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Cross-disciplinary working in the sciences and humanities: historical data rescue activities in Southeast Asia and beyond

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Abstract

This paper argues that more work is needed to facilitate cross-disciplinary collaborations by scholars across the physical sciences and humanities to improve Data Rescue Activities (DARE). Debate over the scale and potential impact of anthropogenic global warming is one of the dominant narratives of the twenty-first century. Predicting future climates and determining how environment and society might be affected by climate change are global issues of social, economic and political importance. They require responses from different research communities and necessitate closer inter-disciplinary working relationships for an integrated approach. Improving the datasets required for long-term climate models is an important part of this process. Establishing a multi-disciplinary dialogue and approach to DARE activities is increasingly being recognised as the best way to achieve this. This paper focuses on the recovery of the long-term instrumental weather observations used for models and reconstructions of the climate over the past two-hundred years. Written from the perspective of an historian working in the field, it does not seek to explore the reconstructions themselves but the process of data gathering, advocating a closer working relationship between the arts, social sciences, and sciences to extend the geographic and temporal coverage of extant datasets. This is especially important for regions where data gaps exist currently. First, it will offer a justification for extending data recovery activities for Southeast Asia and the China Seas region. Second, it will offer a brief overview of the data recovery projects currently operating in that area and the typesof historic source material that are used. Third, it will explore the work currently being undertaken for Southeast Asia and China under the Atmospheric Circulation Reconstructions over the Earth initiative as an example of a successful cross-disciplinary program. Finally, it will argue the importance of advertising DARE activities across different fields and the benefits of a more joined-up discussion on potential data sources by exploring the use of the resource by the wider academic community.

Keywords: Historic weather observations, Data recovery, Southeast Asia

Introduction

Interdisciplinarism and weather records

The practice of using observational weather data gleaned from historical documents has long been considered complimentary to, albeit distinct from, paleoclimatic proxies for climate models and reconstructions. The importance of extending the baseline of documentary evidence further into the past has increasingly been recognised (Farrona et al. 2016; Stucki et al. 2015) and the value of contextualising the source material using historical methodologies has also been acknowledged for some time (Lamb 1982; Le Roy Ladurie 1959, 1972). However, this focus has only relatively recently gained traction outside of specialist fields (Mauch 2009, pp. 5–6; Behringer 2009; Schenk 2007; Bankoff et al. 2004).

Many convincing arguments are now being put forward for integrating environmental and climatic research and, making the best and widest possible use of the sources, across the physical sciences and humanities (Allan et al. 2016). In the field of data recovery, scientists, climatologists and meteorologists determine the types of data required. However, it is often archivists, librarians,

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geographers and historians who have the knowledge of the historic records themselves. This was the case in 2008, for example, when researchers working on behalf of (ACRE), in conjunction with archivists at the United Kingdom Hydrographic Office, uncovered a body of uncatalogued Royal Navy Remarks Books. The Remarks Books are essentially ship's log books (containing instrumental weather observations), from vessels that were engaged in global exploration and hydrographic surveys on behalf of Britain's Royal Navy from 1816 to 1909. To give a sense of the scale of the find, after 1861, there are an estimated 749,168 global daily records of air pressure (SLP), 474,435 air temperature (AT), and 677,444 sea-surface temperature (SST) (Wilkinson et al. 2008).

The benefits of fully collaborative and integrated cross-disciplinary research—rather than simply data gathering—are many. First, understanding the context of the data from an historical perspective is invaluable. Meteorological and/or maritime history provides essential information as to how original observations were made, from the level of scientific development of the organising body, to the type of instruments used. This has direct relevance for instrumental corrections and data homogenisation. There is also a broader argument for collaborative projects that work with not only the instrumental data but the whole source. Weather observations are found in a wide variety of historical documents that include, but are not limited to, ship log books, newspapers, medical records, scientific journals, government reports, gazettes or correspondence, prison and lighthouse records, or personal diaries. The simplest way of fully utilizing the source would be via an imaging project which preserves the data in context with the whole source document: both historians and climate scientists will then be enabled to extract information relevant to their needs. However, a fully integrated approach would be that of the historical climatologist (or historian of the climate depending on perspective) who argues that humans need to be put back into the story of the climate. Despite humanity's critical role in anthropogenic climate change, historical climatology has (with some exceptions) favoured climate reconstructions over socio-cultural interactions with, impacts on, and representations of, the climate (Mauelshagen 2014, p. 6). Whilst the data recovery component should not be lost, a fully integrated humanities/science project could factor in the human element of climate changes.

