From climate change to language change

Over the last decades, our Earth has experienced an alarming number of extreme events, such as heatwaves, heavy rainfall, flooding, melt events, drought, forest fires, cyclones, etc. With progressing climate change, such extreme events can be expected to occur more frequently and potentially become more severe (Martin et al. 2021). A new field of study has risen from the ashes of these events: Geoanthropology studies present and past interactions between humans and the Earth system, integrating fields such as Climate science, Earth system science, Ecology, Environmental history, Archaeology, Economics, Law, Anthropology and Political sciences. In our panel, we wish to add linguistics to this list and explore the relevance of Historical Linguistics for the field of Geoanthropology.

How do climate and language connect? The link between the two lies in humans and how they respond to changing conditions and extreme events. Simply put, climate change can affect speaker populations in the following three ways.

(1) *The speaker population declines to extinction*

Disrupting subsistence industries of speakers of endangered languages, climate change is forcing these speakers to assimilate to the language and subsistence strategies of more dominant linguistic groups or to scatter around the globe, thus threatening linguistic survival. For example, as reindeer populations are threatened by climate change, reindeer herders speaking Evenki, a Tungusic language in Northeastern Siberia, are shifting not only to jobs in industry but also to the Russian language.

(2) *The speaker population migrates to a new environment*

By contrast, climate change can also increase linguistic diversity. During the Little Ice Age these Tungusic speakers expanded their territory because colder weather appears to increase reindeer populations (Hudson 2020, Robbeets & Oskolskaya 2022). Moreover, climate change can force populations to move, along with their crops and languages to search for a more viable environment. In such cases, we expect language split between the part of the speech community that stays and the part that leaves, leading to the development of separate daughter languages. The daughter language on the move can either be maintained and interact with contact languages at its new destination, or, alternatively, it can be abandoned, with speakers shifting to a new target language, spoken by a more dominant speech community in the new environment. For example, a large group of Maldivian climate refugees has moved to India or Sri Lanka. Even if the immigrants' language has received substantial influence from Tamil, Hindustani and English, they maintain Dhivehi, spoken in the Maldives, as their native language.

(3) *The speaker population adapts to the changing environment*

Even if certain speech communities manage to stay in place and maintain their native language, they will need to adapt it to the changing local environment (Frainer et al. 2020). This may involve coining new words, losing specific cultural vocabulary, lexical recycling, borrowing from better adapted speakers, etc. Ongoing climate change in Alaska, for instance, created new opportunities for agriculture. In Aleut, the agricultural verbs 'to plant' and 'to sow' are recycled from original hunter-gatherer terminology meaning 'to drop a fishing line' and 'to distribute sea-catch' (Berge 2017).

How can we extrapolate, projecting observable cases of climate-driven language change to reconstruct linguistic prehistory? Geoanthropologists use the designation "Anthropocene" as a unit of geologic time, used to describe the period when human activity started to have a significant impact on our planet's climate and ecosystems. Other suggestions for the starting date being the Industrial Revolution and the invention of the atomic bomb, some researchers argue that the Anthropocene began approximately 8 000 years ago with the development of farming and sedentary cultures (Foley et al. 2013; Smith and Zeder 2013, Renn 2020). This falls within the time frame that can be investigated by applying the traditional historical-comparative linguistic method, the practical cut-off point for this method lying around 10 000 years ago (Comrie 2000; Campbell 2000). It is no coincidence that many of the world's major language families started to disperse around the Neolithic Revolution. For instance, language families such as Bantu (Philipson 2002) , Semitic (Diakonoff 1998), Austronesian (Blust 1995, 2013; Pawley 2002; Bellwood & Dizon 2008), Transeurasian (Robbeets et al. 2021), Sino-Tibetan (Sagart et al. 2019, Zhang et al. 2020), Tai-Kadai (Ostapirat 2005), Austroasiatic (Higham 2002, Diffloth 2005, Sidwell and Blench 2011, Sagart 2011, van Driem 2017), Dravidian (Fuller 2002) Arawakan (Aikhenvald 1999), Otomanguean (Kaufman 1990, Brown et al. 2013a/b, 2014a/b) are argued to owe their primary dispersal to the adoption of agriculture by their early speakers. The link between postglacial warming and farming/language dispersals is generally accepted (Richerson et al. 2001, Bellwood 2022: 150) but it remains to be investigated how climate versatility and extreme events in specific regions may have influenced language loss, change and dispersal.

