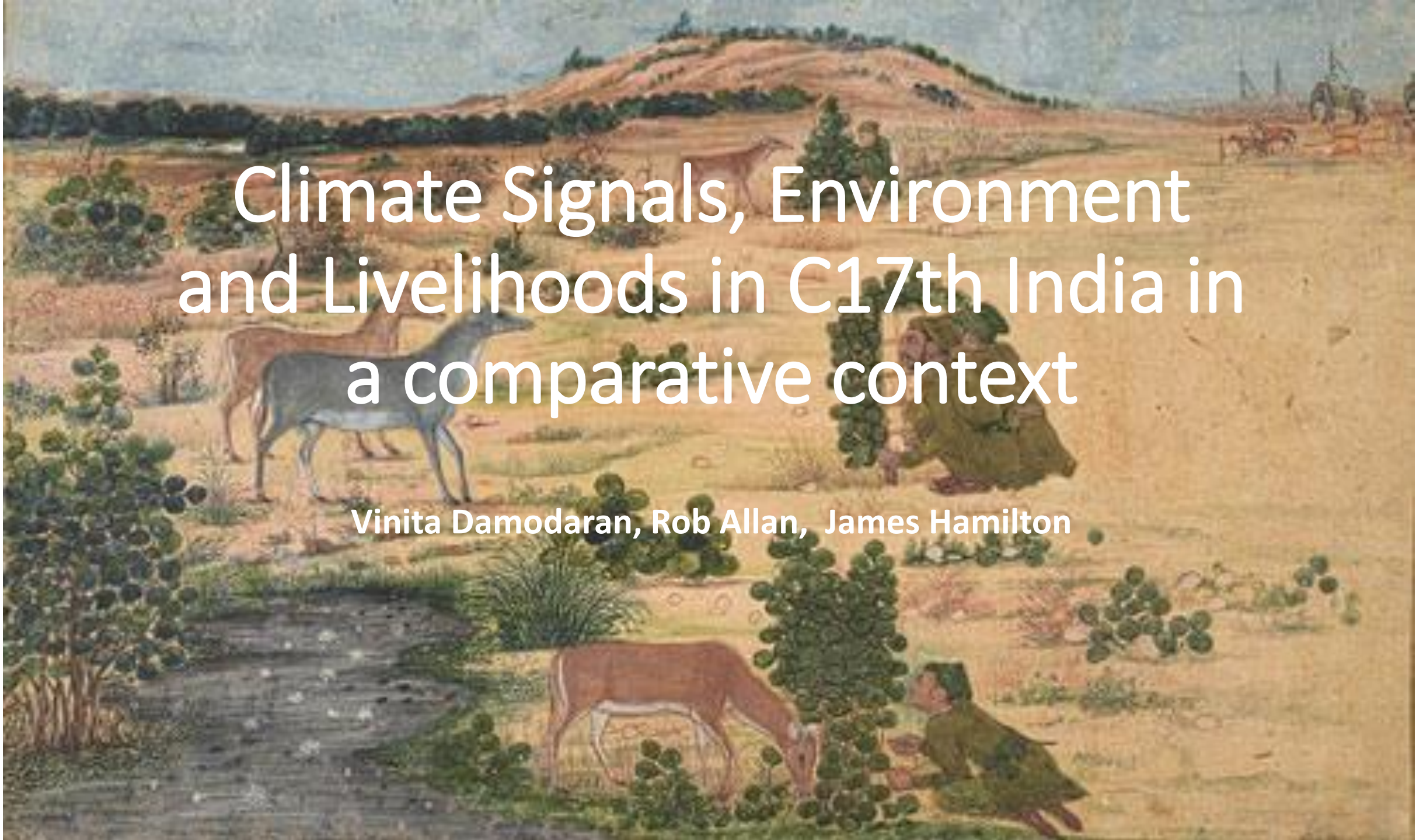


Climate Signals, Environment and Livelihoods in C17th India in a comparative context

Vinita Damodaran, Rob Allan, James Hamilton

Presentation structure

- Sussex/McGill/Met office climate archive project
- Ships logs and ACRE project
- Sources

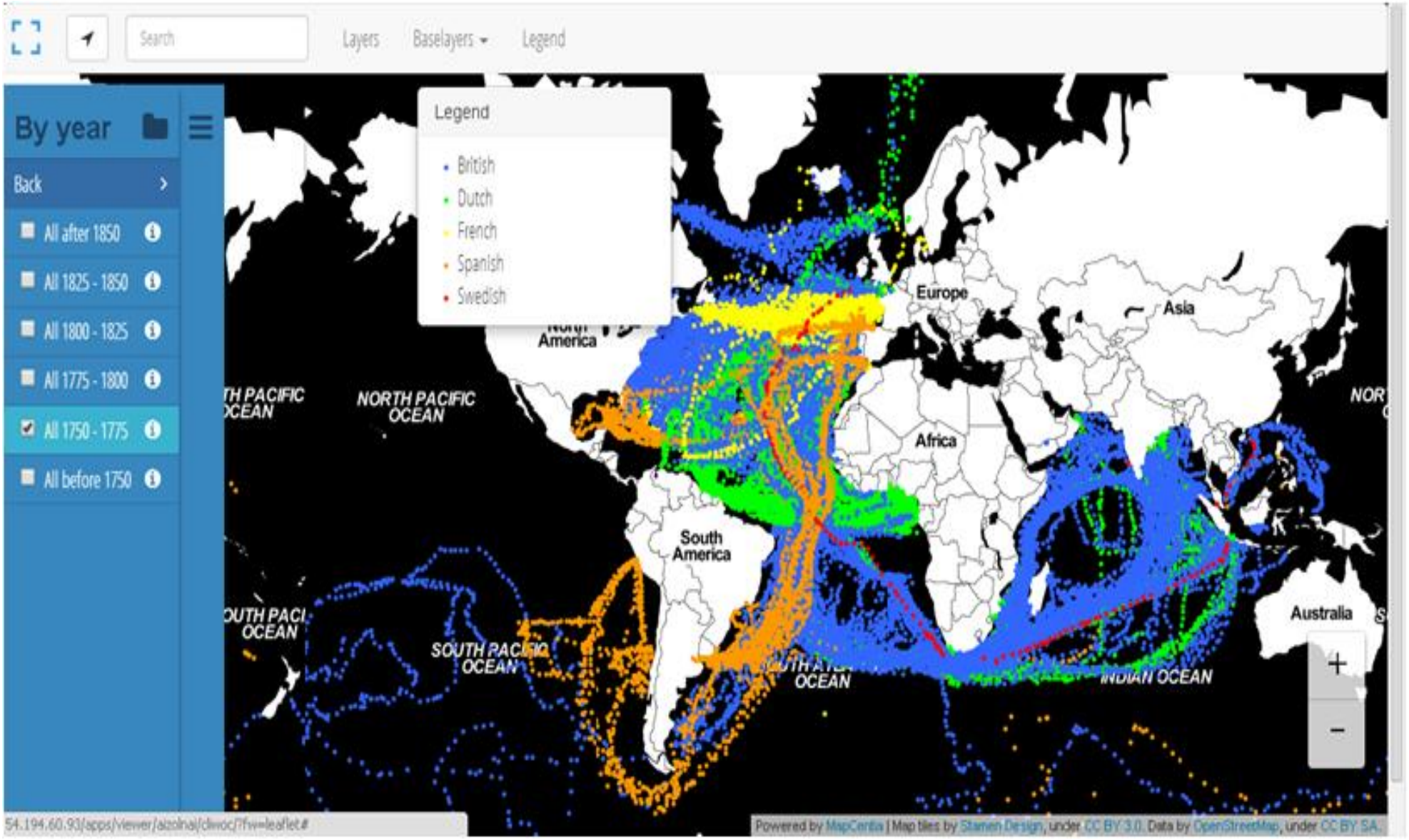
Documentary sources

Paleo sources

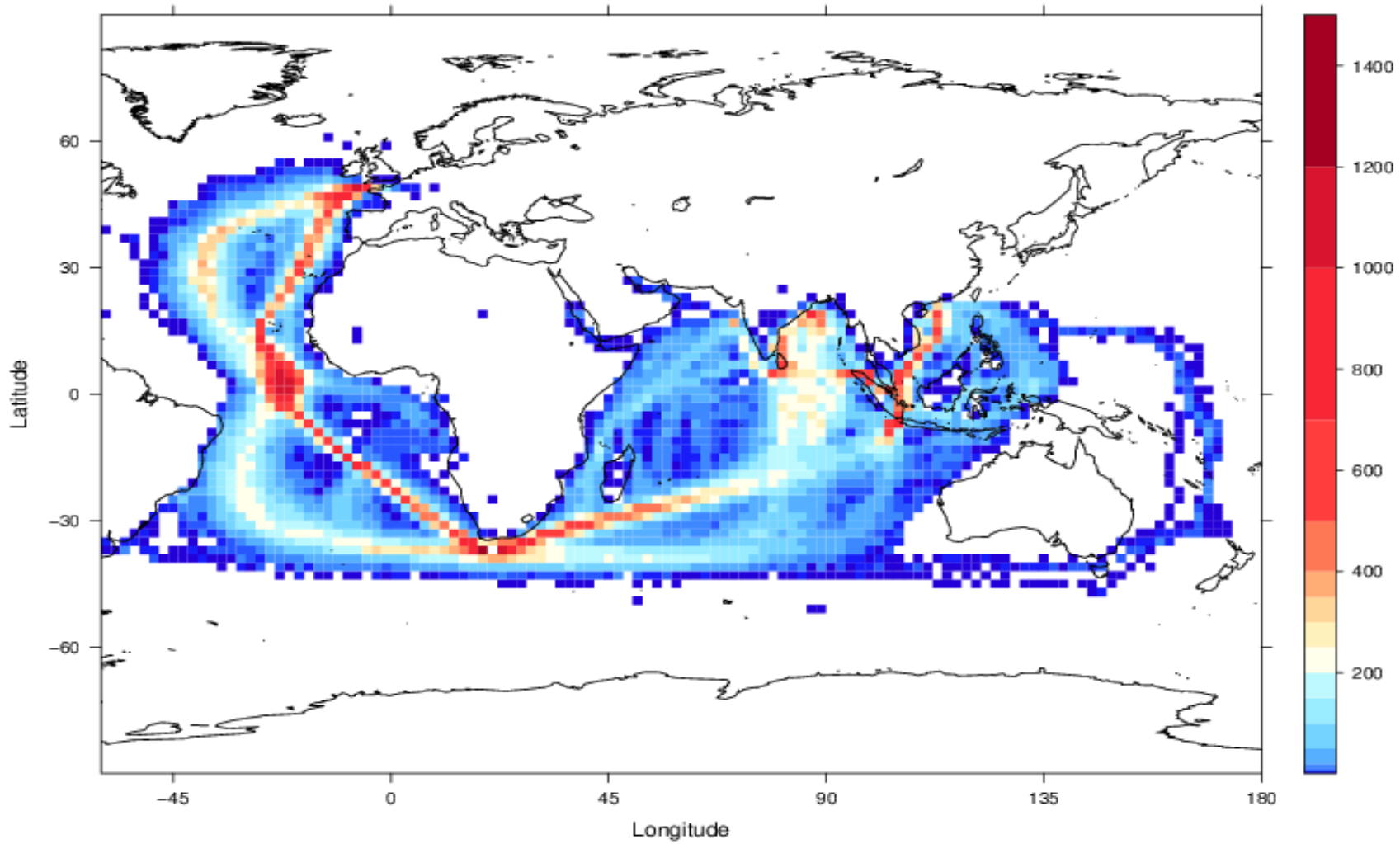
Secondary sources

- Climate signals in India and Indian Ocean World
- The seventeenth century crisis?
- Historiography (Parker, De Vries, Clingingsmith, Grove, John F. Richards)
- The eighteenth century, Famine causation

Ships Logs: CLIWOC 1750-1850 ship coverage through time and nationality of voyages Source: http://maps.zolnai.ca/



Geographical coverage of the tracks of English East India Company (EIC) ships in 900 ship logbooks from 1788-1834 which took instrumental weather observations (e.g. pressure, air temperature and sea surface temperature) and have been digitised under ACRE.. Source: Philip Brohan (Met Office).