There have been several attempts amongst environmental historians and historical climatologists to do just this. One current example is the Arts and Humanities Research Council (AHRC) funded collaborative project 'Spaces of Experience and Horizons of Expectation': Extreme weather in the UK, past, present and future' run by a team of environmental historians, geographers and climate scientists, coordinated from the University of Nottingham. The team explored 'how people have understood, been affected by, and have responded to climate variability and extreme events' by collecting historic narrative and data.[1] Another multi-disciplinary example is the Centre for World Environmental History (CWEH) and McGill University's collaborative project on 'Human Environment Interaction in the Indian Ocean World' which uses historic climate models and visualisations alongside archival material to explore how people have engaged with the climate across the c. eighteenth–nineteenth century Indian Ocean World. Over the course of the project, high-resolution documentary data will also be brought together with that from the Major Collaborative Research Initiatives (MCRI) database and, analysed with technologies such as GIS, to re-look at the past 2000 years climate.[2] Past examples include the UK Arts and Humanities Research Council (AHRC) funded Historic Weather Network which again worked across science and humanities fields to investigate the climate of the past.[3]

This paper will advocate a closer working relationship between the arts, social sciences, and sciences to extend the geographic and temporal coverage of extant datasets. This is especially important for regions where data gaps exist currently. First, it will offer a justification for extending data recovery activities for Southeast Asia and the China Seas region. Second, it will offer a brief overview of the data recovery projects currently operating in that area and the types of historic source material that are used. Third, it will explore the work currently being undertaken for Southeast Asia and China under the Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative as an example of a successful cross-disciplinary program. Finally, it will argue the importance of advertising DARE activities across different fields and the benefits of a more joined-up discussion on potential data sources by exploring the use of the resource by the wider academic community.

Discussion

The need for improved, multi-disciplinary DARE projects for Southeast Asia

Data rescue in this context is the process of sourcing and preserving historic instrumental weather observations. This might be as simple as researching sources of historic data which are already in digital format (such as online

[1] http://www.nottingham.ac.uk/research/groups/weather-extremes/index.aspx.

[2] http://www.sussex.ac.uk/cweh/research/historicalclimatology/mcgill.

[3] http://www.euro4m.eu/Presentations_ACRE/Hughes_knmi.pdf.

gazettes and journals) but are not widely known to the climate community. Once located, data is digitized so that it is usable. An example of this is the recent digitisation of weather observations from Port Moresby, Papua New Guinea 1892–1895. The data was published originally in the British New Guinea Government Gazette and uncovered as a result of the Historical Meteorological Recordings from the UK Colonial Registers and Royal Navy Logbooks (CORRAL) project and held online by the Centre for Environmental Data Analysis (CEDA). It has recently been digitised by ACRE. In other cases, data rescue follows the process from start to finish, uncovering and preserving the original documents which might otherwise be lost due to the deterioration of the medium (usually paper or microfilm). Preservation normally involves the digital imaging of the original source and the latter transfer of information from that source through digitisation. In most cases, the original medium is also put into conservation.

DARE is essential for the preservation of data needed to understand changes in climate and its extremes. Without DARE activities, much of this data will be lost forever. This is especially important in countries where historic data is currently limited and, data is only held in perishable formats. This is a particular issue in Southeast Asia where—prior to 1950—digitised observational data is limited but often exists in hard copy in a variety of repositories. However, it is the case for many Southeast Asian countries that resources for DARE such as staff and equipment, are limited or unavailable.

Current datasets demonstrate this lack of data quite clearly. NOAA's National Centers for Environmental Information (NEI), (formerly NCDC), one of the largest repositories for historic global climate data by station, has a limited amount for the Southeast and East Asian region before 1950. For example, there are no daily summaries for any perimeter prior to 1950 and monthly summaries are limited to temperature and precipitation for a few stations. The earliest observations are precipitation from a station in the Andaman Islands between 1913 and 1940, 1947; one station recording temperature and rainfall in South Korea from 1927 (two stations from 1939); four stations in Thailand from 1943; two stations on the east coast of China (including Hong Kong) and two in the Philippines recording temperature and rainfall from 1946. It is only from 1950 that we see a marked increase in the number of stations and the countries included, for example, Malaysia and Indonesia (NEI, 2016).

The lack of data for some areas of Southeast Asia is illustrated in the following summary (in various stages of the recovery process) (Table 1).

It is vital that we act now to source and preserve data for this region before it is too late. Observational data is so important because it underpins the climate models and reanalyses used to explore how the climate is changing over time. The purpose of reanalysis, e.g. 20CR is to produce the longest possible instrument-based estimates of global weather and climate for comparison to paleoclimate reconstructions and climate model simulations (Brohan et al. 2012). To get the best possible results, it is essential that data is of good quality and has limited temporal and geographic gaps. Reanalyses products are widely used in the energy, agricultural, insurance (and re-insurance), and water sectors.[4] It is also possible to use observational data to reconstruct extreme weather events and/or nature-induced disasters (Brohan et al. 2016).

