Chapter 11
The Dance of Death – A Synthesis

The people of the Late Middle Ages experienced a time that was characterized as a Dance with Death. Mortality was high, and death could carry everyone unexpectedly to the grave, regardless of social position or age. In fact this Dance of Death was performed according to strict rules. The rules for the two major movements – famine and plague – have been carved out in this work. The common people could not escape either of these dangers, and whereas the well-off classes could buy their way out of hunger, they still had to face the plague. In a pre-industrial society climate is one of the major forces that creates the setting for famine and plague, hence it is one of the major forces forming the patterns of mortality in the Dance of Death.

The interest in the environmental conditions that would lead to a rise in mortality is older that the motif of the Dance of Death itself. For England the oldest systematic study of the link between weather and dearth survives from the first half of the fourteenth century. William Merle's 'De pronosticacione aeris' written c.1340 and his weather observations 'Consideraciones temperiei pro 7 annis' for the years 1337 to 1344 bear witness to his enquiring and practical mind. He worked in association with a group of Oxford scholars engaged in the *scientia astrorum*, which encompassed astronomy as well as astrology. Members of this groups were aiming at long-term forecasts of the weather with the help of the stars. Merle supplemented this astrometeorological work and the theoretical treatises of Ptolemy, Aristotle and Virgil with weather rules based on 'inferior signs' in the sky, 'farmers' rules' and the observation of nature, which could serve as the basis for short-term predictions.[1] Although the astrometeorological approach is most bewildering from the modern perspective, the scholars of the science of the stars and Merle had an empirical outlook and were part of the proto-scientific movement in Oxford.[2] Their aims included an identification of meteorological risk factors for the spectre of their times, famine, and a reduction in vulnerability by being able to predict the meteorological conditions that proved to be so detrimental to agriculture in England. Merle's high interest

[1] Thorndike, History of magic and experimental science, vol. 3, 143–145, Jenks, Astrometeorology, 194, Snedegar, Between scholasticism and folk wisdom, 31.

[2] Mortimer, William Merle's weather diary, 42–43, North, Cosmos, 290.

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in famine and its mostly meteorological causes came at a time when the Great Famine of 1315–1317 was still fully within living memory. It had probably been the major event in Merle's childhood or youth, and that of his colleagues at Oxford. A phase of high interannual variability in spring and summer temperatures from the mid-1320s to the mid-1330s had just come to an end, and even though the 1330s were in general marked by dry summers, wet and cold summer seasons had repercussions for agriculture in 1330 and 1335. Then in 1338 incessant rains at winter sowing time and the subsequent cold and long winter ruined the winter corn, and dry weather in April 1339 damaged the spring sowing, so that the consequent dearth lasted from the harvest 1339 to the harvest 1340. Hence, just at the time when Merle is supposed to have composed his work on weather and subsistence crisis, the situation in the wider world demonstrates that Merle's and his colleagues' interest in the subject was far from purely academic or theoretical, but practical and immediate. The volatile and dangerous meteorological conditions from the 1320s to the 1340s affected a country that was still densely populated and consequently very vulnerable to any harvest shortfall, which also reminded people of the risk of a famine on the scale of the 1310s. Merle identified correctly excess humidity as the risk factor for agricultural production *per se* in England, and so described one of the major movements of the Dance of Death on the British Isles.

Merle's work resonated amongst the astronomers at Oxford. 'De pronosticacione aeris', including the chapter dedicated to weather and agriculture, was used by John Ashenden in the 'Summa astrologiae judicialis de accidentibus mundi' (completed in 1348), which in itself is devoted to the prognostication of general events such as storms, floods, droughts, earthquakes, war and famine.[3] The inclusion of his text in Ashenden's work guaranteed Merle a wide and long-lasting reception of his ideas, since the 'Summa anglicana' served as an astrological reference work in late medieval and early modern Europe. It was printed in Venice in 1489, and remained a textbook at the University of Vienna until the sixteenth century.[4]

The object of Merle's observation, recording and analysis – meteorological parameters such as the frequency and form of precipitation, temperature, wind and the occurrence of frosts – is of high interest for the climatologist and the environmental, agrarian or economic historian alike. For studying the impact of weather on the food supply and on human health regional climate data of at least annual but preferably seasonal resolution are essential, otherwise the detail in the meteorological parameters can be lost. Although the regional climate is inextricably linked to the global scale, it can diverge significantly from it, and it is the regional climate that shapes peoples' lives. Due the relative paucity of such data for England and the British Isles in the Middle Ages new data series had to be developed in this book.

