

'The Long slow thaw? Temperature reconstruction 1538-1659 through a reappraisal of the work of Hubert Lamb and Michael Mann' Supplementary information

"I have been asked so often during the period that I have been doing this work this question, well after all this grubbing into the wealth of the past, do you think that our climate is changing or has changed? Where are the old snow storms? My answer is that viewed as a whole the English climate during an historic period say from 400 years before Christ to the present time has always been 'beastly,' we never quite know where we are with regards to weather." Reginal Jeffery late fellow and tutor of Brasenose College Oxford. Author of 'Was it Wet or Was it Fine?'

Introduction

These are the historic records noted within the article 'The Long Slow Thaw- Temperature reconstruction 1550-1659 through a reappraisal of the work of Hubert Lamb and Michael Mann.'

'LINK to The Long slow thaw'

They are used as criteria for reconstructing CET from 1550 to 1659 when instrumental records began. Historic records beyond this period were also examined in order to view preceding information in context.

A list of the material read or used is detailed at the end of this document in **Section Five**. It was obtained from personal research at the remarkable Met office archives in Exeter, together with online research and the examination of additional climate books, historic anthologies and articles. It supplements the information contained in the referenced links and 'additional reading' noted at the end of 'The long slow thaw' which have also been collated in Section Five, where the work is put into further context through an article '**A short anthology of changing climate.**' This document containing supplementary information will be updated as new information becomes available and further versions of the temperature reconstruction will be made. In particular local records, literary references and climate references from historic events such as the English Civil war 1642-1651 will be examined. The information is grouped as follows;

Section 1 General notes

Section 2 Reference material

Section 3 Calculation of temperature for reconstruction

Section 4 Source/author used in 'supplementary information'

Section 5 Material from references and links used in the article 'The Long slow thaw' repeated here.

Section 6 Additional reading and material used in the 1538 reconstruction

Section 1 General notes

1) When accessing historic observations and records, certain caveats need to be made, although generally the information portrayed is reliable as the information of harvest dates, weather patterns etc would be essential for the continued welfare of an agrarian based society. In the context of the time notable events would be chronicled, as even short periods of extremes might have serious consequences for people often living at the margins.

2) The phrase 'the greatest-drought/floods/snow/heat- in the memory of any man living' occurs frequently, but we should not take this as literal (unless it was a claim made by a noted historian) but should instead consider the event mentioned is likely to be 'exceptional' for at least 20 years. Generally there is further information available against which such extravagant claims can be checked. People could expect to live to their 50's or early 60's if they could survive childhood so 'the greatest in living memory,' would not be as long as in the modern era.

3) Some of the reference material has self-evidently accessed the same source material as other chroniclers. Reading the original source material often greatly amplified the comments.

Neither frost nor snow all the winter for more than six days in all.'

- 4) Numerous one off short term events-such as a heavy snowstorm or notable flooding are recorded in journals but not mentioned here, as they don't tell us anything of the month or season
- 5) It is notable how often rain is mentioned in the records, together with a huge amount of catastrophic weather events- and the frequency with which periods of intense cold or heat are juxtaposed, all indicating a highly variable climate.
- 6) Many of these old records are not an easy read and complications are introduced by the change of calendar when 11 days or more were 'lost' in Sept 1752 with the change from the Julian to the Gregorian calendar in England.
- 7) I have presented information as it is recorded with, on occasions, an explanatory comment.
- 8) Sometimes a chronicler is unclear on dates, for example when they refer to say the winter of 1619/20 but might mean that of 1620/21 but usually other references enable clarification.
- 9) Where little information is currently available an 'average' from surrounding years has been used. The temperature range is greater in winter than in Summer (in England) and a notably cold winter will likely affect the mean average more than a hot summer.
- 10) This record covers Central England Temperature (CET) a geographic area of England as described by Gordon Manley who compiled a comprehensive instrumental record commencing 1659. Where possible observations listed below have been limited to that area. However Britain is a small country and it is likely that any notable long lived event outside the geographic definition of CET is also likely to have affected that central area
- 11) Whilst frost fairs may be seen to be a good proxy for extreme cold, during Puritan times this activity may have been frowned on. Also changes in the course/flow of the river may have precluded this activity even though the temperatures might suggest a frost fair was possible. A list of frost fairs is included in the references. As Mann and Jones mention when quoting Lamb 1977 in their own 2004 paper 'Climate over the past millennia' there were only 22 frost fairs on the Thames recorded between 1408 and 1814.
- 12) CET is seen as a reasonable proxy for Northern Hemisphere temperatures. See article 'The Long Slow Thaw' for evidence and caveats.
- 13) Due to its geographical location British weather is often quite mobile and periods of hot, cold, dry or wet weather tend to be relatively short lived. If such events are longer lasting than normal, or interrupted and resumed, that can easily shape the character of a month or a season. Reading the numerous references there is clear evidence of 'blocking patterns,' perhaps as the jet stream shifts, or a high pressure takes up residence, feeding in winds from a certain direction which generally shape British weather.
- 14) A few other events of general interest from other countries have also been inserted, but not included in the reconstruction.

Section 2 Reference material

Some of the most common abbreviations used to identify the reference material -full list of sources at end of paper.

Lowe 'Chronology of the seasons' Lamb- 'Climate history and the Modern World chmw

'Was it Wet or was it Fine' R W Jeffery (3 Volumes) Wof Records of seasons.. T H Baker 1883 volume 1 and 2 (Baker)

A General Chronological History of the Air (agc) Booty-an online history

1407/8 The severe winter affected most of Europe, and is regarded by climatologists as one of the most severe on record. The frost lasted for 15 weeks and people were able to walk across the frozen Thames. According to Ian Currie (a noted authority on historical weather events), "one of the most snowy & was of outstanding duration". [In Europe, ice in the Baltic had allowed traffic between the Scandinavian nations, and wolves had passed over the ice from Norway to Denmark.] booty

1410 In this year, the tidal River Thames froze over for 14 weeks. (I think, given the length mentioned, that we have to assign this to winter 1409/10) booty

1422/3 A severe winter in western Europe / implies parts of Britain. (Easton, in CHMW/Lamb) booty

1430's Majority of winters, [perhaps 7 or 8] contained several weeks of widespread severe weather (NB: 'weeks', not the paltry 'days' we get end 20th / early 21st centuries.) According to Lamb, an experience not repeated / matched until the 1690's, in the depth of the Little Ice Age (and certainly not in modern times). Booty

Neither frost nor snow all the winter for more than six days in all.'

1431/2 A cold (possibly severe) winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

Every winter from 1433/4 to 1437/8 described as severe. Lamb-chmw

1434/35 (may be 1433/34)

(Winter) A very severe winter: the Thames froze solid (from December to February) and was closed to shipping from Gravesend to below London Bridge, and wine had to be transported overland (or over the ice-covered Thames) from Gravesend to London. [Some sources have this as 1433/34]

1442/3 A cold winter western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

1456 great frost and great snowe wof

1457/8 A cold winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

1464/5 A cold winter over western Europe / implied parts of Britain. (Easton, in CHMW/Lamb)

1480/1 A cold winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb)

1496 Summer very good wof

1490's A run of good wheat harvests-Lamb chmw- citing Hoskins wheat harvest journal

1500 Generally warmer conditions until 1550 with frequent anti cyclones and westerlies than in the previous century-Lamb chmw

1503 Hot and dry (agc)

A dry summer from whitsun until harvest lady day- no notable rain Baker

Thames not frozen again until 1506

1506 January ' at that tyme was such a sore snowe and frost that mynte goo with carters over the temse (Thames) and it lasted until after candlemas' (2nd February) wof

River Thames bore carriages through out January Baker also Lowe

Severe frost. Thames frozen throughout January; horse and cart could cross the frozen river. The sea was also frozen at Marseilles. This implies that it must have been bitterly cold (and persistently so) since at least late December. It often needs some period of strong east wind as well to remove the heat from the water. [Given the doubt about which calendar convention was in use, this could be 1507.]

(LWH) booty

1508 Good harvest Lowe

1509 Remarkable plenty Baker

1510 Hot and dry agc

Remarkable plenty again, price of wheat in 1509 and 1510 cheapest recorded in more than two centuries; Baker

1510/11 A cold winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

1511 Severe frost in London (London was much smaller and more rural) wof

1513 July wonderfully hot then great cold and wind and rain to Sept wof

13/14 A severe winter in western Europe, including many parts of Britain. (Easton, in CHMW/Lamb). From (LWH) "Thames frozen" in January 1514: carts crossed from Lambeth to Westminster. This would imply extended period(s) of sub-zero temperatures, together with persistent, and perhaps strong east winds Booty

1515/ Dec and Jan 'there was so great a frost that carriages of all sorts passed over the ice (in London) Lowe

Thames frozen Baker

1516 Thames frozen Baker

Hot and dry agc

Neither frost nor snow all the winter for more than six days in all.'

1517 Hot and dry agc

Jan 1517 A 'great frost' started on the 12th January (OSP). A severe winter (1516/1517) across England - Thames frozen. Booty

1520 An 'ungenial summer' Baker

1523 After great rain and wind in November then cold (sore frost) November so extreme that men died of cold Baker

England – Nov cold winter (began?). Frostbite. Deaths by cold. Booty

1525 Sharp frost-many lost their limbs and perished with the cold wof

1526

1527 Great flood-(Walford)

Great wet in sowing time. In the winter great abundance of rain including Sept Nov and Dec. By Jan 16th everything saturated then dry until April 12 then rained every day until June 3rd in May it rained 30 hours without cease Baker

1528 Spring almost incessant deluges of rain Lowe

Moist rainy and southerly winds for 1528 29 and 30 (Short)

1529

1530 Great floods all year (Walford)

1531

1532

1533

1534 Great frost Nov to Feb 34/5 Thames frozen some miles below Gravesend Baker

Goods carried by land across Kent and Essex as Thames frozen Nov '34 till February '35 Lowe

Frost lasting from November to February; Thames frozen below Gravesend (which presumably means it was also frozen up-river from this point; the river below Gravesend is at the head of the Thames estuary - so perhaps only ice along the shore-line, rather than being completely frozen all the way across?) Booty

1535 Floods at haymaking time Baker

1536 Thames froze over on 22 December wof

Thames froze Baker

Dec 1536 and Jan 1537 Severe frost. Thames frozen in London: King Henry VIII, with his queen (Jane Seymour who was to die late in the year [1537] after giving birth to the future Edward VI) rode on the ice-bound river from London (probably Whitehall) to Greenwich. (booty)

Summer exceedingly rainy Dec and Jan a great frost. Thames froze Short

Dec the Thames froze over Baker

1537 Good summer Baker

Good harvest according to Lamb-chmw- citing Hoskins wheat harvest survey

1538 Excessively hot summer, rivers dried up in summer Baker

1539 Excessively hot summer Baker

1540 Great heat and drought agc

Neither frost nor snow all the winter for more than six days in all.'

