



*Supplement of*

## **15th century climate in the Czech Lands and its Central European context**

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Weather patterns and related phenomena in the Czech Lands for individual years within the 15th century, extracted from narrative documentary evidence and *Liber rationum*, are presented below within a framework of individual decades. Locations of the places, rivers and mountains reported in annual description below are shown over the territory of the recent Czech Republic in Fig. S1. In some cases, Czech data are complemented by those from neighbouring countries.

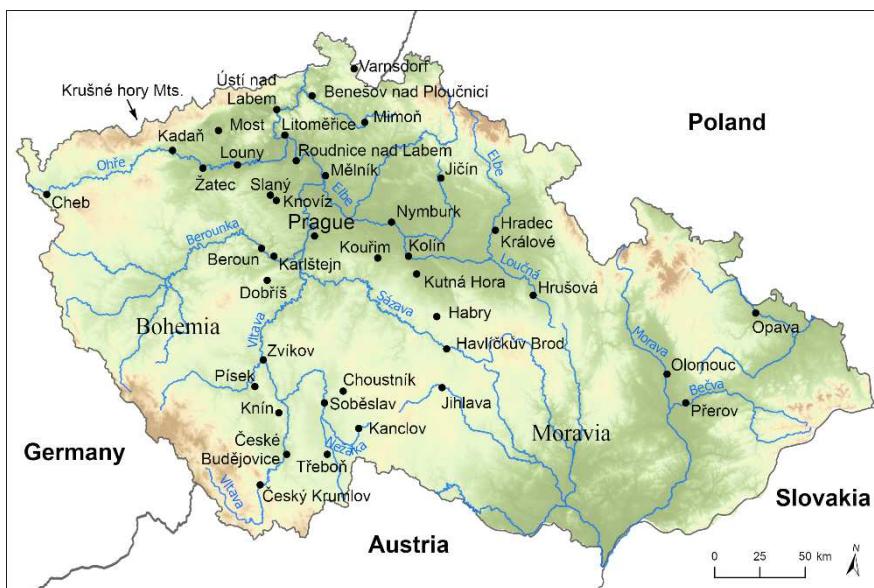


Figure S1. Locations of the places, rivers and mountains reported over the territory of the recent Czech Republic (data source: ArcCR 500 v2.0).

### (i) 1400–1409 CE

A secondary source from the 16th century reports prevailingly rainy weather in Bohemia between 21 March and 26 September 1401, when only a few days were without rain (archival source AS2). Similar information also comes from Magdeburg (eastern Germany), while the entire summer was characterised as “rainy” in Germany in general (Glaser, 2008).

In the spring of 1405, a rapid thaw of the winter snow led to a flood on the River Morava at Olomouc in the eastern province of Moravia, with considerable associated damage (Fischer, 1808, p. 186). In Silesia too, the thawing of a great quantity of snow resulted in heavy flooding, with extensive damage (the flood destroyed all the bridges in Opava, the regional capital). There were also human fatalities (Büsching, 1813, p. 152; Markgraf, 1877, p. 18). A flood caused by heavy rain affected the whole of Bohemia on 3 July (Höfler, 1856f, p. 2; Dušek, 1993, p. 412).

An exceptionally deep frost occurred in Bohemia on 20 November 1407 and continued until 13 March 1408. The winter was so severe "that people died on the roads and domestic

*and forest animals perished*" (Goll, 1893a, p. 628; Palacký et al., 1941, p. 31; Černá et al., 2018, p. 283).

Daniel Adam of Veleslavín, a 16th-century author, reported a mild January for 1409: "*On that day [16 January] and others following it, it was so warm that peasants could plough and sow, particularly in the surroundings of Nymburk*" (AS2). Violets were already in blossom on 11 February in Klosterneuburg (Austria) (Alexandre, 1987, p. 556).

### **(ii) 1410–1419 CE**

The surviving index of an unknown chronicle from Louny reports a great drought and a forest fire after a comet occurrence in 1412 (AS4). On 4 December, a terrible gale, beyond living experience at the time, occurred in Bohemia. It destroyed many buildings all over the region, carried away roofs, and broke and uprooted trees in gardens and woods (Šimek, 1937, p. 12; Palacký et al., 1941, p. 37; Dušek, 1993, p. 413; Černá et al., 2003, p. 167).

On 2 March 1416, it "rained blood" and then snow fell in Bohemia. There was also heavy snow on the night of 3 March (Dobner, 1774, p. 59; Höfler, 1856d, p. 35). A further source mentions that "bloody rain" fell on the snow and then it snowed again, creating three different-coloured layers (Černá et al., 2003, p. 62). An aurora was observed on 3–4 October (Höfler, 1856d, p. 35; Černá et al., 2003, p. 62, 80; Černá et al., 2018, p. 163, 312).

On 5 July 1418, a gale and hailstorm were recorded at Hradec Králové (Černá et al., 2018, p. 7, 57).

### **(iii) 1420–1429 CE**

The winter of 1419/1420, during which the autumn sowing had been damaged, is reported as severe, but the new sowing after this winter yielded a good harvest (Höfler, 1856a, p. 78). Daniel Adam of Veleslavín erroneously reported this winter as mild, because the trees started blossoming as early as 29 March 1420 and the grapevines on 13 April (AS2). A warm spring, with an early onset of phenophases, is confirmed by data from neighbouring countries (Wattenbach, 1851, p. 517; Klemm, 1979).

An intensification of severe frosts at the turn of December 1420 and January 1421 appears in a short report by Vavřinec of Březová (Goll, 1893b, p. 465). The *Magdeburger Schöppenchronik* (Janicke, 1869, p. 357) mentions very bad, rainy weather between 28 September and 11 October 1421 during the siege of the Hussite town of Žatec. Further, the annalist describes the chaotic retreat of the Meissen troops, slowed down by wet roads, when the soldiers sank into the mud and were in danger of being attacked by the Hussites.