The manorial accounts from East Anglia, mainly from Norwich Cathedral Priory, were so meticulously recorded and so well preserved, that those 600–700 year old parchments open an unprecedented window into the changing meteorological

[3] Thorndike, History of magic and experimental science, vol. 3, 329, Snedegar, Between scholasticism and folk wisdom, 30, Ashenden, Summa astrologiae judicialis de accidentibus mundi'.

[4] Meaden, Merle's weather diary and its motivation, 211.

conditions of late medieval England. The reconstruction of the mean temperature in the months April to July, which was achieved with the help of the grain harvest date, shows a cooling trend from the mid-thirteenth century until the third decade of the fifteenth century. Warmer and cooler periods alternated on a decadal level, many cooler times were often associated with problems in agricultural production as in the 1310s and early 1320s, or in the late 1340s, parts of the 1360s and 1370s, and the first decade of the fifteenth century. Interannual variability was equally difficult for crop growing and it was particularly pronounced from the later 1310s to the mid-1330s, and in the 1360s and the first half of the 1370s. Towards the end of the 1420s, in themselves a period of moderate variability, growing season temperatures again began to fluctuate strongly. In the July–September precipitation index, which is based on the harvest duration, periods of higher and lower rainfall levels also alternate. Wetter times were often times that witnessed difficulties in grain growing, they occurred from the mid-1310s to the mid-1320s, from the mid-1350s to the early 1370s, around 1380, in the first decade of the 1400s and in a number of years of the 1420s. Interannual variability was raised from about 1310 to 1330, in the late 1340s, in the first decade of the fifteenth century and in the 1420s. Superimposed on the interannual and decadal variability is a long-term trend of falling rainfall levels, however, due to the human factor in the harvest duration, the long-term trend of the precipitation index is not as meaningful as the short- or medium-term fluctuation. For evaluating the impact of extreme years in terms of temperature and precipitation, a catalogue of very hot or cold and dry or wet spring and summer seasons has been created (Chaps. 6 and 8), which also includes the available information on meteorological, socio-economic and agricultural conditions of these extremes from written records. That the most severe subsistence crises of the Late Middle Ages, those following the harvests in 1258, 1294, 1315–1317, and the dearth 1428 were linked to cold growing seasons, wet summer months and also to high interannual variability in temperature and rainfall is evident. Another phase of high precipitation and cool growing season temperatures with the potential to result in large-scale famine is masked by the Great Pestilence in 1348–1349. The two major famines of the fifteenth century, the famine of the second half of the 1430s and the famine of the early 1480s are equally the consequence of prolonged cool and wet weather conditions.

The data confirm the notion of the Late Middle Ages being not just a time of social, economic and cultural transition, but also of climate change. In England the shift in climatic conditions manifests itself in cooling summer season temperatures from the end of the Medieval Climate Anomaly towards the Little Ice Age; the intermediary period, the fourteenth century, was marked by a high variability of temperature and precipitation schemes. Climate and climate variability played an important role as a driver of late medieval change by influencing human mortality and hence demographic development via exercising control on agricultural success and failure, as well as providing the conditions needed for the outbreak of plague by driving the vegetation productivity and creating the average winters and the sudden shift to warm and dry springs and summers that were necessary for rodent population maxima and flea development.

The impact of climate, however, was not direct, but operated within a socio-economic, cultural and also environmental framework. The cool and wet summer

half years ruining the grain harvest that caused such dearth, particularly in the mid-1310s, were to return even more often in the second half of the fourteenth century. With the diminished English population after 1350, however, harvests reduced by rain and cold translated less frequently into famine and high prices, although the suffering amongst the lower classes was not eradicated. In addition, coping strategies were improved over the Late Middle Ages, the international grain trade became more established and in times of crisis imports of grain were organised by the English crown or the mayor of London (1352, 1390, 1416, see Sects. 6.2, 6.5 and 8.3). With respect to epidemic disease before the introduction of *Yersinia pestis* into England, warm and dry summer half years or at least summers considerably warmer than previous years were not a major factor in mortality crises; the death-toll of gastrointestinal problems which frequently fall to summer was limited. Warm and dry summer months developed into a risk after 1350. Whereas the arrival of plague in England and its high mortality amongst a virgin population were not driven by regional climate factors in the form of warm and dry conditions, the spread of plague across Asia and Europe in the mid-fourteenth century was ultimately connected to climate change in the home region of *Yersinia pestis*, central Asia. In the sixteenth and seventeenth centuries, restrictions on the movement of people and quarantining in the case of an epidemic probably modified the spread of plague.