The ideal scenario is for variety of sources to form the basis of climate reconstructions, in order that a clear picture emerges. By way of example, the ENSO reconstructions of Gergis and Fowler, who used percentile-based paleoclimate data found that 43 % of extreme, and 28 % of protracted ENSO events occurred during the twentieth century, with 30 % of these occurring post 1940 (Gergis and Fowler 2009). It is interesting to note that studies based on paleo records, or historic documentation alone, reveal different ENSO patterns for the pre 1940s period. Take, for example, the difference in the Nino 3 Index Reconstruction by Cook, that uses tree ring data, and the classic dataset compiled by Quinn updated in the early 90 s (Quinn et al. 1987, 1992, 1993) based on historic records. Enriching the observational record will go some way to eliminating, or at the very least mitigating, the biases and limitations of each proxy (Gergis and Fowler 2009; Jones and Mann 2004). Filling the gaps in Southeast Asia is not only important in reducing differences in pre and post 1940s reconstructions for ENSO, but also for enhancing climate reconstructions more generally. As Gergis and Fowler argue, the ideal ENSO reconstruction uses all available annual resolution proxies. Something that currently 'is hardly even possible for the 20th century due to the limited spatial coverage of instrumental data' (Gergis and Fowler 2009).

The sourcing and recovery of data is not only relevant for the climate community. Narrative sources and data sources can be complimentary. An historian investigating the severity of an historic flood, for example, might use contemporary rainfall figures as evidence of intensity, or to argue that man-made factors were more important in creating the scale of the disaster than heavy rains (Williamson 2016). During the research process, other information can be gleaned from the record that is directly

[4] https://reanalyses.org.

Table 1 Table showing an overview of pre-1950s observational weather data for Southeast Asia collated by ACRE

Country	Date range	Repositories	Data type	Coverage	Notes
Cambodia	1894–1947, 1931–1969	National Archives of Cambodia, Phnom Penh; JMA; CISL RDA; Bulletin Economique de'Indo-Chine; JMA; CISL RDA	Rainfall, air temperature	Phnom Penh and 4 stations around Cambodia	Scattered coverage, majority monthly averages for early period
Indo-China (Cambodia, Lao PDR, Vietnam)	1902–1903, 1927–1952	NOAA Library; Bulletin Economique de'Indo-Chine; ISPD	7 perimeters, including air temperature and pressure.	Up to 55 stations	Scattered coverage, majority monthly averages for early period
Lao PDR	1930–1950	DMA; CISL RDA; Bulletin Economique de'Indo-Chine	Temperature, SLP, StnP, rainfall.		1930–1950 holdings at DMH are in hard copy only.
Malaysia	1823, 1863–1865, 1869, 1877–1915, 1929–1950	UKMO Archive; ACRE; MMD; NAM; NA; Royal Society, UK.	Up to 9 perimeters	Penang, Province Wellesley and Malacca. Increasing to 29 stations by 1885 (including Singapore).	NB Monthly and yearly averages available from 1877 continuously, scattered sub-daily from 1869. Consistent sub-daily from 1929.
Myanmar	1875–1940	UKMO Archives/ISPD		6 stations	Scattered coverage, majority monthly averages for early period
Singapore	1840–1845, 1847, 1863–1865, 1868–1940, 1946–	UKMO; UK Climatological Returns; British Geological Survey; MSS; CSS; ISPD, Royal Society, London; British Library, London	Up to 9 perimeters		
Thailand	1846–1890, 1900–	NOAA; TMD; UKMO; National Archive of Australia; Journal of the Siam Society; TNA; FFCUL; National Meteorological Library Archive; JMA; CISL RDA	Up to 6 perimeters	Bangkok	Only rainfall consistent from 1846 to 1890 for Bangkok (TNA: Pollachai 2014)

NB This list is not exhaustive

useful to historical studies of the weather, environment, or nature-induced disaster. Narrative and documentary evidence containing weather observations often also includes reference to social, economic, political and environmental factors. Contemporary accounts of typhoons in government documents, newspapers, diaries, and even literature, for instance, can be revealing of the destructive impact of the storm on a town or city (Warren 2015; Kin-shuen and Kam-bui 2003); ship logs books can tell us about the socio-economic impact of the extreme weather they encountered (Warren 2012); government records can reveal the evolution of meteorological history (Bickers 2016) or, a combination of narrative and data sources can determine historical flood frequency and impact (Kjeldsen 2014). The following example from a newspaper in 1831, reveals a sensational story for a maritime or meteorological historian, as well as including observational data. This account of two hurricanes in the Indian Ocean was included in the 7 May 1831 edition of the British journal, *The Spectator*

In our shipping list of last week, we stated that the Reliance on her voyage from China bad encountered a dreadful hurricane, in lat. 18 south, long. 85 east. It will be remembered that, last year the Company's ship, Bridgewater, was dismasted nearly in the same lat. and long. The extraordinary circumstance of hurricanes occurring in two successive years in the heart of the South East trade, has attracted the notice of nautical men, and we have been requested to give insertion to the following extracts from the Log of the Reliance, as a warning to navigators … [with the] barometer down to 28° 70″ … The sea had now risen to mountains … It blew a hurricane, and the many severe gales hitherto witnessed gave no idea how terrific this was; all the top-gallant masts were blown away, and the larboard quarter boat up to the mizen-top; the other to leeward soon vanished. The roaring of the wind was appalling, laying the ship on her bears ends, and the lower yard-arms in the heavy sea, which overwhelmed and flowed over her, tearing away all her lee barricading, and nearly lifting the sheet anchor on board.'[5]

