DISEASE, CLIMATE, ENVIRONMENT AND THE FORTUNES OF BUDDHISM DURING THE TIBETAN EMPIRE 618–842 CE

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With 4 figures and 2 tables
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Summary: The official adoption of Buddhism by the Tibetan state in the mid-8th Century (761-762 CE) was relatively late compared to its permeation from northern India to elsewhere in south and east Asia, due to the country's geographical isolation. Whilst reasons for its adoption remain uncertain, it is thought that the religion provided a strong unifying influence permitting both the consolidation and subsequent expansion of the Tibetan Empire. Early historical records suggest that the religion was prohibited in 739-741 CE and again in 841-842 CE, the latter coinciding with the fall of the Tibetan Empire. This research presents a detailed examination of Tibetan and Chinese historical records and also of recent fine-resolution palaeoclimatic reconstructions to demonstrate that the 'oscillating fate' of Buddhism during the Tibetan Empire (618-842 CE), was not only linked to the economic fortunes of the Tibetan state as previously envisaged, but also inextricably to disease, the long-term regional climatic deterioration and possibly also to a series of natural disasters, many of which were recorded in the north and north-west of the Tang Empire adjacent to Tibet, as well as in Tibet itself. These 'disasters' noted in the historic records, and both catalogued and quantified here, indicate extreme pressures placed on the rural economy of the Tibetan Plateau and adjoining areas by crop failures, the death of many livestock and associated widespread famine and human mortality. The 'chaos & disorder' of the latter stages of the reign of Emperor Ralpachen (815-836/838 CE), as well as the Second Prohibition of Buddhism by the last Tibetan Emperor Lang Darma can therefore now not only be related to climatic-environmental deterioration, but also to the likely loss of public faith in both Tibetan Emperors and in Buddhism. It is possible that in the eyes of superstitious Tibetans, neither their rulers nor the state religion could address an accelerating spiral of crises. Devine displeasure could have been further signified by a devastating earthquake in Tibet sometime between 839-842 CE and the subsequent 'implosion' of the Tibetan Empire should no longer be considered surprising.

Keywords: Dendroclimatology, geohumanities, historical documentary records, palaeoclimate reconstruction, religion and natural disasters, extreme weather events

1 Introduction

Buddhism originated in the Ganges Plain (5th-4th Century BCE) following the enlightenment of The Buddha, Prince Gautama. The religion spread across central and eastern Asia reaching China in the first century CE, Japan 300-500 CE, south-east Asia 400-600 CE, and Mongolia by 1500 CE (Fig. 1; Park 1994). Its relatively late dispersion and adoption in Bhutan and western Tibet in the 700s CE, is thought to have been the result of the inaccessibility of this region caused by the physio-cultural barrier of the Himalayas (Park 1994).

The first King of Tibet, Nyatri Tsenpo, may have arrived from India, although some consider this implausible, but did establish the earliest capital in the Yarlung Valley, 88 km south-east of Lhasa (Powers 1995). Early Tibetan kings were adherents of Bön, an indigenous religious tradition of shamanistic and animistic practices administered by priests (shen or bönpo – Samuel 1993, 2002), yet by the early 7th Century CE, the Yarlung Dynasty had united warring tribes, and had also founded the Tibetan Empire (TE) (Kapstein 2000, Hazod 2015). The latter was not only capable of outward expansion, but also of successful competition with larger neighbouring Buddhist states to the south and east (Beckwith 1987, Powers 1995, Kapstein 2000, Samuel 2002).

The exact reason or circumstances for the introduction of Buddhism to Tibet is unclear (Hazod 2015), but following the defeat of the Azha (Tuyuhun) kingdom (Qilian Mountains in the upper Yellow River) in the 630s CE, the Chinese Tang Empire came into direct contact with Tibet (Kapstein 2006). This led to the marriage of the second Emperor of the Tibetan Empire (33rd King) Songston Gampo to the Tang Princess of Wencheng (640 CE) - the latter is thought to have brought the first Buddhist sacred image to Tibet (Kapstein 2006). Although Songsten Gampo (d 649 CE) is credited with the initial introduction of Buddhism, the 'religion of Nepal' was not officially adopted by the Tibetan state (possibly seeking a unifying international religion – Hazod 2015: 51f.) until the reign of Tri Songdetsen, (740–798 CE),

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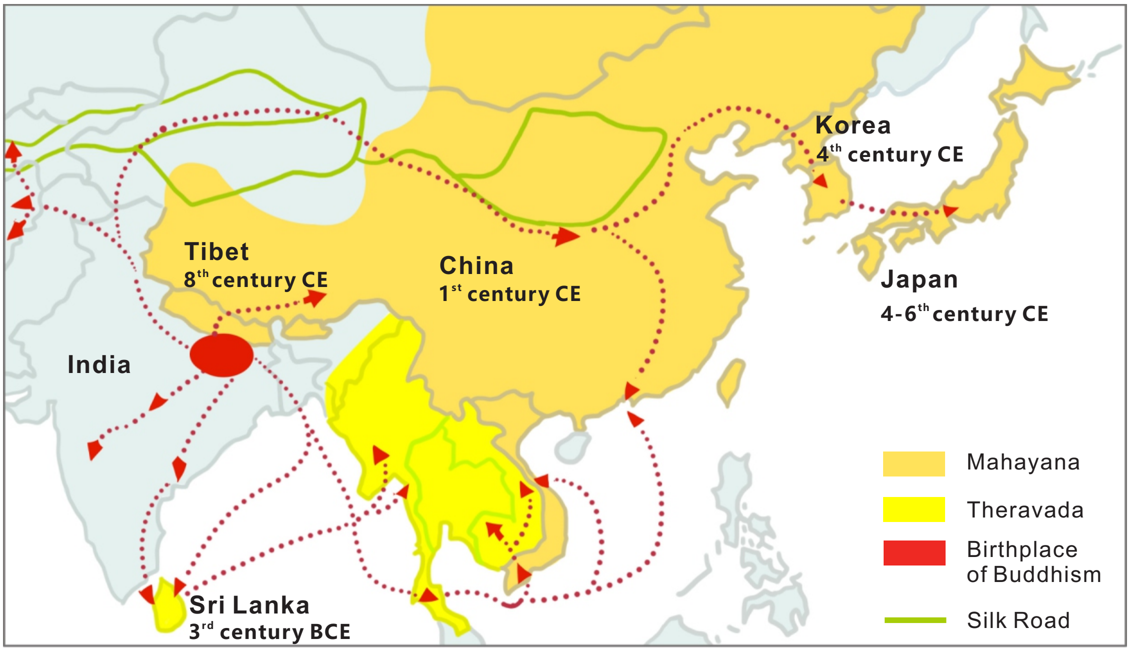

Fig. 1: Proliferation of Buddhism in Asia (Park 1994, Clarke 2000) - Theravada and Mahayana are the two main schools of the religion

when it was widely promoted (Kapstein 2000 and 2006, Hazod 2015). Although Buddhism is considered a religion of 'virtuous action', its adoption in Tibet may well have been due to its hierarchical organisation and mirrored its more 'protective, defensive and even aggressive uses' in China and Japan to protect the state and to express imperial power at home and abroad (Beckwith 1983, Samuel 2002, Kapstein 2006).

Investigations of societal collapse due to adverse climatic and environmental conditions (at the centre of our research) have proliferated in recent decades, for instance a volcanic-related climatic anomaly thought to be linked to environmental degradation and subsequent Mongolian defeat in Syria in 1260CE, a global historical turning point (Di Cosmo et al. 2021). Some caution the dangers of environmental determinism in such approaches, whilst others have highlighted the need for improved theoretical and data-driven approaches in this burgeoning field of 'collapse archaeology' (Bell & Walker 2005, Benati & Geerriero 2023).

Despite these concerns a number of recent palaeoclimatic reconstructions employing calendrical time scales have permitted detailed analyses of and provided possible explanations for major historical events throughout Eurasia over the last two millennia (Büntgen et al. 2011, Zhang et al. 2011, Li et al. 2017, Büntgen et al. 2020). Summer warmth has been shown to coincide with periods of prosperity and economic stability (Büntgen et al. 2011), whilst longer-term cooling, often associated with groups of volcanic eruptions, appears to correlate with significant periods of human migration, economic decline, political unrest and conflicts (McCormick et al. 2007, Hsiang et al. 2013, Oppenheimer 2015, Büntgen et al. 2020). In east Asia, the environmental vulnerability of the Mongolian Plateau and northern China is thought to have been demonstrated by the relocation of the capital of the Northern Wei Dynasty (386-534 CE) in 494 CE in response to low temperatures, natural disasters, crop failures and rapid population growth (Zou et al. 2017). Climate change, droughts and aridity, have also been shown to exert a strong influence on whether Chinese Dynasties were controlled by peoples from the north or the south (Wang et al. 2010).