The significance of socio-economic factors for the shaping of climate impacts also becomes clear in the history of viticulture in England. At first glance a negative impact of cooling and increasingly wet conditions in the fourteenth century on wine-growing would appear to be the reason for the demise of English vineyards. However, taking the socio-economic setting into account, it becomes clear that English viticulture, which had never aimed at the regular production of good-quality wine, was much more efficiently ruined by the lack of labour and rising wages than by the deteriorating climate.

In England the secular trend of falling temperatures had less dramatic consequences for medieval society and agriculture than short-term and especially interannual variability of temperature and precipitation. Plague years are marked frequently by a sudden rise in summer temperatures and probably also a fall in precipitation levels compared to preceding summer seasons. With regard to agriculture, rapidly shifting meteorological patterns made reacting and adapting to new conditions impossible. During or shortly after the highly variable decades following 1350, the age of the ‘Indian Summer’ of demesne farming and maintained high grain prices while population levels had declined sharply, Piers Plowman laments not only about ‘wederes unresonable’, but continues:

> Wederwise shipmen and witty clerkes also
> Have no bileve to the lifte, ne to the loore of philosophres.
> Astronomiens alday in hir art faillen
> That whilom warned bifore what sholde falle after;
> Shipmen and shepherdes, that with ship and sheep wenten,
> Wisten by the walkne what sholde bitide

With unpredictable weather, agriculture too turned unpredictable and even experienced men could not assess the harvest in advance any longer, or plan a future

course of action. Likewise, sailors and shephers now failed to read the signs of sky and nature.

> Tilieris that tiled the erthe tolden hir maistres
> By the seed that thei sewe whit thei selle myghte,
> And what to leve and to lyve by, the lond was so trewe;
> Now failleth the folk of the flood and of the lond bothe –
> Shepherdes and shipmen, and so do thise tilieris:
> Neither thei konneth ne knoweth oon cours bifore another.

The post-Black Death disillusionment with authorities included not only the religious and social elites, but was also directed at Merle's fellows, those scholars who were devoted to astrometeorology and who were unable to forecast the weather:

> Astronomyens also aren at hir wittes ende:
> Of that was calculed of the clem[a]t, the contrarie thei fynde.[5]

With the dramatic arrival of plague in Europe and England, the attention of those committed to the science of the stars, in reflecting the sensitivities and fears of the age, was turned towards epidemic disease and in particular plague. Plague was the movement *par excellence* in the Dance of Death. The regional climate data demonstrates that in England weather patterns had a decisive influence upon the occurrence of plague waves after the Great Pestilence. In the fourteenth and fifteenth centuries, at a time when public health measures were not yet developed, serene summer half years, especially those that were considerably warmer and drier than previous summers, potentially harboured death. At least some parts of the European society were aware – due to the close observation of their environment – of the role that heat played in the genesis of a plague wave, hence the frequent references to the subject. Plague waves formed not in every warm year, but at intervals. The occurrence of national and supra-regional plague waves instead of fragmented local disease outbreaks was set by feedback mechanisms and time delays, such as the replenishment of the vulnerable section of human society and the increase in rodent population numbers, which in turn was influenced by the climate-driven vegetation productivity and tree-mast cycles, the absence of hard winters and finally the weather conditions of the plague year.

The role of meteorological factors in combination with a vulnerable pool of people in a plague outbreak can be illustrated by the events of the 1480s. The early 1480s were a time of subsistence crisis and high grain prices,[6] climate indices from the Low Countries indicate low temperatures and wet summer half years. Nonetheless no major plague developed in England during or after the food shortages as it had done during the last famine in the outbreak 1438–1439. This is due to the severe plague wave shortly before the dearth in 1478–1479, the hard winter 1480–1481, and the fact that after the end of the food shortages, summer temperatures did not rise and remained on a low level throughout the 1480s.[7] With an

[5] Langland, Piers Plowman, 188–189.

[6] Hoskins, Harvest fluctuations, 1480–1619, 31.

[7] van Engelen et al., A millennium of weather, winds and water in the Low Countries.

absence of the meteorological factors involved in major plague waves, came an absence of large-scale plague waves themselves. The pool of vulnerable people remained though, and in the abysmally cold and rainy summer of 1485, it fell victim to a new vicissitude of nature: the English Sweat. When the weather improved shortly after, a plague outbreak of limited nature was registered in Canterbury, London and Oxford in 1487.[8]

