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Experiencing Climate: Finding Weather in Eighteenth Century Cumbria

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Abstract This article examines whether Tim Ingold's concept of the 'weather-world' can be applied within discussions of climate in archaeology. Using a case study of eighteenth century Cumbria, the article first looks at the issues arising when environmental models are used to investigate landscape change. It then assesses the insights on landscape, weather and farming that can be gained from two historical diaries. It is recognised that advances in complex ecosystem and agent-based modelling have improved 'climate change archaeology', but that there are aspects of people's relationships with the weather and climate that are ill-suited to quantification. The article concludes by arguing that people's qualitative engagements with the weather are integral to how past people viewed and used the landscape.

Keywords Weather-world · Climate · Landscape · Early modern

Introduction

The last few decades have seen concerns about global environmental change become more pronounced. This has galvanised support for research initiatives across the academic community that address the relationship between social and environmental processes. Consequently, the study of climate change in the past and how it relates to historical narratives of social change is currently of great interest within archaeology (Mitchell 2008; Van de Noort 2011; Rowland 2010a, b). The view commonly espoused is that archaeology is uniquely positioned to explore the effects of climate change because its historical perspective affords the ability to examine interactions between large scale, long-term human and environmental processes (Mitchell 2008; Van de Noort 2011; Rowland 2010a). In some cases, the experiences of past societies have been seen to offer parallels for

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dealing with contemporary environmental change (Crumley 1994b; Diamond 2005). Although in recent years academic interest in the subject has intensified, there is a long tradition of research exploring the role of climate in human history (Behringer 2009; Crumley 1994b; Huntington 1924; Lamb 1982; McIntosh *et al.* 2000; Le Roy Ladurie 1972; Wigley *et al.* 1981). From the environmental determinism of the early twentieth century to the historical ecology of the 1990s, scholars have striven to explain how climatic processes influence and are influenced by human action.

Climate is defined by Lamb (1972, p. 5) as ‘the sum total of the weather experienced at a place in the course of a year and over the years’, and it is through this aggregative measure that disciplines have tended to characterise people's relationships with meteorological phenomena. However, in recent essays on environment and living, Ingold (2007, 2011) has argued for a greater appreciation of weather, suggesting that we see the landscape not as terrestrial scenery, but as a ‘weather-world’. After all, ‘a body confined to a place in the landscape, and that did not equally inhabit the sky, would be blind, deaf and unfeeling’ (Ingold 2011, p. 135). This follows anthropological research that recognises societies' engagements with weather as cultural practice, comprising identity formation and ritual, as well as wider attitudes towards the natural environment (Hsu and Low 2007; McIntosh *et al.* 2000; Strauss and Orlove 2003). It implies that there is a place for weather in archaeological interpretation.

Unfortunately, issues arise when attempting to reconcile past people's qualitative experiences of *weather* with scholars' quantitative reconstructions of *climate* (Pillatt 2012a). This problem is understandable given the difficulties in integrating data sets that are produced from a variety of different methods and scales of analysis. Over the past 3 years, I have attempted to address this problem by exploring the interfaces between subjective, embodied experiences of weather and the scientifically reconstructed climate. Focussing on Mosser, a small upland former township in Cumbria, I have aimed to develop a landscape and social history that places weather at the heart of the narrative.

Mosser's landscape can roughly be divided into three zones: the parliamentary enclosure on the upper hill slopes, the improved fields used for stockgrazing and arable and the wet lowlands at the valley bottoms (Fig. 1). Although sheep and cattle farming form the predominant agricultural activity in the present day, relict cultivation ridges indicate the prevalence of crop farming in the past. With such diversity of landscape occurring over a relatively small area and on the edge of the marginal uplands, Mosser was chosen in part for its likely sensitivity to climate change (Fig. 2). A further advantage was the existence of two historical diaries from the nearby area, which could be used to provide a first-person perspective on life in Cumbria during the late eighteenth century. I attempted to compare the diarists' experiences with more traditional archaeological and environmental narratives of landscape change. This meant utilising both quantitative and qualitative data and linking long- and short-term processes. This article will first look at the issues arising from using an environmental model to investigate landscape change in Mosser. I will then move on to the historical diaries, demonstrating a means by which qualitative information about the weather can be used in quantitative analyses. I will argue that aspects of diarists' engagements with weather and climate are unsuitable for quantitative assessment, yet were integral to their world views. The article concludes