After the defeat of the Catholic crusader troops near Habry on 17 January 1422, they retreated towards Havlíčkův Brod. Sigismund's Hungarians fled across the River Sázava, which was frozen: "*then the ice breaks under them, some of them getting out, some remaining there*" (Šimek, 1937, p. 38; Černá et al., 2018, p. 370).

On 5 August 1423, there was a great hailstorm around Prague (Höfler, 1856c, p. 53; Šimek and Kaňák, 1959, p. 84; Černá et al., 2003, p. 65; Černá et al., 2018, p. 384).

In the summer of 1425, terrible periods of heat set in during the harvest in Bohemia, causing suffering among the reapers in the fields. Many of them died (Höfler, 1856c, p. 55; Šimek and Kaňák, 1959, p. 87; Černá et al., 2003, p. 66; Černá et al., 2018, p. 390). A reflection of the weather may even have inspired a sermon by Mikuláš of Pelhřimov, a Hussite priest (Bartoš, 1922, p. 116): "*it was a sign on the Sun [...] and people were afraid of the drought which in that year plagued the kingdom*". Plague broke out in Bohemia around 7 October (Höfler, 1856e, p. 88; Černá et al., 2018, p. 16).

On 25 June 1426, in unbearable heat, Hussite and crusader troops clashed near Ústí nad Labem. The crusaders suffered a terrible defeat, many victims to both the Hussites and the heat (Höfler, 1856c, p. 55; Goll, 1893a, pp. 594–595; Šimek and Kaňák, 1959, p. 88).

Sources report a very severe winter for 1426/1427 in Bohemia (Höfler, 1856c, p. 56; Černá et al., 2003, p. 27, 141).

Only a report of a night-time thunderstorm with a downpour on 27 December around Kouřim is available for 1428 (Bartoš, 1934, p. 107).

#### **(iv) 1430–1439 CE**

Around 13 June 1430, frost burned the green corn in such way that “*it became almost white*” (Černá et al., 2018, p. 20). A further source also reports corn damaged by frost around Hradec Králové (Höfler, 1856e, p. 91).

On 19 June 1431, torrential rain fell on Kouřim so heavy “*that such rain [had] not been seen or heard of for a hundred years*”. This led to a massive flash flood that swept away a hospital and its patients, houses, and malt-houses. It destroyed the town walls, and several people drowned (Höfler, 1856c, p. 60; Bartoš, 1934, p. 108; Šimek, 1937, p. 59; Šimek and Kaňák, 1959, p. 100; Černá et al., 2003, p. 71). A similar flood struck the Zvíkov region, where high water carried away a bridge, repaired later in the same year (Čechura and Ryantová, 1989). Further weather reports were associated with the Hussite (“Orphans” faction) expedition to Slovakia (former Upper Hungary). Sources speak of a wet autumn, during which many Orphans died in the rain, and around 18 November they, together with their wagons and guns, became mired down in mud and were dispersed by Hungarian troops. To add to their woes, snowfall and frosts started on 4 December, and the Hussite troops, decimated by rain and severe frosts, returned to Bohemia after heavy losses (Höfler, 1856c, p. 62; Höfler, 1856e, p. 92; Goll, 1893a, p. 606; Černá et al., 2018, p. 21, 68).

For the winter of 1431/1432, the *Chronicon Treboniense* (Höfler, 1856c, p. 62) reports snow cover in Bohemia continuing for 13 weeks from 4 December 1431 (until approximately 4 March 1432). However, the same source also refers to a great quantity of snow that fell on the night of 24/25 November 1431, added to for nearly the entire winter thereafter (ibid., p. 65). On 3 February 1432 a windstorm was recorded in Prague (ibid.). Jan Gaudencius adds to this by mentioning strong winds and a great deal of snow (Boldan, 2016, p. 105). He also reported the long, frosty winter, lasting from 1 December until spring (ibid.). According to Bartošek of Drahonice, deep and severe winter in Bohemia was still evident on 19 February. Subsequently, between c. 18 and 31 March, after almost continuous snow all over Bohemia, there followed a flood, which he described as “*a forty-year water*” (Goll, 1893a, p. 606). *Chronicon Treboniense* (Höfler 1856c, p. 63) reports a severe frost around 13 March and then a flood from ice- and snow-melt, during which the water reached as far as the churches of the Virgin Mary and St. Nicholas in Prague.

In summer 1432, the *Chronicon Treboniense* (Höfler, 1856c, p. 63) mentions great heat before 2 July, which took many lives and continued until nearly the end of that month. On 7 July, during a thunderstorm in Prague, lightning struck the roof of the church of St. Egidius and started a fire (Höfler, 1856b, p. 48; Höfler, 1856c, p. 63; Šimek and Kaňák, 1959, pp. 105–106; Černá et al., 2003, p. 73, 116; Černá et al., 2018, p. 21, 200). A terrible drought, interrupted by only one period of light rain, persisted from 2 May to 28 July in Bohemia (Goll, 1893a, pp. 607–608). The hot, dry spell ended in enough rain cause a massive flood on 31 July. The River Vltava flooded the Old Town of Prague and low-lying parts of the Lesser Town (*Malá Strana*), and the inhabitants could only move around in boats. The water swept away all the mills on the Vltava and destroyed houses. Many people drowned and much livestock was lost. Timber carried downstream by the river built up against Charles Bridge, which was made of stone, and brought down five arches. Damage to the stone bridge on the Otava at Písek and two bridges on the Vltava at Český Krumlov was also reported. The remnants of houses, mills, furniture, and other debris were deposited on the plains around the river. Apart from the Vltava at Prague, the Berounka at Beroun and areas around the Elbe were also flooded. Cereals in the fields were

flooded or swept away. Such a flood was beyond the memories of even old men “[since the time of] *the flood of the world*” (Höfler, 1856c, p. 63; Goll, 1893a, p. 608; Horčička, 1899, p. 466; Šimek, 1937, p. 64; Palacký et al., 1941, pp. 84–85; Šimek and Kaňák, 1959, p. 106). On the same day, flooding ravaged Moravia, Austria and Hungary (Höfler, 1865b, p. 77). The Vltava at Prague flooded for the third time in 1432 on 15 December, but the water was lower than it had been in July, comparable to the flood in spring (Höfler, 1856c, p. 63; Goll, 1893a, p. 609).