Excessive drought rivers dried up 'in other places (All over the country?) hottest and healthiest year in the memory of man (Short)

Summer exceedingly hot wof

Fine weather and heat Feb to Sept 19th mid harvest on June 25th grapes ripe in July, rain fell only six times exceedingly early spring cherries ripe by end may . Extreme drought at end of summer Baker

This year was remarkable for the abundance of corn and fruit Lowe

Very cold winter

1541 Dry and hot wof

Hot and dry. A remarkable drought (Nottinghamshire area) Baker

The river Thames so low that even at ebb, extended beyond London bridge Lowe

1538-1541 These four years apparently experienced drought, with 1540 & 1541 particularly dry - in both these latter years, the Thames was so low that sea water extended above London Bridge, even at ebb tide in 1541. Three successive fine / warm summers from 1538-1540: the weather in 1540 was so fine that picking of cherries commenced before the end of May and grapes were ripe in July.

General warmth over Europe during the spring & summer of 1540. For England, there are several references to a hot summer, with great heat & drought; also many deaths due to the 'Ague'. (The next warm summer of equal worth is possibly that of 2003!)

(also noted in usw via Holland .. " 1540 is described in contemporary chronicles as the 'Big Sun Year'; the lower part of the Rhine from Cologne into the Netherlands is 'dry' - it didn't rain over Italy, with Rome dry for something like 9 months. Forest/city fires, with many people dying of heat stroke, heart failure etc.")

1541: as indicated above, another drought year with rivers drying up (must have been quite extreme given that the previous year was notably dry). Cattle / other livestock dying for lack of water: dysentery killed thousands. Booty

Good harvest according to Lamb chmw, citing Hoskins wheat harvest survey

1542/3 Long cold period-Feb wof

Intemperate wet season (Baker)

1543 A cold winter in Western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

Frosty winter (Short)

Wet summer

1544

1545 Severe winter (Baker)

A cold winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

1546 Good summer (Baker)

1547 Good summer (Baker)

Intense frost at the end of the year [December?] (London/South). Booty

Intense frost (Baker)

Intense frost in England especially London at end of year after Edward VI proclaimed King Lowe

1548 Drought wof

1549

1550 Great rivers in middle of winter were dry- but in summer great floods (Short)

1550 Generally warmer conditions from 1500 with frequent anti cyclones and westerlies than in the previous century-Lamb chmw

Neither frost nor snow all the winter for more than six days in all.'

In the middle of the 16th century a remarkably sharp change occurred' -and over the next hundred and fifty years or more the evidence points to the coldest regime, though accompanied by notably great variations from year to year and from one group of years to the next, than at any time since the last major ice age ended 10000 years ago or so. Lamb cmhw

Mediocre harvest –Lamb chmw

1551 Extreme cold in north (bb)

Mediocre harvest Lamb chmw

1552 Drought booty

1553

1554 Unpleasant summer and early autumn

Mediocre harvest Lamb chmw

1555 A wet year: Westminster flooded after great storm of wind and rain in October (or possibly September - some doubt about attribution and calendar usage here). Booty

Wet rainy floody year rain heat and southerly wind (short)

Very Poor harvest-Lamb in chmw-citing Hoskins wheat survey

1556 The drought of this year was reputed to be responsible for a 6-fold increase in the quarterly price of wheat. Springs failed - implies a 'significant' event, particularly if the entry for 1555 above is correct! Booty

Great drought (Short)

Drought so great that the springs failed Lowe

Great drought, springs failed (Baker)

Very Poor harvest-Lamb in chmw- citing Hoskins wheat survey

(note that poor harvests can be due to drought or rain or cool weather)

(notable amount of sightings of aurora borealis and earthquakes in this period)

Famine from great rains and inconstant seasons heat and long south winds –Walford

End Sept strong cold north wind Short

1557 Drought wof

1558 Spring summer and harvest hot and dry Short

Cold winter with north wind

1559 Stormy autumn

1560 In Switzerland, for example, the first particularly cold winters appear to have been in the 1560s, with cold springs beginning around 1568, and with 1573 the first unusually cold summer (Pfister, 1995).

1561 Winter in N France cold (bb)

1562/63 Thames froze (bb)

1563

1564 on 21st Dec 'began a frost which continued so extreme that on new year eve people played 'foote-ball' on the Thames at Westminster as if it had been on dry land' it thawed on 3rd jan 1565 Wof

Winter of 64 and the following spring a great frost

Neither frost nor snow all the winter for more than six days in all.'

Very severe (bb)

Severe, prolonged frost (set in 7th December 1564/OSP). The court (of Elizabeth I) later (21st/OSP) indulged in sports on the ice at Westminster (perhaps one of the first occasions a great frost had been treated in this way: but see also 1309/10 which contradicts this). Football & other games were played on the ice.

(In the depths of the Little Ice Age, this would not have been too unusual; the reason the event is noted is because the Queen & Court were involved: it would have been an impressive sight!)

Thaw set in circa 3rd (old-style)/13th (new-style) January 1565 - accompanied by a notable Thames flood: A notably 'unhealthy' fog followed this thaw.

The winter of 1564/1565 was notably severe as regards depth of cold - amongst the top 10% of bitterly cold winters in the millennium. (Easton, in CHMW/Lamb). Booty

Severe frost at close of December, football and diverse games played on ice Baker

Surface of river Thames solid as a rock at Christmas . The population could walk the whole distance from Westminster to London on the ice and queen Elizabeth was daily on the river –the frost broke up suddenly into fearful inundations bearing down houses bridges and vessels to destruction. People played football on the frozen river Dee Lowe

1565 N Europe very cold Thames froze (bb)

1566 Wet spring dry summer autumn almost rainless wof

Great and almost continual rains summer and harvest droughty clear not one drop of rain the whole harvest-(Short)

Drought all summer & 'harvest-tide' (London/South). booty

1567 Severe winter in England (bb)

Severe winter (London/South). [Is this 1566/67 or 1567/68? Most often, the year of a great winter is that in which January falls] booty

1567 Dry summer (London/South).

1568 Dry summer and very cold winter Baker

Hot (agc)

Excessively hot with drought (period not given, but presumably includes late spring & much of summer; London/South). booty

V cold in France (bb)

1568/9 A cold winter in western Europe / implied parts of Britain. (Easton, in CHMW/Lamb) booty

1569 Wet spring

Great floods-Walford

Heavy rain in Dec with north wind and sleet wof

1570 December-long lived snowfall until 1st Feb 1571 wof

Severe in England (bb)

A severe winter in western Europe / implied for parts of Britain. (Easton, in CHMW/Lamb) booty

1571 71/72 England v cold (bb)

Extremely intemperate with south wind rain and fogs winter following much moisture with rains or snow to mid feb, then intense cold with north wind . following spring summer and into harvest moist watery with south wind then winter with excessive rains and south wind daily until beginning of Jan 1574 (Short) (3 years?)

1572 Very cold winter, a great and sharp frost almost continual from feast of all saints til after feast of epiphany with sometimes deep and great snow and freezing rain with late spring Baker

Southerly, rainy cloudy harvest then a much wetter winter to middle of Feb with rain winds and snow Short

Neither frost nor snow all the winter for more than six days in all.'

72/73 England very cold (bb)

Hard frost from early November to about mid-January (London/South). [Also a cold winter much of western Europe.]
November 1st (C?) England - cold winter begins. Deep snows & freezing rains to January 6th (C?). booty

1573 Wet summer wof

The weather by Nov pleasant and fair, leaves on hawthorn and plum trees before Christmas wof

Drought common in 16th century wof

73/74 Very warm winter but other accounts say very cold in France (bb)

1574

1575 Cold (bb)

Nov winter early spring Europe - cold winter, Rhine frozen. Great snow until April.
[I've included this as it *might* imply that some part of Britain / the British Isles experienced cold weather too. At the very least, there would have been short-period incursions of bitterly cold air into the SE of England.] booty

1576

1577

1578/9 Summer of 1578 there was a drought that broke on 21 Sept wof

Winter short lived but sharp , snow 4-8 Feb thawed on 10 Feb but in May it was recorded 'that last winter has been very hard.' Wof

The writer noted '1st Nov of 'heavy snow and unusual cold such as has not been experienced for 60 years.' See Note 1

Cold (bb)

1579 Feb 10th(OSP): Thames flooded by melting snow, deposited fish in Westminster Hall.
14th(OSP): 4-day snowfall 14th to 18th(OSP) with N. wind, deep drifts: many people & cattle lost. Booty

May Snow 1 foot (~30cm) deep in London [location not specified, but 'London' was a relatively small area - compared to today] after 5-hour fall on the 4th (not clear if this is 'old-style' dating). Booty

Great floods from seas and rain in Sept and Oct (Walford)

Sept and Oct great winds and raging floods Baker

1580 Intense frost Baker

Frost very intense Lowe

1581 dry autumn

Droughest yeare any man living had known-noted on Dec 21st-(possibly short lived event?) Lowe

1582 Aug Severe thunderstorms & very "big" hail in Norfolk. booty

1583 Hot (agc)

Excessively hot dry summer Short

Jan 13th very remarkable wind that removed three acres of planted ground and took it hundreds of feet over a copse Baker

Drought, very hot / dry summer (London/South). booty

1584

1585 Mild winter (bb)

Neither frost nor snow all the winter for more than six days in all.'