Our panel proposes a wide range of questions stressing the need of case studies that illustrate in what ways climate reshaped individual languages and language families across the world.

Is climate change threatening certain languages and accelerating language loss of already endangered languages? Can climate change also have a positive effect on linguistic diversity, leading to the birth of new daughter languages? What is the relation between the reduction of biological, cultural and linguistic diversity through climate change? What is the reason for/ mechanism behind the correlations? Can the conservation of species be expected to lead to the conservation of languages? Can regions that have high biodiversity be linked to the development of linguistic diversity? Can we correlate established periods of climate change in a certain region in prehistory with periods of linguistic dispersal and language loss? Do dated trees of individual language families support such a correlation? Can we extrapolate our understanding of climate-driven language change not only to reconstruct the past but also to predict the future? In what way and to which extent did the emergence of the Anthropocene impact language loss, dispersal and change? What is the influence of extreme events on language diversification? Can the impact of extreme events be modeled, for instance by Dixon's (1997) equilibrium/punctuation model or by Hudson's (2017) adaptive cycle model? Are there case studies that illustrate the impact of extreme events on language change? What is the impact of time on climate-driven language change? Is it reasonable to expect that linguistic diversity will restore at a higher speed than biological diversity? What is the role of climate in proposals like "the Farming/Language Dispersal Hypothesis" (Bellwood & Renfrew 2002), which posits that many of the world's major language families owe their dispersal to the adoption of agriculture by their early speakers?

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Prehistoric climate changes and their effects on the development of the Eskaleut languages

Anne Berge

Prehistoric climate change, population movements, and language contact in the Bering Sea region are intimately connected. The archaeological and paleo-environmental records consistently show cooler climatic periods associated with more abundant marine resources and population expansions, while warming periods correlate with marine instability, region-wide population stresses, decreases, and migrations, as well as evidence of warfare. Although we see this in the smaller climate fluctuations at local levels, the two biggest changes in the past 4000 years coincide with the most important linguistic splits in the Eskaleut language family.

Eskaleut consists of two major branches: Aleut, with a single language spoken today, Unangam Tunuu, and Eskimo, with two major branches, Yupik and Inuit. The age of Proto-Eskaleut is generally put somewhere between 6000 BP and 4000 BP, during the Neoglacial period in the Bering Strait area. Unangam Tunuu (Aleut) split off first, probably via an independent migration ca. 4500 BP, becoming an independent language by ca. 3500 BP (Berge 2018). This timing corresponds almost exactly both with the end of the Neoglacial period and with a massive volcanic eruption that isolated the Eastern Aleutians from the Alaskan mainland and the related culture on Kodiak Island (Maschner 2016), leading to their linguistic differentiation (Berge forthcoming). The eruption caused a catastrophic population crash in central western Alaska, leading to movements from the interior to the coast and significant cultural changes associated with the development of Proto-Yupik culture, although not necessarily language (Tremayne and Brown, 2017).