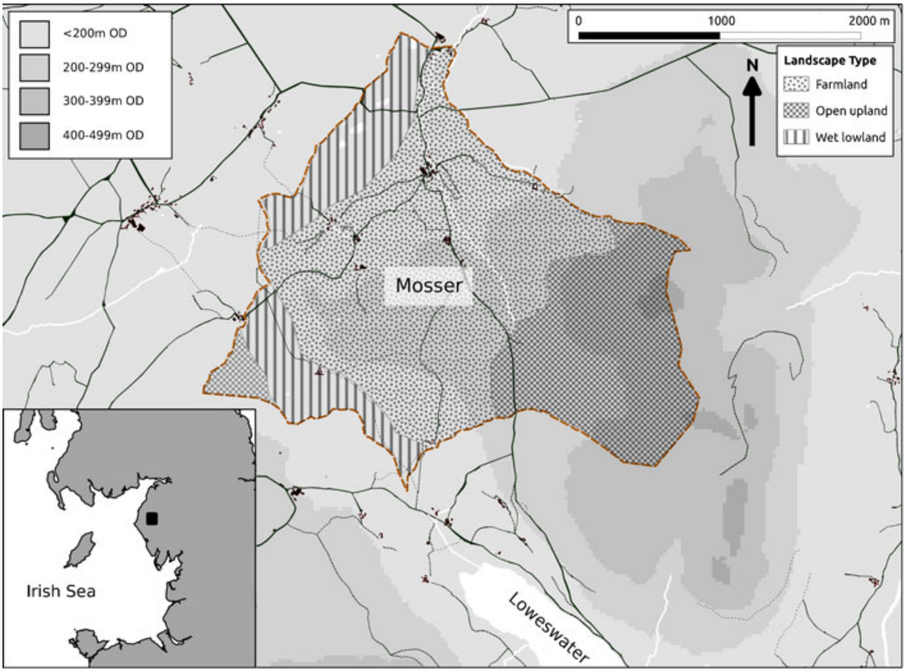

Fig. 1 The location of Mosser and its surroundings. Landscape zones categorised according to the Ordnance Survey 1867 first edition map (Original data: © Crown Copyright/database right 2011. An Ordnance Survey/EDINA-supplied service)

by linking these insights to an appreciation of the weather-world and wider discussions of climate in archaeology.

Fig. 2 The landscape of Mosser. Looking south-east towards Loweswater from Bramley Seat

Modelling Climate in Mosser

Parry's (1975, 1976b, 1978, 1981, 1985; Parry and Carter 1985) environmental model for the Lammermuir Hills has been highly influential in studies of human–environment relations. Parry (1975, 1976a, b, 1978) initially designed the model to describe and explain the relationship between climate change and crop cultivation in marginal environments. Post-medieval settlement abandonment on the upper slopes of the Lammermuir Hills was used as an example of the model's efficacy. He argued that the process was initiated by climatic deterioration from the Medieval Warm Period to the Little Ice Age, resulting in increased incidences of crop failure at high altitudes—a hypothesis described by Tipping (2002, p. 11) as ‘one of the keystones of the deterministic paradigm’. In response to growing dissatisfaction with deterministic accounts of the past, Parry (1981) later argues that the model should be used as a ‘retrodictive’ tool, in which the causal relationships that form the model are hypotheses that are to be tested against the historical actuality. It is in this second sense that I applied the model to Mosser. I wanted to test the model's assumptions in a different upland area, comparing its results to other narratives of social change.

After some initial investigations, Parry (1975, 1976b, 1978) built his model on the premise that of all the various climatic constraints—including wetness, exposure and insolation, amongst others—high altitude cereal cultivation would be most sensitive to changes in air temperature. Of the cereal crops, Parry was most concerned with oats, particularly the Red and Blaisdell varieties that would have been most tolerant of high altitude conditions and were of greatest importance to the upland farmers. To better reflect crop requirements, Parry converted his temperatures to a measure of accumulated warmth: *growing degree-days* (GDD) (Parry and Carter 1985, pp. 96–97). Parry went on to use the Central England Temperature series (CET), as well as records from Edinburgh and the Lammermuir Hills themselves, to reconstruct monthly temperatures for his study area from 1659 to 1981. Following these temperature trends, Parry charted the movement of GDD thresholds as they shifted up and down slope over time. Because Parry believed that the effects of climate change are best expressed as ‘changes in risk of impact from the short-term anomalous event’ (Parry and Carter 1985, p. 95), he created a number of geographic risk surfaces. These were modelled on the frequency of bad years, when accumulated warmth failed to rise above certain selected thresholds. Using this method, Parry argued that cultivable area of the Lammermuirs changed radically over time in response to changes in the climate. Early incarnations of his work linked the model to temperature reconstructions stretching back to the middle ages (Parry 1975, 1976b, 1978). From this, Parry fashioned his argument that climatic deterioration caused settlement abandonment on the upper slopes.

Recreating Parry's Model

Parry's method was dependent on temperature measurements from the CET (Parry and Carter 1985). As one of the most respected instrumental series in historical climatology, the CET is also the longest instrumental temperature record in the world, with records stretching back to the seventeenth century (Parker *et al.* 1992). Although the CET only covers Central England, separate studies have shown that it correlates well with records from other regions of the UK (Jones and Hulme 1997). Parry was thus able to use the CET to create a synthetic local temperature series by extending Mossman's (1897) Edinburgh series according to its relationship with the CET, then further bridging those figures to stations in and around the Lammermuirs (Parry and Carter 1985). In Cumbria, a similar process was undertaken, in which the CET was bridged using a series of regression equations to the Newton Rigg weather station in nearby Penrith, roughly 35 km to the east of Mosser (Pillatt 2012c). Following Parry's method, and his assertion that average temperature declines 0.68 °C with every 100 m of elevation, GDD were calculated at intervals of 10 m elevation for each year, starting with the base height of 169 m OD for the synthesised series (Parry and Carter 1985, p. 96). From the results, it was possible to observe, as Parry and Carter (1985, pp. 97–99) did, where cold years occurred either individually or in clusters.