1586 A cold winter over western Europe / implied for parts of Britain. (Easton, in CHMW/Lamb) booty

By nov 29th the rivers in Suffolk had frozen Lowe

1587 Very fine summer wof

Exceedingly cold and late spring, summer and harvest very backward, intensely cold Sept with north wind (Short)

Witchcraft accusations reach a height in 1587 and 1588-Fagan (witches often accused of meddling with weather)

Cold winter (bb)

1588 Spanish armada-cold and stormy July-seas so rough that sailors in Plymouth said they had 'never seen its equal in July' westerly and south westerly storms lasted much of Aug and Sept with the most severe tempest on 21st Sept -('Since records began')

1589 Cold winter (bb)

1590 Hot (agc)

Great drought-Short

1590 Thought to be the coldest decade of sixteenth century—Fagan poor harvest 1591 to 1597 (possibly 1591 or 1592)A dry year (London/South); Drought so great that horsemen could ride across the Thames at London Bridge. [see also below] booty

90/91 A cold winter in western Europe / implied for parts of Britain. (Easton, in CHMW/Lamb) booty

1591 (1591 or 1592) A drought so great that horsemen could ride across the Thames at/near London Bridge & the River Trent was also said to be almost DRY. These accounts would imply a dramatic lack of rainfall (and winter / early-spring snowfall), not only during this year, but for the previous year as well - hence the possible confusion over dates. Taken with the dry weather noted for earlier years (above), and the cold winter - it looks as if this period was often visited by anti-cyclonically-driven drought episodes. Booty

Uncommon drought in spring baker followed by strong westerly winds and little rain Baker

Spring drought in Notts followed by a summer with strong sw winds and little rain. Great drought on Thames that a man might ride over it on horseback at London bridge Lowe

1592 Severe winter-Baker

1593

1594/5 Wet & unseasonable summer - extensive flooding of fields etc., with loss / spoiling of crops across England: probably the year (1594) referred to in Wm. Shakespeare's "A Midsummer Night's Dream". (This latter was set in Ancient Greece, but it is obvious from the writing that the weather-type was influenced by events in 'middle - England'!) booty

Wretched summer-much rain and wind -Shakespeare wrote 'the ox hath therefore stretched his yoke'

http://nfs.sparknotes.com/msnd/page_38.html

Terrible harvest from 1584-7 Lamb chmw- citing Hoskins wheat survey

Cold from 2 Dec and Thames froze (until?) 5-7 march 1595 wof

A severe winter in western Europe / implied for parts of Britain. (Easton, in CHMW/Lamb) booty

Sea frozen from Marseilles to Venice Baker

Rain from early May to July Baker

Cold (bb)

May June and July much rain, but there followed a fair harvest but in Sept the rain came again (Walford)

1595 'Our years are turned upside down, our summers are no summers, our harvests are no harvests.' John King an Elizabethan preacher speaking in 1595

Neither frost nor snow all the winter for more than six days in all.'

1596 Deplorable bad weather owing to almost perpetual rain which caused a famine as stuff rotted wof

Mild winter (bb)

Philip Wyot wrote; 'in Devon-all this May has not been a dry day and night'-this caused a famine-Fagan

Floods all summer (Walford)

1597 Harvey's ague began in the fall of 1597, yet the years 1594 to 1597 had been so cold and wet that wheat harvests were a disaster (malaria)

1598 very fine summer wof

Great drought & very hot (summer?) (London/South). booty

Cold winter (bb)

1599 Nov floods Walford

March April May cold and dry . June and July hot and dry Short

1600 Cold (bb)

Sea surface Temperatures between Faroes and Ireland 5degrees C lower than today, start of trend- Lamb chmw

April 24th: A deep snowfall (no details as to location).booty

May cold and dry. Late cold spring. Short

Glaciers in alps advanced significantly between 1600 and 1610, again from 1690 to 1700 and around 1820 and 1850 Fagan (see 'Long slow thaw' for details of glacier advances and retreats)

1601 very fine summer wof

Four months drought. Spring and whole summer hot and moist with south wind (Short)

(Heavy rain seems to have been a characteristic of previous decade Short comments)

June floods wof

Late spring and all summer According to East Anglian & Low Countries chronicles, the period covering (roughly) April to August was very dry across these regions. This would imply a persistence of anti-cyclonic weather. (booty)

The month of June was very colde, frosts every morning" J Stow, J. *The Annales of England Increased and Continued Until This Present Yeare 1605* (London, 1605). (see Note 2)

The summer of 1601 was the coldest since 1400-fagan see Note 2

1601/2 Possibly a severe winter in Scotland, lasting from November to the end of April. Frequent heavy snowfall. [*If the winter was severe enough for comment in Scotland, then no doubt it was equally so across northern England & perhaps further south, but I have no data as to that. It is also interesting to speculate that given the anti-cyclonicity implied by the entry for late spring/all summer (above), and the requirement for at least some element of high pressure to the north or northeast of Britain for a notably cold winter, then this may be an exceptional spell of anti-cyclonically, blocked conditions for these longitudes.*]booty

1602 Spring very warm wof

Drought in autumn & winter (London/South). booty

1603 Oct –Lady Margaret Hoby said 'we had a second summer I think the like has seldom been seen.' wof

1604 Great drought and cold furs worn as late as 20 June. Another spell of very cold weather set in during the autumn followed by a cold spell (until Easter 1605?) wof

1605 Oct 30 Mary Coke writes of 'the foul and dirty weather' wof

1606/7 River frozen at Barnstaple wof

Neither frost nor snow all the winter for more than six days in all.'

Mild (bb)

Jan great floods Baker

1607 Unseasonably hot March wof

Extreme hot summer, many died with heat Baker

Hot summer agc

Dry/hot summer (London/South). booty

Very severe winter Baker

Lamb describes this winter in chmw as equally severe to 1683/4-the coldest in the instrumental record which in turn was as severe as 1708/9

Thames froze over by 12 Dec fairs were held on 'ice 5 foote thick-the severity of the weather was so great that many animals and birds perished' wof

Fires on ice on Thames in first week of Dec, great frost and snow from 5th Dec until 14 Feb 1608 enough to bear weight of man beast and laden cart Baker

Another account says 'was an extreme frost which began on 30 Nov (1607) and continued until lent-6 weeks it caused a great scarcity of water for cattle...many old people died.' wof

'Probably the most severe winter on record in W Europe.' wof

Cold bb great frost lasted 7 weeks plus 7 weeks of frost fair

The '**Great Winter**'**: apparently, trees died due to the severity (and length) of the frost; ships were stranded by ice several miles out into the North Sea - this latter a major concern as much commerce was done in these days via coastal shipping. In December, a "deep" frost until mid-month, then a thaw until just before Christmas, then from ~21st December(OSP) intense freeze for much of the time until at least mid-January. Ice formed on the Thames in London, sufficient to bear all sorts of sports, perambulations and even cooking! The frost lasted overall for some two months. (much of the foregoing from Ian Currie). The severe weather lasted in parts of England until about 20th February(OSP), though with variations in depth of cold. For example, in records from Kendal (Westmorland / Cumbria) 'hard frost' is noted from November 3rd, 1607 to March 6th, 1608(OSP).

The Firth of Forth is noted as being 'frozen' during January 1608 & the River Exe (south of Exeter) also experienced major ice formation by the latter-third of January - at this latter location, damage was caused to a local weir.

(* lots of winters will be found in the literature known as "The Great Winter": treat this title with some caution, however, in a series developed by C.Easton, in CHMW / Lamb, this ranks near the top of the most severe winters of the last 1000 yr.)

[This may have been the first occasion of the use of the term 'Frost Fair'] booty

Savage frosts split the trunks of many great trees in England-Fagan

A great froste and snowe which began the five day of Dec and so continued until the fourteenth day of February 1608 at which time all our rivers were frozen and would beare horse and man and cartes laden . Thames froze over and people walked from Southwark to Lambeth . River Ouse frozen at York Lowe

1608 Extreme sharp weather is said to 'have carried many off' wof

Walter Yonge wrote in March 'this winter last past hath been such an extreme winter for frosts as no man living ever doth remember or can speak of the like'. This cold weather seems to have continued as corn was in short supply by the extreme frosts 'as the like were never seen' wof

Hot summer agc

Frost very severe in Jan Thames froze. Baker

Very severe frost Lowe

Winter 08/9 mild in Europe wof

1609 Very severe beginning in Oct 4 months of frosts (bb)

Neither frost nor snow all the winter for more than six days in all.'

Moist rigorous hard frost from Dec to April. The Thames became a highway Short

Great frost commenced in October & lasted four months. Thames frozen and heavy carriages driven over it. (Possible confusion with 1607/08).booty

Drought and frost then flooding so by August the corn lay rotting in the fields (in Devon it was a good harvest) wof

1610 Excessive hot agc

Excessive hot dry summer. Great plenty of wine -Short

Hot, dry summer (London/South); from other records I have, there is mention of 'four months' of drought at Derby, so as might be expected, these hot, dry conditions extended across a greater part of southern & central England at least - more than that it would be wrong to assume. (booty)

1611 Feb to end of May drought then exceptionally wet conditions wof

Floods from rain Autumn, Nov and Dec Walford

11/12 Possibly a severe winter, at least for southern & central England.

*[It is interesting to speculate, given the entry below, that once again some long-lived anticyclonic activity was involved - see for example, 1601/02 above.]*booty

1612 Drought from January to May (London/South). The extended period of dry weather was apparently widespread over England at least, with that affecting the Lake District noted as not breaking until early August.

