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CHRONOLOGY OF STRONG WIND EVENTS IN THE CZECH LANDS DURING THE 16TH-19TH CENTURIES

Abstract: Problems of measuring strong winds are analysed. The efficiency of historical written reports of strong winds and their impacts in the pre-instrumental period are discussed. The chronology of strong winds with damage in the Czech Lands from the 16th to the 19th centuries is presented with the division into gales on the one hand and tornadoes and squalls on the other hand. Cases of gales of the century are described.

Key words: strong wind, gale, tornado, squall, damage, Czech Lands.

1. Introduction

Strong winds belong among the most significant meteorological extremes whose occurrence is often accompanied by human victims and great material damage. Thus, under the conditions of the Czech Republic it is the most significant abiotic factor participating in the form of wind breakage most markedly in the salvage felling (Brázdil 1998). The action of the wind is given by its force effects on the objects, when, in disturbing the limits of their strength or resilience material damage occurs. Under the conditions of central Europe strong winds manifest themselves in the form of gales, squalls and tornadoes. The rise and development of squalls and tornadoes is bound to the development of thunderstorm clouds, which conditions their short duration (within tens of minutes) and a locally limited occurrence of damage most frequently in the months of the warm half-year. On the other hand, gales, lasting several hours or days and affecting more extensive regions, are bound to considerable horizontal pressure gradients, where the intensification of the wind speed can be helped by the deformation of streaming across large orographic obstacles (Štekl 1997). Frequent reports about meteorological extremes and their impacts in recent years evoke the question whether the frequency of those phenomena is increasing and whether the society does not become more sensitive to their impacts. This also holds

for a strong wind, where hitherto papers in the Czech Republic were oriented above all on the synoptic analysis of the individual cases (e.g. Gregor 1955; Setvák, Strachota 1986; Šálek 1994) or on the determination of synoptic situations with the occurrence of a strong wind (Štekl 1997), the study of long-term fluctuation with respect to the impacts being almost completely missing, but for exceptions (such as Slabý 1993; Brázdil 1998; Brázdil, Štekl 1999). This contribution presents preliminary results of the research of strong wind events in the Czech Lands during the 16th-19th centuries.

2. Problems of Strong Winds in the Instrumental Period

The occurrence of strong winds is climatologically usually characterised by the number of days with the wind speed above a certain limit or the magnitude of wind gusts. The most exact data like that can be obtained on the basis of anemographs. But the quality of such measurements is adversely affected by several factors, including interruptions due to ice deposit formation, lightning strikes to the sensors or the adjustment or replacement of the instrument. The homogenisation of series of the above characteristics is, with respect to their extremity and spatial variability only difficult to carry out, irrespective of the problem of, as a rule, incomplete metadata of the station. An idea about the fluctuation of wind gusts on Mt. Milešovka, the windiest station in the Czech Republic, and at the observatory Prague-Karlov, is given in Figure 1. Evidently lower wind gusts for Prague-Karlov up to the year 1964 are connected

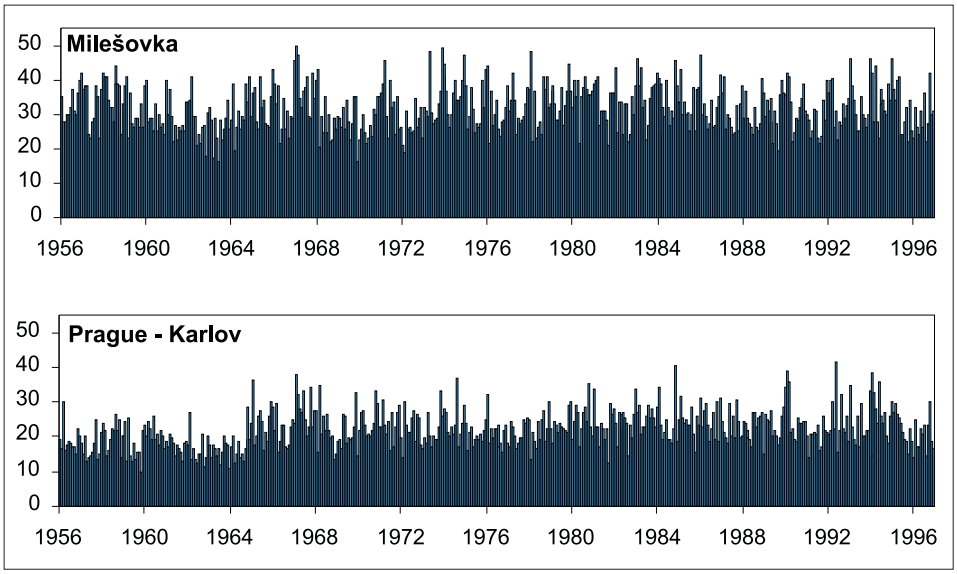

Fig. 1. Fluctuation of maximum monthly wind gusts ($m.s^{-1}$) at Mt. Milešovka and Prague-Karlov in 1956-1996. For Prague-Karlov the impairment of homogeneity after the exchange of the anemograph in October of 1964 is well perceptible.