This research presents the first in-depth assessment of the role played by disease, climate, environmental change, and also socio-economic and cultural factors, in the fortunes of Buddhism in 8th-9th century Tibet. The latter is highlighted by three key and widely accepted historical dates associated with the prohibition of the religion (739-741 CE & 841-842 CE) and its acceptance, adoption and promotion by the Tibetan Empire from 761-762 CE. The former utilises a range of historical sources, including the Old Tibetan Annals and a new examination of Tang Dynasty records, and also recent palaeoclimatic reconstructions from the Tibetan Plateau and from adjoining regions. Additionally, we provide further evidence of multiple factors combining in the apparent 'implosion' of the Tibetan Empire in 842 CE, in contrast to pre-existing paradigms.

2 Materials and methods

2.1 Palaeoclimatic reconstructions

There have been many regional climatic reconstructions in recent decades focussing on the Tibetan Plateau (TP) based on pollen and other proxies (Li et al. 2011, Hou et al. 2017, Sharma and Phartiyal 2018, Hou et al. 2021, Zhang et al. 2021). Whilst temperature reconstructions have in the past been controversial, some differences in moisture regimes have been identified between the north-east and south-west TP, and it is also thought that lake sediment and stalagmite records from caves best reflect the relative dominance of large-scale patterns of atmospheric circulation (Chen et al. 2020). A recent study of lake sediments from the south-west TP for instance identified four major hydro-climatic stages in the last 30 ka, indicating the dominance of North Atlantic climate (mid-latitude westerlies) during the last glacial period and the East Asian Monsoon (EAM) during the Holocene, although the latter weakened from 3.8 ka to the present (Li et al. 2023).

Previous palaeoenvironmental research in Tibet has lacked sufficient stratigraphic resolution and dating control to allow precise comparisons with historical - calendrical timescales (e.g. Tibetan historical chronology and Tang Dynasty annals used in this study). However, two recent studies involving analyses of lake sediment cores from the western and central TP have achieved well-dated palaeoclimatic reconstructions implicating climate change (in particular drought), in the collapse of the Tibetan Empire in the 840s CE (Hou et al. 2023, Chen et al. 2023). Hou et al. (2023) found that variations in the lithographic record, notably for Ti using X-ray fluorescence, revealed sub-annual annual variations in precipitation, and Chen et al. (2023) demonstrated an abrupt change in the ratio of planktonic to benthic diatoms indicating a shift to lower lake levels after 800 CE. The latter correlated well with previous precipitation reconstructions for the south and east TP (Chen et al. 2023, 7). Data from Hou et al. (2023) and Chen et al. (2023) are utilised in our research (Fig. 2E and F) and were freely available as supplementary materials in those two studies.

Previous long-term climate reconstructions for the Northern Hemisphere utilising a variety of proxy records have demonstrated a long-term climatic cooling trend in our study period 600-900 CE (blue arrow Fig. 2), with dating control varying from the high precision of tree-rings (Briffa 2000), to dating peat chemistry using radiocarbon (Hong et al. 2000), and a suite of radiometric methods used in assessing the age of ice-rafted debris in ocean sediments (Bond et al. 2001). Since these studies, there have been considerable advances in dendroclimatology, as research on climatically-sensitive trees at their altitudinal and latitudinal limits has permitted fine-resolution climatic reconstructions on broad spatial and temporal scales (cf Frank & Esper 2005, Esper et al. 2012, Rinne et al. 2013, Esper et al. 2014). The latest tree-ring reconstructions can include networks of sites across the Northern Hemisphere facilitating, detailed analyses of past global and regional climate change, also proffering explanations for the circumstances surrounding major historic events (Büntgen et al. 2011, Pederson et al. 2014, Büntgen et al. 2020, Muigg et al. 2020). The most recent available Northern Hemisphere climate data based on tree ring-widths (Büntgen et al. 2020), was therefore employed in our research to provide annually resolved temperature records and an over-view of regional climate change (cf. Eurasia data subset – Büntgen et al. 2020) to facilitate detailed comparisons with palaeolimnological data (precipitation) from the TP (Hou et al. 2023, Chen et al. 2023). The dendroclimatological datasets were generated from a network of 9 sampling sites (contributory core or disc samples per dataset ranged from 224–2725 series) in the Great Basin western USA, through Europe to Northern Yakutia, Russia, and the associated summer temperature reconstructions (JJA) were illustrated for Eurasia (EA), as well as the entire Northern Hemisphere (EA+), demonstrating similar trends over the last two millennia. An in-depth explanation of chronology development and construction is available in supplementary information online https://doi.org/10.1016/j.dendro.2020.125757 (Büntgen et al. 2020). Relevant time series from the EA and EA+ data sets (600 – 900 CE) are illustrated in Fig. 2A-C and these were supplied to the authors through correspondence with the lead author (Büntgen et al. 2020). This Northern Hemisphere climatic reconstruction also utilised sulfate data from a number of Greenland and Antarctica ice cores, which had previously been used to estimate the magnitudes and possible sources of major volcanic (stratospheric sulfur injection) events between

500 BCE to 1900 CE (eVolv2k database – Toohey & Sigl 2017). These data (volcanic stratospheric sulfur injection & stratospheric aerosol optical depth) were accessed separately from the World Data Center for Climate (German Climate Computing Centre – DKRZ) in netCDF format (https://doi.org/10.1594/Wdcc/eVolv2k_v2) and appear in Fig. 2C and D.

As noted previously, sedimentary records from caves are thought to provide the best evidence of wider regional climate change (Chen et al. 2020) and we therefore also accessed and included a 2650-year annually-resolved summer temperature (MJJA) reconstruction based on stalagmite layer thickness from Shihua Cave, 50km south-west of Beijing (Fig. 2G – Tan et al. 2003) for comparison with other palaeoclimatic and historical data employed in our study. These speleothem data are freely available from the American Geophysical Union (https://doi.org/10.1029/2003Gl017352). Further rationale for the inclusion of these speleothem data is included in Section 2.2.

All palaeoclimatic data were utilised as accessed and underwent no further processing. Figs. 2 and 3 were constructed using Microsoft Excel (Office 365), Grapher ver 4.0 and CorelDraw Ver X8.

2.2 Key dates in Tibetan Buddhism and records of 'disasters'

The three key dates relating to early Tibetan Buddhism were carefully chosen for this research as they represent specific and well-documented points in time when there was not only incontrovertible acceptance of the religion by the Tibetan state (adoption as the official religion in 761-762 CE), but also when there was clear evidence that the religion was distrusted - its prohibition in 739-741 and finally in 841-842 CE (Beckwith 1983 and 1987, Kapstein 2000 and 2006, Kollmar-Paulenz 2007, Hazod 2015 – Tab. 1). These three milestones represent historical marker dates that are accepted in the literature, and that we were subsequently able to compare not only with independent palaeoclimatic datasets (Section 2.1), but with other independent historical records of significant meteorological and environmental events (Sections 2.2 and 2.3). The latter events are of sufficient import to be referred to as 'disasters' and to occur with some frequency in the annals of the Chinese Tang Dynasty.

Periods of environmental stress signalled by concentrations of climate-related and other environmental 'disasters' recorded particularly in northern and western China during the Tang Dynasty are potentially of great significance for understanding of early Tibetan history, due to the proximity of these events and their occurrence to the sensitive and extreme environments of the TP (see Introduction - Wang et al. 2010, Zou et al. 2017 mentioned previously). These areas are dominated by grasslands or rangelands that were as crucial to the livelihoods of thousands of nomadic pastoralists during the times of TE and the Tang Dynasty, as they are today. The health and productivity of these rangelands were and are crucial to the well-being of the rural economy (see Sections 3.1 and 3.3).

During the careful scrutiny of the Tang annals (also fragmentary sources from the TE – see Section 2.3) that coincided with our study period we noted any unusual meteorological or other significant environmental events or 'disasters' that were recorded relating to Tibet itself or that occurred within the area governed by the Tang Dynasty during the period 618-650 CE (spanning the timeframe of the Te). These included the dates and duration of droughts (used to compile Fig. 4), and we also constructed spatial indices to record and to assess the scale of environmentally- and climatologically-related events or 'disasters' caused by droughts, floods, snow/frost, wind, sand/dust, geohazards, pests, epidemics and famines. Each event or 'disaster' was represented by a histogram indicating the number of dào (largest Tang Dynasty administrative area; n=15 in 733 CE) affected in the same calendar year (Fig. 3 A-K) following and expanding on similar methodological approaches used elsewhere in the literature (cf. Fang & Liu 1992, Chu et al. 2008, Lee & Zhang 2010).

It should be noted that Tibetan sources also provided some graphic details relating to specific geological, geomorphological and meteorological 'disasters' in Tibet, particularly in the period 839-841 CE (see Tab. 2). Records of concurrent 'disasters' in the Tibetan and Tang Empires are therefore likely to represent significant impacts on both their rural economies and might also help to explain the anxieties related to the impacts of natural events expressed by the Tang Emperor Wenzong in summer 839 CE (Tab. 2). In this early historical period natural disasters were by necessity taken very seriously due to their often-catastrophic impacts on human society, and such events were inextricably associated with divine retribution for misdeeds, particularly of the country's rulers (Cao 2007). Indeed, natural disasters have often been perceived by religions as 'acts of God' (Chester et al. 2019). For instance, Akasoy noted that both earthquakes and epidemics in the Middle Ages were viewed in Islamic literature as punishments for those disbelieving The Prophet or for 'moral misbehaviour'. These disasters could kill both the pious and unbelievers, for whom death could be a blessing (resulting in martyrdom) or punishment respectively Akasoy (2007). Even in the twenty-first Century religion can utilise natural disasters as forces for social influence. Following the 2009 CE earthquake and tsunami that hit Samoa, religious assistance / aid was deployed to combat the mental and other traumas of the disasters. Divine retribution was however utilised to promote on one hand traditional practices and obligations by established Christian churches, whilst on the other, new churches (also Christian) used the same observation to recommend social and religious change in locii ripe for proselytizing (Holmgaard 2019).