Earlier investigations showed that, on average, oat cultivation requires a minimum of 1,050 GDD (Parry 1978, p. 81). On the Lammermuirs, this threshold occurs between 320 and 350 m OD. Using a known bad harvest of 1799, Parry calculated at this absolute limit of cultivation, crops would only have received 970 GDD that year. He thus concluded that 'a summer in which accumulated warmth failed to exceed 970 [GDD] would have led to an extremely delayed and reduced harvest' (Parry 1978, p. 88). When the method is applied in Mosser, the results show that only the very highest slopes would have been located in the marginal zone Parry devised for the Lammermuirs. This zone was delineated by isopleths marking the 1-in-50 and 1-in-10 risk of a bad harvest (i.e. years below 970 GDD). From 1659 to 1949, the thresholds lie at 320 and 385 m OD (Fig. 3). Evidence of arable cultivation in Mosser is not found above 310 m. If we take these results at face value, then it appears very unlikely that the subsistence cultivation of oats in Mosser would have been impeded significantly by a lack of warmth. There is, however, another threshold that Parry (1978, p. 81) highlights. This is the limit to commercial crop cultivation, an isopleth denoting an average of 1,200 GDD per year. At this limit in the Lammermuirs,

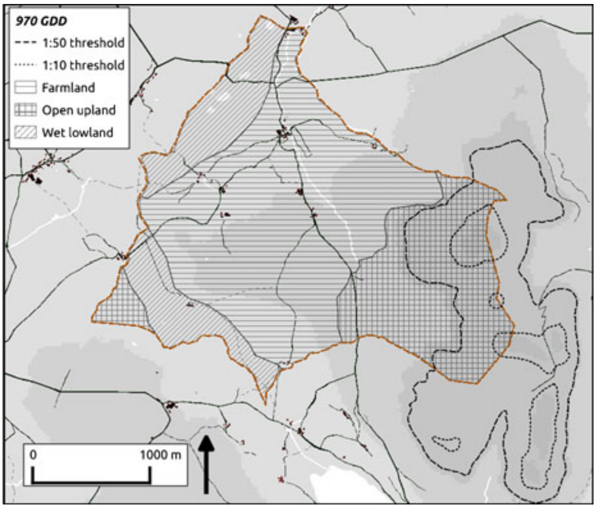

Fig. 3 The marginal zone in Mosser, 1659–1949. Bad harvest assumed to be ≤970 GDD (Original data: © Crown Copyright/database right 2011. An Ordnance Survey/EDINA-supplied service)

accumulated warmth would not have reached more than 1,110 GDD during the bad years highlighted by Parry (1978, p. 88).

It is possible to delineate a new marginal zone based on the 1-in-50 and 1-in-10 risk of warmth not reaching the commercial cultivation limit. In the period 1659–1949, this zone in Mosser stretches between 210 and 285 m OD, incorporating a significant proportion of the improved fields (Fig. 4). The implication is that much of the high ground of Mosser was marginal for commercial cereal farming. Certain periods can be selected to show how this marginal zone shifts up and down slope over time according to the frequency and intensity of cold years (Fig. 5). In all cases, less than a kilometre separates the two thresholds. It is a striking feature of the model that it predicts quite dramatic changes to the viability of cereal farming over very short distances.

Testing the Model

In the Cumbria county archives, there is a Quaker sufferings book recording quantities and values of farm produce confiscated in payment of the small tithe church tax in Mosser (Wh DFCF/1/116). This can be used to reconstruct elements of the local economy. Unlike the great tithe (which was not payable in Mosser), the small tithe was not taxed in kind: produce taken in payment may bear no relation to the things that were actually produced and taxed. Nevertheless, the kinds of products taken in payment of the tithe could reflect the predominant agricultural activity of the farms. de Vries (1980) has suggested that one way in which farming communities moderated the impact of climate change was through altering the balance between crop and livestock farming. With the marginal zone for commercial cereal cultivation dominating much of the Mosser landscape, it is possible that climatic constraints affected the crop/livestock balance across the township. Interestingly then, at the lower lying farms of Graythwaite and Underwood, above 60 % of the products recorded in the

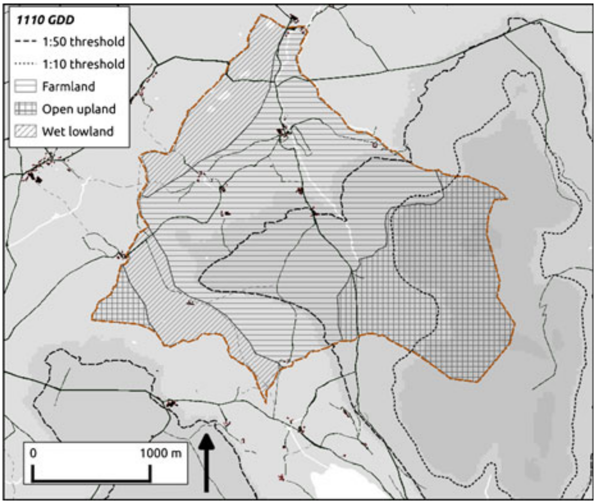

Fig. 4 The marginal zone in Mosser, 1649–1949. Bad harvest assumed to be ≤1,110 GDD. Much of the farmland now falls within the zone. The upper limit is broadly concordant with the edge of the open upland (Original data: © Crown Copyright/database right 2011. An Ordnance Survey/EDINA-supplied service)

