The Climate of Late Medieval England: Reconstruction and Impacts
Lecture at the Town Close Auditorium, Norwich Castle Museum, 2 November 2013

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Historical climatology (the study and interpretation of changes in climate and their effect on human history and development) faces major problems with regard to the Middle Ages because of the lack of surviving documentary sources and the nature of the material available. It has long been accepted that climate in the late 13th century and throughout the 14th century in Britain deteriorated bringing with it bad harvests and starvation. Dr. Pribyl explained the methodology she used to obtain late medieval spring and early summer temperatures; the results of the time-series created collated with precipitation and grain prices; and the preliminary conclusions which have been drawn from her work - the first annually resolved temperature reconstruction for England in the late Middle Ages.

Data on weather as well as on impacts of extreme weather and also on harvests, prices and wages, can be obtained from two types of documentary sources: (1) Narrative sources like chronicles, annals and weather diaries; (2) Administrative sources such as institutional documents, customs records, manorial and municipal accounts.

Narratives are direct, personal and local, giving descriptions of conditions, seasons, harvests, and information relating to plants, wild life, etc. Unfortunately they contain errors in copying, non-contemporary history as well as contemporary descriptions of extreme conditions which may show bias and exaggeration. Examples are Merle's Weather Diary 1337-1344 and the Westminster Chronicle 1381-1394 but there is little historical writing during 1450-1490. They provide an uneven, spatial and temporal distribution which is short term and ends with the individual concerned.

Administrative records are more regular and frequent, giving information on rainfall, floods, famine, agricultural output and prices. They provide a greater variety of data over a long period but can be uneven, are often unpublished and require intensive investigation. Examples are series of manorial accounts – often from Benedictine houses. These include the collection of the Norwich Cathedral Priory, which contains many accounts for Sedgeford.

These sources have been widely used by agrarian historians who have long recognised their value in studying the relationship between agriculture and weather. Hubert Lamb made use of information from the narrative data category in his extensive writings. The Climatic Research Unit at the UEA began to explore the past climate of the Middle Ages and several authors in the 1970s and 1980s incorporated proxy data into their research without aiming at climate reconstruction. This approach was extended by Ogilvie and Farmer (1997), who included more weather references from the administrative sources in their analyses. Further research has continued this century using both types of sources to provide information about weather conditions, particularly the growing season, which enables a starting date of the grain harvest to be employed as a climate proxy for April to July mean temperatures.

Dr. Pribyl explained how the grain harvest date was climate sensitive, i.e. dependent upon the weather ripening the kernels. As long as the grain harvest was cut by hand it could not be delayed, because then shedding would occur and a substantial amount of the grain would fall to the ground. The start of the grain harvest was so important that it can be used as a proxy indicator of the spring and early summer mean temperatures. Warmer weather allows for an early harvest; cooler weather results in a later harvest. Such dates constitute a valuable source of information whereby temperatures can be reconstructed using regression analysis. Dates of the grain harvest were mainly obtained from the manorial accounts of the Benedictine Norwich Cathedral Priory (approximately 700 account rolls survive for the period c.1270 AD to about 1430 AD) and additional smaller series of manorial accounts come from St.Benets Abbey and St. Giles Hospital. Altogether c. 1000 accounts were examined from which 616 dates were extracted which indicated the onset of the grain harvest. This raw data was collected and assembled in regional groups which were used to produce a Norfolk Composite Harvest Data Series. However, there remain gap years for which no information could be gained so it is not a consistent or continuous series.

Data were converted into a temperature proxy series by calibrating a newly constructed comparison series of grain harvest dates in Norfolk from 1768 to 1816 with the Central England Temperature Series. These results were verified over the period 1818-1867. Dr. Pribyl explained that the methods of harvesting remained constant up to c. 1850 before mechanisation occurred. This can be shown by using Farming diaries in the NRO such as those of Thomas Rippingall. Examining the harvest information in farming diaries from Langham, Morningthorpe, Snettisham, and Wymondham over the period 1768 to 1861 showed similar trends, i.e. the harvest dates react to the same driver - the mean temperatures of the growing season April to July. This comparison series was used for reconstructing and calibrating the medieval dates. For the British Isles no other annually resolved temperature proxy data are available and the onset of the grain harvest remains the only proxy for assessing April-July mean temperatures.