In addition, knowledge of the dynamics of the East Asian Monsoon lends further validity to broader regional comparisons of unusual meteorological or other significant events or 'disasters' identified in the historical records across south and east Asia. This vast climatic system is characterised by warm wet summers and cold dry winters, originating in reversals of large-scale atmospheric heating and steady atmospheric circulation, and interactions with the Indian Monsoon and other climatic patterns such as El Nino-Southern Oscillation (ENSO) and Arctic Oscillation (AO), the latter associated with extreme aridity (Yihui & Chan 2005, Ha et al. 2012, Yang et al. 2021). The current northern limit of the EAM region (Monsoon Front) stretches from northern India and Nepal, bisecting Tibet from west to east through China to the Korean Peninsula and the far east of Russia (Yang et al. 2021: 2). Today as summer monsoon rains move through the subcontinent to their northerly limit, their impacts are felt simultaneously not only in southern and central parts of the TP, but also throughout China and elsewhere, concurrent meteorological change experienced over thousands of kms. The present-day dynamics of the Monsoon Front, as a result, demonstrate regional climatic synergies on a broadly west-east transect between the TP and the adjoining areas of western and northern China, probably dating back ca. 3.8 ka (see Li et al. 2023). It is therefore not unreasonable to highlight extreme weather events recorded in the annals of the Tang Dynasty, particularly those affecting the north and west of it's empire, and to expect possible meteorological parallels in the adjoining areas such as the TP (a significant number of meteorologically-related events and 'disasters' (Fig. 3A-K) coincide with the three key dates in Tibetan Buddhism and are catalogued in Tab. 2 - some also coincide with independent documentary evidence from Tibet). The nature of the EAM and the ability of speleothems to record broader climatic patterns provides additional justification for the inclusion of palaeoclimatic data from eastern China for comparative purposes (Tan et al. 2003 – Section 2.1).

2.3 Historical sources

There are some chronicles of the Tibetan Empire, such as The Old Tibetan Annals (historical records from Dunhuang an outpost of the Tibetan Empire between 641 and 765 CE) (Kapstein 2000, Karmay 2003, Kapstein 2006, Dotson 2010), but no detailed Tibetan records exist of political, religious or environmental / climatological events, including disasters, reported during the specific study period for this research (618 to 842 CE - duration of the Tibetan Empire). Those records that do exist are thought to contain elements of 'historical and mythical narration' (Kapstein 2000) and two specific historical documents provided records of religious crises and conflicts, natural disasters and their impacts on Tibetan society, the Testament of Ba, A Scholar's Feast and the Clear Mirror on Royal Genealogy (sBa gSal-Snang 1990, Sørensen1994, Gyaltsen 1996, Wangdu & Diemberger 2000, Guang 2011, Sa-sKya bSod-Nams-Rgyal-Mtshan 2016). The Testament of Ba [written by one or more members of the Tibetan Ba clan] is a detailed account of the long reign of Emperor Tri Songdetsen (755/756-797 CE), which although described as a work of 'historical fiction', is thought to have been based on earlier documents and to contain historical elements verifiable from other sources (Kapstein 2000). The Clear Mirror on Royal Genealogy also provides an account of early Tibetan history written by the Lama Sakyapa Sonam Gyaltsen (1312-1375 CE), including the origins of the Tibetan people, the arrival of Buddhism, Lhasa becoming the capital and the building of temples (Sørensen 1994, Gyaltsen 1996).

So, although some historical dates in early Tibetan records are thought to be accurate and are corroborated by a number of different sources, for instance the three key milestones that we have highlighted in early Tibetan Buddhism, these Tibetan historical accounts are generally viewed as incomplete and at times lacking in historical accuracy (Kapstein 2000, Horleman 2013). We therefore turned to the contemporary annals of the neighbouring Tang Dynasty. These are annual records compiled by the

Chinese state and are regarded as more complete and more reliable than their Tibetan counterparts. Indeed the use of Tang Dynasty annals, notably the Old and New Books of Tang (written in 945 and 1060 CE respectively), and the Zizhi Tongjian (Comprehensive Mirror in Aid of Governance – 1084 CE) (Xu 1975, Xiu & Qi 1975, Guang 2011), has been recommended by Tibetologists as they are thought to provide *"snippets of new information* [*sic* that] *might shed more light on certain historical events and developments in Imperial Tibet."* (Horleman 2013: 191).

Previous observers have also noted with interest the 'remarkable synchroneity' between events in the Tibetan and Tang Empires in the mid-800s CE, particularly relating to the 2nd Prohibition of Buddhism (Tibet 841-842 CE – Tab. 1 and 2), the subsequent collapse of the Tibetan Empire (842 CE), and also the sudden change in policy towards Buddhism in the Tang Empire, with a Great Persecution directed at the religion commencing around 845 CE (Kapstein 2006: 85–86). This persecution by the Taoist Emperor Wuzong of the Tang Dynasty (related in the Old Book of Tang – Xu 1975) was officially attributed to deteriorating government finances (Gernet 1956, Ren 1981) and led to the closure of thousands of monasteries and shrines, with monks and nuns forced to return to lay life (Kapstein 2006).

Historical maps in the Harvard University database for Chinese dynasties (CHGIS), enabled modern place names (e.g. Chinese province or county) to be highlighted in Tab. 2 and to facilitate broader interpretation. The list of Emperors of the Tibetan Empire and the duration of their reigns (Figs. 2H and 3L) was based on key authoritative sources (Beckwith 1987, Samuel 2002).

3 Results and discussion

3.1 Climate change and the Tibetan historical chronology

High-resolution and precisely-dated palaeoclimatic data is presented in this paper for the period 600-900CE spanning the duration of the Tibetan Empire (618–842 CE), as well as key dates associated with official responses to Buddhism in Tibet: the First Prohibition (739–741 CE) of the religion coinciding with and possibly as a response to an outbreak of bubonic plague (Beckwith 1983, Kapstein 2000, Zhang & Lin 2016), the Adoption of Buddhism as the official religion of the Empire (761–762 CE) (MacDonald 1971, Kapstein 2000 and 2006, Hazod 2015, Zhang & Lin 2016) and the Second Prohibition (841–842 CE) (Kapstein 2000 and 2006, Wei 2007, Yang 2008) (Tab. 1). Dendrochronlogical data, with well-replicated, climatically-sensitive tree ring-width records were employed to reconstruct summer temperatures (JJA) for the Northern Hemisphere (EA+) and also for the Eurasia (EA) (Büntgen et al. 2020 – data relating to the study period (600-900 CE) are shown in Fig. 2A-C), in conjunction with Northern Hemisphere stratospheric aerosol optical depth (SAOD) reconstructed from Greenland ice core sulfate data (possible volcanic events Figs. 2C-D – Toohey and Sigl 2017). It is important to note that the annually resolved tree-ring data is expressed as reconstructed medians (timeseries rescaled against extra-tropical landmass (30-70°N) JJA temperature anomalies - wrt 1961–90), a tree-ring index-type approach emphasising short-term annual variations (Figs. 2A and B - Büntgen et al. 2020). In contrast, Fig. 2C expresses the same data as temperature departures (°C) from 100 yr averages and was designed to highlight longer-term climatic trends (Büntgen et al. 2020), and these are therefore more directly comparable to the other palaeoclimatic datasets presented in Figs. 2E, F and G.

In addition, extracts from recent fine-resolution precipitation reconstructions based on lake sediments from western and central Tibet are provided in Figs. 2E and 2F (Hou et al. 2023, Chen et al. 2023), as well as a regional summer temperature (MJJA) reconstruction based on the thickness of stalagmite layers (Fig. 2G – Tan et al. 2003). Further, the timing and spatial impacts (potential severity) of a variety of 'disasters' occurring within the area controlled by the Tang Dynasty as recorded in historical documentary records 618-850 CE (Xu 1975, Xiu & Qi 1975, sBa gSal-Snang 1990, Sørensen 1994, Gyaltsen 1996, Wangdu & Diemberger 2000, Dotson 2010, Guang 2011, Sa-sKya bSod-Nams-Rgyal-Mtshan 2016) are illustrated in Figs. 3A-K.

Earlier climatic reconstructions utilising a variety, and also combinations of proxy records had demonstrated long-term multicentennial climatic deterioration in the Northern Hemisphere throughout our study period (600-900 CE – Briffa 2000, Hong et al. 2000, Bond et al. 2001). However, the more recent fine-resolution palaeoclimatic reconstructions outlined above now make possible a more detailed (precise and accurate) comparison with historic events during our study period and in particular the Tibetan historical chronology (Tab. 1).