After mid-January 1433, severe frosts set in and large quantities of snow fell, described as “loin-high” (c. 1 m). This harsh season, during which travellers died on the roads, lasted until 23 February, when a thaw began (Goll, 1893a, p. 609). The quantity of snow that fell on 20–21 January was so enormous that people were unable to travel to markets in the towns through the snowdrifts. This led to an increase in bread prices in Prague (Dobner, 1774, p. 60; Černá et al., 2003, p. 93, 150). On 2–3 July, floods covered fields, meadows and gardens and swept away mills in the Plzeň region. A week later, on 10 July, another flood, smaller than the preceding one, did considerable damage to meadows and affected other matters (Höfler, 1856e, p. 102). This tallies with a report made by Bartošek of Drahonice (Goll, 1893a, p. 610), who speaks of six floods in June–July that did great damage to cereals, meadows, fields with other crops, and water-mills. After 7 October, a great plague outbreak referred to by annalists as “*pestilentia magna*”, afflicted the whole of Bohemia (Höfler, 1865a, p. 68; Goll, 1893a, p. 611).

Large quantities of snow fell on central Bohemia on 4 May 1434, and continued for another day in many regions (Goll, 1893a, p. 612). A massive flood occurred on 5 August on the River Berounka near Karlštejn; the water was even three ells (c. 178 cm) higher than the flood of July 1432 (ibid., p. 616).

On 9 December 1434, severe frosts set in and an extreme amount of snow fell, cutting off whole towns and villages. Frosts and snow continued until around 10 March 1435, when a gradual warming took place, but “*the water was not high, because the thaw was not sudden*” (Šimek, 1937, p. 68; Černá et al., 2003, p. 97; Černá et al., 2018, p. 203). Jan Gaudencius (Boldan, 2016, p. 104) reported a long, severe winter from 2 December 1434 to 3 March 1435. On 23 July, there was a storm lasting only around half an hour that damaged castles and houses, took away roofs and destroyed buildings. Memories reaching back 30 years could not recall such an intense storm. In some regions of Bohemia, particularly around Knín, hailstones bruised the corn and did great damage (Goll, 1893a, p. 618).

On 22 July 1436, Bartošek of Drahonice reports a massive thunderstorm with a downpour in the Karlštejn region (ibid.). The brooks on both sides of the castle were in flood; on one side the water carried away the mill-wheel and water mill and on the other side, a building. Several children drowned.

The winter of 1436/1437 in Bohemia was very severe. Livestock perished in the frosts and fruit-trees (particularly walnuts and peach-trees) froze. It is remarked that “[only] rarely did anything recover after such a winter” (Šimek, 1937, p. 71).

A comet appeared on 2 June 1439 and then, after 24 June, the plague broke out in Bohemia and other countries, continuing until mid-December (Šimek, 1937, p. 86; Palacký et al., 1941, p. 108).

## (v) 1440–1449 CE

After 21 November 1439, severe frosts occurred in Bohemia and snow fell heavily. Deep frosts, snow and cold spells continued incessantly until 13 April 1440, perhaps even longer. The annalist Bartošek of Drahonice adds that a winter of such severity had not been experienced for 30 years (Goll, 1893a, p. 623).

On 1 April 1441, a heavy windstorm, lasting a whole day, damaged many houses, barns and buildings around Karlštejn. Deep drought afflicted Bohemia from 2 May until 3 July. A

bad harvest resulted; many crops, such as barley, peas, oats and hay were described as “scarce and weak”. Between 13 and 22 July, fogs and smoke were observed, rendering the sun “bloody” in the mornings and evenings (ibid.).

The building accounts for the castle at Zvíkov indicate a harsh beginning for the winter of 1441/1442 in Bohemia; at the end of 1441, a frozen water supply had to be repaired (Čechura and Ryantová, 1989). Terrible drought and heat in the summer of 1442 led to a shortage of water in Bohemia. The grass dried out and the cattle, which had to be driven to water in distant places, roared with hunger and thirst. There was plenty of wine (Šimek, 1937, p. 93; Černá et al., 2018, p. 30).

Very deep frosts occurred in Bohemia as early as 25 October 1442 and many trees froze in the subsequent severe winter of 1442/1443 (Šimek, 1937, p. 93; Palacký et al., 1941, p. 120; Černá et al., 2018, p. 218). Bartošek of Drahonice reported the onset of this winter in terms of severe frosts, much snow, and ice around 10 November. Roads were rendered impassable by the sheer quantity of snow. There was a lack of hay and oats for livestock, a consequence of the preceding dry summer (Goll, 1893a, p. 624). A further source dates the beginning of a very severe winter to 15 December. Many poor people froze on the roads, as well as horsemen; birds died of the cold. Around 11 February 1443, hungry wolves approached human dwellings and attacked travellers, both people on foot and on horseback. Villagers were afraid to leave their houses. Whatever livestock survived the wolves perished in the frost. The winter did not give way until around 28 March (Palacký et al., 1941, p. 125). Daniel Adam of Veleslavín reports great quantities of snow for 10 and 11 May in Bohemia, together with frost damage to vineyards (AS2). This is confirmed by reports from Plock in Poland, where frosts set in again on 9 May, rivers froze and snow fell, particularly on 13 May (Kętrzyński, 1888, p. 450).