Further down the line, recovered (i.e. imaged) sources can be used in different ways, especially if the DARE project involves the imaging of the entire source, not simply the data element. As meteorological data and narrative description are often, though not always, found within the same historic source material, imaging the original source has great potential for scholars across many fields. This was the case for a major project carried out in 2008 by the British Library in conjunction with ACRE, CDMP and the University of Sunderland (Brohan et al. 2012; Freeman and Ross 2009). The project focused on weather observations made in log books from the British East India Company held at the British Library India Office. Images were made of the whole book page which meant that not only was the weather information preserved but the context. The logs offer a fascinating account of life at sea, including medical practices, passenger lists, botany, and explorations of new lands to name but a few. Other examples of joint-working on DARE activities are the CLIWOC and RECLAIM projects.[6] These linked projects imaged logs held at Britain's National Maritime Museum (NMM) and National Archive from ships that travelled from Britain across the globe (Wilkinson 2010). These log books were kept by ship's captains, or in some cases a first mate, who were required to make sub-daily observations of the weather. Log books are a vast resource, covering private as well as national shipping organisations, merchant fleets and national navies (Nash and Adamson 2013; Wheeler 2009). In the above-mentioned cases, research teams comprised historians, geographers and climatologists.

Another example, more specifically focused on Southeast Asia, is a current joint project between science and humanities participants from the UKMO and the National University of Singapore, to reconstruct the circumstances underpinning the massive October 1831 flooding of the Ping River in Siam (Thailand). Identified initially through river sediment analysis, part of this project involves searching for synoptic (daily/sub-daily) instrumental pressure and weather observations for the Indian and Southeast Asian region during the 'protracted' La Nina period from 1830 to 1832 to support the paleo evidence. There is currently a gap in instrumental coverage for the flooding region itself, but information gathered so far suggests a major depression remnant from a typhoon that came into Southeast Asia from across the Philippines, possibly enhanced by the 'protracted' La Nina. With more synoptic pressure data from across the region, a reanalysis could be generated using 20th Century Reanalysis (20CR). This effort can only be achieved, however, by engagement from a wide range of collaborators, with expertise on early nineteenth century documentation and front-end research into extant historical sources.

Multi-use documentary evidence: some examples

Documentary evidence of Southeast Asian weather relevant to different user communities is scattered across

[5] http://archive.spectator.co.uk/article/7th-may-1831/11/east-india-shipping-in-our-shipping-list-of-last-w.

[6] http://pendientedemigracion.ucm.es/info/cliwoc/ and http://icoads.noaa.gov/reclaim/southern.html.

archives, libraries, meteorological services and museums. Sources include (but are not limited to) lighthouse and tidal observatory records, medical records, private letters, diaries, and government reports. Occasionally there is overlap between repositories. This is a particular issue in ex-colonial countries where records are held by former colonial powers, as well as in the country itself. This is not necessarily a problem as it presents more opportunity to recover information. Equally, information about marine Southeast Asia may be held by other countries which had large navies or trading companies. For the world's seas and oceans, ship log books are an excellent resource for understanding marine weather conditions (Naylor 2015). European seamen serving on marine voyages have been compelled to make observations of the weather for several centuries and, during the late-eighteenth century these observations were made using recognisably 'modern' scientific instruments. The English East India Company (EEIC), for instance, recorded sub-daily instrumental observations from the 1780s onwards. Their voyages spanned the Atlantic and Indian Ocean region (Brohan et al. 2012). The following is a good example of a log book from a US naval ship in the estuary of what was then known as the Canton River (Pearl River), near the Boca Tigris (Tiger Gate) (Fig. 1).

Professionals interested in better understanding the weather, including ship's officers and natural philosophers, also kept weather diaries during their travels, or at home. The private journal of Captain Thomas Alexander, for example, made between 1822 and 1824 whilst he was stationed at Penang Island, Malaysia, contains a detailed daily table of the weather during May, June and July, 1823 alongside a record of his stay (Fig. 2).