Tab. 1: Chronology of key historical events associated with the fortunes of Buddhism and the Tibetan Empire 618 – 642 CE

Year	Historical event
618	Foundation of the Tibetan Empire (TE), capital in the Yarlung Valley (First King of Tibet Nyatri Tsenpo had arrived from India)
630s	New religion sought by Yarlung Dynasty (Songtsen Gampo - 33rd King & 2nd Emperor)
640	Marriage of Songsten Gampo to the Tang Princess of Wencheng who is thought to have brought the the first Buddhist sacred image to Tibet
739	Death of the Chinese Princess of Jincheng (wife of Emperor Me Agstom alias Trhi Detsuktsen 704-755/6) '…when the black pox [Bubonic Plague] appeared at her heart'. She had promoted Buddhist funerary rites and temple building
739-741	**First official prohibition of Buddhism** (the religion is thought to have been present in Tibet for over a century). Buddhist clergy [Samgha] were blamed for the outbreak of Bubonic Plague and 'other diseases' and were banished to Gandhāra, India
755/756	'Revolt': Emperor Me Agstom was assassinated by two of his ministers. The subsequent power struggle culminated in the enthronement of his son [legitimate heir?], Tri Songdetsen in 756 CE. Buddhism continued to be supressed by 'ministerial conspiracy'
761-762	**Buddhism adopted as the official religion of the TE** and was promoted by the first 'Religious' Emperor, Tri Songdetsen (740-798 CE). Buddhism's hierarchical structures may have facilitated the legitimization and protection of the new Emperor, but it may also have been better placed than traditional beliefs to provide comfort to victims of disease, conflict and other hardships. Buddhism flourished during the Golden Age with royal patronage. Monasteries gained economic independence through tax laws and related powers, and Buddhist monks became powerful government ministers
763	Tibetan army captured and occupied Chang'an (Tang Dynasty capital). During the next two decades, nearly all of the major oasis cities and towns along the Gansu Corridor were annexed by the TE
779	Consecration of the first Buddhist monastery in Tibet at Samye
786	Dunuang an important trading town and oasis on the Silk Road was invaded and controlled (until 848 CE). Mogao Buddhist cave temples – source of the Old Tibetan 'Dunuang' Annals (today - UNESCO WHS)
822-3	Treaty dictated by Tibet to the Uigurs
836	Discontent amongst lay officials due to the apparent weakness of Emperor Ralpachen (815-836 CE) and the perceived power and excesses of Buddhism (Buddhist monks involved in government) Rumours of an important monk's affair with Emperor's chief queen, led to the monk's execution, the and its queen's suicide and later the Emperor's assassination
841-842	**Second official prohibition of Buddhism** following interventions by Lang Darma, the 41st Tibetan King and its last Emperor, which led to his assassination by a Buddhist monk
842	Collapse of TE
[c 845]	[Huichang Persecution of Buddhism by imperial edict initiated by Tang Emperor Wuzong: crackdown on Buddhist shrines, property, monks and nuns, attributed to deteriorating government finances and a desire to cleanse China of foreign influences]

Sources: Gernet 1956, Xu 1975, McNeill 1977, Ren 1981, Beckwith 1983, Szerb 1983, sBa gSal-Snang 1990, Powers 1995, Jidong 1998, Kapstein 2000, Karmay 2003, Kapstein 2006, Wei 2007, Yang 2008, Hazod 2015

3.2 Bubonic plague and the First Prohibition of Buddhism

Historical background

The death of the Princess of Jincheng (niece of the Princess of Wencheng and wife of Tibetan Emperor Mé Aktsom) in 739 CE (Tab. 1), has been linked to an outbreak of Bubonic plague (Kapstein 2000 and 2006, Hazod 2015), and this event combined with more widespread associated mortality must have been a shock to Tibetans, heightening their superstitions and fears of the unknown. Mountainous areas are particularly vulnerable to human, animal and crop diseases (Jidong 1998, Kapstein 2000, Gardner & Dekens 2007), and it is likely that Bubonic plague would have wreaked

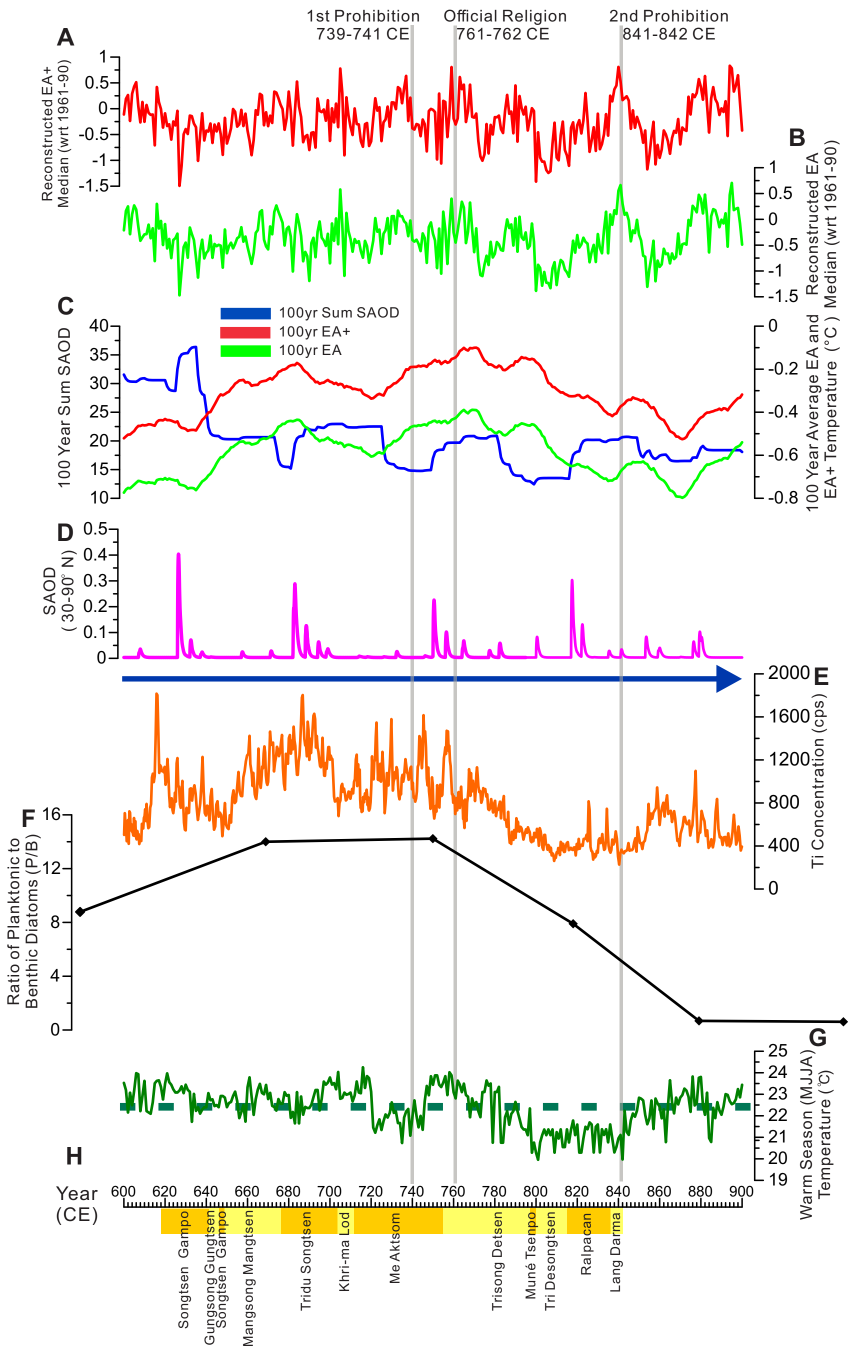

Fig. 2: Selected Northern Hemisphere, Eurasian and specifically Tibetan climate data 600-900 CE plotted against key milestones for early Buddhism in Tibet and associated environmental events. Reconstructed summer (JJA) temperatures (Annual resolution: EA+ Eurasia / North Atlantic – 2A and EA Eurasia – 2B) based on high-elevation / -latitude tree ring-width datasets (Büntgen et al. 2020); 2C- Comparison between one-tailed, 100-year average EA/EA+ summer temperature anomalies (°C with respect to 1961–90 – Büntgen et al. 2020) and one-tailed, 100-year total SAOD (reconstructed stratospheric aerosol optical depth) data (Toohey and Sigl 2017). 2D – Reconstructed stratospheric optical depth (SAOD) 30–90° N (Toohey and Sigl 2017). Blue arrow between 4D and 4E denotes a multicentennial cooling trend evident in temperature reconstructions by Briffa (2000), Hong et al. (2000) (peat cellulose), Bond et al. (2001) (cosmogenic nuclides in drift ice). 2E – Ti concentrations in sediments from Jiang Co lake, central Tibet (precipitation indicator - Hou et al 2023). F - Ratio of planktonic to benthic diatoms (P/B) preserved in sediments from Xardai Co lake, western Tibet (precipitation indicator - Chen et al. 2023). 2G - Warm season (MJJA) temperature reconstruction from stalagmite analyses, near Beijing, China (Tan et al. 2003). 2H - Tibetan Emperors and duration of their reigns during the Tibetan Empire 618–842 CE (Beckwith 1987). Key dates relating to significant religious events in the Tibetan Empire (vertical grey lines): 739–741 CE: First Prohibition of Buddhism; 761–762 CE: Adoption of Buddhism as the official religion; 841–842 CE: Second Prohibition of Buddhism – also under the Tang Dynasty.