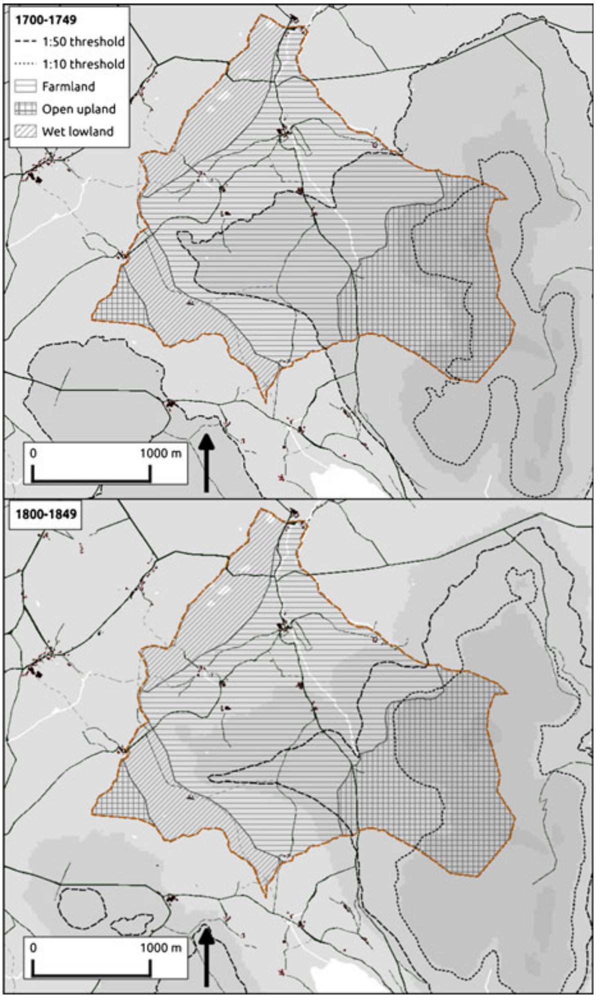

Fig. 5 Mapping the marginal zone for different periods. Bad harvest assumed to be ≤1,110 GDD. The thresholds shift up and down slope over time (Original data: © Crown Copyright/database right 2011. An Ordnance Survey/EDINA-supplied service)

small tithe sufferings are crops. At two of the biggest holdings on higher ground that value drops to under 30 %. There are many reasons to be cautious with this evidence, but it suggests that on the higher ground, livestock farming was more important, whilst on the lower ground crops dominated. This supports the results from the modelling exercise, suggesting that climate could, in part, influence farming decisions.

The small tithe records appear to show another change during the late eighteenth century. In 1747, nearly 90 % of products taken in payment for the tithe were listed as crops, and by 1775, this had dropped to under 40 %. More startlingly, in 1772, no crop products were taken for the tithe at all (Fig. 6). There is a danger of over-interpreting these data. Indeed, it is quite possible that this changing emphasis from crop to animal products was as much a function of what the farmers were willing to

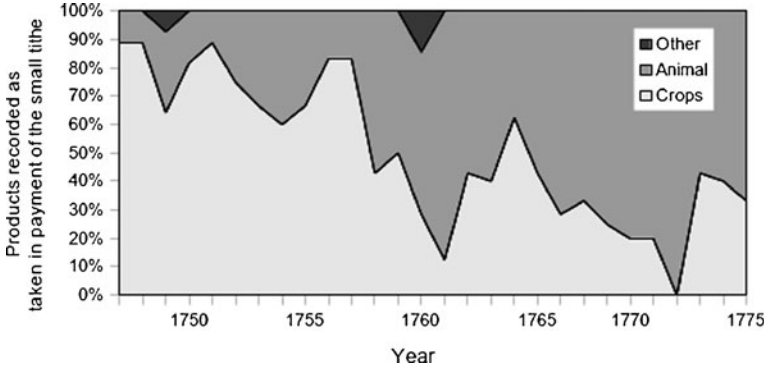

Fig. 6 The change over time in types of product taken from Quaker households in Mosser as payment for the small tithe (Wh DFCF/1/116). Animal products appear to become increasingly important from 1747 to 1775

give, and what the tax collectors were willing to take, as it was a reflection of changing farming practices. It is nevertheless possible that the trend recorded in the Quaker sufferings book is evidence of a growing emphasis on livestock farming. When placed in the context of the model, the implication is that deteriorating climatic conditions during the late eighteenth century forced farmers to move from a predominantly arable agricultural regime to one focussed almost exclusively on livestock.