Overlapping with the entry above (q.v.), it was apparently a hot, dry summer over England at least. Booty

Great drought-Short

1613

1614/15 ' Jan 16 began the greatest snow which ever fell upon the earth with many memorye' lasted on and off until May also ten less snows in April some a foot deep though none continued long. Snow on mayday. Baker

At York in January began a heavy snow and eleven weeks frost followed by great flooding which destroyed many bridges Lowe

Drought followed the great flood and continued until Aug Lowe

1614 Hot dry summer following a very severe winter -Brooks and Glasspool

Frost broke around 10th March wof

The 1607 winter seems to have been equalled here between 10th Jan-7th March when there was serious flooding wof

It began to snow and freeze and on 16th Jan and so by intervals snowing without any thaw till the 7th of March at which time was such a heavy snow upon the earth as was not remembered by any man living.' wof

3 months of snow (bb)

Spring and summer Drought at York lasting from spring to August - severe shortage of fodder and grain. (booty)

Severe winter at Boston (eastern England) Lowe

1615 Lots of snow then great flood then drought until August Baker

Cold (bb)

Several reports of 'great snowfall' from various parts of the country; for example, from Derbyshire, a major snowfall began on the 20th January(OSP) and further new snowfall was noted until at least 12th March(OSP); great snowfall was also recorded across Yorkshire. Further north, in Scotland, this winter was noted as being of 'great severity' (Annals of Scottish History), & by February, the Tay was frozen over, such that foot and horse traffic could pass over it. An 'enormous' fall of snow took place early in March (place unspecified), but this ties in with the Derbyshire report [above]. In Scotland, this was stated to have lasted at least three days, to be the greatest 'within living memory' and many deaths (horses and men) occurred as people tried to move about. It was particularly bad across northern Scotland. Booty

Neither frost nor snow all the winter for more than six days in all.'

Jan 16 began the greatest snow which ever fell upon the earth in mans memory it covered the earth five quarters deep upon the playne and for heapes of snow they were very deep over gates hedges and walles . It fell at ten severall tymes and the last was the greatest . it continued by daily increasing until March 12th upon which day it began to decrease and so little by little consumed until May 28 and then all the drifts were consumed except one upon Kinder scout which lay until witson week Lowe

Great drought throughout Europe Lowe

Spring April was noted as being fair/dry with a dusty ground and significant drought (until late summer), then the melt-event probably followed the final snowfall in the second week of March. Booty

Extended dry conditions / notable drought across central & southern Britain - great stress due to lack of fodder, harvest etc; In Derbyshire (and almost certainly across a much wider area of Britain), noted as running from 25th March (Lady Day) to 4th August (both OSP). Great dearth of corn & hay. Booty

1616 Excessive hot agc

Excessively hot scorching and droughty summer Short

Hot summer with drought (London/South & almost certainly elsewhere across England). booty

Mild booty

Astounding drought until 30 Nov to 2 Feb following year when extreme rains 'so scarce one day fair in all that time' wof

1617 Extreme heat in July and Aug wof

From reports of shipwrecks, wet weather & floods, it appears that the summer of 1617 was notably unsettled. wof

16th August 'so verie hott' that James first had to cease hunting wof

1618/19 Cold (bb)

Late hay harvest carried until 22 august wof

1619 Mild (bb)

1620 Possibly a very wet summer. booty

1620/21 Frost fair Baker

Thirteen days snow known as 'thirteen days drift' in Scotland Lowe

Very severe (bb)

Frost fair held on the Thames. A severe winter over western Europe / implied much of Britain. (Easton, in CHMW/Lamb) booty

1621 frosty may, summer wet and cold mwh

Frost in May. The summer had been very wet and cool-harvest did not end until Nov even in Devon (generally considered the warmest part of the country) wof

summer and autumn Noted as being 'very dry' in eastern Scotland, but 'very cold & wet' further south. However, through the autumn, particularly around 'harvest-tide', all contemporary records note a lot of rain, with a poor crop for the winter. It would not be unusual for eastern Scotland to have a distinctly different rainfall regime from elsewhere, so on balance I suspect that the rainfall was the dominant weather type for a lot of Britain in this period. booty

15th Dec very sharp snap in London water around London were frozen which lasted some weeks wof

Very severe (bb)

1622 Although mixed data, it looks as if the late spring & much of the summer across Britain, but especially across Scotland & the north of England, was 'inclement', such that the harvest was poor: in Scotland in particular, the harvest was stated to be 'catastrophic'. Reports suggest that the poor weather was primarily due to excessive rainfall (see also the previous summer above). [Reports from the winter, spring & early summer of 1622/1623 state that there was great distress in the population of Scotland, with death-rates much higher than normal; this was stated to be due to the famine prevalent following the poor harvest noted above, and presumably the fact that this was

Neither frost nor snow all the winter for more than six days in all.'

(at least) the second very poor year in a row had a lot to do with the lack of produce etc.]

August 18th(C?) - An "extreme & vehement" storm struck the Tamar Valley. (Devon Co. C web site)

[No other details, i.e. thunderstorm, wind-storm etc., so it is difficult to decide the character of this: it may be akin to the Boscastle storm of 2004 August q.v., given the topography of the areas which drain into the Tamar valley.]booty

All the rivers in Europe froze Baker

All the rivers of Europe frozen and also the Zyder Zee (Holland) Lowe

Poor harvest caused a famine wof

Summer excessive wet and moist wof

1622/3 Jan very severe (bb)

22/3 Cold (bb)

1623 Summer At Oxford & other places in the south of England (e.g. Bath, Bristol), the summer was noted as hot & dry. booty

Poor harvest again caused a famine

Last widespread famine in southern England-Fagan (Note this was presumably due to a severe drought rather than excessive wet or cool weather)

1624 Summer unusually hot and dry wof

Hot, dry summer Nottinghamshire & Derbyshire (at least, and presumably further afield across lowland central & southern England). (booty)

1625 Spring unseasonably warm-wet summer wof

Possibly a wet summer, at least over England & Scotland; in Scotland, it was noted that the 'rains' had been heavy/persistent since the middle of May. (booty)

12 June ceaseless rain fell for a month. wof

Evidence of severe snow in Devon in Nov but no other records. wof

A severe winter (Baker)

Very cold (bb)

A severe winter followed the infectious summer Lowe

1626 Wet spring, June and July extreme wet and unseasonable but good August making harvest best for 7 years wof

Dry, hot summer (London/South). Booty

Summer excessive hot like that of 1616, Nov excessive cold. Dec mild soft warm weather like a fine spring (Short)

1627 Possibly a wet late spring & summer - at least in Scotland. booty

1628 Spring and summer wondrous cold and wette with many frosts' wof

1629 Spring and summer Possibly a wet period, sufficient to cause much shortage of foodstuffs produced from the land. (booty)

1630 Series of dry / warm summers, particularly 1632 1636, 1637 & (perhaps) 1638; for 1636, in the London/SE area, it is noted as a "very hot & dry summer, not a drop of rain from March to August". (booty)

Very dry summer (Baker)

1631 London-Earl of Exeter wrote 'on 23 June 'we have a heate here that make us believe we are either in Spaine or Italie' wof

1632 Hot summer (Baker)

Neither frost nor snow all the winter for more than six days in all.'

Autumn and early winter Possibly a notably wet period, ending with a frost. booty

1632/3 Thames nearly froze over on 11 Feb wof

1633 Autumn and early winter another wet period. There are notes that this year saw a major failure of the harvest in places - so perhaps 1632 & 1633 stand out from the generally benign/excellent spell noted against the entry for 1630-1637 summers [above]. Booty

Possibly one of the stormiest (& coldest) in Scotland, with snow in the fields lying from December to March 33/34

Wet august wof

1634 A cold, dry spring, no doubt due to persistently anti-cyclonic conditions with a bias to E/NE winds: during April & May no rain for seven weeks. [But note that areas so affected not clearly specified.] booty

Very hot summer wof

The summer was reported to be 'fine' and early autumn / harvest-time also proved benign; it appears that these 'fine' conditions were confined to the southern parts of Britain (see below). booty

Thames froze (Baker)

1634/5 Heavy snow in Cheshire in Jan 'such as no man then living could remember,' lasted until mid March. Also said to be very wintry in London at times according to a winter service given at St Pauls wof

Severe winter; Thames frozen. Depending upon dating practice, there are other reports from the time that suggest that this winter (1634 / 1635) was widely cold/snowy. In parts of England, a frost lasted from the 15th December 1634(OSP) until 11th February 1635(OSP), with frequent snowfall. In Scotland, a lot of snow and great depth of frost noted, with the snow lying in places from the 9th December(OSP) to the 9th March(OSP). Particularly snowy (and probably with significant blizzard conditions at times) between 26th January(OSP) & the 16th February(OSP) at Perth. The river Tay was frozen over. Significant hardship. booty

Severe frost (bb)

1635 Very fine summer -'very hot weather from March to July wof

A mild but wet autumn with heavy rains and several reports of flooding. (Location/s not known) booty

Uncommonly warm winter (bb)

Winter temperate and mild neither dry nor wet (Short)

March to July no rain at all -wof

1636 Again mention of very hot weather from March to July wof

Extremely dry wof

Extremely dry Baker

Very dry wof

A very forward spring (Baker) (noted as in Derby by Lowe)

Extended dry / drought period began 1st March 1636: by September, serious drought effects. Noted as completely rain-less in 'London Weather' from March to August. [see also entry below which overlaps.] booty

Possibly a warm year overall, with a 'forward spring' & 'very hot' summer; there are also references to it being 'extremely dry' [probably only applies to southern & central England though]. Specifically, a drought was noted as having lasted from 1st March to well into September, with sources noting 'completely rainless' conditions. Trees by August were as if it were mid-winter, given the loss of leaves. booty

Winter of 1636 uncommonly and unfathomably warm the summer as hot and droughty as 1635 wind from spring to winter south or west from March to Aug not one drop of rain (Short) This probably puts a time limit on Pepys comment from 1660

1636/7/8 Three successive fine summers (possibly): see also entry Mar-Sep 1636 above. booty

Neither frost nor snow all the winter for more than six days in all.'

36/37 Warm winter bb

1637 Very exceptional (hot) weather wof

Extreme hot times' at harvest wof

Hot and dry agc

1638 Very exceptional (hot) weather mwh

This summer and 1637 excessive hot and dry Short

Wet spring then hot with very good Oct, 'the warm years had passed however' wof

Hot and dry agc

1639/40 Thames frozen –ox roasted on the ice Jan and Feb wof

Great floods in Oct (Walford)

1640 From several reports throughout the year from widely dispersed parts of Britain, it seems as if this year was WET with frequent flooding. At Tewkesbury (Gloucestershire) for example, where flooding is not unknown even today, there were at least eight floods between Midsummer (24th June) and Michaelmas (29th September). August is specifically mentioned as having heavy rain in the NE England/SE Scotland area. Similarly, October was so plagued across Yorkshire & the NE of England.