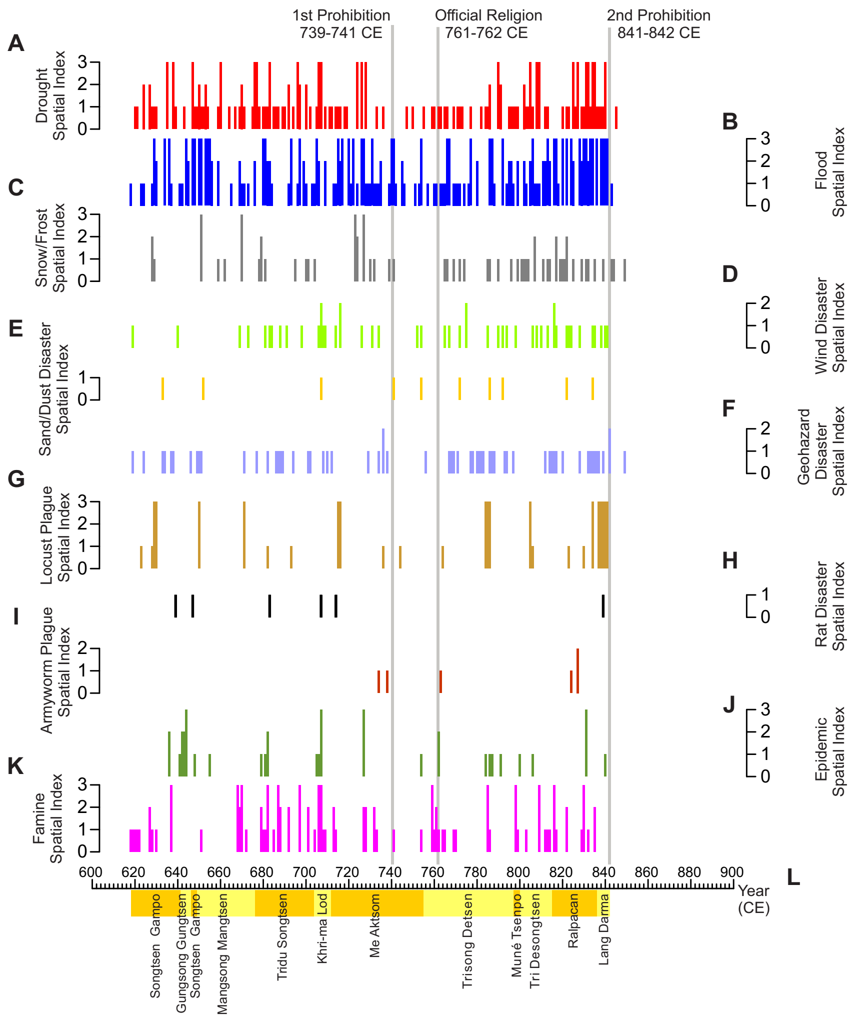

Fig. 3: Records of disasters noted in Tang Dynasty records. Droughts (3A), floods (3B), snow/frost (3C), wind (3D), sand/dust (3E), geohazards (3F - earthquakes & avalanches), locust (3G), rat (3H), armyworm (3I), epidemics (3J), famines(3K) with spatial indices representing numbers of dào (largest Tang administrative area, 3 including numbers 3 and above) impacted by the event. 3L - Tibetan Emperors and duration of their reigns during the Tibetan Empire 618–842 CE (Beckwith 1987). Key dates relating to significant religious events in the Tibetan Empire (vertical grey lines): 739-741 CE: First Prohibition of Buddhism; 761–762 CE: Adoption of Buddhism as the official religion; 841–842 CE: Second Prohibition of Buddhism – also under the Tang Dynasty.

havoc in the geographically isolated eighth century Tibet. Smallpox later hampered the 'Yellow Church' movement of Tibetan Lamaistic Buddhism in 1757 CE (McNeill 1977) and the zoonotic disease Echinococcosis is prevalent in modern Tibet, thriving in low temperatures and high humidity (Veit et al. 1995, Yin et al. 2020, Ma et al. 2021).

The Old Tibetan Chronicle indicates that the First Prohibition of Buddhism occurred in Tibet in 739-741 CE (Tab. 1) and was a direct response by the Tibetan state to the crisis caused by the outbreak of Bubonic plague. One historic document found at Dunhuang clearly stated "*After that* [the death of the Princess] *the laity lost faith and said that the occurrence of the black pox* [Bubonic plague] *and many sorts of disease was an evil due to the arrival in Tibet of the host of the samgha* [Buddhist Clergy]. *It was ordained that not one member of the samgha was permitted to remain in Tibet.*" (Kapstein 2000: 42)

Whilst the appearance of disease was blamed on the presence of increasing numbers of foreign Buddhist monks it was also therefore directly associated with the Buddhist religion, its practices and 'powers' (Kapstein 2000). The banishment of the 'entire samgha' to Gandhāra, then in India, led by implication to a reversion to traditional religious practices (Bön).

It has been noted that such epidemics were "*… outside the domain of human rational control until very recently* [modern times]" (Kapstein 2000: 53).

Climate & environmental reconstruction

The First Prohibition of Buddhism in Tibet (739–741 CE) also occurred against a background of weather-related natural disasters, some recorded with significant human consequences, in both neighbouring and more distant areas controlled by the Tang Dynasty (Tab. 2). Heavy snow and rain 'disasters' were specifically noted in the capital Chang'an (Xi'an – north-west China) in January 739 CE and again in September 741 CE. In southern China serious floods were recorded in Lizhou (Hunan), Yuanzhou and Jiangzhou (both now Jiangxi) and 'other regions' in March 739 CE, whilst floods also occurred in the north (Henan - present-day Shandong, Henan, northern Jiangsu and northern Anhui) in March 740 CE. Twenty-four counties in Henan and Hebei (Henan, Hebei and Shangdong – northern China) 'suffered floods' in autumn 741 CE and floods linked to the Yi and Luo rivers (Henan – northern China) destroyed crops, bridges and houses and had killed over 1,000 people in the previous July.

It therefore seems likely that although there was an upward trend in regional summer temperatures from the 720s CE (Figs. 2 A, B and C), there was marked climatic variability, noted especially in the Tang annals between 739-741 CE. Weather-related 'disasters' occurred across large geographical areas in eastern Asia, several close to Tibet, where similar phenomena may have resulted in further human suffering in addition to that undoubtedly caused by plague.

3.3 Adoption of Buddhism in Tibet linked to climatic upturn

Historical background

The First Prohibition of Buddhism did not put an end to civil and political unrest centred around the 'anti-Buddhist reaction' to the unexpected and unprecedented plague (Beckwith 1983, Kapstein 2000). Whilst Emperor Mé Agstom was assassinated in 755 CE and eventually replaced by his son Tri Songdetsen in 756 CE, Buddhism continued to be suppressed (Beckwith 1983) (Tab. 1). However, when Tri Songdetsen turned 20 years old in 761 or 762 CE, *"various evil omens arose that could not be controlled by established rituals, whereupon the ban on Buddhist worship was lifted and things changed for the good"* (Testament of Ba, Tibetan text cited by Kapstein 2000: 45). Despite blaming and banning the religion as a result of the Bubonic plague (Tab. 1), 'evil omens' (possibly the continued ravages of the plague and also unexplained 'disasters' occurring in the natural environment, akin to those recorded in geographical areas adjoining Tibet by the Tang Dynasty annals in 739–741 CE and 761–762 CE – Section 3.2 and Tab. 2) continued to occur despite 'established [Bön] rituals'. The subsequent adoption of Buddhism as the state religion of the TE in 761–762 CE however marked a 'fundamental transformation' in Tibetan society, with subsequent 'wholescale conversion' to Buddhism (Kapstein 2000), also heralding start of the TE's *'Golden Age'* (760s–820s CE).

Climate & environmental reconstruction

Prior to the First Prohibition of Buddhism (739–741 CE) tree-ring records indicate rising Eurasian summer temperatures (Fig. 2C), although climatic variability is implied in the 720s CE by a sharp fall in the summer temperature-stratospheric aerosol ratio (725–727 CE) (Fig. 2C – Büntgen et al. 2020, Toohey & Sigl 2017) and by a rapid decrease in summer temperatures in the eastern TE commencing in 721 CE and sustained in to the 740s CE (Fig. 2G – Tan et al. 2003). Subsequently, climatic amelioration is noticeable across Eurasia with summer temperatures rising in to the 760s CE (Büntgen et al. 2020), coinciding with an upturn in the temperature–aerosol ratio from the 750s CE (Fig. 2C), increasing regional temperatures in to the 760s CE (Fig. 2G – Tan et al. 2003), and also with the official adoption of the Buddhist religion by the Tibetan Empire in 761-762 CE (Tab. 1).