A major source of observational data are of course the records of meteorological registering stations, which are today held in meteorological service archives, or were published contemporaneously in newspapers and special interest journals. Not all stations were run by meteorological services, however, as these were rare before the 1880s. In British Malaya, for example, weather observations were kept at hospitals under the guidance of the medical branch of the British administration throughout the nineteenth century, before transfer to the Museums Department, and finally the survey Department in 1927. In 1929, all services became independent under the newly formed Malayan Meteorological Department.[7] Most Western governments established national meteorological services in the mid-to-late nineteenth century. Their role was significantly different from today. A large part of their work comprised making systematic observations, in keeping with the contemporary idea that the prime function of the service was to build a comprehensive record of the weather by taking simultaneous observations over a wide geographic area (Moore 2015, p. 132, Williamson 2015, pp. 480–481; Golinski 2007, p. 210). Information gathering, not forecasting, was the aim of these early services. It was thought at the time that, if patterns could be identified, then weather could be understood. This method ran in tandem with greater engagement in naming and classifying weather phenomenon (Hamblyn 2001). The practice of making regular observations was extended across the former French, German, and British colonies in Asia, from where we now have surviving records from registering stations across the nineteenth century, albeit only systematically from the 1870s. Their records consist of sub-daily or daily observations usually comprising rainfall, temperature, and pressure. Today, many of the observations made under colonial governments in Asia is held in the libraries and archives of France, Germany, Holland, Portugal, and Britain, although copies have, in some cases, been reunited with their country of origin. A good example of this is the University of Lisbon's ongoing effort to recover (image and/or digitise) historic meteorological data from the former Portuguese colony of Macau as part of an ACRE-FFCUL collaboration under ERA-CLIM2. Their data covers the period 1894–1914.

Many Asian governments also established national meteorological services by the end of the nineteenth, or very early twentieth century. The Chinese authorities were active in collecting sub-daily instrumental observations across various provinces from the late-nineteenth century. Some of the earliest recovered so far were recorded in Beijing in 1868 but Wuhan (1880), Shenyang (1887), and Chongqing (1891) also stand out.[8] In other parts of East Asia, Taiwan had established six observing stations by 1897 (Shieh et al. 1998) and South Korea had a modern weather service from 1904.[9] Several modern-day Asian meteorological services, including the CMA, KMA, CWB, CSS and PAGASA are currently engaged in, or have already undertaken excellent in-house data recovery programs in an attempt to image and/or digitise as much of their country's early data as possible. Nevertheless, this is not the full extent of Asian observations. Many places have long traditions of weather watching. South Korea and China are two good examples. Korean scholars were watching the skies and noting extreme or unusual weather events across the Joseon dynasty (1392–1910) and likely earlier. A network of rain gauges

[7] NAS: CO273/541/1-17, Straits Settlements Original Correspondence, 01.01.2927-31.12.1928.

[8] Information courtesy of Prof. Guoyu Ren, CMA and ACRE China.

[9] http://web.kma.go.kr/eng/aboutkma/briefhistory.jsp.

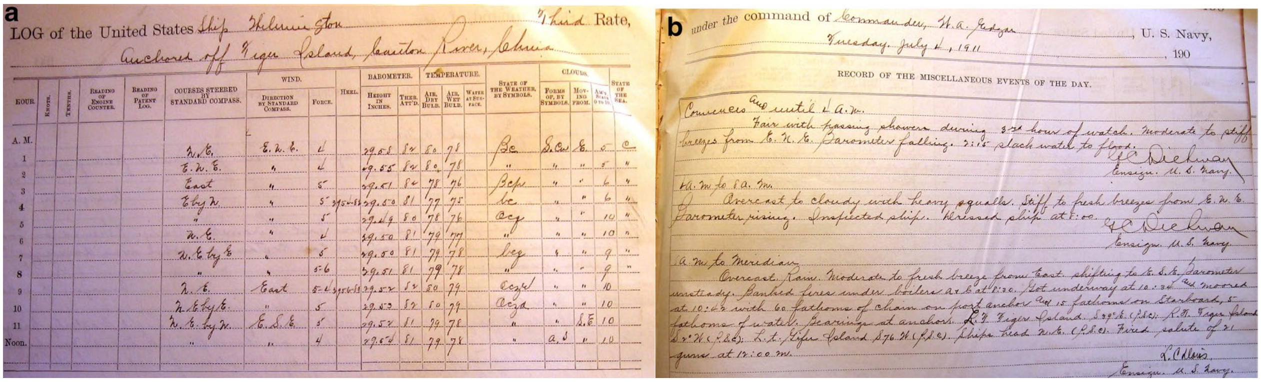

Fig. 1 Deck Log, USS Wilmington 1 July 1911, RG 24, US National Archives, Washington DC. Source courtesy of Dr. Cary Mock, University of South Carolina. For more information on this source, see Mock (2012).

was established under King Sejong the Great in 1441 (Park 2005, p. 100). In China, 'oracle stones' of the Shang dynasty (3700–3100) have been used by modern scholars as a record of contemporary weather (Nash and Adamson 2013, p. 4; Bradley 1999, p. 518) and, rain and snow gauges were placed in cities and in mountain passes from the 1200s (Strangeways 2010). In eighteenth century eastern China, the French Jesuit missionary Joseph Amiot made weather observations as early as 1743.