Documentary sources

Mcgill C17th sources new - Excel

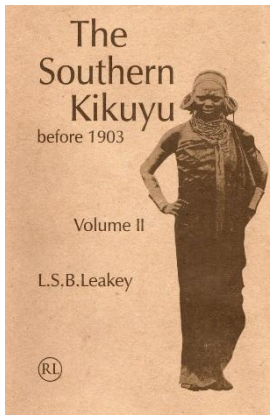
James Hamilton

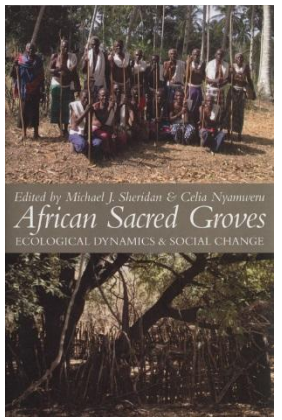
Memoirs of Jahangir

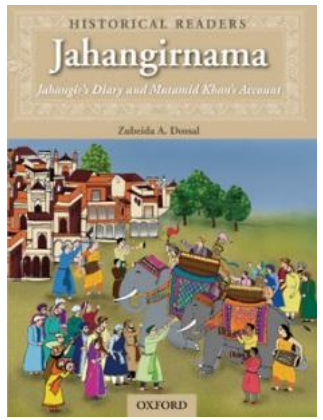
	A	B	C	D	E	F	G	
19	Elizabeth Lee Saxe papers.		British Library	N	1657	1717		Various
20	Thomas Bowrey papers.		British Library	N	1680	1709		Person
21	Robert Beake papers		British Library	N	1658	1679		Person
22	Isaac Lawrence papers		British Library	N	1659	1696		Person
23	William Hurt papers		British Library	N	1632	1639		Person
24	Jeremy Blackman papers		British Library	N	1651	1653		Person
25	Rowland Thomas papers		British Library	N	1615	1617		Person
26	EIC general correspondence	India	British Library	N	1602	1859		
27	VOC documents	India, Indonesia, S.E Asia and East Africa	Jakarta, Colombo, Chennai, Cape Town, The Hague	N	1602	1795		Various
28	Journal of John Jourdain	from Britain to India via The Cape, Aden, Moche, Socotra, Gandavee, Surat, Agra, Sumatra, Red Sea	Online	Y	1607	1617		Travel J
29	Journal of Peter Floris	From Holland to India	British Library	N	1611	1615		Travel J
30	History of the reign of Shah Jahan, Manuscript	Moghul Empire	Windsor Castle/British Library	N	1628	1658		Imperia
31	Letters of Aurangzeb	Moghul Empire	British Library	N	1618 (emperor from 1658)	1707		letters f
32								
33	History of the Reign of Akbar	Moghul Empire	British Library		1556	1602		Court H
34	Memoirs of Jahangir	Moghul Empire	British Library	Y	1569	1627		Imperia
35								
36	Court History of Shah Jahan	Moghul Empire	British Library	N	1627	1670		Court H
37								
38								
39								
40	Memoirs of Jahangir	Moghul Empire	British Library	N	1569	1627		Imperia
41	Travels of Peter Mundy	Surat, Agra, Patna, Lahore, The Cape	online	Y	1628	1638		Travel r
42								
43								
44	Factory records	Madras	unknown	N	1642	1650		social /
45	Contemporary history	India	British Library	N	unknown, covers 1650s			Contem
46								
47								
48	Travel report, John Marshal	Bengal	unknown	N	1668	1672		Travel r
49	Social Geographical survey, Thomas Bowrey	Bengal		Y	1669	1679		Social /
50	Travel report, Nicola De Graaf	India and Asia	online in French	Y	1639	1687		Travel r
51	Imperial History	India	British Library online in Perian	Y	1658	1707		Contem
52	Travel report, Manucci	India	online in English translation	Y	1653	1708		Travel r
53								
54								
55								
56	History	India	Khuda Bakhsh Oriental Public Library	N	1132	1719		Contem
57	History	India	Khuda Bakhsh Oriental Public Library	N		1606		Contem
58	History	India	Khuda Bakhsh Oriental Public Library	N		1695		Contem
59	History	India	Khuda Bakhsh Oriental Public Library	N		1719		Contem
60	History	India	Khuda Bakhsh Oriental Public Library	N		1759		Contem
61	History	Hindustan and the Deccan	Khuda Bakhsh Oriental Public Library	N		1789		Contem
62	History	India	Online in English	Y				Contem
63	History							

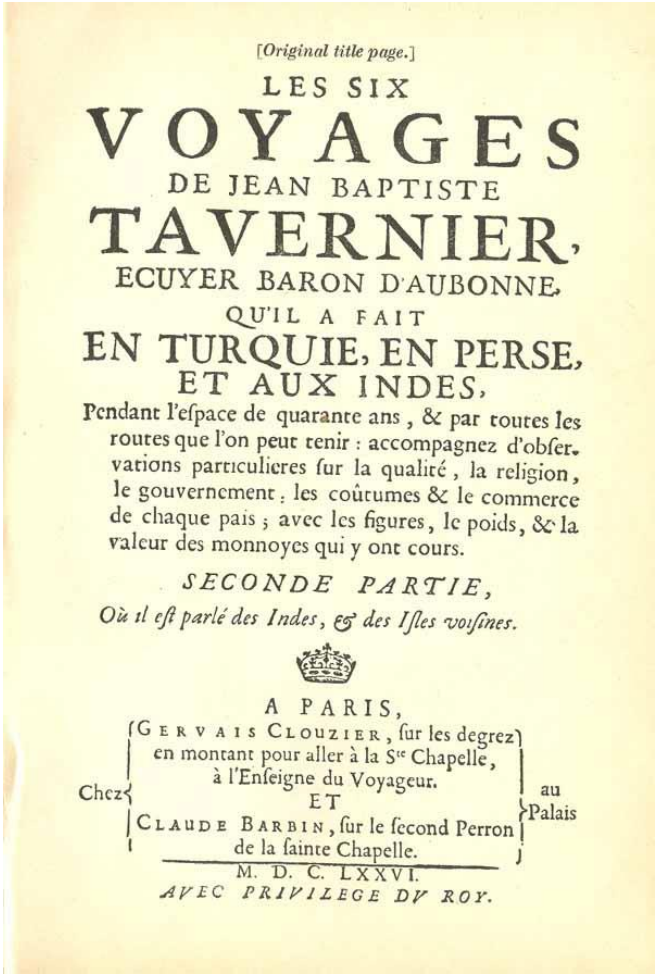
Note | Documentary_Sources | Paleo_Sources | Secondary_Literature | Timeline | Volcanic_activity | Solar_Activity | ENSO | Event Plot

READY









[Original title page.]

LES SIX
VOYAGES
DE JEAN BAPTISTE
TAVERNIER,
ECUYER BARON D'AUBONNE,
QU'IL A FAIT
EN TURQUIE, EN PERSE,
ET AUX INDES,

Pendant l'eſpace de quarante ans, & par toutes les routes que l'on peut tenir : accompagnez d'obſervations particulieres ſur la qualité, la religion, le gouvernement, les coûtumes & le commerce de chaque pais ; avec les figures, le poids, & la valeur des monnoyes qui y ont cours.

SECONDE PARTIE,
Où il eſt parlé des Indes, & des Iſles voiſines.

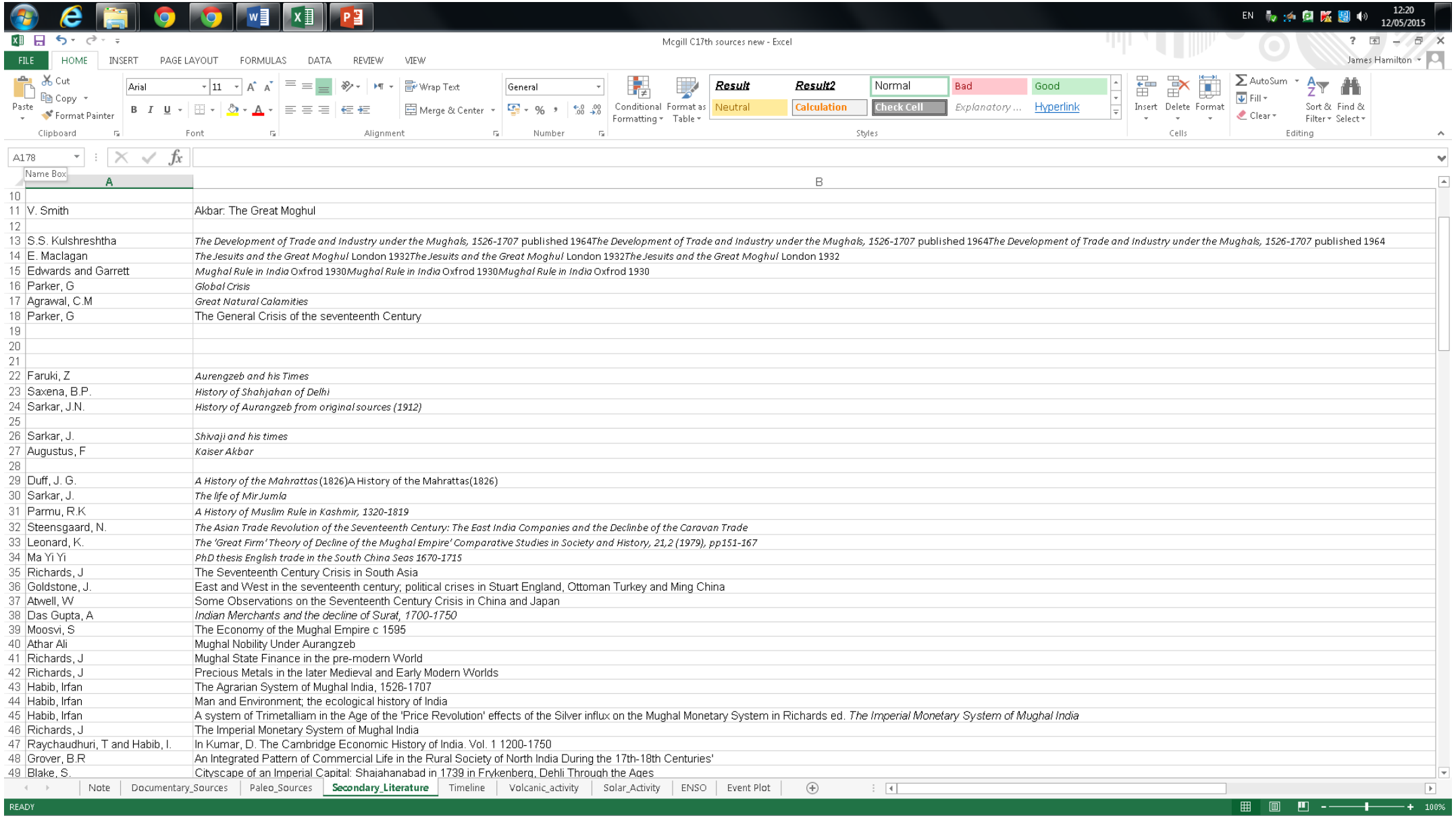
A PARIS,
Chez { GERVAIS CLOUZIER, ſur les degrez en montant pour aller à la Ste Chapelle, à l'Enſeigne du Voyageur. ET CLAUDE BARBIN, ſur le ſecond Perron de la ſainte Chapelle. } au Palais
M. D. C. LXXVI.
AVEC PRIVILEGE DV ROY.