with the Dines pressure tube anemograph up to 1960, exchanged by the anemograph Metra which, in 1964, was exchanged by another anemograph of the Metra type. From extreme values of the individual wind characteristics no information can, however, be obtained about their impacts, i.e. about the caused material damage or losses of human lives. In those cases it is necessary to combine meteorological records with other sources (chronicles, newspapers, technical publications, etc.), a squall or a tornado not being necessarily registered at the given station at all. Besides, the employed series of measured wind gusts express only several decades of years.

3. Sources of Information about Strong Winds besides Instrumental Measurements

At weather stations without anemographs or anemometers the wind force was observed according to the Beaufort scale. On the basis of the verbal description of the wind manifestations strong wind falls to degrees 8 (fresh gale), 9-11 (strong gale to storm) and 12 (hurricane). These observations are another possible, hitherto not much utilised, source of data (see e.g. Schiesser et al. 1997). For the period before the beginning of these systematic observations the utilisation of written weather reports may be used (to their sources see e.g. Brázdil 2000), in which it is possible to find the exact dating and the description of the phenomenon and its effects. Thus, in the Czech Lands the earliest record is Kosmas's description of a tornado of 30 July, 1119 from Prague (Bretholz 1923). Written records deal for the most part with cases when a strong wind made some damage. The information value of such reports is, as can be understood, different, their density varying considerably, linking up with the comprehensiveness, accessibility and hitherto study of the source material. Despite certain limitations of those data it is possible to compile from them chronologies of the strong wind, yielding a certain statement about its fluctuation in the period before the beginning of regular observations.

4. Chronologies of Strong Winds Events in the Czech Lands during the 16th-19th Centuries

From the data base of historical-climatological data of the Department of Geography all cases of strong wind events were chosen since 1500 which, according to the verbal description were included into some of the following groups: 1 - tornadoes, 2 - squalls, 3 - strong winds, 4 - gales (gale, storm, hurricane). In the case of the tornado the description had to include the report of a typical funnel cloud pointing to the ground and/or about its effects. As squall were classified cases, when a strong wind was mentioned together with a thunderstorm or a hailstorm. The group of gales included cases with a strong wind of major territorial range with damage of different intensities or reports from narrative sources about a strong wind where information about damage was not mentioned. If a strong wind was mentioned without any further specifying information in daily weather records, the inclusion of such event was considered case by case into the category of gales. In the fluctuation of the frequency

of all strong winds, gales and wind caused damage in the 16th-19th centuries in the Czech Lands two maxima are apparent (Fig. 2). The first one appears in the late 16th and in the early 17th centuries, the other then between the years 1800-1870. A question is, to what extent these maxima are conditioned by the density of records in those periods as against the other parts of the four centuries studied. In the case of the frequency of squalls and tornadoes the former of the above maxima is better expressed. Although the frequencies of tornadoes in our data base are higher than their number