Limitations of the Model

By initially focussing on a period with good instrumental records, the model avoids the problems associated with a reliance on palaeoenvironmental proxies to reconstruct past climates. Although new, high-resolution sampling techniques continue to be developed in this field, dating palaeoenvironmental sequences remains problematic and chronological resolution can be poor (Baillie 1991; Coombes 2003; Schulting 2010). Despite this advantage, Tipping (1998, 1999, 2002, 2004) has challenged Parry's conclusions a number of times, arguing that the palaeoecological evidence from the Lammermuirs and nearby Cheviot Hills does not support the model of abandonment. Tipping (2002, p. 21) suggested that upland communities could have been resilient to climatic changes due to trading links with the lowlands and an emphasis on farming livestock. It could be that Parry's model therefore places too much onus on cereal cultivation. That being said, Parry (1978, p. 82) understood well that his climatic thresholds would be dependent on a range of factors, including the various ‘economic or social incentives to cultivation operating at any one time’—in this respect, Tipping's accusations of environmental determinism are perhaps overstated.

In Mosser, there is evidence for a change in farming practices that can, following the mechanism laid out in Parry's model, be correlated with and explained by climatic changes. An archaeologist might be satisfied with this: such correlations have often formed the basis for archaeological explanations, and climate has been very seductive for those looking for prime movers in human affairs (Peiser *et al.* 1998; Ryan and Pitman 2000; Sherratt 1997; Weiss *et al.* 1993). It is testament to this that such systemic interpretations of human–environment relations have persisted so long after the vigorous critique of systems theory in the archaeology of the late 1980s and early

1990s (Hodder 1991). Developed in the 1970s, Parry's environmental model falls foul of much of this critique. In particular, there is a reliance on formalist economic decision-making, as farmers are thought to modify their actions according to a simple assessment of risk *versus* reward. This means that, in the words of Hodder (1991, p. 27), past people are reduced to ‘predictable automata’. It is why, despite Parry's (1978, p. 82) explicit recognition that climate would not be the only factor affecting people's decisions, Tipping (2002) refers to the method as being deterministic.

In recent years, ecological concepts such as resilience, self-organisation and criticality have contributed to less simplistic and less deterministic explanations of climatic influence. Of these, resilience theory is particularly attractive because it attempts to identify and explain the dynamic relationships between long- and short-term processes, thereby accounting for both social stability and change during times of climate-caused stress (Redman and Kinzig 2003). In combination with the adoption of complex modelling techniques and a recognition of non-linear dynamics from mathematics, these developments mean that Hodder's arguments against mechanistic conceptions of human agency are no longer as relevant as they once were (Crumley 1994b; Kirch 2007; van der Leeuw and McGlade 1997; McGovern *et al.* 2007; McIntosh *et al.* 2000; Redman and Kinzig 2003; Wilkinson *et al.* 2007). There is a greater—some would say more realistic—understanding of what models can and cannot contribute to the historical narrative (Coombes and Barber 2005; Wilkinson *et al.* 2007). Political, social and religious factors are thus drawn into processual frameworks that stress the importance of cultural adaptations to environmental change (Van de Noort 2011, p. 1044). Such socially aware system modelling goes above and beyond physical, environmental constraints and better accounts for the complexities of human decision-making.

A wider look at the history of Cumbria suggests that this sort of approach would be useful for the Mosser case study. The latter half of the eighteenth century saw the county transform from a rural backwater into one the most advanced industrial areas of the country. Mineral wealth and trade with overseas colonies helped Whitehaven grow to become the second biggest port in the country. Urban centres were also expanding at Workington, Maryport, Carlisle, Cockermouth and Keswick (Bouch and Jones 1961; Hughes 1965). Urbanisation fuelled demand for meat and dairy products, which doubled in priced over the last three decades of the eighteenth century (Searle 1983, p. 162). Improving transport and communication networks helped facilitate trade and ensured that the farms of the Lake District were linked to the demands of the northwestern coastal fringe (Dilley 1991, p. 128). Some scholars have attributed the first waves of parliamentary enclosure and decline of customary tenant rights to these processes (Dilley 1991; Searle 1986, 1993; Whyte 2003), and there is little doubt that the changes to Mosser's agricultural regime could have been related to the wider economic transition towards urban centres.

Any model of the above processes must accommodate a diverse array of variables. Inspired by developments in computing technology and complex modelling, Wilkinson *et al.* (2007) are developing such models for Bronze Age Mesopotamia. Here, households are modelled as agents, each with their own specific economic and social behaviours. As agents interact, large-scale ‘emergent properties’ or patterns are produced. Broad changes in society and environment are shown to be a function of myriad inter-related processes, ranging from soil nutrient cycling to inheritance practices. This kind of approach can certainly relate the changes in eighteenth century Cumbrian society and economy to both weather and climate, without relying on the simplistic mechanism of cause and effect engaged in Parry's model (but see Wilkinson 2012). However, while there is an acceptance that complex models can begin to explore the dynamics underlying concomitant changes in society and environment, there remains a structural functionalism that tends to downplay the role of individual agency (Pillatt 2012b). As Redman and Kinzig (2003) point out, applied uncritically, a resilience model can suggest ‘an underlying uniformity to cultural history’, with explanations of change dependent on systems passing through a series of characteristic phases. Overall, the ‘soft’ determinism engendered through a reliance on formalist economic rationality can be partially dispelled by an appreciation of non-linear dynamics, complexity and resilience, but it nevertheless remains the case that no model can account for ‘the great richness, variability and specificity of cultural production’ (Hodder 1991, p. 34). In this respect, Hodder's (1991) critique is as relevant as it has ever been.