The latter period also coincides with high Ti concentrations in lake sediments from Jiang Co, a lake in central Tibet that indicate higher precipitation levels on the TP from the late 650s CE onwards (Hou et al. 2023). Both elevated temperatures and higher precipitation would have favoured plant growth in the rangelands of the TP and hence also assisted the rural economy (The TE was heavily dependent on pastoralism, as are the TP and adjoining regions today). Hou et al. estimate that this climatic amelioration during the TE could have led to a 24% increase in arable land for barley cultivation. Hou et al. also cite documentary evidence for the introduction of new agricultural methods in Tibet following the links established with the Tang Dynasty in the mid-late 7th century CE (Hou et al. 2023: 1190f.).

It is noticeable that this period not only coincided with the acceptance and Adoption of Buddhism, but it also marked the expansion of the TE including the capture of Chang'an the Tang capital in 763 CE and the later invasion and control of Dunuang on the Silk Road (786 CE) (Tab. 1). Increased productivity of rangelands in central and eastern Asia was likely to have been an important factor for the stability and prosperity of Tibetans, and the successes of their army and its cavalry. A similar climate-environmental explanation has been proffered for the later Mongolian expansion from its central Asia heartland in the 13th-century (Pederson et al. 2013).

3.4 Accelerating climatic and environmental deterioration 770s–840s CE

Historical background

The TE and Buddhism initially thrived in the late 8th and early 9th centuries (Tab. 1), but its sudden 'implosion' in 842 CE has been previously attributed to economic decline associated with a large, over-stretched empire (Kapstein 2006). The earlier peace treaties signed between Tibet and both the Tang Dynasty and the Uighurs (821-823 CE – Beckwith 1983, Szerb 1983, Kollmar-Paulenz 2007), not only marked the end of the expansion of the TE, but also the likely cessation in its wealth accumulation. From the early 820s CE therefore, the imperial coffers started to empty, exacerbated by a lack of new conquests and also by increased religious expenditure (including the introduction of harsh new measures to ensure public respect for Buddhism during the reign of penultimate Tibetan Emperor Ralpachen 815-836/838 CE) (Kapstein 2006). The resulting 'crises and disorder' lead to the assassination of the 'weak' Emperor and his replacement by Lang Darma, the last Tibetan Emperor (838–842 CE) (Kapstein 2000). The latter is thought to have gained power ahead of his siblings due to his support for a campaign to reduce the perceived power and alleged corruption of the Buddhist clergy, some of whom were government ministers. Lang Darma instituted the Second Prohibition of Buddhism 841–842 CE (Tab. 1), leading to his subsequent assassination by a Buddhist monk, and also his later demonization (Karmay 2003).

Climate & environmental reconstruction

The 770s CE marked a significant climatic reversal, with a downturn in Eurasian temperatures for over seven consecutive decades in to the 830s CE (Fig. 2C – Büntgen et al. 2020), mirrored by a steep decline in summer temperatures in the eastern Tang Empire from the 790s CE, with sustained lower temperatures in the period 798– 842 CE (Fig. 2G – Tan et al. 2003). Ti concentrations in contemporaneous lake sediments from the central TP also demonstrate a synchronous and accelerated decline in annual rainfall from the 790s CE with associated lower lake levels (Fig. 2E - Hou et al. 2023). Contemporaneous long-term ecosystem change and lower lake levels are also indicated by an abrupt change in diatom fauna at Xardai Co, western Tibet, from 800 CE (Chen et al. 2023).

The significance of this climatic shift is further emphasised by regional drought records from the 8th and 9th centuries CE. Our scrutiny of the Tang annals revealed reduced drought frequency from the 730s to the late 750s CE (coinciding with reductions in the numbers of snow/frost disasters (Fig. 3C) and with the previous climatic amelioration - see Section 3.2), but subsequent drought incidence rose from every 2.70 yrs (700–799 CE) to 1.66 yrs (800–847 CE) (Figs. 3A and Fig. 4). An unprecedented 12-yr long drought also occurred immediately preceding the demise of the TE, also coinciding with the death of Tang Emperor Wenzong in 840 CE.

Prolonged periods of drought, that can occur during colder as well as warmer phases, are known to have significant impacts and consequences in agrarian economies, particularly those in extreme environments such as the TP and its surrounding areas. The New Book of Tang notes that in 839 CE rats destroyed crops and that 'people starved to death due to epidemics', both in Tibet (Tab. 2). Rodent pests (rats) are also recorded in Jiangxi province in the south of the Tang Empire in 839 CE, whilst 'locust disasters' were experienced in the north of the Tang Empire in May of the same year (Tab. 2). The Testament of Ba (Tibetan record) also significantly records that in Tibet the capital Lhasa was *"…hit by frosts and droughts. Crops were infected with rust. Livestock and people were infected with plague"* (sBa gSal-Snang 1990: 138) at a similar date (Tab. 2). Another Tibetan record lends further credence to a picture of extreme climatic-environmental conditions in Tibet in the late 830s – early 840s CE, as the Clear Mirror on Royal Genealogy notes 'frequent hail and droughts', that 'farmlands were barren' and that 'famine broke forth'. People and livestock also 'suffered from epidemics' (Tab. 2).

In addition, we also quantified both the temporal and spatial occurrence of drought and many other types of 'disaster' recorded in the Tang annals (Tang Empire) and found their increasing frequencies from the 780s to the 840s CE (see in particular for floods, wind, geohazards, locust plagues and famines - Figs. 3B, D, E, F, G and K).

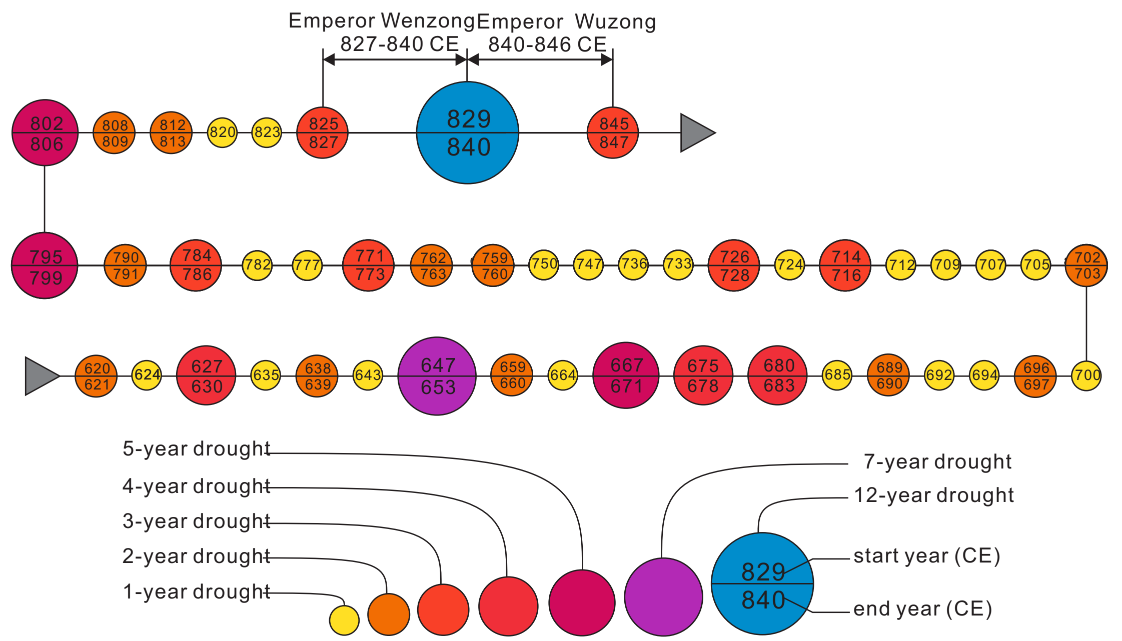

Fig. 4: Significant droughts recorded by official records (618-847 CE) of the Tang Dynasty. Drought incidence – every 2.70 years (700–799 CE); every 1.66 years (800–847 CE – Xu 1975, Xiu and Qi 1975, Guang 2011).

3.5 Impacts of 'disasters' in the Tibetan Empire

The TP is notable for its high elevation (3500–5400 m asl), rugged and challenging terrain, and vast geographical area, a climatological barrier or transition zone, profoundly affecting westerly air masses and the south and east Asian monsoons (Bird et al. 2017, Wünnemann et al. 2018). Fluctuations in these competing weather systems associated with changes in the cryosphere are thought to be important influences on both regional and global climate (Yao et al. 2012, Niu et al. 2021), corroborated by recent dendroclimatological research in drought-sensitive forests (*Picea likiangensis* - 4000 to 4500 m asl) in south-eastern Tibet, where a 500 yr hydroclimatic reconstruction demonstrated that Pacific Decadal Oscillation (PDO) was the dominant climate driver (Lyu et al. 2019). The TP therefore has a severe continental climate and 168 million ha of rangelands today support around two million nomadic pastoralists, "*one of the harshest pastoral areas on Earth*" (Miller 2000: 86).