The warmer period that followed the Neoglacial allowed the spread of whales northward into the Bering Sea, and consequently to the development of the whaling cultures later associated with the Yupik and Inuit peoples on the Siberian coast (Crockford and Frederick 2007). Despite local variations in climate, the next 2000 years were relatively stable and cool (although not glacial), allowing these cultures to flourish, particularly from 2000-1100 BP. From about 1000 BP, the climate warmed significantly, with drastic consequences. In the earliest part of this Medieval Climate Optimum, one of these cultures spread out aggressively from Siberia to Alaska (Mason 2009), precipitating a period of intense societal destabilization in northern coastal Alaska. Around 800 BP, there was a sudden and a very rapid emigration from this part of Alaska and colonization of the northern Canadian arctic to Greenland, a movement associated specifically with the development and spread of Inuit. Although Moss et al. (2007) find no evidence linking this expansion with the start of the climate change, the earlier migration from Siberia does correlate with the change. A concurrent Inuit expansion southward in Alaska precipitated five centuries of tribal wars and population displacements in Yupik areas (Funk 2010). This movement resulted in the arrival of the Yupik language Alutiiq to the Pacific Coast, its replacement of Unangam Tunuu on Kodiak Island (Berge, forthcoming) and the dialect leveling of Unangam Tunuu along the Aleutians (Woodbury 1984).

Climate change is certainly not the only factor in linguistic development. Natural disasters such as the volcanic eruption at the end of the Neoglacial may be a more direct cause of the development of Unangam Tunuu. Other factors include resource depletion as a result of increases in human population, activity, or improvements in technology; and cultural contact through trade, warfare, etc. have all affected the development of the Eskaleut languages. Nevertheless, when climate changes occurred, they acted as significant stressors leading to isolation, migration, or warfare. In this paper, I discuss how important prehistoric climate changes have been on the development of the Eskaleut languages.

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Seals and sea ice: the (possible) climatic background of Amuric influence on Ainu

Martijn Knapen

Amuric is a small language family historically and presently spoken on the Lower Amur and Sakhalin Island by the Nivkh people. Since the thirteenth century at least, the language family has shared Sakhalin with the local variety of Ainu (Janhunen 2022a). While this variety extensively borrowed from Amuric (Shiraishi and Tangiku 2022), there is also Amuric linguistic material in Proto-Ainu, the ancestor to the modern Ainu varieties, which implies their interaction predates the arrival of Ainu to Sakhalin. For contact to occur, two languages must have been present in the same location. The most likely location appears to be Hokkaidō, which therefore suggests an early Amuric presence there (Vovin 1993; 2016).

Before Amuric spread to Hokkaidō or even Sakhalin, it was most likely spoken in the southern section of the Amur Basin, near the Ussuri and Sungari, as recent research suggests (cf. Janhunen 2022b; Knapen, in press). The trajectory of its expansion mirrors that of the Okhotsk culture, an archaeological culture that has its origins on the Amur and was present on northern Hokkaidō from 550 AD to 1200 AD. It was characterised by heavy reliance on marine resources and was noticeably distinct from its contemporary neighbours on Hokkaidō, the Epi-Jomon (100BC-550 AD) and Satsumon (600-1200 AD) cultures, the predecessors of later Ainu culture (Hudson 2004). The impetus for the migration of the Okhotsk culture to Hokkaidō may have been a cold period that lasted from 150 AD to 650 AD, which resulted in increased sea ice on the Sea of Okhotsk and with that improved conditions for hunting pinnipeds (Abe et al. 2016). As the bearers of the Okhotsk culture are often suggested to be related to the Nivkh (but also various other modern Northeast Asian ethnic groups) (Zgusta 2015), these climatic conditions could also be tied to the spread of the Amuric language family to Hokkaidō. The main indeterminate here is whether Amuric may be regarded as the language spoken by the bearers of the Okhotsk culture. This problem is approached from the perspective of linguistic palaeontology (Heggarty 2014): by reconstructing terminology suggestive of familiarity with a particular way of life, the homeland of a particular proto-language is inferred. The vocabulary in this case will be delimited to items referring to local marine fauna and the exploitation of such resources. The procedure follows Janhunen's (2016) approach, by not just considering Amuric internal data (cf. Fortescue 2016), but also external data, primarily from the Tungusic languages. To avoid circularity, Ainu data is not included. Additionally, the evidence of Amuric-Ainu contact proposed by Vovin (1993; 2016) is evaluated as well as further connections. This evidence is then set against other hypotheses on the linguistic identity of the Okhotsk culture. Aside from advancing the line of inquiry started by Vovin (1993; 2016), this paper will provide further clarification to the (linguistic) prehistory of northeast Asia and its indigenous peoples, for which written records are scarce, as well as the possibility of climatic factors influencing language dispersal.