[It may also have been cold/snowy at the start as well, but there is the usual ambiguity about whether the reports belong to this year or to 1641.] booty

cold (bb)

Springs did not break until after Christmas Baker

1641 Ducklington (Oxfordshire) 'harvest weather' was hot & dry from June until 17th September. No water in springs and grass withered. [sounds like a significant drought.] booty

Heavy snow in Yorkshire Nov 1640 to Feb 1641 wof

1642 October unusual frosts-autumn was inclement and wintry wof

Wet in July and Aug and Sept wof

1642/3 Winter very cold wof

1643 April very hot wof

Spring almost constant rains, summer excessive hot Short

Excessively hot dry summer agc

Bitterly cold and foggy for much of Nov wof

December was very cold wof

Hot summer (London / South). Some suggestion that the fine / dry weather extended to Scotland (Edinburgh) as well - which would be logical. Booty

43/44 Contemporary reports of this being a cold winter - presumably colder than 'normal' if such remarks are made. January in particular is noted in several accounts as being cold/snowy and in January 1644: 8-day snowfall 31st January to 7th February(OSP). Booty

Much rain Aug-Oct wof

1644 Jan much snow wof

March heavy snow fall wof

Excessively hot dry summer agc

Neither frost nor snow all the winter for more than six days in all.'

Frost and snow in Oct wof

December cold wof

Cold (bb)

1645

1642 -1651 English civil war-many records of the weather

Feb extreme cold Baker

The air very warme several birds in their flight over Leeds drooped dead (Baker) no month specified

Excessive hot and dry summer- Short

Excessively hot dry summer agc

Hot / dry summer (London/South). booty

Dec 'new moone, it began to freeze and so continued exceeding violent,' (it froze until Jan 28 1646) wof

V cold (bb)

Between 1645 and 1708 no aurora was observed in Londons skies –very frequent references prior to this-Fagan

1646 Excessively hot (Baker)

Excessively hot-great heat Lowe

Autumn ' a marvellous wet season 15th Sept continued into Oct wof

Rain stopped on 12 Nov with a first frost wof

Oct/Nov From several reports during these two months (e.g., heavy, persistent rain in Essex in October, major flooding in Norwich in November & parliamentary reports of rain/floods in early December), this autumn may have been excessively wet. booty

1647 Jan extreme frost and snow in S Yorkshire-probably local wof

Aug and Oct fine wof

47/8 Mild winter (bb)

1647/8 'this was a most exceedingly wet year neither frost nor snow all winter for more than six days in all' Evelyns diary-(Walford)

48 Very wet, but probably not as wet as 1258 & 1527. The summer in particular was described as worse than several of the past winters (i.e. 'cold & wet').booty

Inequality of seasons has been uniform the last two years mostly southerly windy cold rainy and floody Short

Exceedingly wet summer, exceeding wet year neither frost nor snow all the winter for more than six days in all (Baker)

June July very wet 'such a wet time of the yeare hath not been seene in the memory of man.' Wrote Capt birch on 8July 1647 rest of summer the same wof

28th August 1648 the 10 week siege of Colchester ended the whole period accompanied with 'the most excessive rains floods and dismal weather. Wof

Whole of 1648 said to be a most exceeding wet year wof

1648 /9 Half a dozen days of snow and ice wof

48/9 Great frost; Thames frozen. Booty

Thames frozen Baker

Neither frost nor snow all the winter for more than six days in all.'

'Jan, dry open and warm and free from winde, roses leaves out and fruit trees beginning to shoote out' wof

Very mild winter but wet Baker

Very cold (bb) (Probably referring to December)

May hot and fine wof

1649 Thames froze (Baker)

Great frost in Jan-Thames froze over. Now was the Thames froze over with horrid tempests of wind' according to Evelyn-on 22 Jan Lowe

Apparently a famine this year in the north of England & Scotland because of the impact of rains (and war). Generally a 'poor' year with the weather impacting upon agriculture: cold/dry spring after severe winter (see above) & periods of heavy rain. booty

1650 A wet year hay harvest delayed early autumn crops ruined by steady rain which by Nov resulted in floods wof

1651 Scorching hot summer and dry agc

Four successive fine (i.e. often dry / hot) summers but that of 1651 appears to have been 'fine' only across England; Scotland though is specifically included for the other years in the various chronicles. 1651 in particular across England (only?) was noted as being dry with a 'scorching' summer - a 'great' drought with excessive heat. Kent is specifically mentioned (continental influence). It may be that only the southern half of Britain was so favoured, as there are notes that in Scotland, this year (1651) was subject to even 'greater dearth' than the preceding year. In 1652, the summer of this year was noted for 'extraordinary drought' across the whole of Scotland, with high temperatures and little rain - great impact upon agricultural production, both good and bad; in England, 1652 saw a good harvest, particularly as regards fruit. The summer of 1653 was also described as being one of 'great drought & excessive heat' across England. From October 1653 until 21st March 1654 (i.e. across nearly the entire 'winter-half' of the year), the weather was apparently benign, mild & dry; likened to a 'second summer'. In Scotland, the extended winter period 1653-1654 was notably dry, which of course would have been a disaster for autumn/winter-sown crops. The summer of 1654 was 'dry & scorching'. Although drought would have impacted on some arable crops (and farm animals depending upon the feed), other agriculture, such as fruit growers, had a bumper harvest during 1654. From Edinburgh & Fife, great lack of water (wells drying up), with lesser problems in the west. booty

1652 Jan long hard frost Baker

Very warm summer drought of nearly four months by May 25th when there was a tempest warmth very great summer being driest ever known in Scotland Baker

Very great warmth. Summer driest ever known in Scotland Lowe

Summer excessive hot and dry 1651 52 53 54 all great drought and excessive heat in England Short

June hot wof

Scorching hot summer and dry agc

Frosty in Dec between Oxford and London wof

1653 Scorching hot summer and dry agc

1654 July 'extremity of heate at Deptford but very bad August' wof

Scorching hot summer and very dry agc (presumably June and July but deteriorated in August)

1655 Substantial frost-little snow wof

Very cold (bb)

During August & September, it seems from contemporary reports that it was unusually stormy, at least around southern British waters, specifically along the English Channel & Dover Strait. There are also reports inland of frequent 'foul' weather and much rain. Booty

Harvest season ruined by rain which delayed it until mid oct wof

55/6 A cold winter in western Europe / implied for much of Britain. (Easton, in CHMW/Lamb).booty

1656 7 July 'weather was so excessive hot and dusty that he aborted his journey wof

Neither frost nor snow all the winter for more than six days in all.'

Jan great frost May day hills white with snow; July excessive hot and dusty wof

1657 Similarly, in 1657 to 1658, snow lay on the ground for 102 days—indicating exceptionally cold weather even for the times. The summer crops were a disaster, Defoe and Malaria Severe throughout Britain from 28th Jan until 7th March when Evelyn wrote 'this has to be the severest winter that any man alive had known in England) wof

In Dec it was equally cold in London and Cambridge wof

Seine froze Baker

Cold bb

Summer scorching hot and dry agc (note a blocking high bringing extreme cold in winter if it remained in place would bring a hot summer if wind was from east)

Summer Some notably hot & humid weather over England - noted as beginning from last third of June (C?), but no other details. From Scotland, it was noted as being 'exceedingly pleasant and early' and hot/dry, with a good harvest. It may also have been a dry year over England, but no details on this. Booty

1657 11th December 1657: Beginning of one of the longest periods of snow lying in England, lasting (reputedly) until 21st March 1658. A notably severe winter over western Europe & much of Britain (Easton in CHMW/Lamb). In some parts of England, the frost lasted from 1st December (OSP) to 10th March (OSP). Ice was reported around coasts of SE England. In Scotland, the winter was also 'seasonably severe', but the cold lingered through March into April, with frequent wind from the east or NE. [see also entry below re: June.] booty

1658 Similarly, in 1657 to 1658, snow lay on the ground for 102 days—indicating exceptionally cold weather even for the times. The summer crops were a disaster. Oliver Cromwell (1599-1658)died of a tertian ague in September 1658, just as another severe winter was setting in. (malaria)

March 7th severest winter any man alive had known Baker (refers to 1657/8)

In 1657 to 1658, snow lay on the ground for 102 days—indicating exceptionally cold weather even for the times. Records for central England from 1670 to 1700 suggest that snow lay on the ground for an average of 20 to 30 days (in some years more than 100 days) Lamb chmw Northerly wind for 6 months Baker

Excessively cold Lowe

Cromwell died in a tempest (Baker)

June A cold month - likened at the time to a 'winter' month. (booty)

June a season as cold as winter Baker

As the last summer was remarkably and excessively hot the following winter was severely cold from Dec 1st to equinox earth covered in snow not wind continual and continued till June which was like winter. Winter was uncommonly healthy (Short)

58/9 Mild (bb)

Possibly a very mild (and perhaps windy?) winter across England. Some reports suggest that January in particular was stormy, which would tie in with a highly zonal type, enhanced westerly jetstream and frequent cyclonic disturbances moving in off the North Atlantic. Booty

S Clarke observations of the weather from 1657 to 1686 communicated to the Royal Society in 1699

1658 Jan 1 frost begun Feb 2 much snow Feb 26 snow ended may plenty of rain at end of month June showers Aug much rain on 29th Sept lots of rain Nov rain then snow on 22 sharp frost on 23/24 then rain and snow to end of month

Dec 1st Much snow sharp frost then by 12th much rain lasted on and off to end of month

Neither frost nor snow all the winter for more than six days in all.'

1659 Jan much rain for most of month with several days of strong winds Feb started wet but by 5th had become very dry for rest of month, March strangely calme and drye all month, May was dry, June a miserably dry month. July much rain with thunder. Aug lots of rain. Sept much rain, some excessive a very wet month. Oct a temperate month. Nov, first half wet with much snow on 4th but then seasonable Dec much snow and frost from start until 19th then started again to end of month (note the use of 'seasonable' suggesting that snow had once again become the norm in December).