Traditional societies dependent on subsistence agriculture and pastoralism are known to be particularly vulnerable to adverse weather events or 'weather shocks'. These can be sudden, or prolonged in the case of drought and result in losses of crops and livestock, causing famine / mortality and associated phenomena, and are thought to be closely-correlated to both economic development and political stability (Torry 1986, Burgess & Donaldson 2010, Gentle & Maraseni 2012, Dell et al. 2014, Sujakhu et al. 2016). In pre-modern Tibet (before 1959 CE), people's livelihoods were inextricably linked to the TP's extreme climate and environment (Huber & Pedersen 1997). This was particularly so also during the TE 618-842 CE (Hazod 2015: 38).

The Tang annals record many widespread and often catastrophic 'disasters' and we have demonstrated unusual clusters of these coincided with the three milestones in early Tibetan Buddhism (739–741 CE, 761–762 CE, 841–842 CE – Tab. 2). Extreme examples included the famine in the Yangtse and Huaihe river basin areas (southern Tang Empire) that was so severe it led to cannibalism in 761 CE. Elsewhere on the Mongolian Plateau snowstorms caused 'heavy losses of sheep and horses' in 839 CE and together with contemporaneous epidemics, were implicated in the fall of The Uyghur Khaganate (Xiu & Qi 1975, Guang 2011). In particular, the impacts of extreme weather events are illustrated in the Tang annals by a hailstorm in June 840 CE that killed 36 people and a large number of cattle and horses in Puzhou, northern Tang Empire (Xiu & Qi 1975).

There were also 'disasters' other than those directly associated with meteorological phenomena (Tab. 2). In 839 CE The New Book of Tang records

"An earthquake struck the country [Tibet], *causing springs, landslides and the Tao River to reverse its flow for three days"* (Xiu & Qi 1975: 6105). These events are corroborated in *A Scholar's Feast* that reported *"There was a big earthquake. Boundary mountains on the Han-Tibet border 'fell over'. The Tao River was blocked for three days"* (dPav-Bo gTsug-Lag-Vphreng-Ba 2010: 274).

Superstition in early and modern Tibetan society

Humans have long inhabited the TP (Chen et al. 2019), developing a system of shamanistic beliefs (*Bön*), in part incorporated into Tibetan Buddhism (Samuel 1993), and closely linked to the weather phenomena that are of fundamental importance in daily life (Salick et al. 2012). Spirit powers, deities and dragons are thought to reside in local environments and to control weather patterns (Samuel 1993, Huber and Pedersen 1997, Salick et al. 2012, Nyima & Hopping 2019). Human actions could and are still thought to incur weather-related punishments, such as the much-feared hail (*bimbau*) (Huber & Pedersen 1997, Salick et al 2012, Nyima & Hopping 2019). The devastating effects of such extreme meteorological phenomena appear frequently in the Tang Dynasty's records, exemplified by the hail event that occurred in Puzhou (northern Tang Empire) in 840 CE (Tab. 2), and explain the continued use of 'hail protectors' in modern Tibet to provide ritual protection for crops (Huber & Pedersen 1997).

Whilst snow and frost 'disasters' occur sporadically in the Tang Empire before 740 CE, their absence is noticeable in the period 742–764 CE (Fig. 3C - coinciding with the climatic upturn, see section 3.2). Thereafter this type of 'disaster' appears regularly, particularly between the 780s and 830s CE, intensifying with decreasing regional and Eurasian summer temperatures (our data Figs. 2 A-C and G). Other research using historical documents supports these regional trends with negative snow anomalies (640–750 CE) and positive ones (more snow 760–850 CE) correlated with larger-scale climatic fluctuations (PDO) (Chu et al. 2008). Further research reviewing regional data from historical documents and a number of other proxies also identifies a warm phase from 551 CE ending in 760 CE, followed by a cold interval 781–950 CE (Ge et al. 2013). Although the climate of the TP is harsh, it has distinct and generally predictable seasons facilitating livestock migrations to both winter and summer pastures. Despite centuries of experience and coping strategies enhanced by modern technology (transport and agricultural buildings), unusually heavy snowfall, particularly in autumn and early winter, can cover winter pastures leading to widespread livestock starvation and death even in the 21st century CE. This in turn causes hardship and famine amongst pastoralists deprived of the means to buy their basic staple, barley grain, from agricultural communities on the TP and in valleys to the south (Miller 2000, d'Alpoim Guedes et al. 2014, Tang et al. 2021).

Present-day Tibetans relate strong deterministic links between weather events and environmental consequences, as *"rains bring disease and weeds, and drought brings insect and rat plagues, both causing poor crop yields and human tragedy"* (Salick et al. 2012: 453). Droughts therefore not only directly affect the productivity of the rangelands, key to the pastoral economy (TP, northern and western China, Mongolia), but they are also associated with increased incidence of pests and crop diseases. Locust plagues for instance are recorded in the Tang records with increasing frequency and intensity from the 780s–840s CE (Fig. 3G – also see Tian et al. 2011), whilst rat 'disasters' appear not only to correlate with more intense drought episodes (Fig. 3H), they are also specifically mentioned in Tibet (839-841 CE - see Tab. 2). Climatic variability with consequences for the rural economy, are also signalled by plagues of Armyworm caterpillars (*Mythimna separata* – impacting rice crops, see Dong et al. 2010) in the Tang Empire (730s, 762 and late 830s – Fig. 3I), and a 'rust' outbreak (*Puccinia striiformis* – pathogen affecting cereals, see Hu et al. 2020) also occurring significantly in Tibetan crops (839–841 CE - see Tab. 2). Crop failures associated with climatic deterioration have been invariably linked with widespread human consequences (in Europe 1500-1800 CE - Zhang et al. 2011; in China throughout last 2 ka - Tian et al. 2017) and such failures may also have resulted from the increasing frequency and spatial impacts of both epidemics and famines recorded in the Tang records from the 780s–830s CE (Figs. 3J and K). These latter 'disasters' occurred particularly in the environmentally- and climatically-sensitive north and northwest of China, areas that are not only adjacent to Tibet, but noted for the importance of their agricultural production (Fang & Liu 1992, Wang et al. 2010, Li et al. 2017, Zou et al 2017, Tang et al. 2021).

Tibet during the reigns of Ralpachen and Lang Darma appears therefore to have been beset by an unusual and increasing number of climatic-environmental 'disasters', as well as socio-political 'chaos and disorder', probably leading some to question the divine (mythical) status of Tibetan Kings (and Emperors). The latter were previously associ-

Tab. 2: 'Disasters' recorded (Year CE and Chinese Lunar Month) in the annals of the Tibetan Empire (TE), Uyghur Khaganate (UyKh) and the Tang Dynasty (TD) and their coincidence with the three key events in early Tibetan Buddhism (present-day locations in bold)