On 3 May 1444, a terrible storm with hail and rain struck Prague. A number of houses and barns were damaged and trees were uprooted in gardens and forests. This storm raged through many countries and did extensive damage (Černá et al., 2018, p. 220).

On 13 April 1445, Hradec Králové suffered a flood that swept away a bridge and watermills and did much damage in the suburbs (Šimek, 1937, p. 101; Palacký et al., 1941, p. 127; Šimek and Kaňák, 1959, p. 176). Another great flood, following three days of continuous rain, occurred in Prague on 2 July, while the retaining walls of fish cultivation lakes collapsed around Dobříš. The flood harmed villages, a fortress, fields and meadows. People and livestock drowned. The remnants of log buildings were swept to Prague by the high water (Šimek, 1937, p. 102; Palacký et al., 1941, p. 128; Šimek and Kaňák, 1959, p. 177; Černá et al., 2018, p. 221). Private correspondence also reports the July flood, saying it breached fishpond dams and damaged villages and the town of Soběslav (Palacký, 1844, p. 30; Kalousek, 1895, p. 14). After 17 September, the plague was reported in Hradec Králové and then in other regions (Šimek, 1937, p. 103; Palacký et al., 1941, p. 129; Šimek and Kaňák, 1959, p. 178).

Frosts from 21 to 23 May 1448 burned foliage in all the vineyards around Prague (Šimek, 1937, p. 106; Palacký et al., 1941, p. 139; Šimek and Kaňák, 1959, p. 190). On 15 November, so much snow fell in Bohemia that many trees in both forests and gardens were broken and uprooted (Palacký et al., 1941, p. 141).

In August 1449 an unknown author wrote from Prague to Lord Oldřich of Rožmberk in Jihlava, saying that he would bring fruit “*if there is anything to bring, because almost no fruit has grown around the town [Prague], except grapes*” (Čornej, 1989, p. 113).

## (vi) 1450–1459 CE

A letter written by Enea Silvio Bartolomeo Piccolomini, dated 30 August 1451 (Wolkan, 1912, p. 22), speaks of cold and rainy weather in Bohemia. Haymaking began in the Louny region before 12 July (Vaniš, 1979, p. 258), and finished after a delay of seven days compared with the average time (see Table 1 and Fig. 1 in the main text), before 16 August (ibid., p.

261). Cereals began to be reaped before 19 July (ibid., p. 259) and the harvest finished before 13 September (ibid., p. 264). The beginning of the grape harvest was very late, delayed by 19 days, taking place in the week before 8 November (ibid., p. 270). The plague was reported in Bohemia (Šimek and Kaňák, 1959, p. 214; Černá et al., 2018, p. 37).

In the week preceding 31 January 1452, fishermen had to cut ice on the River Ohře at Louny (Vaniš, 1979, p. 279). Wages paid to carpenters on 20 February for repairs to the bridge (ibid., p. 281) may indicate damage caused by the movement of ice floes or flood. The times at which field work in the Louny region took place in 1452 indicate no anomalous weather patterns; haymaking and the grain harvest started in the week before 10 July (ibid., pp. 296–297). The harvesters were paid for the last time on 11 September (ibid., p. 299). The grape harvest began before 23 October (ibid., pp. 307–308).

Fishermen were paid to cut ice in Louny on 19 February 1453 (Vaniš, 1979, p. 319), then on 16 April entries appear for the costs of providing liquid refreshment to labourers cutting ice (ibid., p. 324). Haymaking in the Louny region started before 2 July (ibid., p. 402) and finished before 13 August (ibid., p. 406). Cereals were first reaped before 23 July, a nine-day delay, and the harvest continued until the week before 10 September (ibid., p. 404, 408). The grape harvest was also delayed by nine days, to the week before 29 October (ibid., p. 414). On 11 December such severe frosts set in that not only did the water in wells freeze, but many people succumbed to the cold. The frosts lasted until 17 December. A thaw set in on the following day, heralded by a strong wind. Thunder was heard three times in the night (Palacký et al., 1941, p. 148).

According to Litoměřice sources (AS1; AS3), a thaw started at the end of March 1454 and the ice on the River Elbe yielded. Ice floes accumulated at the bridge in Litoměřice, which broke under the combined pressure of ice and flood. The time at which the damage took place can be derived from the words that the first bridge “[was] finished after St. Gallus [25 October 1452] and taken away by water a year and a half later”. Haymaking in the Louny region started in the week before 22 July (Vaniš, 1979, p. 433) and only finished before 19 August (ibid., p. 436), i.e., after delays of 15 and 12 days respectively. Cereals were reaped in the period before 15 July until the week before 23 September, i.e., after a delay of 14 days (ibid., p. 433, 438). The beginning of the grape harvest started after delay of eight days, in the week before 28 October (ibid., p. 438).

Wages were paid for clearing snow from a track in Louny on 27 January 1455 (Vaniš, 1979, p. 448). A report dated 7 April notes no income from the mills because a flood on the Ohře made their operation impossible (ibid., p. 341, note 77). The summer of 1455 was characterised by an advanced onset of vegetation. Thus, the haymaking started in the Louny region 28 days early, in the week before 9 June (ibid., p. 456). It ended 17 days early, before 21 July (ibid., p. 459). The harvest began seven days early, before 7 July (ibid., p. 458) and ended 15 days early, before 25 August (ibid., p. 461). The grape harvest ended seven days early, before 13 October (ibid., p. 466). A poem by Jiří Bathold entitled “*Bruxia Bohemia ...*”, describing storm damage to the town of Most, is attributed to this year (Truhlář et al., 1966, p. 151).