Temperature is not the only important variable. Dry and warm conditions were infrequent and without serious effect since the clay soils of Norfolk are not drought sensitive but wet conditions could be disastrous for output resulting in high prices, shortages and starvation. Increased rainfall at harvest results in longer drying periods for the grain, so a short harvest period implies dry weather, a long harvest period indicates high precipitation levels (although there other variables like the size of harvest, labour supply, and harvesting methods). The information in the length of Norfolk harvest during the Middle Ages was compared to precipitation sensitive data from oak rings of central England. The graphs showed a connection for large parts of the study period.

Dr Pribyl provided a number of complicated graphs showing mean temperatures plotted against precipitation and the wheat price. Using the length of harvest provided good information on the year to year variability but made it difficult for long-term reconstruction. Other variables such as warfare and taxation may be important so the series requires additional information. Nevertheless there were definite correlations of Temperature, Precipitation Index and Price movements. Dr. Pribyl explained the impacts which these demonstrated. The medieval data show a pronounced short term variability as would be expected. Over the long term results suggests that here is a cooling trend in mean April-July temperatures over the period 1256 to 1431. Average temperatures dropped from 13^{o}C to 12.4^{o}C possibly indicating the onset of the Little Ice Age. This cooling trend is seen in all five

groups of the Norwich Cathedral Priory manors, although some of the groups display a considerable steeper trend than the other due to microclimatic and soil condition. The decline in values was not steady and the reconstruction period contains decades of warmer spring-early summer temperatures (e.g. the 1320s to early 1330s and the 1350s) as well as colder conditions (e.g. the 1310s, the late 1330s, 1340s and parts of the 1380s). The wet conditions of 1314-17 prevented the proper sowing of oats, barley and wheat. Crop yields in 1316 were the worst in several centuries being roughly two-thirds of the average during the 150 year period from 1217 to 1410. Further wet weather in the year 1335 and 1346 was disastrous for output resulting in high prices as was the bad weather after 1350 particularly the cold and excess rain in 1367,1374,1379 and again in 1428 and 1438. The decline in grain-growing-season average temperatures would not have been a major problem for medieval agriculture but the phases of very high inter-annual variability partly found in the medieval time-series, such as 1315-1335 and 1360-1375, proved disruptive resulting in poor harvests, soaring grain prices, famines and population decline.

There are anomalies within the Data, mainly caused by the effects of volcanic eruptions and the plague. The 1257/8 apocalypse caused by the gigantic explosion of Rinjani in Indonesia resulted in *"such unendurable cold ... suspended all cultivation and killed the young of the cattle"* so that by midsummer *"scarcely were there visible any of the small and rare plants or any shooting buds of flowers (or) ... fruit crops. Owing to the scarcity of wheat a very large number of poor people died and dead bodies were found in all directions, swollen and livid, lying by fives and sixes in pigsties, on dunghills, and in the muddy streets"* - Matthew Paris, Benedictine monk of St.Albans Abbey in his *Historia Anglorum* which covers the period 1250-1259. The same was true of 1428/9 after another volcanic explosion on 28th June 1427 of Mt. Fuji in Japan – torrential rain destroyed hay and corn and caused the sheep to die (William Gregory Chronicles)

The Black Death of 1349 was merely the worst of several bad disease years – 1360/61, 1369, 1375, 1390 – the Great Pestilence 1349 alone resulted in a population loss of c. 30%, in the subsequent plagues waves the population was further reduced and remained low during the fifteenth century. Normally bad weather resulted in higher prices but the population decline from the middle of the fourteenth century onwards meant less consumption so food scarcities were less pronounced than before 1349 and after 1380 the demand for grain was so low that prices were generally not driven upwards by bad weather impacts. Marginal farmlands proved incapable of absorbing the sudden rain so their topsoil fertility was drastically reduced as was grain production. Much of the land was turned over to sheep grazing. This and population decline caused upland settlements to be abandoned resulting in numerous deserted villages in Norfolk during the fifteenth century.

The President of the Society, Helen Paterson, thanked Dr. Pribyl for an interesting and detailed lecture and invited a few questions from the audience which were duly answered.

See:
Reconstructing medieval April-July mean temperatures in East Anglia, 1256–1431 by Kathleen Pribyl, Richard C. Cornes, Christian Pfister
In Climatic Change July 2012, Volume 113, Issue 2, pp 393-412

Also:
Weather in late medieval Norfolk: agricultural practices and their climatological significance by

Kathleen Pribyl: Published 2011

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