Date (CE)	Event	Region affected	Record	Source
739-741	**1st Prohibition of Buddhism**	**Tibetan Empire**		
739 (Jan)	Heavy snow & rain Chang'an (**Xi'an**), capital of the Tang Dynasty	NW China	TD	OBT, Vol.9
739 (March)	Floods Lizhou (**Hunan**), Yuanzhou and Jiangzhou (both **Jiangxi**) and other regions	S China	TD	NBT, Vol.36
740 (March)	Floods Henan (**Shandong, Henan, northern Jiangsu & northern Anhu**i)	N China	TD	NBT, Vol.36
741 (July)	Floods Yi & Luo rivers (**Henan**): crops, bridges & houses destroyed and 1000+ people killed	N China	TD	NBT, Vol.36
741 Autumn	Twenty four counties in Henan and Hebei suffered floods (**Henan, Hebei & Shangdong**)	N China	TD	NBT, Vol.36
741 (September)	Heavy snow and rain hit Chang'an (**Xi'an**)	NW China	TD	NBT, Vol.36
762-763	**Buddhism adopted as official religion**	**Tibetan Empire**		
761	Famine in Yangtse & Huaihe River Basins, so severe it led to cannibalism	S China	TD	ZT, Vol.222
762	Severe epdemic Jiangdong (**Zhejiang, Fujian & southern Jiangsu**) killed half the population	SE China	TD	NBT, Vol.36
762	Drought. No rain July to August in Chang'an (**Xi'an**)	NW China	TD	OBT, Vol.11
762	Famine Jiangzhou (**Shanxi**)	N China	TD	ZT, Vol.222
763	Flood & drought hit **Zhejiang**, people suffering hardship. The Emperor asked the government not to buy supplies from the victims & to bury those who had died of the plague	SE China	TD	NBT, Vol.6
763 (Autumn)	Crops attacked by pests in autumn. Guanzhong (**Shanxi**) hit hardest	N China	TD	NBT, Vol.35
763 (September)	Heavy rain causing flooding in Chang'an (**Xi'an**)	NW China	TD	NBT, Vol.36
841-842	**2nd Prohibition of Buddhism**	**Tibetan Empire**		
839	Crops suffered pests in Henan (**Shandong, Henan, northern Jiangsu & northern Anhui**)	N China	TD	NBT, Vol.35
839	Jiangxi (**Jiangxi & Hunan**) suffered rodent pests (rats)	S China	TD	NBT, Vol.34
839	Famine led to an epidemic. Snowstorms killed most of the sheep and horses in the Uyghur Khaganate (**Mongolia**)	Mongolian Plateau	UyKh	NBT, Vol.217
839	The Uyghur Khaganate (**Mongolia**) fell (regime change) because of epdimics and heavy losses of sheep and horses due to snowstorms	Mongolian Plateau	UyKh	ZT, Vol.246
839 (May)	Tianping (**Shangdong**), Weibo (**Hebei, Shangdong & Henan**), Yiding (**Hebei**) & other regions suffered locust disasters	N China	TD	OBT, Vol.17
839 (Summer)	Chang'an (**Xi'an**) suffered Drought. Emperor Wenzong was very anxious when prayers were not answered	NW China	TD	OBT, Vol.36
839 (July)	Hailstorms in Zhengzhou (**Zhengzhou City, Henan**), Huazhou (**Huaxian County, Henan**) and other regions	N China	TD	NBT, Vol.36
839 (August)	Zhenzhou (**Zhending City, Hebei**) Jizhou (**Hengshui City, Hebei**) and other regions suffered locust disasters	N China	TD	OBT, Vol.17
839 Autumn	Heavy rainfall caused floods in Xichuan (**Sichuan**), Cangjing (**Hebei**) and Ziqing (**Shangdong**)	W China / N China	TD	NBT, Vol.36
839 (September)	Heavy snow and rain froze trees in Chang'an (**Xi'an**)	NW China	TD	NBT, Vol.34
839 (November)	Another' earthquake in Chang'an (**Xi'an**)	NW China	TD	NBT, Vol.35
c.839	An earthquake struck the country, causing springs, landslides and the Tao River to reverse its flow for three days. Rats destroyed crops. People starved to death due to epidemics	Tibet	TE	NBT, Vol.216
c.839-841	**Lhasa** was hit by frosts and droughts. Crops were infected with rust. Livestock and people were infected with plague	Tibet	TE	TB
c.839-841	There was a big earthquake. Boundary mountains on the Han - Tibet border 'fell over'. The Tao River was blocked for three days	Tibet	TE	SF
c.839-841	Frequent hail and droughts. Farmlands were barren. Famine 'broke forth'. People and livestock suffered from epdemics	Tibet	TE	CMRG

Date (CE)	Event	Region affected	Record	Source
840 (June)	Thirty-six people and a large number of cattle and horses died in Puzhou (**Juanchen County, Shandong**) due to a hailstorm	N China	TD	NBT, Vol.36
840 (June)	The Emperor (Wuzong) was prevented from using the throne room - an act of contrition before God in order to end the disaster The Emperor also ordered subordinates to conduct trials as wrongful conviction of prisoners could also have caused the disaster/s	NW China	TD	NBT, Vol.8
840 (July)	Zhenzhou (**Zhending City, Hebei**) and Jiangnan (**Zhejiang, Jiangsu & Anhui**) suffered floods	N China / E China	TD	NBT, Vol.36
840 (summer)	Youzhou, Weizhou, Bozhou, Yunzhou, Caozhou, Puzhou, Cangzhou, Qizhou, Dezhou, Zizhou, Qingzhou, Yanzhou, Haizhou, Heyang, Huainan, Guozhou, Chenzhou, Xuzhou, Ruzhou and other regions (**Yellow River & Yangtze River Basins**) suffered 'serious pests'	China	TD	NBT, Vol.36
840 (summer)	Epidemics struck Fuzhou, Jianzhou, Taizhou and Mingzhou (**Zhejiang & Fujian**)	SE China	TD	NBT, Vol.36
841 (July)	Floods hit Jiangnan (**Zhejiang, Jiangsu & Anhui**), and the Hanjiang River flooded Xiangzhou (**Xiangyang City, Hubei**), Junzhou (**Shiyan City, Hubei**) and other regions	E China / C China	TD	NBT, Vol.36
841 (July)	Guandong (**Luoyang & Henan**), Dengzhou (**Dengzhou City & Henan**), Tangzhou (**Biyang County & Henan**) and other regions suffered locusts	N China	TD	NBT, Vol.36

Sources: OBT (Xu 1975: *Old Book of Tang*), NBT (Xiu & Qi 1975: *New Book of Tang*), ZT (Guang 2011: *Zizhi Tongjian)*, TB (sBa gSal-Snang 1990: *Testament of Ba*), SF (dPav-Bo gTsug-Lag-Vphreng-Ba 2010: *A Scholar's Feast*), CMRG (Sa-Skya bSod-Nams-Rgyal-Mtshan 2016: *Clear Mirror on Royal Genealogy*)

ated with 'the ideals of a heroic and aristocratic society', and referred to as 'tsenpo', denoting power and strength, and also as rulers of 'tsen', the gods associated with mountains, high ground and cliffs (Kapstein 2000: 54). Records of a 'large' earthquake and related geomorphological phenomena affecting the Tibetan border (839–841 CE – Tab. 2), possibly refer to the 842 CE event recorded in the Gansu Province, Tang Empire (Yuan et al. 2014). This may have been seen as a sign of divine displeasure, not only causing devasting environmental impacts [today high mountainous areas are particularly susceptible to 'cascade events' (Gardner & Dekens 2007, Haeberli et al. 2017), such as considerable human mortality, and economic and political disruption (Van der Woerd et al. 2004, Podolskiy et al. 2010, Cook & Butz 2013, Shugar et al. 2021)], but also emphasising the Tibetan Emperor's inability to control the natural world.

4 Conclusion

Modern climate reconstructions using increasingly sophisticated techniques, for instance to analyse and interpret tree-rings and lake sediments, have been shown to offer explanations for major global historical events. In this research we have utilised the latest regional and Tibetan-specific climate data for a precise 300-yr period between the 7-9th centuries CE that was key, not only to the formation and expansion of the Tibetan Empire, but also crucial for an understanding of the dynamics of early Tibetan Buddhism (inextricably linked to the fortunes of the TE).

Detailed analyses of these climate data and Tang Dynasty historical records (surviving Tibetan records generally lack temporal coverage and accuracy) have revealed a picture of regional climatic amelioration leading up to the official acceptance of Buddhism by the Tibetan state as its official religion (761–762 CE) followed by long-term climatic-environmental deterioration from the 770s–840s CE. The assassination of the last Tibetan Emperor in 842 CE coincided the second prohibition of Tibetan Buddhism and the end of the Tibetan Empire.

Our research not only supports recent findings where proxy records were employed to reconstruct the fluctuating climate within Tibet and in the wider region between the 7–9th centuries CE, but it also provides details of concurrent and precisely-dated 'disasters' from the historical records (Tang Dynasty and some Tibetan). These indicate extreme pressures placed on the rural economy through crop failures and the death of livestock, leading to probable widespread famine and human mortality.

These historical data have helped to bring the 'chaos & disorder' of the latter stages of the reign of the penultimate Tibetan Emperor Ralpachen into clearer focus. Buddhism had been previously blamed for the outbreak of Bubonic plague in 739 CE, but the failure of the native Bön religion to address this, and possibly also other climatic-environmental 'disasters', lead to the 'wholescale' adoption of Buddhism by the Tibetan State in 761–762 CE. There followed the Tibetan Golden Age (760s–820s CE) with not only the expansion of the Empire, but a parallel increase in the visibility and influence of Tibetan Buddhism. However, even as its territories increased, the Tibetan Empire was being subjected to increasing numbers of climatic-environmental 'disasters' during a prolonged climatic downturn (770s–840s CE), leading to extreme pressures being placed on the rural economy. Tibetan Emperors, once considered mythical rulers of gods and the natural world, were then seen to be 'weak' and impotent in the face of such crises, as was Buddhism. The religion was banned for a second time in 841–842 CE by Emperor Lang Darma due to its perceived failure to rectify the bad circumstances being experienced by Tibetans. Lang Darma's subsequent assassination by a Buddhist monk, highlighted the on-going tensions between the religion and the state, as the latter fell apart.

Environmental determinism has long been proffered as an explanation for the origins and fluctuating fortunes of religions, as early human societies were often strongly influenced by their surroundings, highly susceptible to superstitions, and to rituals and beliefs that could mitigate omnipotent external forces (Kasche 1795, Huntington 1951, Buttner 1980, Park 1994, Huber & Pedersen 1997). Such approaches have however drawn criticism for oversimplifying the impacts of natural events and of societal processes. Indeed, our research supports the need for more sophisticated analyses of the relationship between environmental change and humans, as it suggests that the 'oscillating fate' of Buddhism during the Tibetan Empire (618–842 CE) was not only associated with probable imperial economic decline, but also inextricably with the outbreak of disease and also climatic-environmental change, as well as the superstitions of a geographically vulnerable early pastoral and agrarian society.

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