Data recovery in Southeast Asia and beyond: current status

Overview

In addition to the DARE programs mentioned earlier, several projects have been, or are, underway to facilitate data recovery in the Southeast Asian region. These include, but are not limited to, the Digitisasi Data Historis (DiDaH) joint project by the National Meteorological Services of Indonesia (BMKG) and the Netherlands (KNMI) 'focusing on the digitization and use of high-resolution historical climate data from Indonesia' from 1850 onwards.[10] As already noted above, the University of Lisbon is imaging and digitising 19th and 20th century sub-daily data for the former Portuguese colony of Macau (China), for surface and upper air data, financed by ERA-CLIM2. The results of this part of the project, now almost complete, will feed into 20th Century Reanalyses used by the ECMWF and UKMO amongst others. In addition, a program within the Timor Leste Ministry of Agriculture and Fisheries (MAF) known as Seeds of Life, has digitised rainfall data for Timor Leste from 1914 onwards, and stream flow data from 1952.[11]

ACRE Southeast Asia and ACRE China

The international ACRE initiative was conceived in 2006 in order to meet a need for improved DARE activities globally. ACRE has five core partners—the Queensland State Government in Australia; the Met Office Hadley Centre in the UK; the US National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory and Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado; and the universities of Giessen in Germany and Bern in Switzerland (Allan 2010). ACRE also works closely with the International Environmental Data Rescue Organisation (IEDRO). IEDRO provide much of the 'hands-on' expertise for country-specific data rescue activities.[12] ACRE, ratified by WMO's Commission for Climatology in 2010, acts as an umbrella organisation linking more than thirty-five disparate projects focusing on recovering historic weather observations (marine and terrestrial), but also provides front-end research into sources of weather observations over the last two-hundred years and, facilitates the imaging and digitisation of the same. Digitised data covering a period of 140 years has already been released into the public domain and, by doing so, ACRE has contributed to a new global estimate of weather patterns. Currently, weather reconstructions mainly focus on the period post-1948. What ACRE is doing is making it possible to extend these datasets back to explore weather and climate change over a much longer timescale (Allan 2010, 2011). By way of example, ACRE's data has been fed into the 20th Century Reanalysis Project (20CR) (Compo et al. 2011).

Since 2006, ACRE has extended its reach to Asia. ACRE Southeast Asia (ACRE SEA) began work officially in 2013 with the aim of sourcing and recovering data across a region of currently sparse coverage. ACRE SEA

[10] http://www.didah.org.

[11] http://iedro.org.

[12] http://icoads.noaa.gov.

