Climate Change and Losses through Natural Disaster: Some Remarks from Experience in the Czech Republic

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Of all natural disasters, floods and windstorms are the most devastating in the Czech Republic. They often involve loss of human life and extensive material damage. The most spectacular cases to date have been the July 1997 flood in the eastern part of the Czech Republic (52 dead, material damage 63 billion Czech crowns) and the August 2002 flood in the western areas (19 dead, material damage 73 billion Czech crowns). Events of lesser extent occurred in July 1998 (flash flood in eastern Bohemia with 6 dead and damage estimated at 2 billion Czech crowns) and March/April 2006 (9 dead, damage 5.6 billion Czech crowns).

Recent developments in climate change, floods and windstorms in the Czech Republic

The process of global warming is reflected in the Czech Republic by statistically significant increases in air temperature with reference to the average series for 1848–2000, with the following linear trends: winter 0.93, spring 0.88, summer 0.36, autumn 0.52 and year 0.69°C/100 years. These trends are even more marked in the case of some individual stations. On the other hand, series of seasonal and annual precipitation totals show no significant linear trends, with the exception of an increase in winter.

Some important conclusions may be derived from analysis of floods in the instrumental and pre-instrumental periods in the Czech Republic (Brázdil et al., 2005a). In the period covered by systematic hydrological observations (i.e. since around the mid-19th century), the total numbers of the floods, as well as their extremities expressed through the N-year return period of maximum peak discharges, have been falling (Fig. 1). This decline may be ascribed primarily to a reduction of the frequency of floods of the winter synoptic type, those related to snow melting and ice damming accompanied by rain. This, in turn, is a consequence of global warming in which, following on from a later onset of winters and lower accumulation of water in snow cover, the number of floods has decreased, mainly in the months of February to April. Information held in documentary evidence makes it possible to extend the flooding information base back for several centuries. A synthesis of floods based on instrumental data and documentary sources indicates long-term trends, with a maximum of floods in the 19th century and the second part of the 16th century. From this analysis it becomes evident that, although several destructive floods occurred in the 20th century, it could well be classed as a very favourable hundred years (with the exception of the flood of July 1997).

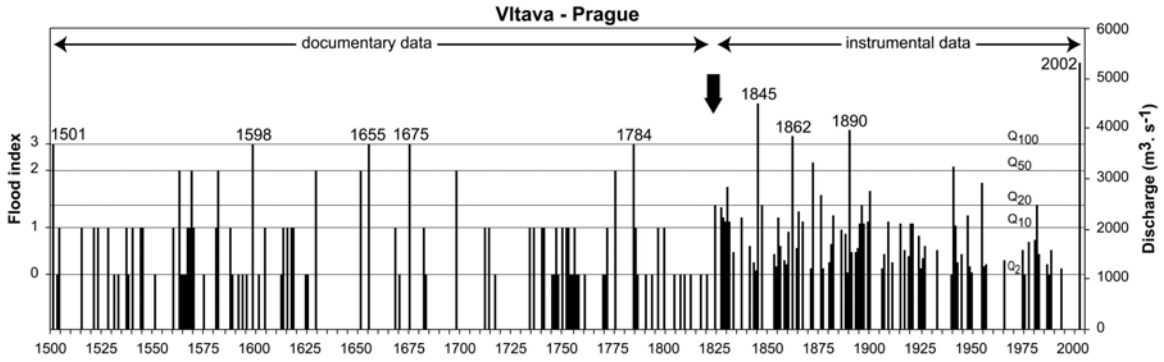

Fig. 1. Chronology of floods on the River Vltava at Prague in 1500–2002 – a synthesis of documentary data and instrumental records. Left axis: flood indices with reference to documentary data interpreted on an intensity scale of 0–3. Right axis: measured maximum peak discharges during floods with N-year water levels; for example, Q20 corresponds to a maximum peak discharge with a return interval of 20 years (Brázdil et al., 2005b)

The state of knowledge about changes in windstorm conditions (Brázdil et al., 2004) is blurred by far more complication than that involved in floods. Wind speed measurement data are significantly biased by changes in instruments over time, rendering the matter of obtaining homogeneous series complex, at best. The apparent frequency of strong winds reflects, at least to some extent, an increase in the number of documentary sources from the past. Despite this, it remains possible to speak of a higher frequency of strong winds at the cusp of the 16th and 17th centuries and largely in the years 1800–1830 and 1900–1940. On the other hand, the series of strong winds created does not allow presentation of any serious conclusions about long-term trends; the documentary records are simply incomplete (Fig. 2).