In 1456, the harvest in the Louny region began 16 days early, before 28 June (Vaniš, 1979, p. 519). However, as late as the week before 8 November (ibid., p. 531) there appeared payment “*for finishing the oat harvest*”, i.e., two months later as usual. There are no records concerning the start of haymaking, which ended 12 days early, in the week before 26 July (ibid., p. 522). The grape harvest was delayed by 12 days to the week before 1 November (ibid., p. 531).

In the working weeks before 31 January 1457 and before 14 February, workers were paid for the cutting ice from the water-mills on the Ohře (Vaniš, 1979, p. 539). A record of incomes for 7 March notes: “*nothing from the mills due to flood*” (ibid., p. 486, note 36).

Haymaking in the Louny region started and ended within the limits of its usual timing, in the weeks before 11 July and before 1 August (ibid., p. 551, 553). While the grain harvest began at the average time, in the week before 11 July, it ended 25 days early, in the week before 15 August (ibid., p. 551, 554). The grape harvest also started early, by 17 days, before 3 October (ibid., p. 558). On 30 November, Oldřich Kříž from Telč arrived in Prague to take up a teaching post in Vyšehrad. There was deep snow when he moved in (Mareš, 1896, p. 529).

The accounts note no income from the Louny mills twice, citing “*magna aqua*” (“great water”) as the reason, on 10 April 1458 (Vaniš, 1979, p. 491, note 64) and on 17 April (ibid., p. 491, note 66). Haymaking began in the week before 19 June, 18 days early (ibid., p. 579), but there is no record of when it finished. Cereals were harvested at the average times, starting in the week before 10 July and ending before 4 September (ibid., p. 581, 585). The beginning of the grape harvest was 11 days early, in the week before 9 October (ibid., p. 588).

A lack of income from the water-mills on the Ohře at Louny, due to flooding, appears in *Liber rationum* entries for 19 and 26 March 1459 (Vaniš, 1979, p. 593, notes 11–12). Haymaking started in the Louny region in the week before 2 July and ended before 30 July (eight days early) (ibid., p. 646, 649). The first wages were paid to cereal reapers in the week before 23 July (nine days late) and the last before 20 August (20 days early) (ibid., p. 648, 650). The grape harvest took place at the average time, before 22 October (ibid., p. 655).

#### (vii) 1460–1469 CE

Field work in the Louny region in 1460 took place at times that differed slightly from “normal”. Haymaking started seven days early, before 30 June (Vaniš, 1979, p. 674), although the grain harvest began seven days late, before 21 July (ibid., p. 676) and ended eight days early, before 1 September (ibid., p. 679). The grapes were picked before 20 October (ibid., p. 683). This year saw a population explosion of caterpillars in Bohemia. They devoured foliage to the extent that most of the trees dried out, particularly around Hradec Králové. The annalist called it “*an Egyptian blow*” and remarked that it could last for two years (Černá et al., 2018, p. 47).

A record dated 30 March 1461 mentions that high water on the Ohře at Louny prevented the operation of mills (Vaniš, 1979, p. 601, note 67). For the summer, there exists only one note, reporting the beginning of haymaking, before 6 July (ibid., 703). Secondary sources from the Mimoň and Varnsdorf regions, indicate periods of great heat, rivers dry to the bed, and very early grain harvests (Tille, 1905; Palme, 1913). This situation is confirmed by a reference to an exceedingly hot, dry summer in Silesia, so much so that people fell dead in the fields and the levels of the Oder and other rivers dropped considerably (Wächter, 1883, p. 78).

According to Vaniš (1982), snow fell in Bohemia in December 1461 and frosty weather set in, continuing until the end of February 1462. Haymaking and the harvest in the Louny region both started in the week before 12 July (Vaniš, 1979, p. 755). Haymaking ended before 2 August (ibid., p. 756) and the grain harvest 10 days early, before 30 August (ibid., p. 757). The grapes were picked at the average point, before 18 October (ibid., p. 761).

Ice on the Ohře at Louny had to be cut in the weeks before 17 and 24 January 1463. Before 31 January, wages were paid for work on “*jesle*” (Vaniš, 1979, p. 768), i.e., oak pales driven obliquely into the river bottom to break up ice floes; this was repeated on 14 and 28 February (ibid., pp. 769–770). Labourers were paid to remove ice from mills on 7 March (ibid., p. 770). On 14 and 28 March, payments were made for emptying water from cellars (ibid., pp. 771–772); this activity was also reflected in wages paid on 4 and 11 July (ibid., pp. 779–780). On 3 July, a flash flood occurred on the Loučná around Hrušová, so severe that a number of people were drowned, some villages were damaged and so much mud was deposited in the fields that “*they will never be fit to plough again*” (Šimek, 1937, p. 130; Palacký et al., 1941, p. 161). Haymaking began in the Louny region in the week before 4 July (Vaniš, 1979, p. 779) but ended 13 days early, before 25 July (ibid., p. 781). The grain harvest started before 11 July and ended

in the week before 12 September (ibid., p. 780, 785). The grape harvest took place before 17 October (ibid., p. 787). A massive outbreak of the plague was reported for 1463–1464 in Bohemia (Palacký et al., 1941, p. 161; Šimek and Kaňák, 1959, p. 271).