Paleo Sources

Mcgill C17th sources new - Excel

Type of sequence	Ref.	Location	Latitude	Longitude	Start date (+/-=AD/BC)	Finish date(+/-=AD/BC)	Length of record	Continuity	Type of data	Quantitative/qualitative	Dating technique
Sea sediment core	BJ8-03-31MCA	Indonesia, Makassar Strait	-3.53	119.27	1711	1986	275	full	SST	Quant	C14
	Bj8-03-32GGC	Indonesia, Makassar Strait	-3.53	119.27	52	1950	1,898	irregular	SST	Quant	C14
	BJ8-03-34GGC	Indonesia, Makassar Strait	-3.53	119.27	-365	1622	1,987	irregular	SST	Quant	C14
	MD98-2160	Indonesia, Makassar Strait,	-5.2	117.29	1004	1815	814	irregular	SST	Quant	C14
Calcite analysis		Lake Edward, C. Africa	0.25	29.45	-3,460	1950	4,500	full	moisture	Qual	isotope analysis
Lake core	M98-1P	Lake Malawi	12.17	34.3	-22,368	1849	24,000	full	Climate general	Qual	biogenic silica and geochemical accumilation
Lake core	M98-2P	Lake Malawi	12.17	34.3							
Corals and Sclerosponges		Madagascar	-18.8	47.5	1708	2006	298	full	Rainfall, SST	Qual	spectral luminescence scanning
Foraminiferal Oxygen Isotope		Arabian Sea	24.62	65.98	-10,764	1,990	13,000	full	raw	uninterpreted	spectral luminescence scanning
Sea sediment core	Core RC27-23	Arabian Sea	17.9	57.59	-63,438	1820	63638	full	raw	uninterpretted	C14
Various		Central Asia, Aral Sea	45	60	950	2010	1,000	full	moisture	Qual	C14 and sediment accumilation rates
Lake sediment core		Lake Qinghai Tibet/ China	36.5	99.6	-1550	1980	17,500	full	precipitation, monsoon strength	Qual	sediment reflectivity
Tree ring		N.India, Gahan	31.18	77.27	1673	1989	326		temp, preciptiation, climate variability	Qual/quant	tree ring analysis
Multiple source study		N. India, Jageswar	29.77	79.17	1657	1990	333				
		N. India, Jangla	31.36	78.1	1538	2004	566				

Secondary Sources



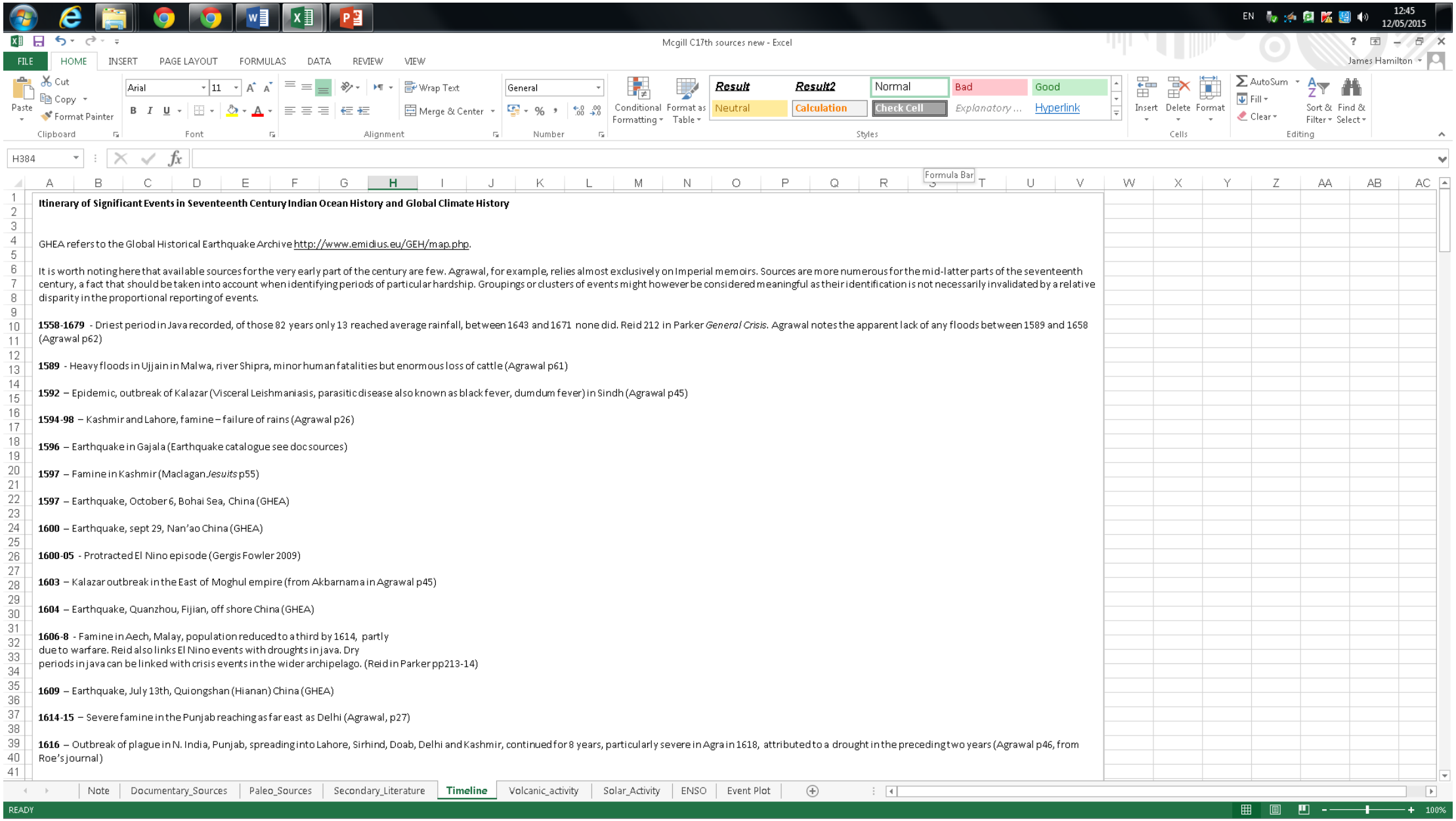
Mcgill C17th sources new - Excel

	A	B
10		
11	V. Smith	Akbar: The Great Moghul
12		
13	S.S. Kulshreshtha	*The Development of Trade and Industry under the Mughals, 1526-1707* published 1964*The Development of Trade and Industry under the Mughals, 1526-1707* published 1964*The Development of Trade and Industry under the Mughals, 1526-1707* published 1964
14	E. Maclagan	*The Jesuits and the Great Moghul* London 1932*The Jesuits and the Great Moghul* London 1932*The Jesuits and the Great Moghul* London 1932
15	Edwards and Garrett	*Mughal Rule in India* Oxfrod 1930*Mughal Rule in India* Oxfrod 1930*Mughal Rule in India* Oxfrod 1930
16	Parker, G	*Global Crisis*
17	Agrawal, C.M	*Great Natural Calamities*
18	Parker, G	The General Crisis of the seventeenth Century
19		
20		
21		
22	Faruki, Z	*Aurengzeb and his Times*
23	Saxena, B.P.	*History of Shahjahan of Delhi*
24	Sarkar, J.N.	*History of Aurangzeb from original sources (1912)*
25		
26	Sarkar, J.	*Shivaji and his times*
27	Augustus, F	*Kaiser Akbar*
28		
29	Duff, J. G.	*A History of the Mahrattas* (1826)A History of the Mahrattas(1826)
30	Sarkar, J.	*The life of Mir Jumla*
31	Parmu, R.K	*A History of Muslim Rule in Kashmir, 1320-1819*
32	Steensgaard, N.	*The Asian Trade Revolution of the Seventeenth Century: The East India Companies and the Declinbe of the Caravan Trade*
33	Leonard, K.	*The 'Great Firm' Theory of Decline of the Mughal Empire' Comparative Studies in Society and History, 21,2 (1979), pp151-167*
34	Ma Yi Yi	*PhD thesis English trade in the South China Seas 1670-1715*
35	Richards, J	The Seventeenth Century Crisis in South Asia
36	Goldstone, J.	East and West in the seventeenth century; political crises in Stuart England, Ottoman Turkey and Ming China
37	Atwell, W	Some Observations on the Seventeenth Century Crisis in China and Japan
38	Das Gupta, A	*Indian Merchants and the decline of Surat, 1700-1750*
39	Moosvi, S	The Economy of the Mughal Empire c 1595
40	Athar Ali	Mughal Nobility Under Aurangzeb
41	Richards, J	Mughal State Finance in the pre-modern World
42	Richards, J	Precious Metals in the later Medieval and Early Modern Worlds
43	Habib, Irfan	The Agrarian System of Mughal India, 1526-1707
44	Habib, Irfan	Man and Environment; the ecological history of India
45	Habib, Irfan	A system of Trimetalliam in the Age of the 'Price Revolution' effects of the Silver influx on the Mughal Monetary System in Richards ed. *The Imperial Monetary System of Mughal India*
46	Richards, J	The Imperial Monetary System of Mughal India
47	Raychaudhuri, T and Habib, I.	In Kumar, D. The Cambridge Economic History of India. Vol. 1 1200-1750
48	Grover, B.R	An Integrated Pattern of Commercial Life in the Rural Society of North India During the 17th-18th Centuries'
49	Blake, S.	Cityscape of an Imperial Capital: Shajahanabad in 1739 in Frykenberg, Dehli Through the Ages

Note | Documentary_Sources | Paleo_Sources | Secondary_Literature | Timeline | Volcanic_activity | Solar_Activity | ENSO | Event Plot

READY

Time line for the seventeenth century



Itinerary of Significant Events in Seventeenth Century Indian Ocean History and Global Climate History

GHEA refers to the Global Historical Earthquake Archive http://www.emidius.eu/GEH/map.php.