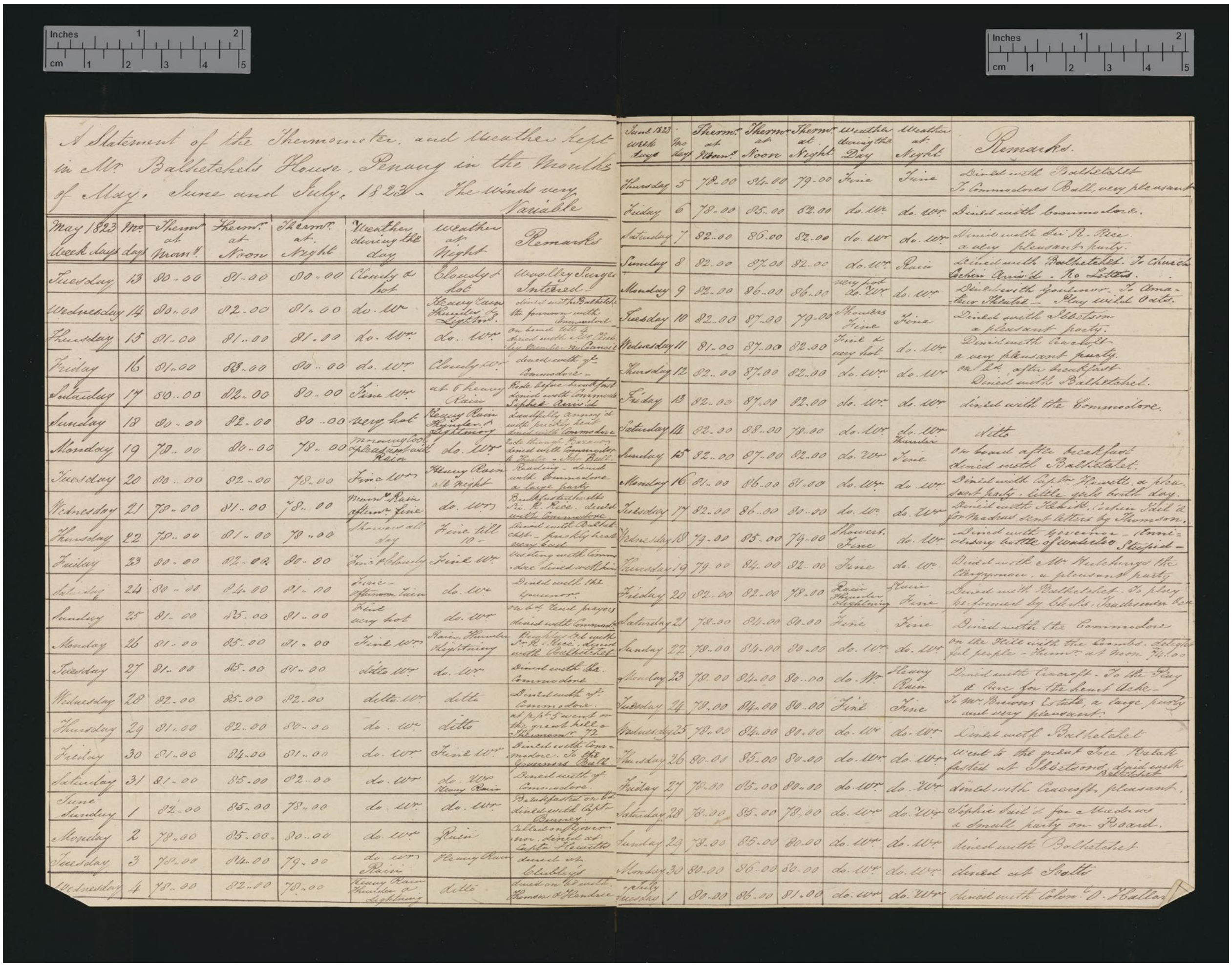

Fig. 2 Cambridge University Archive, MS. Add.7223: Extract from the private journal of Captain Thomas Alexander made between 1822 and 1824

currently investigates sources extant in Cambodia, Lao PDR, Thailand, Vietnam, Malaysia, Singapore, and the Philippines; South Korea and Taiwan in East Asia, and the special administrative region of China, Macau. It is closely involved with scholars and scientists working in China, Hong Kong and Japan, where many data for this region are currently being recovered under programs run by the China Meteorological Administration (CMA), City University Hong Kong, the Hong Kong Observatory, and Japan Agency for Marine Earth Science and Technology (JAMSTEC). ACRE SEA is currently building a database of all known extant data in, or relating to, Southeast Asia with the help of their partners. Data includes that which has already been digitised but is not widely known by the global scientific/academic community and, importantly, that which is still in hard copy. Where data remains in hard copy formats, funds are then sought for DARE activities to recover and bring this data to public attention. Rescued data is fed into international databases, including ICOADS[13], the ISPD[14], or the World Data Centre via the International Surface Temperatures Initiative.[15] The ACRE initiative is also closely involved with WMO and GFCS' new International Data Rescue (I-DARE) Portal. This is a significant step in making data available and accessible to the scholarly community and the general public.

Under the ACRE umbrella, ACRE China is being developed by experts at the China Meteorological Administration (CMA). The inaugural of ACRE China workshop was held in 2016 at CMA offices in Beijing with the support of the CMA, Beijing Climate Centre (BCC), the UK Hadley Centre, and the China University of Geosciences (CUG). Since the beginning of 2015, the National Meteorological

[13] https://reanalyses.org/observations/international-surface-pressure-data-bank.

[14] http://www.surfacetemperatures.org/home.

[15] https://idare-portal.org/content/international-data-rescue-i-dare-portal.

Information Center (NMIC) has digitised sub-daily temperature and precipitation data up to 1953 for 19 stations in mainland China and pre 1954 sub-daily surface air pressure data for 13 stations. Research work into new sources of data continues with ACRE China participants at CMA and NMIC actively working with regional archives at Shenyang City and Dalian City, amongst others.

A principle element of ACRE is the commitment to working with humanities organisations and projects to fully utilise the possibilities of historical weather records. To this end, ACRE has formed a relationship with various public facing humanities initiatives. One past example was the Botanical and Meteorological History of the Indian Ocean World research project. Based at the Centre for World Environmental History at the University of Sussex, UK, their joint research agenda melded two complementing foci. First, to think about the development of environmental knowledge across the British Empire and, second, to map the historic climate archive and to model specific climate events for the Indian Ocean region. It is here that we can see a good example of interdisciplinarity. The same sets of data, or data sources, are collected by researchers and studied as historical and as scientific sources. The context of the document can be revealing of how knowledge was shared and transferred across the world, and the data itself can be used to enhance climate databases and reconstructions. At the same time, case-studies of specific weather events can be studied from a social, as well as climatic perspective thinking, for example, about human impact, or the frequency of extreme weather events over time.