Climate Change Archaeology

Many of the problems outlined above are prevalent in the wider study of climate in archaeology. Van der Noort's (2011) recent conceptualisation of ‘climate change archaeology’ around the North Sea recognises a lot of the limitations, as well as some opportunities. He points to a growing emphasis on human agency to inform and update more scientific understandings, such that ‘climate change archaeology explains the operation of certain feedback mechanisms that have gone largely unnoticed in climate change science’ (Van de Noort 2011, p. 1046). Then, similarly, scientific understandings of change are shown to be tied into social narratives: for example, in how national identities or religious ideologies might have been influenced by the changing physical environment (Van de Noort 2011, p. 1045). Here, qualitative and quantitative assessments of human–environment interactions are seen to work side by side, with each adding something to the other. The focus, however, is very much on the terrestrial environment: the land and its relationship with the sea. This frame of working is linked to a trajectory of academic thought in which landscapes are defined as ‘the material manifestation of the relation between humans and the environment’ (Crumley 1994a, p. 6; see also Sauer 1925; Schama 1995; Darvill 2001). Ostensibly, the environment includes both weather and climate, and the emphasis on land and sea presupposes climatic influence, but I have suggested elsewhere that this sense of landscape is one in which weather is isolated as a separate sphere of research—one not necessarily considered appropriate for archaeological investigation (Pillatt 2012a). This separation of landscape, weather and climate runs directly counter to Ingold's concept of the weather-world, outlined above. Ultimately, very little of this climate change archaeology appears to be focussed on the lived experience of climate—the weather.

Finding Weather in Mosser

Mosser was chosen as a suitable case study partly because of two historical diaries, which can be used to explore past people's relationship with the weather. The first, the diary of Isaac Fletcher, runs from 1756 to 1782. Transcribed and compiled by Winchester (1994), Fletcher's diary contains an almost daily record of weather. The second, the diary of Elihu Robinson, a friend of Isaac Fletcher, was written in Eaglesfield just a few kilometres to the north-west of Mosser. Consisting of a series of unpublished volumes held in the Library of the Religious Society of Friends (RSS Box R3), the diary runs from 1779 to 1806 and contains a weekly or monthly review of the weather. In both diaries, instrumental and, crucially, non-instrumental observations on the weather are entered side by side with discussions about farming and business interests, as well as comments on everyday life. The temporal span of the diaries incorporates a number of the bad years used by Parry to calibrate his model, as well as the turbulent years at the end of the eighteenth century, when war and soaring food prices caused widespread social unrest. The diaries are useful in three ways: firstly, systematic weather observations allow quantitative climate reconstructions that can be compared against the instrumental weather records; second, the connections between weather and farming practices can be examined in detail, showing ways in which the farming economy was affected by the weather; and third, the writing of the diaries gives insights into the diarists' attitudes towards weather and the ways in which they were bound up with their cosmologies and personal identities. Each of these points will be treated in turn.

Reconstructing the Climate

Isaac Fletcher's diary contains over 8,000 entries, of which 3,800 contain information about the weather. Researchers in historical climatology have long understood how diary entries can be used to produce high-resolution climate reconstructions (Brázdil *et al.* 2005). Commonly, qualitative statements on the weather are translated onto an ordinal scale, where integers represent degrees of intensity (Brázdil *et al.* 2005, pp. 378–380). Temperatures, for example, might be rated from extremely cold, −5, to extremely hot, 5. Scaled this way, the weather records are condensed into a format that is readily interrogated. Such a method was used with both diaries to quantify statements on temperature, precipitation and a more general measure of weather impact. When the quantified diary entries are compared against the synthesised instrumental record for Mosser, there is a high level of disparity between datasets. In part, this is due to averaging records to stand in for missing values. In some months, only one or two entries might contain information about the weather, whereas in others, 25 or more days might be recorded. It is not surprising that the two types of record covary the least during periods of sparse weather observations. Nevertheless, accepting these limitations, there are some instances where correlation between records is very good (Fig. 7). Here, we can be confident that the method by which qualitative statements are turned into quantified values is effective, and that the lived experience of weather does relate to the sterile scientific lists that form our records of past climates. Finding such relationships in the historic period is important because long instrumental records are often used to calibrate the palaeoclimate proxies that allow us to reconstruct climate in the deeper past (Baker *et al.* 2002; Brázdil *et al.* 2005; Jones *et al.* 2001).