It is worth noting here that available sources for the very early part of the century are few. Agrawal, for example, relies almost exclusively on Imperial memoirs. Sources are more numerous for the mid-latter parts of the seventeenth century, a fact that should be taken into account when identifying periods of particular hardship. Groupings or clusters of events might however be considered meaningful as their identification is not necessarily invalidated by a relative disparity in the proportional reporting of events.

1558-1679 - Driest period in Java recorded, of those 82 years only 13 reached average rainfall, between 1643 and 1671 none did. Reid 212 in Parker *General Crisis*. Agrawal notes the apparent lack of any floods between 1589 and 1658 (Agrawal p62)

1589 - Heavy floods in Ujjain in Malwa, river Shipra, minor human fatalities but enormous loss of cattle (Agrawal p61)

1592 – Epidemic, outbreak of Kalazar (Visceral Leishmaniasis, parasitic disease also known as black fever, dumdum fever) in Sindh (Agrawal p45)

1594-98 – Kashmir and Lahore, famine – failure of rains (Agrawal p26)

1596 – Earthquake in Gajala (Earthquake catalogue see doc sources)

1597 – Famine in Kashmir (Maclagan *Jesuits* p55)

1597 – Earthquake, October 6, Bohai Sea, China (GHEA)

1600 – Earthquake, sept 29, Nan'ao China (GHEA)

1600-05 - Protracted El Nino episode (Gergis Fowler 2009)

1603 – Kalazar outbreak in the East of Moghul empire (from Akbarnama in Agrawal p45)

1604 – Earthquake, Quanzhou, Fijian, off shore China (GHEA)

1606-8 - Famine in Aech, Malay, population reduced to a third by 1614, partly due to warfare. Reid also links El Nino events with droughts in java. Dry periods in java can be linked with crisis events in the wider archipelago. (Reid in Parker pp213-14)

1609 – Earthquake, July 13th, Quiongshan (Hianan) China (GHEA)

1614-15 – Severe famine in the Punjab reaching as far east as Delhi (Agrawal, p27)

1616 – Outbreak of plague in N. India, Punjab, spreading into Lahore, Sirhind, Doab, Delhi and Kashmir, continued for 8 years, particularly severe in Agra in 1618, attributed to a drought in the preceding two years (Agrawal p46, from Roe's journal)

Time line of events

- ***1630-1631*** *– 'perfect drought' in N. India followed in 1632 by catastrophic floods*
- ***1630-1632*** *– Deccan Famine, roughly 3 million die in the Deccan and Gujarat. Also Effects Burma and Arakan (Reid p214)*
- ***1631-1645*** *– Something like half the Chinese population dies in this period. Telford Fertility p70-3, Beatty Land p47-133*
- ***1633*** *- Failed rice crop in Siam. (Reid p214) 1633 - Prolonged drought and crop failure in Siam all from (Reid in Parkerpp213-214) 1633-38 - Very dry years in java,* ***1634*** *and* ***1637*** *the worst rice shortage in Baliin* ***1633****, drought in Maluku in 35 and epidemic in Makassar in* ***1636*** *which killed60,000 in forty days. (Reid in Parker pp213-14)*
- ***1635*** *– Popular revolts spread from NW China to Yangzi valley (to* ***1635****)*
-
- ***1637*** *– Revolt at Shimabara (to* ***1638****)*
- ***1637-1639*** *- Protracted La Niña episode (Gergis and Fowler, 2009)*
- ***1638-1644*** *– Twelve known eruptions around the Pacific (p13)*
- ***1638-1661*** *– El Niño years* ***1638, 1639, 1641, 1642, 1646, 1648, 1650, 1651, 1652, 1659, 1660, 1661*** *(Gergis and Folwer, A History of ENSO events. Also Diaz and Markgraf El Nino suggest that the mid-seventeenth saw the weakest period of monsoons on record.*
- ***1639*** *– Chinese (Sangleys) revolt in Manila*
- ***1640*** *– Gazetteer reports Grand Canal which brings food into Bejing runs dry – an unprecedented event*
- ***1640-1670*** *– trade winds in Pacific notably slack, crossings which took 80 days at the start of the century now average 120 days. Average return journey rises from 160-200 (p16, from Garcia: Atmospheric Circulation)*
- ***1640s*** *– decade-long dry period in China. (Reid p214)*
- ***1641*** *– Simultaneous eruption of three volcanoes near Java*
- ***1641*** *– Revolt of Portuguese in Mombasa, Goa, Ceylon against Spain*
- ***1641*** *– Third coolest summer on record over parts of Northern Hemisphere, second coldest in New England, coldest in Scandinavia*

Background ENSO

- ENSO or El Nino Southern Oscillation operates in two distinct phases alternating over a period of roughly 2-7 years
- These phases are characterised by warming in the tropical pacific and the Indian ocean, often suppress rainfall in the western Pacific in the case of El Nino and converse in the case of La Nina
- ENSO evens vary widely in their manner of expression, ‘centres of action’ duration and depth, but are typically accompanied by extreme weather events
- Links Of El Nino with Asian Monsoon. Structure of SSTs in the Indian ocean is linked to more familiar pattern of SSTs in the Pacific ocean
- The mid-seventeenth century saw the weakest period of monsoons on record

Protracted El Nino and La Nina

- ENSO example details the resolution of both reconstructed ElNino and La Nina longer protracted episodes
- Protracted episode is defined as a period of two years or more when measures of the phenomena and various precipitation extremes (drought or flood) in ENSO sensitive regions persist
- Authors of the South Asian monsoon index note that it captures 18 of 26 recorded famine events in India over the last millennium; notably 11 of 16 short events with durations of 1-3 years are accurately depicted in the reconstruction

ENSO impact

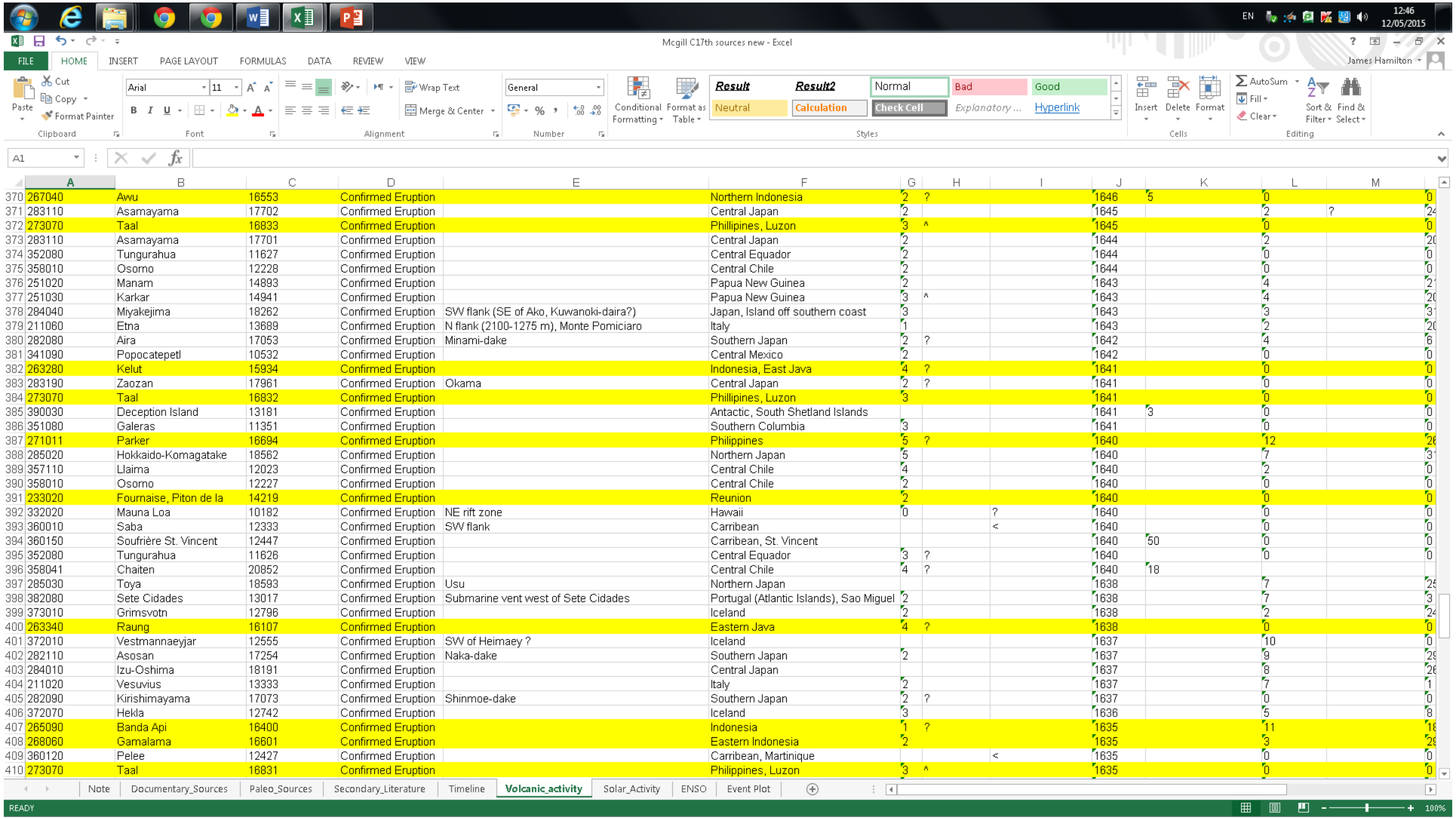
- In the seventeenth century ENSO events happened twice as often. Normal arrival once in 5 years
- Period saw the weakest East Asian monsoons of the past two millennia
- ENSO events may trigger volcanic eruptions
- The global footprint of El Nino events incudes three regions besides the land adjoining the Pacific.