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Spread of Proto Japanese from Korean Peninsula to Japanese Archipelago influenced by natural environment change

Kazuo Miyamoto

It is believed that there were four stages of spread of early agriculture in North-East Asia (Miyamoto 2014, 2015). The first stage involved the spread of millet agriculture to the Korean Peninsula and to the southern Russian Far East in the middle of the fourth millennium BC. The second stage was the spread of rice agriculture from the Shandong Peninsula to the Liaodong Peninsula at c. 2400 BC. The third stage, in the middle of the second millennium BC, consisted of irrigated agriculture and spread from the Shandong Peninsula via Liaodong Peninsula to the Korean Peninsula. Finally, the fourth stage involved the spread of irrigated agriculture from the southern Korean Peninsula to Northern Kyushu, Japan, beginning about 9th century BC. These four stages were triggered by immigrants due to cooler climate conditions and the development of faming society.

The fourth spread of early agriculture from 9th to 8th century BC is spread of irrigated rice agriculture with rice paddy field from southern Korean Peninsula to Northern Kyushu. This spread was triggered by the immigration form Southern Korea to Northern Kyushu to get new lands for cereal agriculture due to cooler climate conditions (Miyamoto 2016, 2019). The spread direction of irrigated rice agriculture from Korean Peninsula to Northern Kyushu was divided into two phases. The former phase is immigration from Namgang River basin to Karatsu and Itoshima Plains at 9th to 8th century BC. The latter phase is immigration from lower Nagdong River basin to Fukuoka Plains at 7th century BC. Those dual phases accorded to cooler climate conditions (Miyamoto 2016, 2019).

These dual immigrations speaking Proto Japanese in Korean Peninsula spread to Northern Kyushu mixed with Jomon people speaking Jomon Languages. They invented Yayoi culture in Fukuoka Plains based on Mumun culture in southern Korean Peninsula at 6th to 5th century BC. In this time, Yayoi culture people in Fukuoka Plain replaced Proto Japanese from Jomon languages (Miyamoto 2016, 2022).

Yayoi culture originated from Fukuoka plain spread immediately to the whole of western Japan at 6th to 5th century BC. This spread of Yayoi culture is also spread of Proto Japanese replaced from Jomon Languages in the Western Japan. The spread of Yayoi culture with irrigated agriculture was promoted by demographic pressure due to the stable weather conditions.

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Climate change and the dispersal of Proto-Tibeto-Burman

David Bradley

From a likely origin in the Majiayao Culture of what is now Gansu in China from circa 5.3K YBP, the Proto-Tibeto-Burman (PTB) community migrated and divided rapidly during times of ancient climate change. Their initial agriculture was mainly based on *Setaria* and *Panicum* millet and rice, and their domestic animals were dogs, pigs and *Bos Taurus* cows (Liu & Chen 2012). Etyma for these three crops and three domestic animals are reconstructed for PTB (Bradley 2011, 2016, 2022). Majiayao was a western offshoot of Proto-Sino-Tibetan (PST) Yangshao Culture, which flourished to the east of Majiayao from circa 7K-5K YBP during a period of favourable climate, cultivated the two millets and had domestic dogs and pigs, and later developed into Sinitic Longshan Culture. Domestic taurine cows were introduced from the west circa 5.6K YBP (Brunson et al. 2020), and the PST COW etymon ***ŋwə** supports dating the PTB/Sinitic split to after 5.6K YBP. Rice was first domesticated in the lower Yangtse area by circa 6K YBP and later spread northwest to late Yangshao and early Majiayao cultures (Fuller et al. 2007), with PTB but no earlier PST etyma.