On 9 January 1464, payments were made for timber intended for the protection of water-mills and the diversion of ice on the river at Louny (Vaniš, 1979, p. 792). As winter progressed, carpenters and labourers were paid for work at the mills on 30 January, 6, 13 and 17 February, and 5 March (ibid., pp. 793–795). On 12 March, labourers were paid for work on water-mills “*in aqua magna*” (in “great water”) (ibid., p. 795). On 26 March, wages were paid for removing water from cellars (ibid., p. 796). Further, the index of an otherwise unknown Louny chronicle speaks of a flood (AS4). Heavy March floods are reflected in a report that a delegation from King George of Poděbrady to Emperor Frederick III, due to set out on 13 March, was delayed by severe March floods (Tomek, 1886, pp. 84–85). A secondary source speaks of drought but plenty of good wine in Bohemia (AS2), a situation confirmed by reports of a dry, warm summer in Germany (Glaser, 2008).

Records in the municipal book of Kadaň (Stocklöw, 1890) mention a very cold spring for 1468. Even as late as 30 April, there were still large quantities of snow, not only in the Krušné hory mountains, but also in the valleys. On that day, new snow fell and frosts set in, which lasted for another 10 days. Although it is difficult to confirm this information concerning snow and frosts directly, Pfister and Wanner (2021) interpreted this spring as very cold.

Ice was cut on the Ohře at Louny in the week before 20 March 1469 (Vaniš, 1979, p. 845). Of the field work records, only mentions of the beginning of haymaking, before 3 July (ibid., p. 855) and the start of the grape harvest, before 16 October (ibid., p. 863), survive.

### **(viii) 1470–1479 CE**

As early as the week before 11 December 1469, wages were already being paid for cutting ice on the Ohře at Louny (Vaniš, 1979, p. 868), then again in the week before 25 December (ibid., p. 869). Labourers paid for work on the weir on 18 December (ibid., p. 868) and at the mill race on 8 January 1470 (ibid., p. 870) were probably cutting ice. Unspecified work at the mills further merits continuous mention from the week before 29 January until the week before 12 March (ibid., pp. 872–875). A Polish source reports severe frosts in December–January, in which many women and children froze to death, particularly in Moravia, among other places (Markgraf, 1872, p. 220). On 3 August, during a thunderstorm in Kutná Hora, lightning struck the municipal church and set it on fire; it was almost completely burnt down (Petrů and Pražák, 1955, p. 146). The harvest data from the Louny region indicate marked delays to the start of haymaking, by 23 days, in the week before 30 July (Vaniš, 1979, p. 889) and a delay of nine days for the grape harvest, in the week before 29 October (ibid., p. 895). Water had to be removed from cellars before 12 November (ibid., p. 897).

In 1471, water was removed from cellars at Louny in the week before 25 March (Vaniš, 1979, p. 909), and again before 20 May, 12 August and 21 October (ibid., p. 915, 922, 927). The beginning of haymaking was delayed by 15 days, to before 22 July and its end by 12 days, to before 19 August (ibid., p. 920, 923). The grape harvest was advanced by 20 days, to before 30 September (ibid., p. 925). Non-contemporary sources report a very good harvest of cereals and further crops at České Budějovice (Šimák, 1913, p. 6), as well as periods of heat in summer severe enough to dry up rivers (Tille, 1905; Palme, 1913). Confirmation of the hot, dry summer appears, among other places, for Austrian Salzburg (Dückher, 1666, p. 212), Silesian Wrocław (Markgraf, 1872, p. 246), and Germany (Glaser, 2008).

On 30 December 1471, the Louny records speak of “*an ice gorge*” and removing water from cellars (Vaniš, 1979, p. 933). Labourers were paid for cutting ice on 20 January 1472 (ibid., p. 935). A secondary source from the town of Varnsdorf (Palme, 1913) mentions a deep drought and intense heat, to the extent that shortages of water and many forest fires were

reported from all over its surroundings. The drought also affected adjacent Silesia, which straddles the Czech-Polish border, where very low water in the Oder was recorded (Markgraf, 1877, p. 27). The warm, dry summer was also reported by other sources, cited in Camenisch et al. (2020).

According to Jan Gaudencius (Boldan, 2016, p. 106), the warmth of spring was already evident around 11 February 1473. The harvest started very early, around 3 June, and cereals were harvested everywhere before 3 August. Dry weather took over from previous rainy spells at the end of May, a dry trend that continued until August (ibid.). Further, the Old Czech Annals report great heat, no rain for three and a half months, forest fires, dried-up rivers and brooks, a poor harvest of cereals, and the entire loss of beetroot, cabbage and other crops. A massive outbreak of the plague also afflicted Bohemia (Palacký et al., 1941, p. 179; Šimek and Kaňák, 1959, p. 282). A secondary source based in Benešov nad Ploučnicí cites a great shortage of water, with streams drying out and water-mills out of operation (Paudler, 1887, p. 29). That the Oder dried up and a huge drought prevailed was mentioned for Silesia (Kunisch, 1827, p. 299).

On 8 July 1474, a storm in Cheb damaged houses, barns, and trees in gardens in the town and forests in its surroundings (Gradl, 1884, p. 34). On the same day, lightning during a thunderstorm in Jihlava started a fire in which 67 of the most important houses in the town were destroyed and 20 people burned to death (d'Elvert, 1861, p. 19). A storm was also recorded in Moosbach, Bavaria (Klemm, 1983) and from Melk in Austria (Wattenbach, 1851, p. 522). An ancestor of Mikuláš Dačický of Heslov reported an incursion of locusts “*as long as a thumb, of a shiny greenish colour, [with] cattish, mask-like faces, their bellies like those of snakes*” that flew and clattered “*paying no heed to either people or livestock*” (Petrů and Pražák, 1955, p. 164; Černá et al., 2018, p. 239).