Caribbean suffers floods

Ethiopia and north West India experience drought

Europe suffers hard winters

Seismic Activity



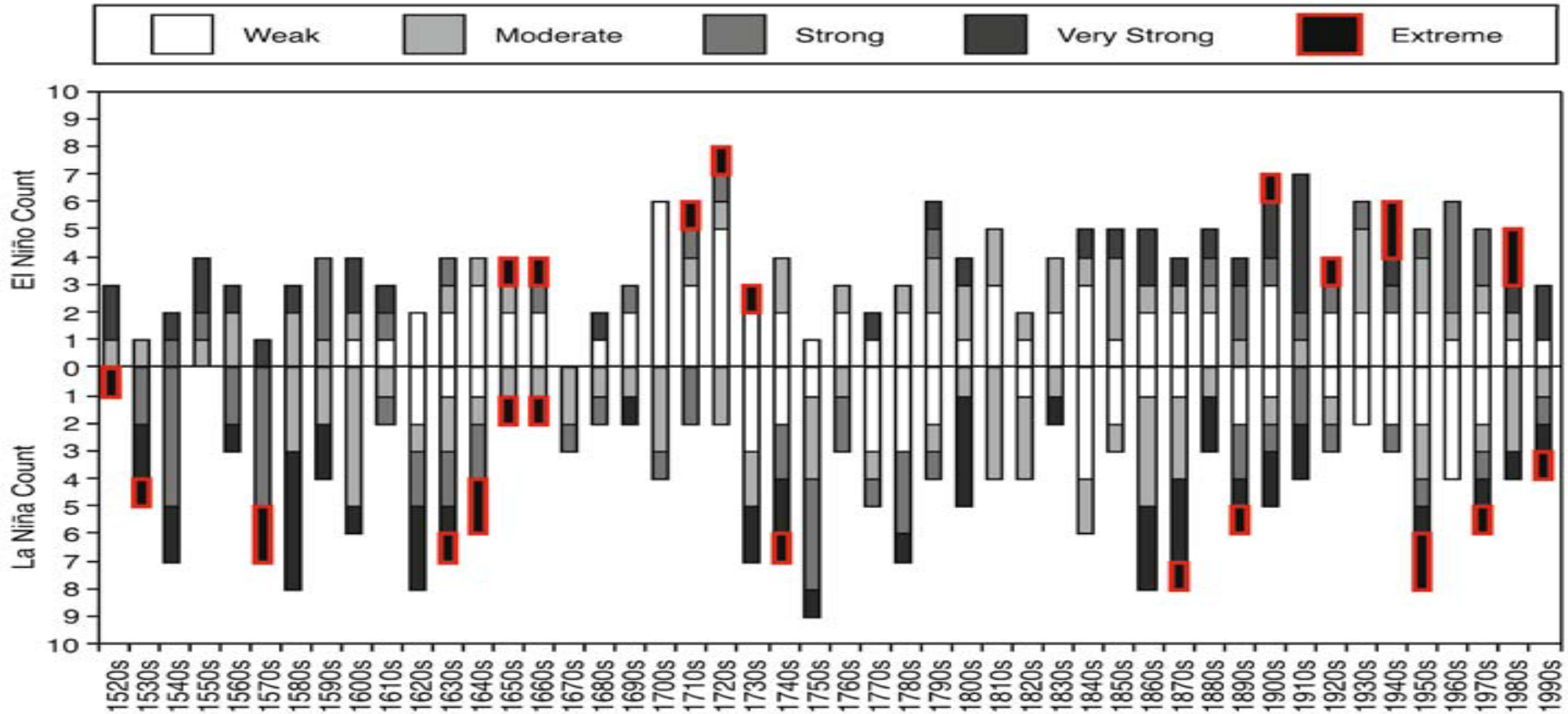
Mcgill C17th sources new - Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	
370	267040	Awu	16553	Confirmed Eruption		Northern Indonesia	2	?		1646	5	0		0
371	283110	Asamayama	17702	Confirmed Eruption		Central Japan	2			1645		2	?	24
372	273070	Taal	16833	Confirmed Eruption		Phillipines, Luzon	3	^		1645		0		0
373	283110	Asamayama	17701	Confirmed Eruption		Central Japan	2			1644		2		20
374	352080	Tungurahua	11627	Confirmed Eruption		Central Equador	2			1644		0		0
375	358010	Osorno	12228	Confirmed Eruption		Central Chile	2			1644		0		0
376	251020	Manam	14893	Confirmed Eruption		Papua New Guinea	2			1643		4		21
377	251030	Karkar	14941	Confirmed Eruption		Papua New Guinea	3	^		1643		4		20
378	284040	Miyakejima	18262	Confirmed Eruption	SW flank (SE of Ako, Kuwanoki-daira?)	Japan, Island off southern coast	3			1643		3		31
379	211060	Etna	13689	Confirmed Eruption	N flank (2100-1275 m), Monte Pomiciaro	Italy	1			1643		2		20
380	282080	Aira	17053	Confirmed Eruption	Minami-dake	Southern Japan	2	?		1642		4		6
381	341090	Popocatepetl	10532	Confirmed Eruption		Central Mexico	2			1642		0		0
382	263280	Kelut	15934	Confirmed Eruption		Indonesia, East Java	4	?		1641		0		0
383	283190	Zaozan	17961	Confirmed Eruption	Okama	Central Japan	2	?		1641		0		0
384	273070	Taal	16832	Confirmed Eruption		Phillipines, Luzon	3			1641		0		0
385	390030	Deception Island	13181	Confirmed Eruption		Antactic, South Shetland Islands				1641	3	0		0
386	351080	Galeras	11351	Confirmed Eruption		Southern Columbia	3			1641		0		0
387	271011	Parker	16694	Confirmed Eruption		Philippines	5	?		1640		12		26
388	285020	Hokkaido-Komagatake	18562	Confirmed Eruption		Northern Japan	5			1640		7		31
389	357110	Llaima	12023	Confirmed Eruption		Central Chile	4			1640		2		0
390	358010	Osorno	12227	Confirmed Eruption		Central Chile	2			1640		0		0
391	233020	Fournaise, Piton de la	14219	Confirmed Eruption		Reunion	2			1640		0		0
392	332020	Mauna Loa	10182	Confirmed Eruption	NE rift zone	Hawaii	0		?	1640		0		0
393	360010	Saba	12333	Confirmed Eruption	SW flank	Carribean			<	1640		0		0
394	360150	Soufrière St. Vincent	12447	Confirmed Eruption		Carribean, St. Vincent				1640	50	0		0
395	352080	Tungurahua	11628	Confirmed Eruption		Central Equador	3	?		1640		0		0
396	358041	Chaiten	20852	Confirmed Eruption		Central Chile	4	?		1640	18			
397	285030	Toya	18593	Confirmed Eruption	Usu	Northern Japan				1638		7		29
398	382080	Sete Cidades	13017	Confirmed Eruption	Submarine vent west of Sete Cidades	Portugal (Atlantic Islands), Sao Miguel	2			1638		7		3
399	373010	Grimsvotn	12796	Confirmed Eruption		Iceland	2			1638		2		24
400	263340	Raung	16107	Confirmed Eruption		Eastern Java	4	?		1638		0		0
401	372010	Vestmannaeyjar	12555	Confirmed Eruption	SW of Heimaey ?	Iceland				1637		10		0
402	282110	Asosan	17254	Confirmed Eruption	Naka-dake	Southern Japan	2			1637		9		29
403	284010	Izu-Oshima	18191	Confirmed Eruption		Central Japan				1637		8		26
404	211020	Vesuvius	13333	Confirmed Eruption		Italy	2			1637		7		1
405	282090	Kirishimayama	17073	Confirmed Eruption	Shinmoe-dake	Southern Japan	2	?		1637		0		0
406	372070	Hekla	12742	Confirmed Eruption		Iceland	3			1636		5		8
407	265090	Banda Api	16400	Confirmed Eruption		Indonesia	1	?		1635		11		18
408	268060	Gamalama	16601	Confirmed Eruption		Eastern Indonesia	2			1635		3		29
409	360120	Pelee	12427	Confirmed Eruption		Carribean, Martinique			<	1635		0		0
410	273070	Taal	16831	Confirmed Eruption		Philippines, Luzon	3	^		1635		0		0

Note | Documentary_Sources | Paleo_Sources | Secondary_Literature | Timeline | Volcanic_activity | Solar_Activity | ENSO | Event Plot

READY

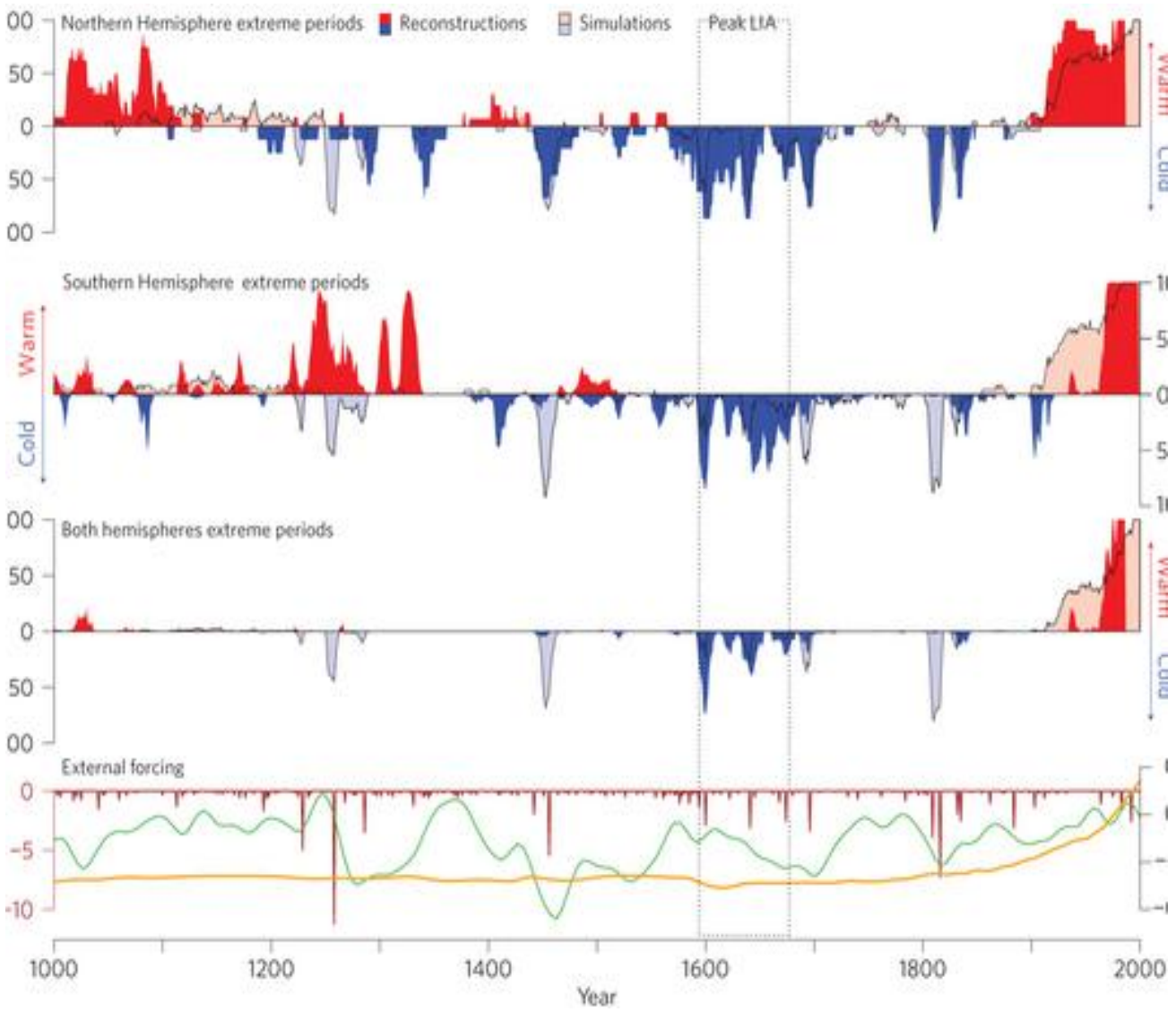
Decadal trends in reconstructed El Niño and La Niña event magnitude characteristics, A.D. 1525–2000. Five percentile classes of the MQ time series were used to classify ENSO magnitude into extreme (>90th percentile) very strong (70th–90th percentile), strong (50th–70th), moderate (50th–30th) and weak events (<30th). Source: Gergis and Fowler, 2009)