Ends-----

59 Aug and Sept Possibly highly unsettled (i.e. cyclonic) with frequent spells of high winds, heavy rain & flooding across Scotland (and almost certainly other areas of Britain). The period 1st to 4th September (OSP) in particular is noted as one where areas adjacent to the Firth of Forth were subjected to dramatic & damaging storms. There are also reports of flooding & damaging winds from England - for example, in September, the marshy areas of Lincolnshire were inundated by flood waters. booty

1659 /60 Great frost for much of January in London wof

Feb was wet as was March wet lasted until mid April wof

May was fine (note; There seems to have been very notable periods of rain during the past 10 or 20 years)

Very cold winter Baker

Very cold Lowe

Note; the CET instrumental record begins in 1659-additional observations have been supplied for the period following, and records up to 1738 were examined in order to see the developing context of the earlier period-prior 1660 seems to be colder than post 1660 (but hotter summers?) Certainly very variable with cold juxtaposed to hot and extreme rain/snow events plus great winds.

1660 **"It is strange what weather we have had all this winter; no cold at all; but the ways are dusty, and the flyes fly up and down, and the rose-bushes are full of leaves, such a time of the year as was never known in this world before here."** p

Pepys 21 Jan 1660/1 (Probably the mildest winter since 1636)

Seasonable spring free from sharp east winds very cold winter Baker

May most glorious weather wof

Nov/Dec Significant flooding is recorded in the Thames Valley on the 11th November(OS); taken together with the entry below (re: winter warmth), this implies a markedly zonal type (or high NAOI), with the associated mean jet translated far enough south to propel cyclonic disturbances across southern Britain in quick succession.

Based on contemporary reports from London [Pepys], Yorkshire & Edinburgh, it seems as if the month of December 1660 was often windy/stormy; [this unsettled/zonal weather possibly extended into early January 1661, which would tie in with the remarks at note above]. In particular, around the 8th December(OSP), from late afternoon through the night, high winds caused considerable damage to thatch, windmills, trees etc., across the north of England at least.booty

60/61 Mild winter - using the (early) CET record (nearest whole degC only), the average comes out at 5degC, or roughly one-and-a-quarter C above the all-series mean. Pepys mentions in late January that there had been a general lack of cold weather, and that it was 'dusty' (implying a warm & dry winter), with plants well ahead for the season. However, to counter that statement, there are reports elsewhere at the time of 'high winds, excessive rainfall & flooding'. The two 'types' aren't mutually exclusive though because it could mean that the southeast / London was subject to broadly above-average pressure and small amounts of rain, whilst stormy, wet spells affected the more 'Atlantic' facing regions north & west. (booty)

1661-Summer remarkably dry and remarkably warm (also made some comment for 1665 and 1666

1661/2 Jan 15th Pepys noted 'it having hitherto been summer weather-just as if it were the middle of May or June'

1662 Pepys 'found the tops of the houses covered in snow which is a rare sight that I have not seen these 3 years' in Dec Evelyn noted the new sport of skating. Thames froze cold weather lasted with some thaws until 13 Feb

1663 Last half of March very cold also very cold in April but no real winter like last year Pepys

1663/4 no winter worth recording wof

1664 16 th May excessive hot the chronicler Wood says' the like hath not being knowne in the memory of man for at least 60 years wof

Neither frost nor snow all the winter for more than six days in all.'

London 22 Dec until well into March very cold wof

1665 6th Feb 'one of the coldest days all say they ever felt in England,' said Pepys

Reputedly coldest ever in England (bb)

1665/6 Very short winter wof

1666 From Christmas until 9th Jan very cold but from then until 24th Feb it was misty and warm summer weather' then bitter cold until 6th march ' the king saying today it was the coldest he had ever known in England . another worthy remarked such weather at this time of the year will not be remembered by man. Still very cold in April until 4th when temperature became normal wof

1667/8 Nov saw snow for some days in Henley and Oxford wof

Note 1; Bearing in mind the Brugel paintings of 1565 showing a severe winter we must assume the combination of cold was earlier in the year than previously seen.

Note 2 See year 1601 ref-Stow, J. *The Annales of England Increased and Continued Until This Present Yeare 1605* (London, 1605). 'the month of June was very colde, frosts every morning" This account came from 'Nature' 1998 firmly identified as being due to a volcanic eruption.

<http://www.dartmouth.edu/~ears5/handouts/volcano.pdf>

"Patterns of tree growth across the Northern Hemisphere, analysed by Briffa *et al.*, confirm that the summer of 1601 was by far the coldest of the past 600 years, and about 0.8 7C cooler than the summer mean for the period 1881–1960." This comment repeated by Fagan in his book. Also noted by the Washington Post

Stowe frequently revised his chronicles. The British museum has a copy of his 1604-not 1605 version
<http://www.british-history.ac.uk/report.aspx?compid=60010>

Cold June nights are not uncommon when associated with fine clear anti-cyclonic weather. Other reliable pre 1998 chroniclers suggest the summer was fine and the winter nothing exceptional. The analysis was from tree rings and whilst post 1998 articles frequently refer to this extreme cold event, pre 1998 papers do not. The assertion is probably incorrect.

Note 3 Whittlecraft in his book '**Rural gleanings**' dated 1851 observes that our milder winters (during the period he wrote about) are almost all of them wetter than the colder ones, for warmer winds from South and West bring most rain and the opposite winds are dry and cold (we can see this very well in the records) the observations would be very familiar to a modern day person especially after the last few severe winters. The winters around 1851 were seen as exceptional and very cold and not the norm by that date. The author talks of summers of 1818 (two years after the 'year without a summer') 1826 1846 and 1847 as seen as being unequalled since 1780, but all are outside of our period of study. He wrote when referring to matters of farming trade or science-'and our records of daily things should be such as to be read by all and clearly understood by all kept in a plain manner without technical terms and not as we see them stuck in periodicals so as to interest only those who sent them.'

Note 4 Whilst outside of our period of study it is interesting to notes that in 1780 the **Societas Meteorological Palatine** of Mannheim, a standardised network of 40 observing stations, was set up in Germany and other European countries and a small number in the USA, all equipped with comparable instrumentation with standard instructions for use. This came to an end in 1795 with the siege and capture of Mannheim.

Note 5 In 1657 to 1658, snow lay on the ground for 102 days—indicating exceptionally cold weather even for the times.

Records for central England from 1670 to 1700 suggest that snow lay on the ground for an average of 20 to 30 days (in some years more than 100 days) as opposed to 2 to 10 days in the present century. In the winter 1683-84, the ground was frozen to more than 1 m. Belts of sea ice 5 km wide were present along the coast in the English Channel and are believed to have been 30 to 40 km wide off the coast of the Netherlands. The average summer growing season was approximately 5 weeks shorter than in the 20th century, and in some years the difference may have been more than 2 months (1). (all above from Lamb climate history and modern world)

Section 3 Calculation of temperature for reconstruction

The mean average temperature or each year has been calculated as follows. Where no information-or too little information- was available, an 'average' for that period has been calculated (which has been amended as trends emerged). Some notably cold winters were balanced by exceptionally hot summers so mean averages for some of the frost fair years, for example, are not as cold as may be expected. Subject to revision as new evidence is found.

Neither frost nor snow all the winter for more than six days in all.'

1538 10.30C 1539 10.30C 1540 10.50C (would have been even hotter if it were not for the cold winter)

1541 10.20C 1542 9.70C 1543 9.50C 1544 9.50C 1545 9.20C 1546 10.00C 1547 9.90C 1548 9.50C

1549 9.50c 1550 9.50c 1551 9.40c 1552 9.51c 1553 9.50c 1554 9.00c 1555 9.40c 1556 9.60c

1557 9.40c 1558 9.70c 1559 9.40c 1560 9.30c 1561 9.00c 1562 8.80c 1563 9.30c 1564 8.00c

1565 8.30c 1566 9.20c 1567 8.80c 1568 8.80c 1569 8.70c 1570 8.60c 1571 8.80c 1572 8.50c

1573 9.50c 1574 9.40c 1575 8.90 1576 9.10c 1577 9.10c 1578 8.90c 1579 8.90c 1580 9.00c

1581 9.10c 1582 9.10c 1583 9.40c 1584 9.10c 1585 9.40c 1586 8.90c 1587 9.00c 1588 9.10c

1589 9.00c 1590 8.90c 1591 8.90c 1592 8.80c 1593 9.10c 1594 8.20c 1595 8.90c 1596 9.10c

1597 9.10c 1598 9.30c 1599 9.30c 1600 8.90c 1601 9.00c 1602 9.20c 1603 9.20c 1604 8.80c

1605 8.90c 1606 8.90c 1607 9.60c year was very warm until December. 1608 7.80c 1609 8.00c

1610 9.30c 1611 9.10c 1612 9.10c 1613 9.10c 1614 8.70c 1615 8.70c 1616 10.20c 1617 10.20c

1618 9.10c 1619 9.10c 1620 8.40c 1621 7.90c 1622 8.20c 1623 8.90c 1624 9.80c 1625 9.50c

1626 10.10c 1627 9.10c 1628 9.90c 1629 9.10c 1630 9.10c 1631 10.10c 1632 10.00c 1633 8.90c

1634 9.90c 1635 10.20c 1636 10.40c 1637 10.20c 1638 10.30c 1639 8.80c 1640 9.10c 1641 9.30c

1642 8.90c 1643 9.20c 1644 8.80c 1645 10.20c 1646 9.80c 1647 9.10c 1648 9.50c 1649 9.40c

1650 9.10c 1651 10.10c 1652 10.20c 1653 10.30c 1654 10.30c 1655 9.10c 1656 8.90c 1657 8.60c

1658 8.50c Note Instrumental record starts. Following for comparison purposes only 1659 8.83c

1660 9.08c 1661 9.75c 1662 9.50c 1663 8.58c 1664 9.33c 1665 8.25c 1666 9.83c

Section 4 Source/author used in 'supplementary information'

Was it wet or fine by Reginald Jeffrey volume 1 and 2 Very detailed accounts of thousands of observations drawn from hundreds of journals records and diaries until 1768

Original weather diary from Rutland of 1736 and 1737

The original Stroud diary (4 volumes) of Thomas Hughes 1771-1813/9 plus articles on it

Articles by Gordon Manley on the mean temp of England 1659 to 1973 printed 1974 and 1698-1952 printed 1953 plus associated article 'in the beginning- a historical review of Wmo'

Rural gleanings by O Whistlecraft 1851 which gave observations on the climate and of each month.