The rules for plague in the Dance macabre remained valid throughout the fifteenth century, but towards the end of this period a strange lacuna of outbreaks can be noted. No widespread plague epidemic hit England again before the very last years of the century. The gap between the national outbreak 1478–1479 and renewed epidemic conditions in England from 1499 onwards is considerably longer than between most other major plagues. During the gap of the 1440s to the late 1450s the precursor of weather conditions is missing, it simply was rarely warm enough in those years and interannual temperature variability was comparatively low, but small-scale outbreaks in London or plagues confined to a single county were frequent.[9] However, in the late fifteenth century the meteorological patterns to trigger a plague outbreak were present in 1495 (Appendix 6).[10] This prolonged absence of plague, even though weather conditions were adequate for a disease outbreak, raises the possibility that either the aetiology of plague was changing at that time,[11] or that another pre-condition indispensable for a bigger outbreak, either the reservoir of vulnerable people or sufficient numbers of rodents, were not present. The findings on mortality and life expectancy in the monastic communities at Westminster Abbey, Christ Church Canterbury and Durham Cathedral Priory reveal a high mortality rate and low life expectancy in the late fifteenth century.[12] Further evidence such as probated wills indicate that the high death rate was not confined to the monasteries.[13] It is therefore conceivable that after the previous plague waves and other epidemics in the 1460s and 1470s, the famine of the early 1480s, the English Sweat 1485 and the

[8] See note 30 in Chap. 10.

[9] Low interannual variability in summer half year precipitation in England is clear in Cooper et al., Hydroclimate variability, 1026 and Wilson et al., March–July precipitation reconstruction, 1011. For the low summer half year temperatures and variability in the Low Countries, see van Engelen et al., A millennium of weather, winds and water in the Low Countries and Camenisch, Endless cold, 1062–1063. Also the data on vine harvests from Burgundy indicates cold summers, mostly temperature did not fluctuate much, Chuine et al., Grape ripening as a past climate indicator. The plagues in London are listed in Bean, Population and economic decline in England, 428 and Gottfried, Epidemic disease, 47–50 adds the provincial plagues.

[10] The weather during the summers 1490 and 1494 was approaching conditions that would have allowed a plague wave to develop (Appendix 6). The summer 1492 then bore many of the meteorological hallmarks of a plague year, it was warm and considerably warmer than the year before. However, 1491 had been a year of great trials, both the winter 1490–1491 and the summer 1491 had been extremely cold. A high mortality level prevailed at Westminster Abbey in 1491, see Harvey, Living and dying, 122–125. Medieval English major plagues did not follow shortly after extremely cold winters or just one year after an extremely cold summer, see Chap. 10.

[11] Gottfried, Black Death, 156.

[12] Hatcher et al., Monastic mortality, 674–685.

[13] Hatcher et al., Monastic mortality, 684–685.

high mortality in the extremely cold year 1491 the remaining pool of vulnerable people was simply too small to facilitate the development of a supra-regional English plague outbreak. In the mid-1490s a sequence of bountiful harvests may have helped to lower mortality in the southern monasteries and regions.[14]

Living through an age of climate change, the time of the onset of the Little Ice Age, took its toll on the people of the Late Middle Ages. In particular, extreme temperature and precipitation conditions, and periods of high interannual variability with the associated rapid cycling of weather patterns caused a considerable amount of environmental stress and so accelerated the rhythm of the Dance of Death. It is no coincidence that during those times of unstable climate the demographic shocks were pronounced. The period from the 1310s to the 1330s of frequently cool and wet conditions combined with a high variability in terms of temperature and precipitation in England, and the ensuing Great Famine and agrarian crisis have been described at length in this work, as has been the period of wet and cool summers in the late 1340s (Sects. 6.4 and 6.5). While reduced population pressure made the English more resilient to weather-induced harvest failures after 1350, the next period of mortality crisis came in the 1360s when the April to July temperature reconstruction for East Anglia, the summer and winter index for the Low Countries, as well as the central European winter conditions fluctuated most severely.[15] In this decade two supra-regional plague waves (1361, 1368–1369) and an outbreak of 'Pokkes' haunted England (1365). Early in 1362 a massive and memorable storm crossed the British Isles, and the winter 1363–1364 was one of the coldest of the last millennium in Europe.[16] The decade was punctuated by poor harvests in 1366 and 1367, the latter caused the price of grain to rise. Depending on the timing and severity of major plague waves, these could also contribute to a price spike for grain as after the harvest 1369. Another period of raised variability covers the years around 1400. Variability in the English growing season temperature was moderate, in the late summer precipitation it was high after 1400. The summer conditions in the Low Countries and in Burgundy fluctuated considerably. Two major plagues in southern England (1400, 1407) and a plague in the north (1409) occurred between 1400 and 1410, the summer half years in the middle of the decade were wet. After a quieter interval in the 1410s climatic variability increased considerably in the 1420s. The moderate interannual fluctuation of spring-summer temperatures in England throughout most of the 1420s surged at the end of the decade, and summer precipitation on the island was very variable. In the Low Countries the summers began warm in the 1420s and then deteriorated from year to year while fluctuating extremely, except in the early 1430s, to a nadir in the mid- and late 1430s. Burgundy

[14] Hoskins, Harvest fluctuations, 1480–1619, Harvests were good in 1492–1495 and in 1499.