Subsequent PTB migrations were shaped by climate change; firstly, a warm and wet climate from circa 5K YBP, which permitted cultivation of these crops at higher altitudes in eastern Tibet and western Sichuan (d'Alpoim Guedes et al. 2014, 2016). Later periods of cooling climate (Cheung et al. 2019, Chen et al. 2020) perhaps triggered further migrations beyond southwest China, with the Karenic subgroup reaching west Southeast Asia and the Central subgroup reaching northeast South Asia. Ecological changes led to shifts in crops and domestic animals, with contact introducing some new crops and animals. This discussion will trace the lexical outcomes for crop and domestic animal vocabulary and show how archaeologically documented dates for contact-introduced and newly-domesticated crops and animals can assist to date the early phylogeny of PTB.

Two crops arrived from the west circa 4.5K YBP: *Triticum* and *Hordeum.* Unlike *Setaria* and *Panicum*, these can adapt to cooler climate, so their cultivation spread and increased rapidly with cooling climate from circa 4.2K YBP. Rice was also more suitable for some new ecological niches. Two domestic animals also adaptable to cooler climate, sheep and goats, were introduced from the west circa 4.4K YBP (Liu & Chen 2012). The subgroup of PTB which on independent comparative evidence appears to have separated first from PTB, Karenic, lacks cognates of PTB etyma for WHEAT, BARLEY and GOAT; it has a cognate of the PST and PTB etymon for wild BOVID ***jaŋ**, also present in Sinitic (the later Longshan Culture offshoot of Yangshao Culture in its original area and further east) and in PTB. The cognate means 'goat' in Karenic, while it means 'sheep' in the rest of PTB, and both in Sinitic; the PTB GOAT etymon is ***cʰit** (Bradley 2022). Thus the split of Karenic from PTB may have preceded 4.5K YBP.

Bos grunniens (yak) was probably domesticated by 3.65K YBP (Jacques et al. 2021) and cultivation of *Hordeum vulgare* var. *nudum*, a variety of barley suitable for cold climate (d'Alpoim-Guedes et al. 2015, Zeng et al. 2015) developed in parts of the area during expansion into higher-altitude environments such as the Karuo Culture, and expanded during the cold climate period from circa 3.5K YBP. The horse was introduced from the west into China circa 3.3K YBP (Liu & Chen 2012). *Fagopyrum* (buckwheat) cultivation started in upland southwest China by circa 3.15K YBP (Xue et al. 2022). These developments are reflected by the distribution of etyma for these crops and animals among TB languages. A YAK etymon has cognates in Eastern and Western TB but not Central TB. Western TB and Eastern TB have distinct BUCKWHEAT etyma; the latter is borrowed into Chinese. The forms for HORSE are loans, with a wide variety of alternative forms, including various similar Eastern TB forms, a completely different Western TB form, also Indic loans in Central TB and some Western TB languages south of the Himalayas, and another form in Karenic languages. Overall, this suggests that the second split within PTB was Central TB, perhaps associated with the 4.2K YBP climate cooling, followed by a later split between Western and Eastern TB associated with the 3.5K YBP climate cooling, after the domestication of the yak but before the introduction of the horse circa 3.3K YBP and before the domestication of buckwheat.

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Climate change reflected in early Sino-Tibetan borrowings for crops and animals

Bingcong Deng

The Holocene Climatic Optimum (HCO) occurred in northeastern China around 9500-5000 BP, marked by increased precipitation and temperature (Jia et al. 2016, Liu et al. 2022). Previous studies suggest that the period from 7000 to 5000 BP was characterized by a favorable climate in the Yellow River region (Liu et al. 2022), until the temperature and humidity dropped around 4000 BP (Sun et al. 2019). During this time, there was a significant increase in the spread of rice in northeastern China (d'Alpoim et al. 2015). In the West Liao River basin, the Bronze Age was characterized by a transition of human subsistence strategies as a response to climate change, with an increased reliance on animal husbandry in comparison to millet cultivation (Jia et al. 2016).