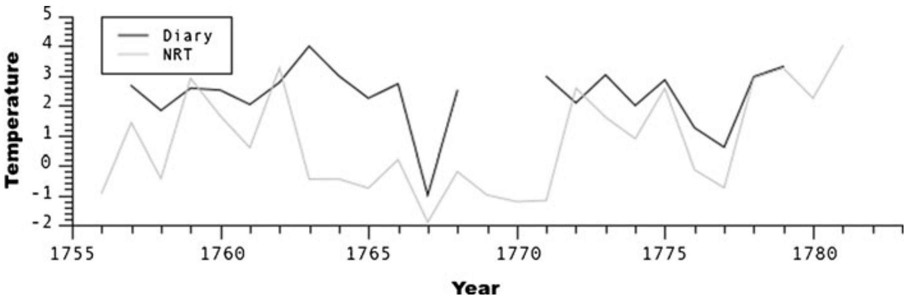

Fig. 7 A measure of summer (June–July–August) temperatures from Isaac Fletcher's diary (Winchester 1994) compared with seasonal averages compiled from the CET (Parker *et al.* 1992). Although there was often disparity between the two types of temperature record, here there is a good correlation between datasets, particularly from 1773 onwards

Weather Events

By quantifying qualitative weather statements from the diaries, it is possible to identify the years, seasons or months that were most remarkable in terms of their weather. For the most part, these records are based simply on whether it was warm, cold, wet or dry on a particular day; they can only tell us a little of how the diarists' lives were affected by the weather. The written diary entries can help address this. Comments regarding extreme and unusual events are very prevalent. They show, for example, that major floods damaged Fletcher's properties in 1761, 1764, 1773 and 1777. Other entries speak of the remarkable intensity of the Cumbrian frosts, when on several occasions the ice on Loweswater was so deep that people could skate on it. Without modern insulation, the frost could get into the houses: in January 1775, Fletcher wrote that 'it freezes to the very fire sides'. Although these events make the most interesting diary entries, it is striking to note how often lives were affected by only moderately bad weather. There are many occasions when ice and snow made the roads difficult or impassable, but even a burst of rain or a particularly cold day was sufficient to make Fletcher reconsider travel plans.

Of course, some of the biggest concerns for these two farmers were the effects that weather had on their farms. The diaries are full of comments bemoaning the timing of seasons and a lack of, too much, or untimely rainfall. Livestock could be affected as much as the crops: during the cold winter of 1776–1777, 3 in. of frozen snow prevented the animals foraging, and in June 1778, Fletcher commented that the cold and showery weather was 'very dangerous for the cattle just put out'. In addition to helping us observe the weather's impact on daily life, the diary entries can be used to examine how perceptions of weather were formed and assess whether those perceptions matched the observations. A systematic analysis of Elihu Robinson's diary explored this further. It showed that worries about the quality of the forthcoming harvest were not always realised. In 1801, for example, Robinson was extremely sensitive to the weather, frequently commenting on its adverse effects on the crops and the poor harvest prospects. Taking these factors alone, the year would stand out as by far the worst for crops, yet despite these concerns, the summer of 1801 ended with a very good harvest and a lowering of grain prices.

Although high grain prices were not necessarily bad for farmers, high prices certainly had an impact on the rest of the population, most notably the urban poor (Jones 1964). This is evidenced in Robinson's diary, where entries record distress amongst the poor in 1784, 1791, 1795 and from 1799 to 1802—precisely the years when grain prices were at their highest. This was no mild grumbling: in 1791, Robinson described people as ‘starved’, and in 1795 following a period of wet weather during the height of the hay harvest, Robinson records ‘mobs rising in several places!’ Worst of all was 1800. In May of that year, food was extremely scarce. In an effort to help some of the poor, Robinson sent his maid to Cockermouth with a coop of potatoes and strict instructions not to ask above 8 pence per stone—well below the market rate that day. ‘She was soon surrounded by a multitude, agitated by different passions! Some swearing some praying! & perhaps some crying in order to be served: They were soon sold & notwithstanding her care & vigilance, she supposes several did not pay—however she made One Pound, Five Shillings & Nine pence half penny—I think the most I ever made out of one coup—deplorable distress!’ Through Robinson's compassionate eye, the severity of the situation is thrown into stark relief. Robinson himself was not unaffected, and his comments from 1799 to 1801 become increasingly negative. At the end of 1800, he laments that it is ‘still a gloomy prospect! Deplorable distress! War & rumours of war! Manufactories dull & trade languid! Provisions exceeding high!’ His comments were perhaps justified, as this is the only year within the diary when the prospect of famine is raised.

Attitudes to Weather

In addition to the diarists' direct observations, it is possible to use the diaries to gain perspective on attitudes to weather and how they related to the wider zeitgeist. In engaging in the process of data collection and diary-keeping, Isaac Fletcher and Elihu Robinson were joining contemporaries in a gentlemanly community of amateur meteorologists, dedicated to the advancement of scientific understanding of weather. Despite this aim, there are signs of tensions between the rational Enlightenment outlook and more traditional received wisdom. Both diarists were keen to take note of traditional signs of spring, such as thorn leaves and cuckoo calls. Golinski (2007, p. 91) writes that ‘this lore is integrated with the rhythms of rural life, the festivals and other communal activities that punctuate the cycle of the year’. It is a form of weather forecasting that is intimately linked with the agricultural calendar and life outdoors. References to weather proverbs, such as “3rd month came in spring like, or according to ye old adage ‘like a lamb’. The flowers begin to spring, the skies to brighten, & the birds to sing” (Robinson 1802) are also examples of this type of ‘weather wising’ (Strauss 2003). By incorporating these observations into the more programmatic accounts of weather, the diarists are attempting to reconcile the two competing bodies of knowledge: traditional and scientific.