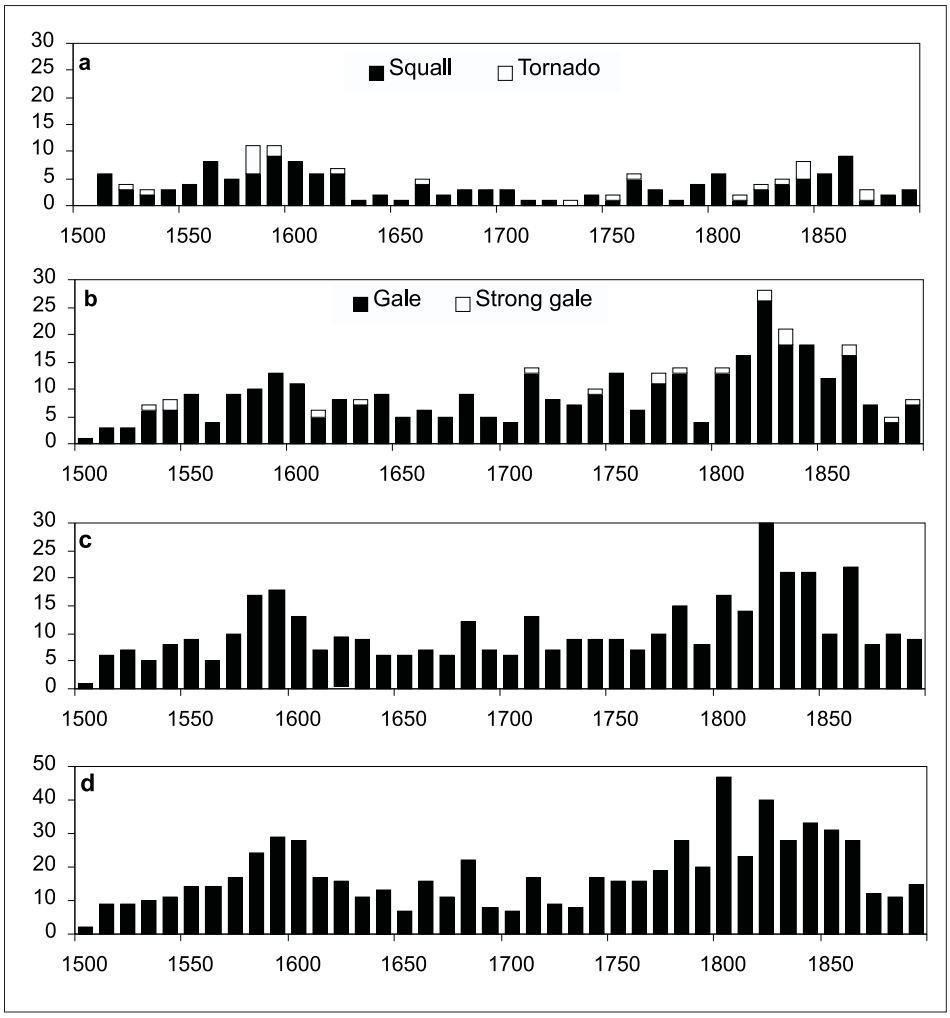

Fig. 2. The variation of ten-year frequencies of occurrence of squalls and tornadoes (a), gales (b), cases of strong wind with damage (c) and all cases of strong wind (d) in the Czech Lands in the 16th-19th centuries.

given in the paper by Munzar (1995), their number against the actual occurrence is markedly underestimated. Thus, web pages of the CHMI mention only for the years 1996-1999 seven tornadoes, out of which three in 1999. Every completion of the record about the occurrence of this phenomenon is, however, valuable for their further study (see e.g. Paul 1999 for France).

5. Gales of the Century

In the 16th century most records are related to the New Year's night of 1556 and to the night from 4 to 5 January 1556 (due to a limited extent of the contribution neither here nor further are given quotations of the corresponding sources). In both cases a thunderstorm, a gale and great damage are mentioned in narrative sources for many places in the whole of Bohemia. Probably in both cases it was a passage of a cold front across Bohemia with a conspicuous intensification of the wind speed of the character of a squall. On 28 December 1612 an exceptionally destructive gale affected Bohemia, but also the Bohemian-Moravian Highlands as well as north Moravia. Besides damage in towns also great wind breakage is mentioned. An analogous situation evidently occurred on 20 December 1740, when reports of a gale and great damage, including wind breakage, appear from all parts of the Czech Lands. Several exceptionally destructive gales are also mentioned by sources for the 19th century. The greatest of them included above all a gale of 25 May 1830, 18 December 1833, 7 December 1868 and in the night from 26 to 27 October 1870, which are documented for a number of places over the whole Czech Lands. In the 20th century the strongest gales are considered those of 17 January 1955 (Gregor 1955), of 2-4 January 1976 (Červený 1984), of 23-24 November 1984 (Setvák, Strachota 1986) and of 26 February - 1 March 1990 (8.4 million m^3 of salvage timber was obtained from wind breakage in the Czech Republic in 1990).

6. Conclusion

To recognise meteorological extremes it is necessary to extend the knowledge about them to the period before the beginning of instrumental measurements. At the same time it is necessary to register those which were extreme from the point of view of the impacts on nature and society, which also holds for strong winds. Further study in archives is an essential assumption of extending the corresponding data base. This extremely time requiring process is also a pathway to a better knowledge of strong winds and their impacts on the territory of the Czech Lands.

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