This paper aims to investigate the lexical borrowings of crops and animals in northeastern China, which could reflect the climate events linguistically. Emphasizing on the loanwords in northeastern China, two language phyla will be the focus of this study, namely Sino-Tibetan and Transeurasian. Rice cultivation, which was spread during the peak of HCO in northern China, may have led to borrowing of vocabulary related to rice farming from Sino-Tibetan to Transeurasian languages. Similarly, the increased reliance on animal husbandry in the West Liao River Basin could lead to borrowings of animal-related vocabulary from Transeurasian to Sino-Tibetan languages. Based on these premises, the research questions of this paper are: (1) What is the impact of climate change on crops and animals in northeastern China? How is that reflected in prehistoric lexical borrowings? (2) Can climate be seen as an impact of the transmission of the words for crops and animals?

This paper maps the approximate climate situations on the contact settings between Sino-Tibetan and Transeurasian in time and space, in reference to the loanwords to specific contact settings based on a loanword database compiled by the current author. A separate database for loanwords of crops and animals between Sino-Tibetan and language families in the south (e.g., Austronesian, Austroasiatic, and Tai-Kadai) was also collected, for the purpose of comparing the quantity and quality of borrowings that happened in the northeast. Data on archaeological sites and climatic information were collected from previous research.

The preliminary results suggest that (1) climate change correlates with the spread of certain crops and animals, further coinciding with the borrowing date of related lexical items. For instance, the introduction of wheat and barley from Central Asia is mirrored by the lexical borrowings referring to these crops detected in Old Chinese, Tungusic, Japonic and Korenic. This suggests that climate is likely to have played an important role in agricultural lexical borrowings between the two phyla. (2) The lexical borrowings between Sino-Tibetan and languages with a southern origin are larger in size in comparison to loans detected in the north (i.e., with Transeurasian). This difference might also be explained by the climate different between the two geographical regions. This research sheds light on the human response to climate change from a linguistic perspective. By investigating prehistoric lexical borrowings, it shows that climate events are one of the contributing factors to language contact and lexicon change.

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Austroasiatic dispersal: sea levels and estuarine environments in late Neolithic Mainland SEAsia.

Paul Sidwell

The paper discusses a radical reinterpretation of Austroasiatic (AA) prehistory in the light of sea level changes in Mainland Southeast Asian during the late Neolithic revolution there (circa 4kyBP).

How and when the Austroasiatic language phylum dispersed has been a contensious and difficult problem for a century. Nonetheless, in the past decade a consensus has begun to emerge based on a synthesis of linguistics, archaeology, and genetics called the "two layer hypothesis". The model holds that AA emerged in northern Indo-China from the fusion of indigenous neolithic forager-farmers with East Asian cereal farmers attracted to the delta environments that faciltate intensive rice cropping.

Historically scholars have proposed the AA homeland in diverse locations (Indo-China, Gangetic India, Eastern India, Cental China, Southwest China, etc.), all conceptualizing the dispersal as a problem of determining which overland or down-river routes were taken. Recent proposals (Sidwell 2022, 2020, Rau & Sidwell 2019, etc.) have argued that early AA speakers dispersed out of Northern Vietnam and around the Indo-Chinese coast and beyond to India by coastal navigation.

In this context, we need to consider how conditions differed from the present day. We know that Holocene sea levels peaked at around 2m higher than present some 7kyBP, gradually dropped by 3 metres, and rose again to almost the same peak from 4ky to 3.5kyBP. Many present day delta environments that are intensively cultivated for rice were very different: coastlines were further inland and low islands, coastal marshes and mangroves existed in places where paddy fields dominate today.