As diligent records of the weather, the diaries provided a means through which claims could be tested. It is not uncommon to encounter a weather proverb followed directly by an evaluation of its predictive veracity. For example, in 1800, Robinson wrote this entry: ‘1st month came in with a morning red! Which is often looked on as a sign of wind, snow or rain! Fine calm day; but next morning a storm of snow from

SE'. While today we might put more faith in scientific meteorology over weather proverbs, the diarists were equally sceptical of both types of knowledge. Elihu Robinson's trials and tribulations with his barometers are a case in point. Barometers during the eighteenth century were the main instrument within 'polite science', and they clearly fascinated Robinson (Golinski 2007). He had at least two, noting the purchase of a new 'diagonal' type in the autumn of 1799. This followed a string of entries that showed intense dissatisfaction with the old barometer's readings, culminating in the frustrated exclamation: 'we have no instrument to prognosticate rain or fair'. The device's intransigent behaviour meant it could be likened to other long-established means of weather prediction, such as astrology, that were less fashionable in polite society. Although the barometer was developed as a means to transcend discredited superstitious practices, the tradespeople that sold them relied on tacit references to those traditions in order to cement the instrument's wide popularity (Golinski 2007). In this respect, the diarists are situated at the very threshold of modern meteorological understanding. It was a position in which every failed forecast, whether by weather proverb or barometric reading, represented superstitions that were increasingly derided by polite society as relics of barbarism and ignorance, and yet also a scientific understanding that was only incompletely formed and still wedded to a less rational past (Golinski 2007, p. 171).

Weather-worlds

These examples from the two historical diaries reveal how the diarists' experiences of weather were deeply entwined as part of their daily lives. Much recent work on past climate changes has been influenced by the historical ecologists' assertion that landscapes are 'material manifestation' of human–environment relations (Crumley 1994a, p. 6). This is true, but the diaries show that to truly get to grips with all aspects of human–environment relationships, these must not be conceptualisations that marginalise weather. As Ingold (2011, p.135) writes: people live 'not on the fixed surface of the landscape but in the swirling midst of the weather-world'. The concept of the weather-world and its expression within the diaries demonstrates a level of engagement with climate that goes far beyond that explored in Parry's model. It suggests that although land use and economy can be quantitatively linked to changes in the climate, and although there are ways—as in the examples above—of moving between qualitative observations and quantitative reconstructions, approaches that see their end point primarily as quantitative assessments of change will always be incomplete.

Within the model, as well as more widely in archaeology, climate is conceived of as a set of physical processes that can be measured, recorded and reconstructed, with impacts on human action that can be quantified materially and economically. In this sense, Lamb's definition of climate as 'the sum total of the weather experienced at a place in the course of a year and over the years' is restricted to an aggregation of daily variables. By thinking about weather-worlds, however, Lamb's definition takes on new meaning: the diaries show how past people's experiences within the weather-world were aggregated to create understandings of climate that were embedded in their daily interactions with the landscape, their senses of personal, religious and community identity and their attitudes towards the natural environment. In this way, the weather *in* which one stands can be as much responsible for generating a sense and use of place as the ground *on* which one stands (Pillatt 2012a).

Climate is not only rendered in less physical, more social terms, but the broad-scale climatic and social changes observed in the archaeological record are better linked with an interpretive emphasis on how people confronted changing material conditions: The diarists' struggles to understand the turbulent weather towards the end of the eighteenth century—commonly linked by climatologists to the culmination of the ‘Little Ice Age’ (Jones 2001)—through scientific and religious perspectives were, in part, constituent of the wider, more encompassing transition to modernity. Advances in complex modelling, the development of resilience theory and Van de Noort's climate change archaeology indicate that quantitative and qualitative accounts of change need not be mutually exclusive. In terms of measuring the influence of climate on past societies, however, this study suggests that only by applying a more weather-centred perspective can we begin to apprehend the full breadth of interactions.

Conclusion

To conclude, it is clear that researchers are beginning to see the value of crossing theoretical divides to produce better archaeologies of climate change. However, this process will be incomplete until weather, as the lived experience of climate, is considered in the same vein as any other aspect of the past. Parry's environmental model may now be outdated, but it does help highlight some useful points. In particular, it ably demonstrates how climatic factors affecting crop growth can vary markedly across small areas as a result of changes in elevation. Yet the attempt to apply the model in Mosser provides a cautionary tale against assuming causal links when climatic and social changes correlate, even when a physical mechanism linking the two can be reasonably postulated. The combination of historical documentary evidence with the two eighteenth century diaries has revealed deeply complex links between human practice and weather, but in archaeological attempts to quantify the effects of climate on human populations, economy is often foregrounded. This is true even when sophisticated models can accommodate increasingly complex accounts of human agency. Qualitative data can be used to develop and enrich quantitative assessments of change—the translation of diary weather statements into a coherent scalar weather record is a good example of this. Moreover, an understanding of how weather events impacted upon daily life could be used to update and refine processual models of change. But there are aspects of people's relationships with the weather and climate that are ill-suited to quantification. These are the expressions of identity and world view, and the complex cultural norms that have been generated through people's everyday engagements with the weather-world. In this respect, climatic change and climatic stability, bad weather and good, are all intrinsic to our understanding of how past people went about in the world.

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