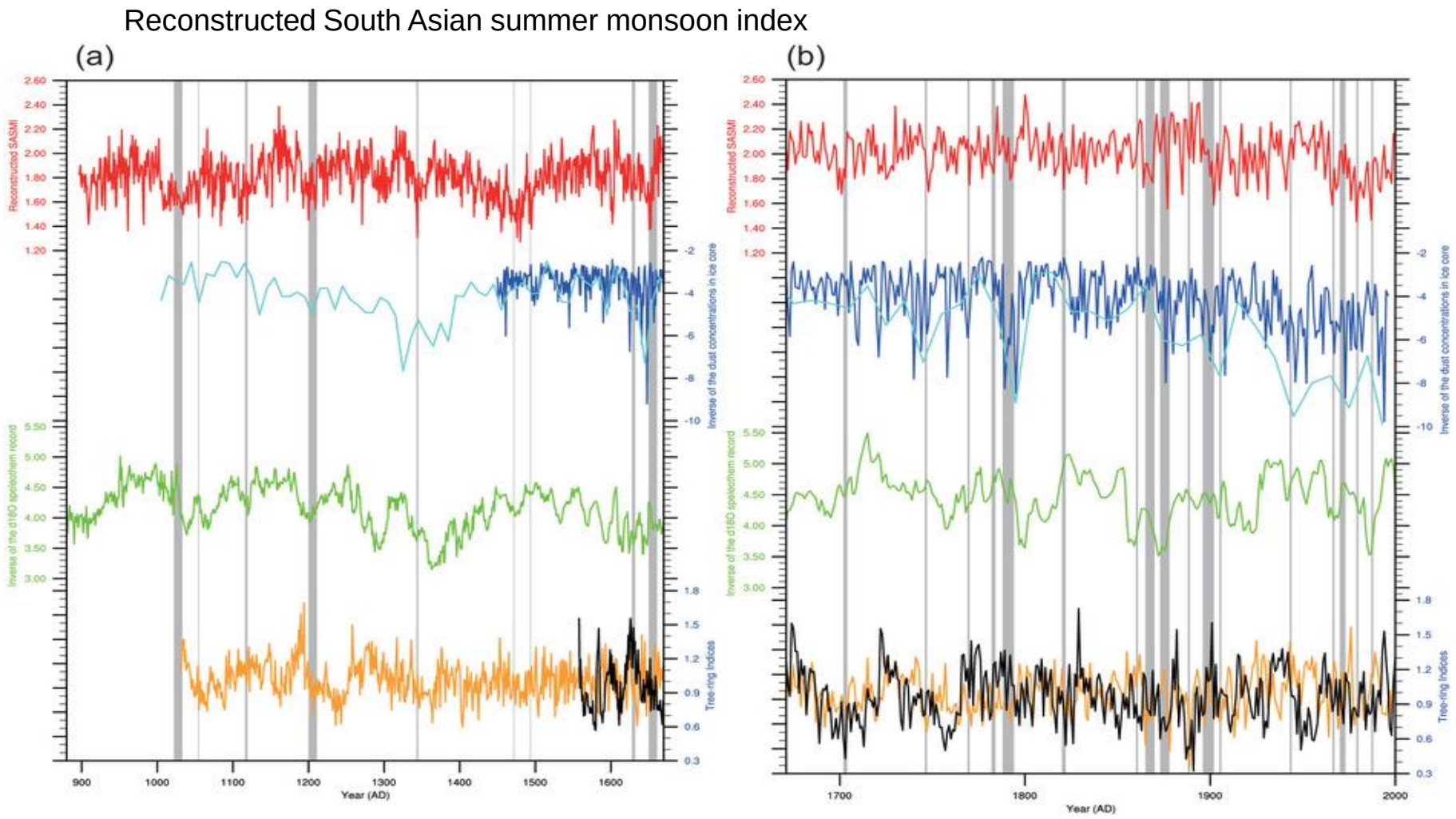
Little Ice Age Peak period 17th century

a,b, Fraction of ensemble members with extreme warm (red) or cold (blue) decadal temperatures in the Northern Hemisphere, (a) and Southern Hemisphere (b), respectively. Dark shading represents the reconstructions, light shading with black border the model simulations. c, Probabilities for simultaneous extreme periods in both hemispheres are calculated by multiplying the fractions in a and b. d, Volcanic (brown), solar (green) and greenhouse gas forcing(yellow) relative to 1961–1990. Dotted lines enclose the globally expressed peak Little Ice Age (LIA) 1594–1677. Source: Neukom et. al. (2014)

Possible realisations of what the system was doing.



Time series of the reconstructed South Asian summer monsoon index (SASMI) (red line), the decadal (cyan line) and annual (blue line) inverse of dust concentrations in ice core record1, the inverse of the δ18O speleothem record (green line)8, and the tree-ring chronologies from Mae Hong Son (MHS) (black line)12 and Bidoup Nui Ba National Park (BDNP) (orange line)11 before AD 1670 (a) and after AD 1671 (b). The grey periods indicate the 26 famine events identified in India over the past millennium. Source: Shi, Li and Wilson (2014). Tree ring data



Protracted CEI ENSO events reconstructed since A.D. 1525. The 17th Century episodes shown here in bold and in colour - El Niño (red) and La Niña (blue). Following Allan and D'Arrigo (1999), a protracted episode is defined as persisting for two years or more – only those of three years or more are shown. Source: From Gergis and Fowler (2009).

El Niño Episodes and durations

- 1964–1969 6
- 1957–1959 3
- 1937–1942 6
- 1924–1926 3
- 1918–1920 3
- 1911–1915 7
- 1876–1878 3
- 1864–1866 3
- 1856–1858 3
- 1844–1848 5
- 1814–1817 4

Total 24

- 1791–1794 4
- 1782–1784 3
- 1768–1771 4
- 1746–1748 3
- 1718–1724 7
- **1659–1661 3**
- **1650–1652 3**
- **1618–1621 4**
- **1607–1609 3**
- 1585–1583 3
- 1525–1527 3

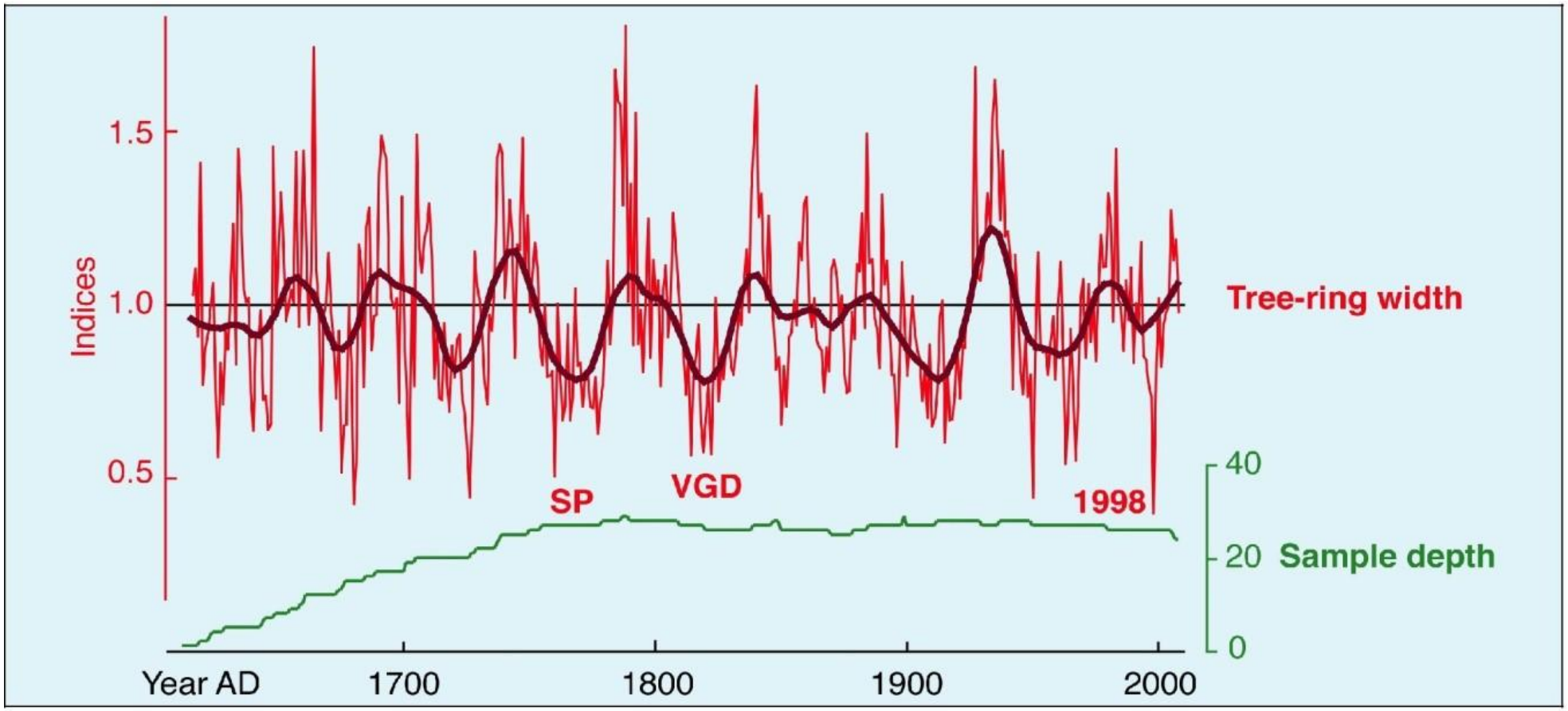
La Nina Episodes & Durations

- 1988–1990 3
- 1984–1986 3
- 1970–1975 6
- 1955–1960 6
- 1921–1923 3
- 1916–1918 3
- 1907–1910 4
- 1890–1894 5
- 1878–1880 3
- 1870–1875 6
- 1866–1868 3
- 1860–1864 5
- 1847–1851 5

