow water to build up on one side only.



Contents damage in an apartment block in Dresden

In city centre areas, the damage is concentrated in ground floor, single-storey commercial properties. Warehouses lacking a second storey have also been badly affected. Industrial facilities are generally better protected and also often become the focus of emergency flooded defence measures due to their potential to cause pollution.

Motor vehicles, both privately owned and belonging to hire companies and in sales showrooms have suffered a great deal of damage. In areas where there is evidence of flowing water, cars have been transported tens if meters, resulting in further damage to nearby vehicles and property.

Lifelines have been severely affected in many regions, with many areas suffering loss of electricity and water supplies. The transport network has also suffered due to structural damage to bridges as well as direct flooding of roads and railways.



Contents damage to clothing store in Dresden



Damaged car, Germany

Loss Estimates

Early estimates suggest that economic damage will be on the order of €15 to 20 billion, with around €2 to 3 billion being covered by the insurance market. Individual companies have thus far failed to provide estimates. Insurance losses are likely to be limited by lack of cover, especially in Eastern European countries, and policy limits for flood cover.

Enquiries / Further information

A full EQECAT report will be available in September. To obtain a copy of this report, or for information regarding the August 2002 floods, EQECAT's flood modelling capabilities or our EUFlood software, please contact Jane Toothill (E-mail jtoothill@absconsulting.com; Tel. +44 (0)1925 287390) or Henry Bovy (E-mail hbovy@absconsulting.com; Tel. +33 (0)1 44 790101)



Square outside Dresden railway station.