It is proposed that early Austroasiatic speakers ventured to seek new favourable estuarine environments rich in opportunities for hunting, fishing, vegeculture and cereal production. However, areas available for paddy farming were much more limited than today and this motivated growing populations to migrate ever further, eventually settling in the Malay peninsula, the Nicobar islands, and the Mahanadi River Delta in Eastern India. As sea levels declined larger delta areas formed, faciltiating the rise of more organised societies such as the Davaravati Mon and pre-Angkorian Khmer states. In some areas the attactive coastal areas were overtaken by newer migrants, such that the Aslians in Malaysia and Mundas in India moved inland to rely more on shifting cultivation. The Nicobarese larely abandoned cereal farming in their adopted island home, assimilating culturally to some extent with Austronesians.

While today the greater diversity of AA speakers appears to be reflected in upland and shifting cultivators, this is a reflection of later diversification of those who moved inland. Environmental, cultural and societal change along the coasts and near inland favoured state formation and linguistic assimilation as sea levels fell and stabilised around present values.

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Languages, ecology and climate change: Worldwide perspectives and the test-case of the Andes

Paul Heggarty

This workshop raises a series of open questions on climate change and language(s). Here I explore illustrative cases from around the world that offer valuable perspectives on several of these big-picture questions.

Research into the world linguistic panorama, and on how it came to be, has long looked for correlations with ecology, articulated especially through the subsistence strategies practised by different speaker populations. Most far-reaching is the farming/language dispersals hypothesis, invoked to account for how just a few language families expanded so spectacularly — and drove other language lineages, and overall human linguistic diversity, into decline. In effect, this hypothesis looks to climate change as an ultimate driver, for it was only once post-glacial warming took hold that agriculture emerged at all, repeatedly and independently.

The correlation is not so straightforward or immediate, however. Many language families hypothesised as spread by early farmers do not in fact seem to have started expanding until long after agriculture first began in the regions concerned, even by up to a few millennia. Alternative hypotheses stress later phases of intensification, secondary products, or specialisations (e.g., to pastoralism), which themselves may arise in response to ongoing climate changes.

So as this contrast already illustrates, the basic question is not whether links between languages and ecology exist, for they clearly do. Rather, it is about how far those links either point to environmental determinism, or reflect how human societies have responded to their ecological contexts and challenges, to mitigate and even take advantage of them. The contrasting fates of human language lineages through prehistory may in part record failed or successful responses to ecology. The parallels with the debate on the Anthropocene, and when it began, are striking. For our language diversity, too, has over time been transformed (and increasingly destroyed) by our own human impacts. Today's globalization marks an acceleration, but of a linguistic transformation that began many millennia ago.

Language-ecology relationships can differ greatly in causation and scale, however. Some language expansions are hypothesised as driven by one-off, extreme 'punctuation' events, such as the White River Ash volcanic eruptions pushing Athabaskan speakers southwards (Workman 1974), or a possible role for a 'Black Sea deluge' in spreading early Indo-European (see Nichols 2007). Even short-term events, if extreme enough, can have long-term linguistic consequences. Sometimes, humans also induce their own ecological collapses — although of the five cases explored by Diamond (2005), only one led to language extinction (of Greenlandic Norse). It is a different, much broader question how far linguistic fates have been shaped by full-blown climate-change, more gradually over far longer time-scales.

Many of these questions are ideally illustrated in one particular part of the world, where topography and the Tropics conspire to fashion a natural laboratory of ecological extremes and diversity, in immediate proximity. Out of the rainforest of Amazonia, the dry Andes rise rapidly to host the highest farmable lands on Earth, before dropping swiftly away to a coastal desert, but fringed by the superabundant waters of the Pacific. In this microcosm of extreme and fragile ecologies, a pristine civilisation arose, perhaps even before farming, and followed a tumultuous trajectory through both sudden and longer-term climate perturbances. This makes for an ideal test-case in how far language distributions may have been shaped by climate changes, or largely resistant to them, where their speakers ingeniously adapted to attenuate and harness the ecological challenges.