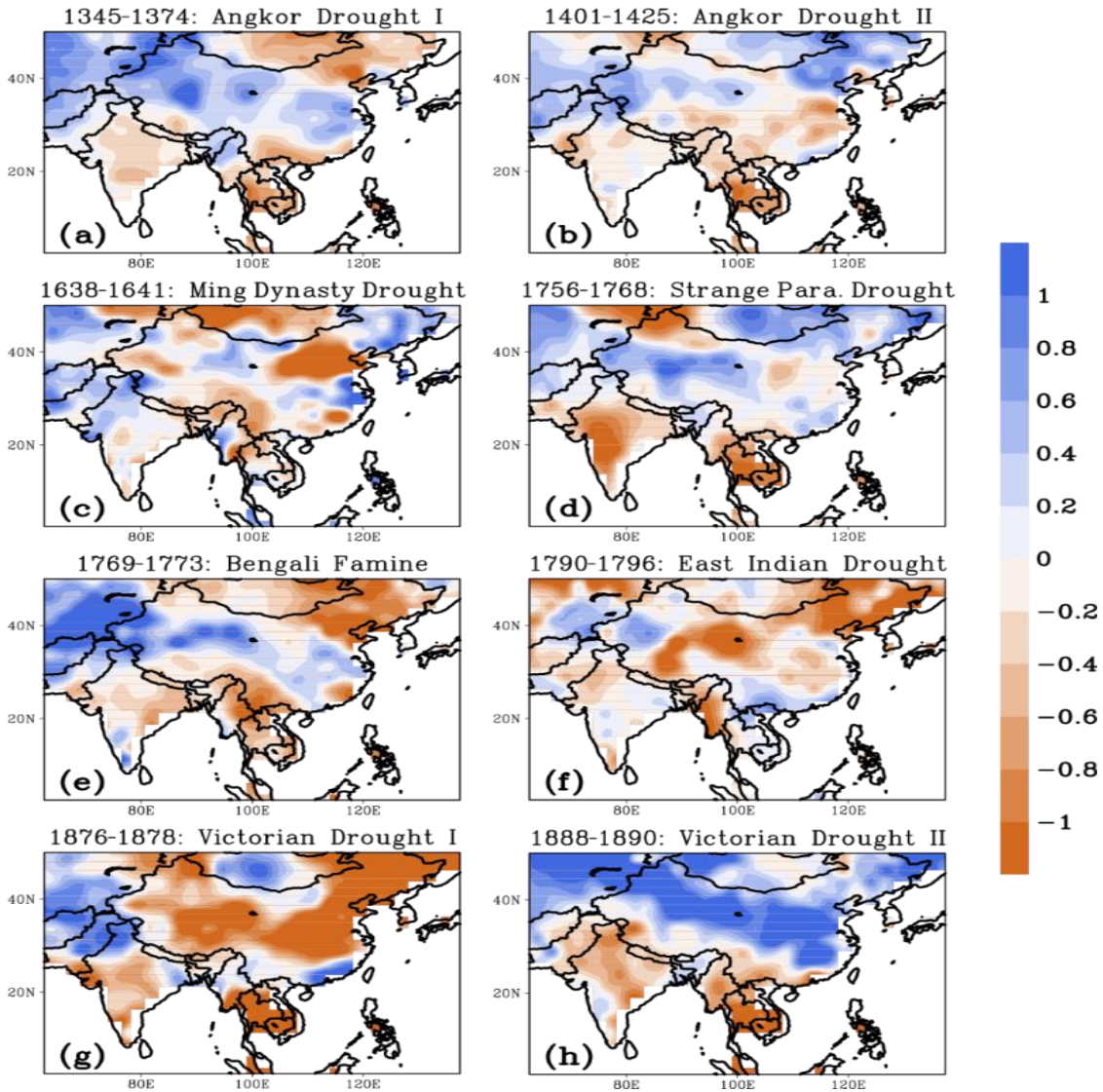
Total 26

- 1808–1811 4
- 1785–1790 6
- 1778–1780 3
- 1750–1758 9
- 1739–174p'3 5
- 1730–1733 4
- **1637–1639 3**
- **1622–1632 11**
- **1600–1605 6**
- 1576–1581 6
- 1571–1573 3
- 1540–1542 3
- 1531–1533 3

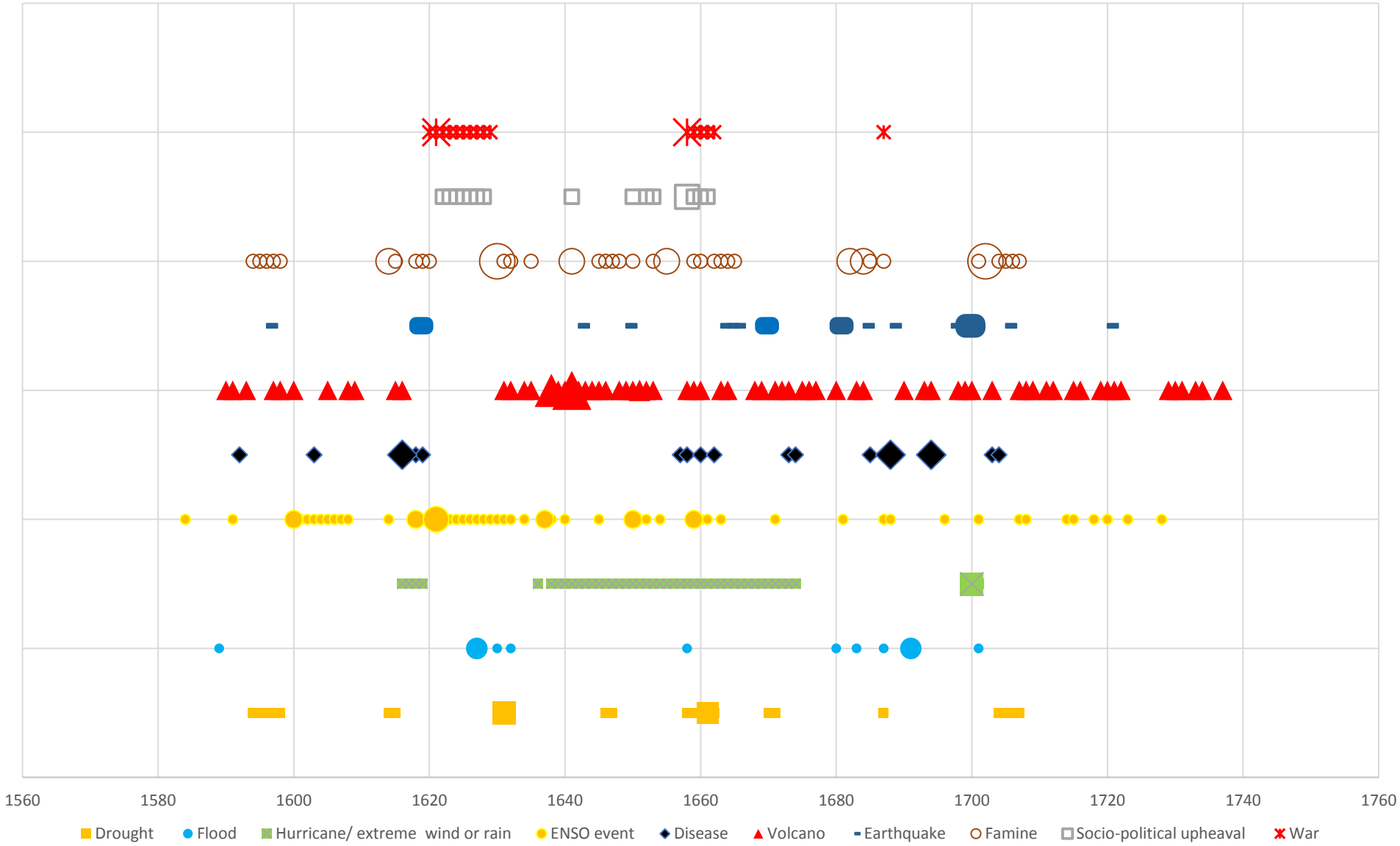
Tree-ring width chronology of teak (in dimensionless indices or values) for central Myanmar, spanning 1613-2009 AD, with sample depth (number of individual tree samples). Sample depth is near its peak over much of the chronology, gradually declining prior to the middle 1700s. Plot labels time of Strange Parallels (SP) drought in the 1700s, the late Victorian Great Drought (VGD), and narrow ring at time of 1997-98 "El Niño of the Century". Source D'Arrigo et al. (2013).



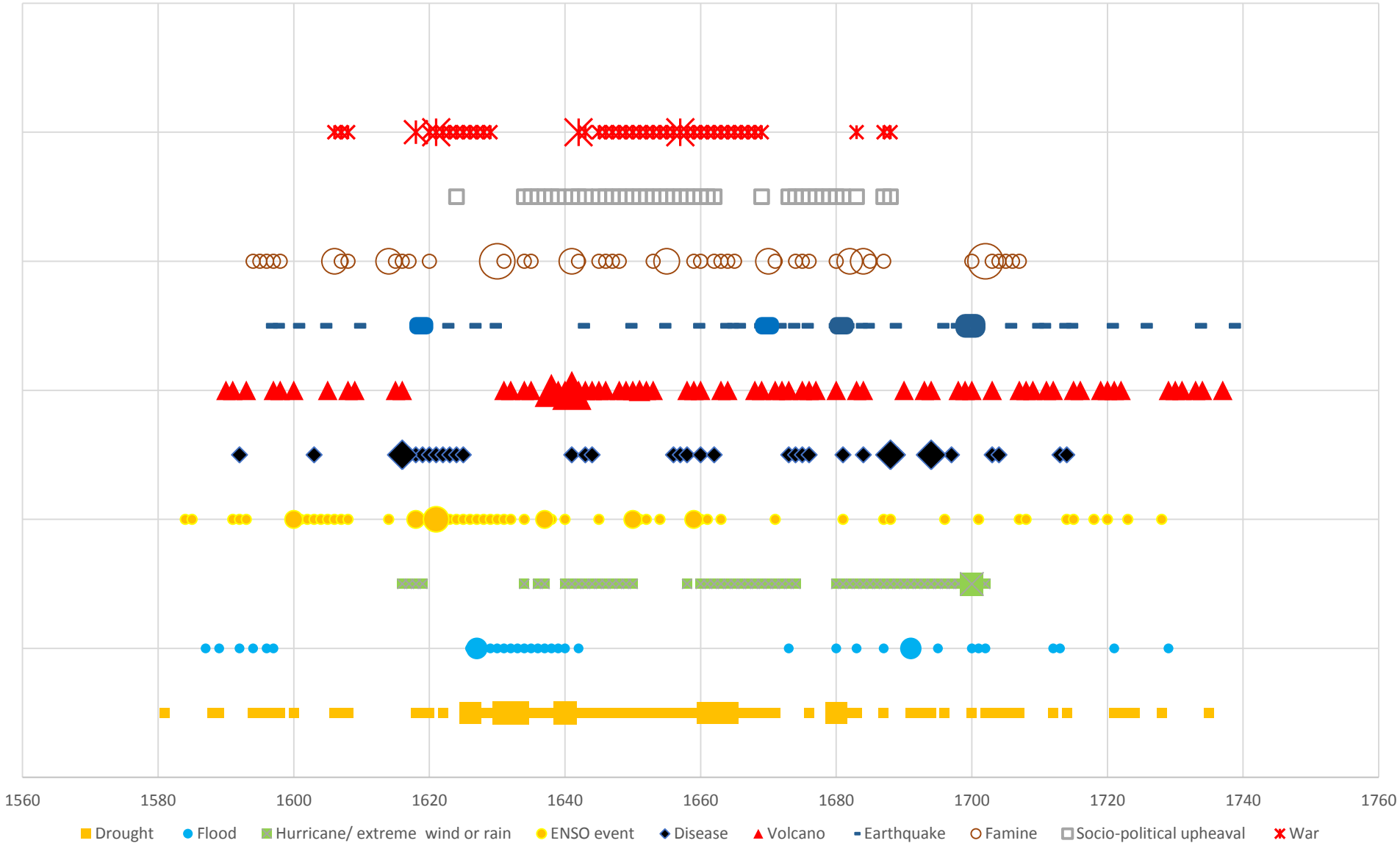
Palmer Drought Severity Index(PDSI) maps of the MADA data averaged for the period of years as indicated at the top of each panel and the corresponding historical drought across Monsoon Asia. Scale bar on the right shows relative values of PDSI, with negative values (red) indicating dry conditions and positive (blue) indicating wetness. Understanding the spatial footprint of these historically significant droughts is important for determining the primary causes for droughts of a particular magnitude. Data derived from the Monsoon Asian Drought Atlas, sites shown as red dots, overlaid with site locations of Wanxiang Cave, Dandak Cave, Annamite Range, and Angkor. Source: Buckley et al. (2014)