ACRE's meetings and workshops also include a range of invitees and speakers from different fields including historians, archivists, librarians, and physical scientists. This provides an ideal venue for scholars from different backgrounds and countries to mix, share knowledge and ideas. This has had particular value in highlighting new sources of weather observations, as well as thinking about ways to recover, store and digitise data on a mass scale. The contributions of organisations such as IEDRO, the British Library, Galaxy Zoo, and the Citizen Science Alliance have been invaluable in this respect. Information about ACRE and other regional data recovery projects can be found on the developing I-DARE website, part of a joint WMO/GCFS initiative.[16]

Conclusions: arguments for enhancing interdisciplinary working

Much recovered data for the 1850–1950 period has been used to underpin reconstructions, particularly of ENSO events (Allan and D'Arrigo 1999); case-studies of especially violent storms or typhoons (Stucki et al. 2015; Ribera et al. 2011; Grossman and Zaiki 2009; Kubota and Chan 2009), flood frequency and cause (Lim 2012), or to track climate trends (Mikami and Zaiki 2015). However, there are also number of scholars from humanities backgrounds, especially geography and history, using historic records of weather and nature-induced disaster as a way of exploring the 'long-term frequency and magnitude of extreme events' (MacDonald 2007, p. 136), or to examine climatic and environmental processes. Climatic processes are not distinct from society and culture. Indeed, the Anthropocene—the period to which observational data belongs—is the perfect example of the interconnection between man and nature. Climate, and changes to climate, cannot be distanced from complex social, political, economic, and even cultural, processes. Disasters resulting from extreme weather, for example, are only 'nature-induced'; their scale and impact is exacerbated by social processes including urbanisation (Pfister 2009).The extension of systematic comparative research into disasters is discussed at length by several scholars, who highlight the limitations of current studies (Bavel and Curtis 2016; Lübken and Mauch 2011; Bankoff 2003).

Opening a dialogue to enable a knowledge exchange between people working across different fields is one positive way to enhance joint-working and provide opportunities for collaborative studies. This can be achieved by encouraging more multi-disciplinary workshops and projects regionally. Successful joint-working can only be achieved, however, by addressing perceptions of how, for example, historians can work with scientists. Currently, there is some bias toward thinking that historians can undertake the task of data collection, without considering the benefits of a two-way interaction between the fields. The way in which academic publishing promotes dedicated journals for specific fields also creates a gap as they are pitched for very different audiences and interests. Terminology and field-based precedent and/or historiography likewise heightens the issue (Allan et al. 2016). Historical climatologists and hydrologists have gone some way to address the gap. They combine theoretical and methodological approaches and primary materials from the natural sciences, and the social sciences/humanities (Brádzil et al. 2006; Mauelshagen 2014, p. 2). Both fields look toward reconstructions to understand the past but, unlike approaches purely from the sciences, explore the cultural interactions of climate and society, and issues of impact, vulnerability and resilience (Galloway 2013; Rohr 2013). However, whilst such approaches have become relatively popular over recent years, relatively few studies have integrated humanities methodologies with long-term

[16] https://www.idare-portal.org/

observational datasets or, have focused on Southeast Asia. There remains much more to be done to broaden and open cross-field communications, and avenues for publishing and collaborative projects.

Abbreviations

ACRE: Atmospheric Circulation Reconstructions over the Earth; AHRC: Arts and Humanities Research Council; BAMS: Bulletin of the American Meteorological Society; CEDA: Centre for Environmental Data Analysis; CDMP: Climate Database Modernisation Program; CISL RDA: Computational and Information Systems Laboratory Research Data Archive; CWEH: Centre for World Environmental History; NCAR: National Centre for Atmospheric Research; CLIWOC: Climatological Database for the World's Oceans 1750–1850; CORRAL: Historical Meteorological Recordings from the UK Colonial Registers and Royal Navy Logbooks; CUG: China University of Geosciences; CWB: Central Weather Bureau Taiwan; DARE: data rescue; DMH: Department of Meteorology and Hydrology, Vientiane, Lao People's Democratic Republic; ECMWF: European Centre for Medium-Range Weather Forecasts; ENSO: El Niño Southern Oscillation; ERA-CLIM2: European Reanalysis of the Global Climate System2; FFCUL: Fundação da Faculdade de Ciências da Universidade de Lisboa; GFCS: Global Framework for Climate Services; ICOADS: International Comprehensive Ocean–Atmosphere Data Set; I-DARE: International Data Rescue Portal; ISPD: International Surface Pressure Databank; JMA: Japan Meteorological Agency; KMA: Korea Meteorological Administration; LPDR: Lao People's Democratic Republic; MMD: Malaysian Meteorological Department; NA: National Archives (London, UK); NAM: National Archives of Malaysia; NCDC: National Climatic Data Centre; NCEI: National Centers for Environmental Information; NMIC: National Meteorological Information Center; NOAA: National Oceanic and Atmospheric Administration; QJRMS: Quarterly Journal of the Royal Meteorological Society; RMetS: Royal Meteorological Society; RECLAIM: RECovery of Logbooks and International Marine data; TNA: Thailand National Archives; WIREs: Wiley Interdisciplinary Reviews; WMO: World Meteorological Organisation.

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Competing interests

The author declares there are no competing interests.

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