[15] For England, see Sect. 5.2. For the Low Countries, see van Engelen et al., A millennium of weather, winds and water in the Low Countries, and for central European winter conditions, see Pfister et al., Winter severity, 101.

[16] This storm causes the storm surge of the St Marcellus Flood or Grote Mandrenke (Great Drowning of Men) on the Dutch and German North Sea coast, see Gottschalk, Stormvloeden, vol. 1, 368–378. For the winter 1363–1364, see Pfister et al., Winter severity, 101–102.

summers were also variable over this period. At the same time the winter variability was raised between the mid-1420s and the mid-1440s, while winters were on the whole also extremely cold, this was after all the time of the early Spörer Minimum.[17] Mortality crises in these two decades were frequent. During the 1420s a major plague (1420), a minor plague (1426)[18] and the 'Mure' (1427, a sort of rheumatic fever or influenza)[19] affected the English people. The summers 1421, 1423 and 1428 were wet and cold, and a dearth held England in its grip after the harvest 1428. The climate data for summer in the Low Countries and Burgundy show a calm start for the 1430s, a decade which then saw nonetheless quickly changing and extreme conditions in its middle years, and indeed the time was marked by two more major plague waves (1434, 1438–1439), a minor plague (1431), an unidentified epidemic disease in 1435[20] and the most severe famine of the fifteenth century which occurred in the second half of the 1430s. Compared to such a sequence of affliction, the 1440s and most of the 1450s appear almost benign. High climatic variability in the summer half year returned in the Low Countries and Burgundy around 1460, it came into full swing by the 1470s and stayed almost until the end of the century. From c.1470 onwards the demographic shocks were hard on each others heels. Whereas the 1460s still only witnessed one major plague (1464) and a regional plague (1466), the next decade was marked by two large-scale plagues (1471, 1478–1479), a severe epidemic of dysentery in the hot and dry summer of 1473,[21] and – unconnected to climate – the arrival of the 'French Pox' with the soldiers returning from the continent in 1475.[22] In the 1480s high variability in winter conditions was added to that of the summer seasons in the Low Countries. Renewed food shortages in the early 1480s were followed by the appearance of the English Sweat (1485) and a plague of limited scale in Canterbury, London and Oxford (1487). The freezing year 1491 was accompanied by a high mortality in the London region[23] and at the end of the 1490s plague returned to England (1499–1500). The consequent raised levels of mortality are reflected in the annual death rates at the monastic establishments at Westminster, Canterbury and Durham; in accordance with the evidence of epidemic disease from chronicles, monastic mortality crises were more frequent and severe after c.1460.[24] Life expectancy was falling in the southern mon-

[17] Camenisch et al., Early Spörer Minimum.

[18] See note 21 in Chap. 10.

[19] Chronicon Rerum Gestarum in Monasterio Sancti Albani, 19. According to Creighton, Epidemics in Britain, 225 and Gottfried, Black Death, 157 the disease might well have been influenza, which was prevalent around that time in France, the Netherlands and Spain.

[20] For 1431 and 1435 see note 28 in Chap. 10.

[21] Gottfried, Epidemic disease, 44, Rawcliffe, Urban bodies, 369.

[22] The 'French Pox' are the contemporary name for syphilis. Gottfried, Epidemic disease, 43–45. He finds no substantially raised death rate in the studied testamentary evidence in East Anglia and consequently doubts the epidemic nature of the 'French Pox'. On the spread of syphilis through Europe, see Gottfried, Black Death, 158–159.

[23] Harvey, Living and dying, 122–125.

[24] Hatcher, Mortality, 30, Harvey, Living and dying, 122–127, Hatcher et al., Monastic mortality, 676–678.

asteries particularly from the late 1420s onwards, when variability increased with regard to temperature and precipitation. Life expectancy stabilized on a lower level around 1450, and entered a veritable depression at Westminster Abbey between about 1460 and 1485[25], coinciding with the highly changeable weather conditions after c.1460.

Periods of increased short-term climate variability hence correlate with periods of frequent demographic shocks due to epidemic disease and subsistence crisis. The Danse macabre, the high death toll, went hand in hand with social change and this social change contributed largely to the end of the medieval world.

[25] Hatcher et al., Monastic mortality, 674–678.