Plot of References to Natural Disasters, Wars and Societal Upheaval in the C17th India



Plot of References to Natural Disasters, Wars and Societal Upheaval in the C17th Indian Ocean Region



Significance for the IOW? ENSO, flooding and drought

- The plot for Indian Ocean region allow for identification of groupings and coincidences between various occurrences and events born of both natural and human causes
- In the seventeenth century incidence of ENSO happened twice as often
- 2 periods of sustained ENSO expression in the early part of the century, the first following 1600 and the second longer period from 1610-1630
- An extended period of regular drought 1625-1670
- A period of regular flooding 1625-1640
- Sustained period of warfare in 1620s and stretching from 1640s-1660s
- A coincidence of social upheaval, warfare, volcanic events, droughts, epidemic and famines early-mid century 1620-1640

Significance? Reduced solar energy, volcanic eruptions

- 1626-1640 droughts were accompanied by regular floods in China where between 1585 and 1645 and a 40% decline in population
- In 1627 and 1630 disastrous floods in Gujarat killed many whilst the 1632 famine in Deccan and Gujarat led to 3 m. loosing lives
- Reduced sun spot activity via an increase in cosmic ray incidence linked to low rainfall contributing to desiccation. The sources highlight the 1632 famine and the resulting cannibalism (Oberoi)
- 12 major eruptions between 1638 and 1644, three of which occurred in Java

The Parker thesis

- For Geoffrey Parker, *War, climate change and catastrophe in the seventeenth century* and Sam White, *Climates of Rebellion,* there is a robustness of evidence that a global cooling occurred in the seventeenth century
- The idea of a global crisis is here to stay and the fact that climate formed an integral part of it is accepted by these historians
- A central premise of the seventeenth century is that the synchronicity of the many disorders of mid-seventeenth century Eurasia was no accident
- The term first coined by English Marxist historian Hobsbawm*, Past and Present, 1954* and later taken up by Trevor Roper

Impact on Mughal India

- In the mid fourteenth century a combination of violent climate oscillation halved Europe's population and caused severe depopulation in Asia
- The years of the little ice age coincide well with the Mughal empire. The Mughal empire was spread over large parts of north and central India and the Deccan plateau. Long rule by emperors, Akbar 1556-1605, Jahangir, 1605-1627, Shahjahan, 1628-1659, and Aurangzeb, 1659-1707.
- Akbar's reign dominated by two major famines in Gujarat, 1556 and 1595 lasting three years. Man ate their own kin and the streets were blocked with corpses. Abul Fazl describing the horrors of this famine noted that the mortality was great. Abdul Qadit Badauni notes that the whole country was deserted and no husbandmen remained to till the ground.

A ‘moment’ of crisis

- In 1595 another famine caused by the failure of rains affected north India especially Kashmir and Lahore. The streets of Lahore were blocked up with human corpses as reported by Jesuit missionaries
- In 1618-19 there was famine in the Deccan and on the Coromandal coast. Methwald who left the East coast in 1622 writes about the ravages of the famine in Vijaynagara.
- In the reign of Shahjahan, during the protracted La Nina episode in 1630 31 a severe famine occurred which affected Golconda, Ahmednagar and parts of Malwa. According to Abdul Hamid Lahori no rainfall in the Mughal territories of the Deccan and Gujerat. The drought was followed by severe floods.
- The middle of the seventeenth century saw the weakest period of monsoons on record.
- The rains failed in 1646 and 1647. Heavy mortality was reported from Pulicat and Madras William Foster recorded that half the people in the area of Nagapatnam were dead and the stench of the dead bodies and the dying people was terrifying.

- The first year of Aurangzeb's reign was likewise marked by a famine of intense suffering causing unspeakable suffering in Northern and Central India. Col Tod noted, ‘there was no longer distinction of caste, sudra and Brahmin were indistinguishable. Men ate men’. Cities were depopulated. Bihar had a severe famine in 1671. The Bihar famine of 1670-71 encouraged the slave trade.
- In 1687 there was another severe famine that broke out in Golconda. In June 1687 saw floods and the city of Hyderabad was depopulated, houses, rivers and plains filled with corpses.
- From 1704-1707 another great famine hit the Deccan but this famine caused by drought was not so severe as that during the reign of Shah Jahan.

Crisis and decline and effect on living standards

- Parthasarathi (1998) uses a comparative real wage study of Britain and India to support the “California School” view that living standards in the most developed parts of Asia were on a par with the most developed parts of Europe as late as the end of the eighteenth century (Frank, 1998; Pomeranz, 2000).
- Broadberry and Gupta (2006) argue that the Great Divergence was already well underway during the early modern period.
- Broadberry and Gupta’s evidence of a prosperous India at the height of the Mughal Empire at the time of Akbar, much of this prosperity had disappeared by the eighteenth century.

Criticisms of Parker:
The concept of the LIA is not well defined

- Climatologists refer to the period as one of cooler average temperature prevailing at the end of the medieval warming to the beginning of our contemporary era of global warming
- Parker does not engage in this debate he simply appropriates the term to refer to the crisis and the little ice age referring to climatic conditions between 1610 and the winter of 1708-9
- Parker notes that three natural forces combine in this period, to generate cooler temperatures and greater climatic variability- reduced solar energy, increased volcanic activity and a greater frequency of El Niño

What makes these particular anomalies different?

- What makes these weather anomalies different from say a century earlier or a century later?
- Parker asserts that ‘the seventeenth century experienced extremes of weather seldom witnessed before or after and never so far since’ (p. 112) In his analysis LIA possesses a decisive agency revealing itself in striking weather events that intervened in historical processes influencing the outcome of battles, destroying empires
- The claim requires comparative and quantitative evidence, more detailed work on documentary and paleo sources
- Impacts are always asymmetric, simplistic notions such as weak or strong monsoons or intense El Niño episodes do no justice for the possibilities of variation in mode of expression and centres of action

The eighteenth century

- J Williamson and D. Clinginsmith believe that the political fragmentation of the eighteenth century following the collapse of the Mughal empire resulted in a decline in agricultural productivity that was reinforced by a devastating climatic shift and a steep upward trend in the frequency of droughts
- They argue that the 5 year drought 1788-1793 surpasses in severity any drought of the seventeenth century
- They also argue that India experienced a low rate of drought between 1650-1774. (Possibly using other data)
- Worsening climate enforced the impact of the Mughal empires decline
- As central Mughal authority waned, the state resorted increasingly to revenue farming an the practice became even more increasingly widespread in successor states. Revenue assessment increased to 50% or more compared to China's 5-6%
- The key extraction of peasant surplus was revenue demand and the British increased it further doubling it in some places. Midnapur *zamindars*' memorandum, 1791

Regional and national differences important

- The economic historian De Vries has identified problems with Parker's thesis
- 'The term crisis has come to encompass what for those engaged in the study of other centuries would term history'
- Was climate change the primary agent of seventeenth century demographic change?
- Williamson and Clingingsmith locate the most difficult climatic conditions in the mid 18th century though citing El Nino events
- LIA associated with highly differentiated demographic performance among states and regions
- Goldstone argues that shifts in the level of mortality were driven by largely autonomous patterns of epidemic disease in the early modern world
- Another approach which is more useful focuses on regional and national differences and the resilience of agricultural production in the face of population pressure, exogenous shocks and environmental change

The monsoon or the military?

- India’s population may have grown slowly in the seventeenth century when the Chinese population fell during the population of the Ming.
- Mughal building projects funded by taxation.
- Drought and famines struck with varying severity in the seventeenth century between 1629 and 1632 and 1702-1704.
- When the Mughal empire came to and end in 1760s it perhaps was not a result of the monsoon but of military overreach.

Famine causation complex: 1770 famine in Bengal Lessons from the 18 century

- Between 1765 when the British EIC took over Bengal to 1858 Bengal experienced 12 famines and 4 severe scarcities
- Knowledge of the ecological basis of different peasant economies is critical to the understanding of the capacity of certain communities to withstand drought and famine
- From the late eighteenth century many Indian communities were disturbed by the interventions of the EIC and their revenue and agricultural regimes which increased taxation, encouraged sedentarisation and attempted to restrict raids hunting and nomadism

EIC in Bengal and revenue extraction

- Periodic famines were seen as a check to population growth
- These Malthusian ideas which were voiced all through the colonial period in the pursuit of free market economics
- India like Ireland became a utilitarian laboratory where millions of lives were wagered against a dogmatic faith in markets overcoming the ‘inconvenience of dearth’.
- The oppressions of India…under the rapine and cruelties of the servants of the company have now reached England and there is a clamour here….to such monopolies were imputed the late famine in Bengal and the loss of 3 million inhabitants

Famine migration

- The famine of 1770 was preceded by a partial crop failure of the monsoon in Bengal and Bihar in 1768
- 1769-70 was a year of dearth, the fields of rice had become like fields of straw
- In the famine which ensured the mortality and beggary exceeded all expectation
- Many of the surviving peasants migrated to Nepal where the state was less confiscatory
- More revenue was collected in 1770-71 than in 1769-70. No remission was allowed by the EIC

Famine and disease

- The rain in September 1770 brought some relief, but it came too late to avert depopulation
- An epidemic of small pox killed millions
- By May 1770, 1/3 of the population was calculated to have disappeared. In June the deaths were returned as 6/16
- It was predicted that ½ of the cultivators and payers of revenue would have perished
- The final estimates 10 million. The failure of a single crop following one year of dearth had wiped out millions

Jungles, Banditry and Religious Rebellions

- The monsoon was on time in the next few years but the economy of Bengal had been drastically transformed
- Agricultural classes affected. Of the lime workers in Birbhum mortality was especially high only 5/150 survived. Mortality high among non-cultivating population as well, weavers, spinners, boatmen, salt and lime workers
- 1500 communities out of 6000 in Birbhum were destroyed and Birbhum returned to jungle inhabited by wild beasts
- In the years subsequent to the famine commencing with the cold weather of 1772 starving peasants with no seed or implements, burnt, pillaged and plundered in bands of 50-1000 men. Sanyasi rebellion, fakirs, mendicants

Conclusions

- The idea of a seventeenth century crisis for India requires more detailed mining of documentary and paleo sources.
- A more useful approach is one that focuses on regional and national differences and the resilience of agricultural production in the face of population pressure, exogenous shocks and environmental change.
- Famine causation is complex and links between drought and famine needs to be re assessed in the early modern period.
- There is a need to develop a database with our partners that will help us put together a clear famine series, climate series, disease series, wage series and price series for South Asia and the Indian Ocean world from 1500-1900 which is currently woefully inadequate.

CWEH partners