On 3 June 1475, a storm in Kutná Hora destroyed nearly 30 houses and tore roofs from others, as well as damaging churches and towers. In a nearby Cistercian monastery in Sedlec (now part of Kutná Hora), it tore down an artistically precious gable and two decorative stone pillars (Palacký et al., 1941, p. 180). Locusts appeared in Bohemia in the week around the festival of Saint Laurentius [19 August] and covered the area from Kolín to Roudnice nad Labem. In the course of their passage, they darkened the sun and made a noise “*like knights on horseback*”. They were as large as sparrows and, where they landed, they devoured everything in the fields, vineyards and forests (d'Elvert, 1861, p. 19; Palacký et al., 1941, p. 180; Petrů and Pražák, 1955, p. 164).

On 15 June 1476, Abbot Marek, in a letter from Třeboň to the Rožmberks in Český Krumlov, remarked that “*the mills are not operating near the castle and fishes are dying for lack of water*” (AS5).

A very severe winter govern in Bohemia around 25 February 1477. Streams were fully frozen and snow reached to saddles of horses, because snow fell continuously until 21 March (Palacký et al., 1941, p. 182; Šimek and Kaňák, 1959, p. 284).

An undated letter, written in 1478 by Stanislav of Přerov to Kunrát of Petrovice concerning compensation, mentions that a strong wind tore roofs from Choustník Castle and damaged buildings in the town of Soběslav (Čornej, 1989, pp. 301–302).

On 15 July 1479, a great storm, with hail, damaged vineyards and fruit-trees, particularly around Košíře (now part of Prague) (Černá et al., 2018, p. 241). A secondary source from Bohemia reports a warm, dry weather with a lack of rain between 8 June and early October (AS2); this was partly paralleled in Germany, which had a similarly warm, dry summer, but with occasional downpours (Glaser, 2008). After a report that “*during that year, the apples and pears were a second time*”, subsequent rainy weather is mentioned (Palacký et al., 1941, p. 187; Šimek and Kaňák, 1959, p. 286).

## (ix) 1480–1489 CE

The winter of 1479/1480 was very mild, particularly in January and February, so much so that “*astonishingly, many plants grew*”. Such unusually mild weather lasted until 5 February 1480 (ibid.).

On 17 June 1481, Prague suffered a flood of dimensions that had not been attained since Charles Bridge had been damaged in July 1432. The water almost covered the head of Bradáč, the sculpted figure of a bearded man located close to the River Vltava and long used as an indicator of the water levels reached during floods (Elleder, 2003). Transport in parts of Prague was only possible by boat, and the water even approached, or even penetrated, certain churches. The flood did a great deal of damage to water-mills and buildings and swept away large quantities of lumber from the river banks (Palacký et al., 1941, p. 191; Šimek and Kaňák, 1959, p. 289). The same spate on the Vltava was also recorded at České Budějovice (Šimák, 1913, p. 6).

A hailstorm did great damage around Prague on 9 July 1482. On 13 July, the sky became overcast and on the following day it started to rain (Palacký et al., 1941, p. 198; Šimek and Kaňák, 1959, p. 290). The continuator of the chronicle of Beneš Minorita (Dušek, 1993, p. 427) indicates that the waters of the Vltava were coated in something green, with an evil smell, in August. This could well be related to hot, dry weather, a situation perhaps confirmed by the report of a warm summer for Germany (Glaser, 2008). The plague broke out after 24 June in Bohemia and lasted until early October (Palacký et al., 1941, p. 198; Šimek and Kaňák, 1959, p. 290).

Vladislaus II, king of Bohemia, summoned the Diet to Kutná Hora on 15 December 1483. However, very heavy snow fell, beyond the 40-year memory of even the old. The representatives of Žatec, Louny and Slaný, who had set out together from Slaný, were forced to return from the very outset of their journey because the road beyond Knovíz was rendered impassable by such snow that “*even if they had 20 horses for every wagon, they could not have made progress, even with a sleigh*”. Only a few of the participants invited managed to reach the Diet; it had to be postponed until 11 February 1484 (Palacký et al., 1941, p. 204).

Chronicle sources from České Budějovice report an extraordinary harvest of grapes and low wine prices for 1484 (Šimák, 1914, p. 6; Mareš, 1922, p. 10). There was so much wine in Kadaň that the city council forbade barrels wine to be sold to “foreigners” (Stocklöw, 1890). An unusual abundance of wine was also reported for Germany (Glaser, 2008).

Before 10 May 1485, deep frosts occurred in Bohemia and in neighbouring countries, leading to severe damage to fruit-trees, vineyards, green corn and forests (Palacký et al., 1941, p. 206; Černá et al., 2018, p. 247). Further, a terrible windstorm, which uprooted many trees in the forests, was reported, but lacks exact dating (Černá et al., 2018, p. 247).

Annals dating to the 16th-century describe the winter of 1485/1486 as only variable or fairly mild. However, deep frosts set in on 30 April/1 May 1486 and more than a quarter of an ell of snow (c. 15 cm) fell. People started moving around on sledges. The weather suddenly warmed on 4 May and the snow melted (Hájek, 1541, fol. 453b; AS2). This late frost and snow may appear in the index of a Louny chronicle (AS4): “*There was a great frost. Snow fell.*” An average or mild winter was interpreted for Germany and frosty periods interrupted a wet spring (Glaser 2008). The arrival of King Vladislaus II of Bohemia in Jihlava on 10 September was marked by heavy rain (Palacký et al., 1941, p. 207).

On 24 August 1487, a great storm accompanied by hail occurred in Bohemia and damaged fruit-trees and vineyards. The grape harvest was very poor that “*if [wine] remained anywhere, it was sour or tart*” (Palacký et al., 1941, p. 208; Černá et al., 2018, p. 248).

According to James, a monk, a lightning struck the monastery church in Třeboň on 23 June 1489 and set fire to its roof and tower (Mareš, 1896, p. 527).