The second year of prodigies 1662

Famines of the world past and present by C Walford

Records of seasons TH Baker vol 1 1883 and vol 2 1911

Miscellanea curiosa 1707-royal society

A general chronological history of the air weather seasons meteors London 1749-Short vol 1 and 2 (Referenced as AGC)

J Loudon Met journal, J Ruttly and I Butler a monthly register of seasons in Dublin plus J Ryle memo relating to the state of the weather original hand written around 1839 all within same package

Neither frost nor snow all the winter for more than six days in all.'

Italian journal by F Bonaventura for the period 1591-97

Weather foreknowledge by R Inwards about 1875 Including letter from Met office dated 1889

The earliest known journal of the weather compiled by the Rev William Merle in 1891 covering the period 1337-1344

Pre instrumental Meteorology 85AD to 1582 AD by E A Ormerod around 1878 all hand written. Seems to be the source of many of the other chroniclers looking at this period) Worthy of re-examination

Record of the seasons-hand written by Baker in 11 volumes –these seem to be the basis of his published book 1240 onwards must be much more than in his printed two volumes. Worthy of re-examination.

E L Hawke, Summaries of a diary of the weather Nov 11 1668 to 31 Dec 1689 3 volumes hand written

G Shepherd The Climate of England 1656 to 1861 printed 1861

J Cadbury A diary of the weather 1668 to 1689

Royal Society 1880 'philosophical transactions' mainly 18th century Meteorological observations

S Clarke Observations of the weather from 1657 to 1686 communicated to the Royal Society in 1699

J Locke weather diary 1682-1703

The English climate Hubert Lamb

London Weather J H Brazell 1968 1698 reputed to be coldest year between 1695 and 1742 cool summers 1687 1694 and 1695

British Floods and drought - Brooks and Glasspool 1928

Natural phenomena chronology of the seasons 1870 Lowe. Worth reading again

This Shrinking Land by Professor Robert Duck 2011

Since records began by Paul Simons

Historic storms of the North Sea, British isles and Northwest Europe Hubert Lamb

Climate History and the Modern World Hubert Lamb

The Little Ice Age Brian Fagan

Weather Handbook Maria Constantino

Historical geography of Europe, 1500-1840 By Norman John Greville Pounds

Climate of Europe, past, present, and future: natural and man-induced ... By Hermann Flohn, Roberto Fantechi, Commission of the European Communities

Chill-Peter Taylor

Chambers book of days

<http://www.thebookofdays.com/months/march/14.htm>

Section 5 Material from references and links used in the article 'The Long slow thaw' repeated here.

(Link to long slow thaw;)

A short anthology of changing climate;

<http://wattsupwiththat.com/2011/11/01/a-short-anthology-of-changing-climate/>

Neither frost nor snow all the winter for more than six days in all.'

References used in 'The Long Slow Thaw.'

- (1) <http://www.cru.uea.ac.uk/cru/people/lamb/>
- (2) <http://www.met.psu.edu/people/mem45>
- (3) <http://www.sciencedirect.com/science/article/pii/S0031018265900040>
- (4) <http://climateaudit.org/2008/05/09/where-did-ipcc-1990-figure-7c-come-from-httpwwwclimateauditorgp3072previewtrue/>
- (5) http://www.astro.uu.nl/~werkhnv/study/Y3_05_06/data/talk/14-juni/mannetal1998.pdf
- (6) <http://holocene.meteo.psu.edu/shared/articles/MBH1999.pdf>
- (7) http://www.grida.no/publications/other/ipcc_tar/?src=/climate/ipcc_tar/wg1/069.htm#fig220
- (8) http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/Surface_Temps_final.pdf

- (9) http://www.ipcc.ch/publications_and_data/ar4/wg1/en/figure-ts-20.html
- (10) <http://holocene.meteo.psu.edu/shared/articles/medclimopt.pdf>
- (11) <http://www.nature.com/nature/journal/v392/n6678/extref/392779A0.Data.html>
- (12) <http://webarchive.nationalarchives.gov.uk/+http://www.metoffice.gov.uk/climatechange/policymakers/policy/slowdown.html>
- (13) <http://wattsupwiththat.com/2011/11/01/a-short-anthology-of-changing-climate/>
- (14) <http://en.wikipedia.org/wiki/Neoglaciation>
- (15) <http://www.rmets.org/pdf/QJ53manley.pdf> *
- (16) <http://www.rmets.org/pdf/qj74manley.pdf>
- (17) <http://wattsupwiththat.com/2011/05/23/little-ice-age-thermometers-%E2%80%93-history-and-reliability-2/>
- (18) <http://www.21stcenturysciencetech.com/Articles%202005/NoGlobalWarm.pdf>
- (19) <http://diggingintheclay.wordpress.com/2010/09/01/in-search-of-cooling-trends/>
- (20) http://berkeleyearth.org/Resources/Berkeley_Earth_Summary_20_Oct
- (21) http://cdiac.ornl.gov/ftp/ndp030/global.1751_2008.ems
- (22) <http://www.pepysdiary.com/about/history/1660/>
- (23) <http://www.pnas.org/content/104/49/19214.full>
- (24) <http://coast.gkss.de/staff/storch/pdf/lmm.kihz.summary.pdf>
- (25) <http://www.tmgnow.com/repository/solar/lassen1.html>
- (26) http://books.google.co.uk/books?id=FNhd_sTwTkwC&pg=PA189&lpg=PA189&dq=cet+good+proxy+for+northern+hemisphre&source=bl&ots=6XB1V7u3h&sig=nib0OGq5Mp4MB8ESP7-eDQf5TM&hl=en&ei=UiyxTuz4O4Og-Abl8NSmAg&sa=X&oi=book_result&ct=result&resnum=9&ved=0CGMQ6AEwCA#v=onepage&q&f=false
- (27) <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627969/pdf/10653562.pdf>
- (28) http://www.google.co.uk/imgres?imgurl=http://www.nancyhunting.net/hunters.jpg&imgrefurl=http://www.nancyhunting.net/Bruegel-Talk.html&h=368&w=500&sz=72&tbnid=o_0huYiLyPfeM:&tbnh=90&tbnw=122&prev=/search%3Fq%3Dhunters%2Bin%2Bthe%2Bsnow%26tbm%3Disch%26tbo%3Du&zoom=1&q=hunters+in+the+snow&docid=q1gMDYih1vb4AM&hl=en&sa=X&ei=pNSyTq63MMOF-waZ49zPAw&ved=0CC8Q9QEWaAQ&dur=592

Neither frost nor snow all the winter for more than six days in all.'

(29) <http://home.uchicago.edu/eoster/witchech.pdf>

(29a)

http://books.google.ch/books?id=LUncBn_pF7UC&pg=PA94&lpg=PA94&dq=30+years+war+cold+winters&source=bl&ots=Q55qYHCeyq&sig=or1yhBpSm40x8rApYCeVJlMg8fk&hl=de&ei=cVC-TqqBBM7LtAavsMn2Ag&sa=X&oi=book

(30) <http://www.iberianature.com/material/iceage.html>

(30a) http://www.volker-doormann.org/images/ghi4_vs_patzelt_dsh1.jpg

(30b) http://www.waldwissen.net/waldwirtschaft/waldbau/bergwald/bfw_klima_waldgrenze/index_EN

(30c)

http://www.alpenverein.at/portal/Home/Downloads/Bergauf_2_08/Gletscherschwund.pdf

(31) http://www2.sunysuffolk.edu/mandias/lia/little_ice_age.html

(32) <http://www.sciencedirect.com/science/article/pii/S0031018209001345>

(33) <http://www.nps.gov/glba/naturescience/glaciers.htm>

(34) <http://academic.emporia.edu/aberjame/ice/lec19/holocene.htm>

(35) <http://www.springerlink.com/content/n161427g860g63n3/>

(36) http://arxiv.org/PS_cache/arxiv/pdf/1110/1110.1841v1.pdf

(36a)

http://books.google.co.uk/books?id=QgocnouWFnoC&pg=PA198&lpg=PA198&dq=botanical+gardens+through+the+little+ice+ages&source=bl&ots=u-5znNPMOR&sig=jrC99VL6eRoP1qYnBlUQhMLzhZU&hl=en&ei=c82ZTpTXDYmxhAexp6WLBA&sa=X&oi=book_result&ct=result&resnum=5&ved=0CDcQ6AEwBA#v=onepage&q&f=false

(36b) <http://www.econ.ohio-state.edu/jhm/AGW/Loehle/>

(37) <http://wattsupwiththat.com/2011/11/01/a-short-anthology-of-changing-climate/>

(38) <http://holocene.meteo.psu.edu/shared/articles/medclimopt.pdf>

(39) <http://academic.evergreen.edu/z/zita/articles/solar/MaunderMin04Shindell.pdf>

(40) <http://holocene.meteo.psu.edu/shared/articles/littleiceage.pdf>

(41) <http://www.meteo.psu.edu/~mann/shared/articles/MannetalScience09.pdf>

(42) <http://www.skepticalscience.com/Was-there-a-Medieval-Warm-Period.html>

(43) <http://holocene.meteo.psu.edu/shared/articles/medclimopt.pdf>

Neither frost nor snow all the winter for more than six days in all.'