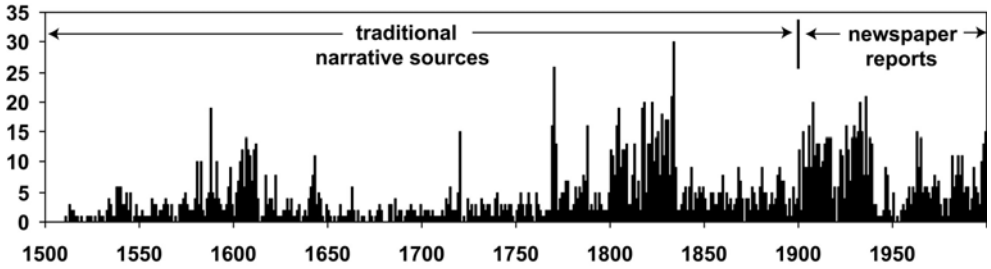

Fig. 2. Annual frequencies of strong winds derived from documentary evidence in the Czech Republic in the period 1500–1999 (Brázdil et al., 2004)

Factors accounting for increased costs associated with disasters in recent decades

No series of calculations of the costs of disasters exists for the Czech Republic. No institution systematically collects this type of data, while problems remain inherent to any comparison of recent costs of disastrous natural events with historical ones. Regardless of this, meteorological and socio-economic factors contribute to loss of human life and material damage in the course of disasters. With respect to climate change, it is expected that changes in the mean values will accompany changes in the simple occurrence of extreme weather patterns, followed by changes in the frequency and severity of extremes. The impacts proper can be then modulated by various socio-economic circumstances:

- **failure of historical memory**
  It appears that people quickly forget that floodplains are not suitable places for building and other localised human activities. Lack of foresight in the utilisation of such areas increases material damage during floods. Historical buildings, such as churches, have not usually been flooded in the course of recent events because more care went into selecting safe areas for them.
- **changes in the landscape**
  Considerable changes in land-use have taken place that largely reduced the water-retention capacity of the landscape. This is related to a significant increase in the area of arable land, expanding through deforestation and the drying-out of water-meadows and wetlands. Forestry management has concentrated on the production of monocultural fast-growing trees, growths that not only influence the water-bearing capacity of the land, but are not resistant to weather extremes such as wind, snow, ice deposits, drought and pollution. The canalisation of rivers is also an important factor. Original riverbeds have often been significantly shortened, straightened and reshaped by various water structures. In many cases, this has resulted in acceleration of runoff and the parallel occurrence of flood waves on different rivers.
- **the more complicated structure of human society**
  An increasing number of inhabitants and the extension of human activities have increased pressure on the landscape and extended its use. In comparison with the past, significant changes in life-styles, as well as the use of more developed equipment in households, increase the potential for loss in recent events.
- **mistakes in planning and zoning**
  An important means of diminishing losses is sensible territorial planning and zoning. Although information on potentially inundated areas by floods of various return periods is freely available, building permission has

nevertheless often been given in potentially dangerous areas.

- **poor social education about disasters**
  Disastrous natural events have a long return period. The severity of floods is expressed in terms of the N-year return period of culmination discharges in which the corresponding value is achieved, or higher on average, than once per N-years. This is, however, confusing for lay people who often believe that, for example, "a hundred-year water will not occur twice in my lifetime". On the other hand, people believe in the potential for technological protection; the system of water reservoirs on the Vltava below Prague (known as the Vltava Cascade) was built in the 1950s and a relatively quiet period followed. Many believed, until the catastrophic events of 2002, that Prague had been exempted from floods by the intervention of civil engineering.

Recent insights into natural disasters: implications for research and policy

Research related to natural disasters should address the following questions:

- Is the occurrence and severity of natural disasters part of a random process, or is it already a reflection of recent global warming (e.g. as reflected in the increased frequency of flood disasters in the Czech Republic, or Central Europe since the 1990s, or in the course of the past 10 years in the Czech Republic)?
- Can local or regional data on disasters indicate anything about larger trends and relationships?
- What conditions are necessary and sufficient to identify signals of climate change in disasters on local or regional scales?
- Are instrumental records long enough for useful insight into disastrous events with long return periods? For example, on the Vltava in Prague, a flood with a return period of $N \geq 100$ years recurred after 112 years (September 1890 and August 2002), but before 1890 similar floods occurred in February 1784, February 1799, March 1845 and February 1862
- How useful is information about extremes derived from documentary (the past millennium) and palaeclimatological sources (before that) in the study of the severity, seasonality and impacts of past disasters – mainly in terms of the magnitude of events not experienced in recent time.

The recent behaviour of the insurance industry raises problems, in that it is now impossible to insure a house and/or property if they are located in a potential floodplain. In concrete terms, this entails a shift or responsibility for assistance in such events to the government (politicians) or to other parts of the decision-making sphere (managers).

It becomes clear that only one alternative exists for the future – to cope with natural disasters. Society, managers and politicians must have only one aim in preparation for extreme situations: to save human lives and diminish potential material damage. This needs organisation of all the activities that might make any contribution whatsoever in such critical situations.

Acknowledgements: This paper has been prepared with the financial support of research project MŠM0021622412 (INCHEMBIOL).

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