## (x) 1490–1499 CE

The winter of 1490/1491 probably began before 13 December 1490, when the first wages for cutting ice from the mill-wheels in Louny were paid (Vaniš, 1979, p. 98). Further payments for knocking ice from the mill-wheels appeared in *Liber rationum* for 2 January 1491, 17 January, 31 January, 7 February, 14 February and 28 February (ibid., pp. 100–104). On 24 January, labourers were paid for work on ice-avoidance structures (ibid., p. 101). On 21 February, payment was made for an axe broken while cutting ice (ibid., p. 103). The harvest in the Louny region started only in the week before 7 August and ended in the week before 29 August (ibid., p. 123, 127). On 31 July, a destructive thunderstorm with intense hail struck Jičín, then Prague, on 3 August. The cereals it ruined were left in the fields not only there, but also in a number of further places (Palacký et al., 1941, p. 211). A 16th-century source reported a bad harvest of cereals. The grapes failed to mature in the wet conditions and the wine was sour (AS2); this is confirmed by reports of a cold, wet summer followed by sour wine in Germany (Glaser, 2008).

On 15 July 1492 a massive storm with rain in Prague and its surroundings did damage to houses, buildings, churches, mills and trees and took its toll of fatalities (Palacký et al., 1941, pp. 211–212; Zilinskyj, 1984, p. 57; Dušek, 1993, p. 428; Černá et al., 2018, p. 250).

Lightning struck Prague castle during a thunderstorm on 3 August 1493, partly damaging its spire and a truss (Palacký et al., 1941, p. 212; Černá et al., 2018, p. 251).

At some point before 14 May 1494, a flood arose on the River Bečva. Mud and lumber became stuck at the bridge when “*the water took some barns near Přerov*” (Dvorský, 1897, p. 19). According to the 16th-century chronicler Václav Hájek of Libočany (Hájek, 1541, fol. 556a), frequent spells of rain made Bohemia wet, leading to muddy roads and complications with the harvest. This may be confirmed by annals kept in Salzburg, Austria, which reported very frequent floods in summer and autumn (Dückher, 1666, p. 222).

The only part of winter of 1494/1495 that annalists considered worthy of mention was that January 1495 was rainy. A very strong wind blew on 20 and 21 January. In the summer of 1495, a hailstorm did extensive damage to vineyards and fruit-trees around Košíře (today part of Prague) (Palacký et al., 1941, p. 213; Černá et al., 2018, p. 254). The plague broke out in Prague before 7 October, lasting until 11 February 1496 (ibid.).

Frosts set in during December 1495 and large quantities of snow fell in Bohemia. This fact derives from a source available to the renowned Danish astronomer and mathematician Tycho de Brahe (Straka, 1913, p. 383), now lost: “*this winter abounded in harsh frosts at the time of the solstice [21 December 1495] and such an amount of snow accumulated that people quite easily passed the tops of country cottages on sledges*”. On 20 January 1496, almost all of Prague was covered in a thick fog. Heavy frosts persisted in February, when even the Elbe and the Vltava froze up, as did many other rivers. Water-mills around Prague could not function. Such was the later accumulation of ice that “*the river could not flow between the banks and it flooded*” two villages near Mělník (Palacký et al., 1941, pp. 213–214; Černá et al., 2018, 254). On 30 April, a massive hailstorm was recorded near Malešice (today, part of Prague) with hailstones the size of acorns (Palacký et al., 1941, p. 214; Šimek and Kaňák, 1959, p. 310). June and July brought such immense heat that many people died (Anonymous, 1832, p. 176). Three days of incessant rain after 14 August led to a flood around Kutná Hora that did great damage (Palacký et al., 1941, pp. 214–215; Šimek and Kaňák, 1959, p. 309). Around 24 August, a spate swept away a bridge at Kanclov and the timber from it stuck in the bridge over the Nežárka (Teplý, 1927, pp. 142–143).

“*A harsh and immense winter*” afflicted Bohemia from around 3 January 1499 (Šimek and Kaňák, 1959, p. 312), but there are no indications of when it ended. Prague suffered a notable thunderstorm in the night 1/2 July and lightning struck the monastery of the Holy Spirit and set its roof on fire. According to the annalist “*there was very great and frequent thunder and lightning that whole night, almost incessant*” (Palacký et al., 1941, p. 217). The year 1499 saw an abundance of cereals, fruits and wine. Such quantities of wine were almost beyond living

memory, to the extent that there was a lack of barrels not only in Bohemia, but also in neighbouring countries (Palacký et al., 1941, p. 217; Šimek and Kaňák, 1959, p. 313).

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(AS1): Knihovna Královské kanonie premonstrátů Praha-Strahov, sign. DA.IV.1: Manuscriptum Joannis junioris Nožirž alias Adami, qui Litomericii 1558 natus est dein civis ibidem, religioni sub utraque communi cantum eddictus, anno 1601 mortuus.

(AS2): Regionální muzeum Litoměřice, inv. č. SV 14142: Kalendář Historický. To jest krátké poznamenání všech dnuov jednoho každého měsíce přes celý rok. K nim přidány jsou některé paměti hodné Historiae o rozličných příhodách a proměnách, jak národuv jiných a zemí v Světě, tak také a obzvláštně národu i Království Českého z hodnověrnych Kronik. S pilnosti sebráno, vytištěno a vydáno prací a nákladem M. Daniele Adama z Veleslavína. Vytlačeno v Starém Městě Pražském. Leta posledního věku: MDXC.

(AS3): Státní okresní archiv Litoměřice, fond AM Litoměřice, st. sign. 12: Letopisecké záznamy v litoměřickém právním rukopise ze 14. stol. označený nově “Das Magdeburger Recht”.

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