(44)

http://books.google.co.uk/books?id=0Nucx3udvnoC&pg=PA281&lpg=PA281&dq=england+temperature+representative+of+world&source=bl&ots=5I5sLr9UK9&sig=vi-l6ely0G6sAk3t3ywyeZalAko&hl=en&ei=sKicTqf4GtCYhQfOzfihCQ&sa=X&oi=book_result&ct=result&resnum=6&ved=0CEQQ6AEwBTgK#v=onepage&q=england%20temperature%20representative%20of%20world&f=false

(45) <http://www.rmets.org/pdf/blissmem1-6.pdf>

(46)

http://books.google.co.uk/books?id=FNhd_sTwTkWC&pg=PA189&lpg=PA189&dq=cet+good+proxy+for+northern+hemiisphere&source=bl&ots=-6XB1V7u3h&sig=nib0OGq5Mp4MB8ESP7-eDQf5TM&hl=en&ei=UiyxTuz4O4Og-Abl8NSmAg&sa=X&oi=book_result&ct=result&resnum=9&ved=0CGMQ6AEwCA#v=onepage&q&f=false

(47) <http://physicsworld.com/cws/article/news/42298>

(48) <http://www.ecn.ac.uk/iccuk/indicators/1.htm>

(49) http://www.baltex-research.eu/publications/PubNo_22/BSSG12_minutes_app.pdf

(49a)

<http://holocene.meteo.psu.edu/shared/articles/JonesMannROG04.pdf> *

(50) <http://www.richardbird.info/CLIMATE/tonybrownrecords.htm>

(51) <http://judithcurry.com/2011/10/04/climate-crises-half-a-millennium-ago/#comment-118906>

(52) <http://judithcurry.com/2011/06/27/unknown-and-uncertain-sea-surface-temperatures/>

(53) [http://www.priweb.org/globalchange/climatechange/studyingcc/scc_01.html...*](http://www.priweb.org/globalchange/climatechange/studyingcc/scc_01.html...)

(53a)

<http://holocene.meteo.psu.edu/shared/articles/JonesMannROG04.pdf> *

54) <http://xroads.virginia.edu/~HYPER/JEFFERSON/ch07.html>

(55) <http://www.pnas.org/content/105/36/13252> *

(56) <http://www.meteo.psu.edu/~mann/supplements/MultiproxyMeans07/> *

Section 6 Additional reading and material used in the 1538 reconstruction (also see additional reading in 'The Long Slow Thaw.')

This is a scientific study about the Little Ice Age. <http://coast.gkss.de/staff/storch/pdf/lmm.kihz.summary.pdf>

This about notable climate events worldwide.

Neither frost nor snow all the winter for more than six days in all.'

<http://www.breadandbutter-science.com/Weather.pdf>

This also about notable climatic events worldwide

<http://www.climate4you.com/ClimateAndHistory.htm>

This about notable climate events in the UK.

http://booty.org.uk/booty.weather/climate/TimeSlice/slice_matrix.htm

These about British Winters

<http://www.netweather.tv/index.cgi?action=other;type=winhist;sess>

<http://www.archive.org/details/TheHistoryOfBritishWinters>

220,000 log books of the Royal Navy from 1669 to 1976 are being studied for meteorological information that can give an insight into climate change.

http://icoads.noaa.gov/reclaim/pdf/British_logbooks_v3.pdf

A project to recover worldwide weather observations made by Royal Navy ships around the time of World War I.

<http://www.oldweather.org/>

Any serious study of Climate needs to begin with this book by Hubert Lamb.

http://www.amazon.co.uk/Climate-History-Modern-World-Hubert/dp/0415127351#reader_0415127351

This book by Brian Fagan takes a learned look at the Little Ice Age.

<http://www.amazon.co.uk/Little-Ice-Age-Climate-1300-1850/dp/0465022723>

This is the original 1855 book by Maury which provides a wealth of information on our knowledge of the sea at the time-much used in Sea surface temperature calculations.

http://books.google.co.uk/books?id=I05AAAACAAJ&printsec=frontcover&dq=mf+maury+The+Physical+Geography+of+the+Sea%E2%80%99&source=bl&ots=6V1ne1aX7e&sig=6Dab2GjEgpzXdzG97fiEFVPfnG4&hl=en&ei=rKJGTdbxJ8a94Aa4u_AZ&sa=X&oi=book_result&ct=result&resnum=1&ved=0CBkQ6AEwAA#v=onepage&q&f=false

Definitions of Sea Surface Temperatures

http://ghrsst-pp.metoffice.com/pages/sst_definitions/

The multi proxy data used in mbh98

<http://www.nature.com/nature/journal/v392/n6678/extref/392779A0.Data.html>

Another very useful account of the LIA

http://salempress.com/store/samples/global_warming/global_warming_ice.htm

The following is an account of The frozen Thames and great frosts

http://books.google.co.uk/books?id=gtw3AAAAYAAJ&pg=PA35&lpg=PA35&dq=thames+frozen+over+in+1063&source=bl&ots=a-89F9dpvt&sig=7S0uVzXBCssfia6UcXtfFAigPGE&hl=en&ei=Koc7S-WBLZQjiAeetoCRDg&sa=X&oi=book_result&ct=result&resnum=3&ved=0CBiQ6AEwAg#v=onepage&q=thames%20frozen%20over%20in%201063&f=false

This is where the postscript to the article is derived where Prof Fagan gives a very good description of variability of the LIA.-page 48

<http://books.google.co.uk/books?id=LwvkmXt5fQUC&pg=PA48&lpg=PA48&dq=when+was+term+little+ice+age+first+used&source=bl&ots=K3XMkLFQwJ&sig=ljwGLC6ENO6WLFBywFF->

http://books.google.co.uk/books?id=LwvkmXt5fQUC&pg=PA48&lpg=PA48&dq=when+was+term+little+ice+age+first+used&source=bl&ots=K3XMkLFQwJ&sig=ljwGLC6ENO6WLFBywFF-MTxMd0s&hl=en&ei=5sudTrfgCKnf0QHx7qSdCQ&sa=X&oi=book_result&ct=result&resnum=6&ved=0CEUQ6AEwBQ#v=onepage&q=when%20was%20term%20little%20ice%20age%20first%20used&f=false

Neither frost nor snow all the winter for more than six days in all.'

Another excellent piece on The LIA

http://www.eh-resources.org/timeline/timeline_lia.html

Useful article stressing the need to rescue historic data

<http://www.realclimate.org/index.php/archives/2011/04/rescuing-data/>

“The Frozen Thames” by Helen Humphreys (2007) is a great chronicle of the 40 times that the river froze over between about 1100 and the present. In 40 vignettes she describes the people and the times of these events — the experiences of both ordinary and important people who found themselves on the frozen river. The book is fascinating reading and puts a human face on our ever-changing climate.

Interesting analysis of problems with early temperature records by Phil Jones and D Camuffo

<http://www.isac.cnr.it/~microcl/climatologia/improveb.php>

Registers and Navy log books

<http://www.corral.org.uk/>

This on the period 1685 to 1770

<http://www.springerlink.com/content/e76867q12842270m/>

Temperatures since 1500

http://www.giub.unibe.ch/klimet/docs/SOM_luterbacheretal_science.pdf

This about notable climatic events worldwide

<http://www.climate4you.com/ClimateAndHistory.htm>

This about notable climate events in the UK.

http://booty.org.uk/booty.weather/climate/TimeSlice/slice_matrix.htm

This about British Winters

<http://www.netweather.tv/index.cgi?action=other;type=winthist;sess>

<http://www.archive.org/details/TheHistoryOfBritishWinters>

(The archive org doc seems to be the original of the netweather one.)

220,000 log books of the Royal Navy from 1669 to 1976 are being studied for meteorological information that can give an insight into climate change.

http://icoads.noaa.gov/reclaim/pdf/British_logbooks_v3.pdf

A project to recover worldwide weather observations made by Royal Navy ships around the time of World War I.

<http://www.oldweather.org/>

Any serious study of Climate needs to begin with this book by Hubert Lamb.

http://www.amazon.co.uk/Climate-History-Modern-World-Hubert/dp/0415127351#reader_0415127351

This book by Brian Fagan takes a learned look at the Little Ice Age.

<http://www.amazon.co.uk/Little-Ice-Age-Climate-1300-1850/dp/0465022723>

This is the original 1855 book by Maury which provides a wealth of information on our knowledge of the sea at the time

Neither frost nor snow all the winter for more than six days in all.’

http://books.google.co.uk/books?id=_I05AAAAcAAJ&printsec=frontcover&dq=mf+maury+The+Physical+Geography+of+the+Sea%E2%80%99&source=bl&ots=6V1ne1aX7e&sig=6Dab2GjEgpzXdzG97flEFVPfnG4&hl=en&ei=rKJGTdbxJ8a94Aa4u_AZ&sa=X&oi=book_result&ct=result&resnum=1&ved=0CBkQ6AEwAA#v=onepage&q&f=false

Definitions of Sea Surface Temperatures

http://ghrsst-pp.metoffice.com/pages/sst_definitions/

The first frost fair was held in 1608. The most famous -lasting several months- was in 1684. The link below leads to a promotional poster of that event.

<http://janeaustensworld.wordpress.com/2009/01/16/the-last-frost-fair-on-the-thames-river/>

This about Frost fairs

<http://www.she-philosopher.com/gallery/frostfair.html>

A pre historical Temperature record to the present day

http://www.appinsys.com/globalwarming/GW_Part1_PreHistoricalRecord.htm

A succession of violent south westerly storms in the mid 16th century moved the shingle ridge eastwards to its present position. This blocked the entrance to the harbour and caused it to silt up and become overgrown by salt marsh.(Southern Britain)

<http://www.seatonvisitorcentretrust.org/Geology.html>

Useful article on the effects of solar variation-see ref 39 Oct 11

<http://wattsupwiththat.com/2011/10/10/bbc-the-little-ice-age-was-all-about-solar-uv-variability-wasnt-an-ice-age-at-all/>

An account of some of the great frosts in the British Isles

http://books.google.co.uk/books?id=gtw3AAAAyAAJ&pg=PA35&lpg=PA35&dq=thames+frozen+over+in+1063&source=bl&ots=a-89F9dpvt&sig=7S0uVzXBCssfia6UcXtFAigPGE&hl=en&ei=Koc7S-WBLZOqjAeetoCRDg&sa=X&oi=book_result&ct=result&resnum=3&ved=0CBkQ6AEwAg#v=onepage&q=thames%20frozen%20over%20in%201063&f=false

Climate phenomena through the ages and world

<http://www.phenomena.org.uk/page29/page33/page33.html>

Neither frost nor snow all the winter for more than six days in all.'