Generally, language distributions align with the stark differences between Amazonia, the Andes, and the Pacific Coast. The first complex societies, on the coast, did not spread their languages beyond the ecological limitations they faced. Major language expansions came only once complex societies in the highlands so transformed the Andean landscape, by terracing and irrigation, as to raise carrying capacity, expand demographically, and take their languages with them. The very name of the major surviving language family of the Americas, Quechua, originally denoted an ecological zone, the qiĉwa mid-elevations ideal for cultivating what became the primary staple, maize. The grasslands of the higher puna zone, meanwhile, suited pastoralism better, once camelids like the llama had been domesticated, as well as tuber crops like the potato. These underpinned the Tiwanaku culture around Lake Titicaca, up until its collapse, widely attributed to climate change. Yet this did not efface their language, Puquina, although it did leave it vulnerable to the later power of the Incas, and their mastery of the Andean environment. The Incas even named languages, too, in 'ecological' terms (Itier 2015). They also resettled populations en masse far across their Empire, but often deliberately into regions ecologically similar to their homelands, and taking their Quechua and Aymara languages with them.

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(Im)mobility, climate, and language: Towards a geoanthropology of the Balkans

Brian Joseph

The ways in which humans interact with the physical environment of the geography within which they live, i.e. their geoanthropology, have ramifications for their language. The peoples of the Balkans offer various case studies showing such geoanthropological effects, focusing on movement, or lack thereof, across different environments, for different reasons, and with different results. Thus, by way of illustrating the range of these geoanthropological interactions with language, I survey here some of these cases, drawing in part on Friedman & Joseph 2023. In particular, I discuss the linguistic correlates of a nomadic versus a sedentary lifestyle for Roma populations in the Balkans, as well as the effects of the "transhumance" of both the Balkan Romance speakers of Aromanian in the central Balkans (especially Albania, Greece, and the Republic of North Macedonia) and the Sarakatsani speakers of Greek who live in northern Greece, Bulgaria (where they are known as Karakačani), and the Republic of North Macedonia (where they are known as Sarakačani), by which whole villages relocate at different altitudes for summer and for winter.

I then draw parallels with similar situations in other parts of the world, looking in particular at the linguistic consequences of nomadic versus settled Bedouin Arabic lifestyles in the Middle East (as discussed in Cadora 1992) and the so-called "vertical" bilingualism in the Caucasus (Nichols 2015), by which people in higher altitude villages know the languages of those lower down the mountain, but those in the lowlands do not bother to learn highland languages.

Based on these case studies, I argue first that the observed effects have largely to do with differential patterns of contact with speakers of other languages brought on by the differential interaction these groups have through their shared geography. Ultimately, therefore, I claim further that there is no specific geoanthropological effect as a *primary* mechanism of language change, but rather that any such effects are secondary, deriving from well-known and well-understood mechanisms of contact-induced change (as outlined in Weinreich 1968, Thomason & Kaufman 1988, Winford 2003, and Matras 2009, among other sources).

In this way, the linguistic effects of geoanthropology are rather like what has been argued for other aspects of the historical development of languages, especially grammaticalisation (Campbell 2001) and exaptation (Joseph 2016), i.e. they are real, yes, but are derivative and thus arguably epiphenomenal, in that they reduce to already well-established patterns of linguistic change.

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Risk, resilience and the ecology of farming/language dispersals
Mark Hudson

The farming/language dispersal hypothesis is ultimately about demography. As farmers have more babies, their population increases and they expand at the expense of hunter-gatherers who have lower fertility. This process is known as the Neolithic Demographic Transition and occurred despite the fact that farming also led to higher mortality through new disease vectors. The basic pattern of farming expansion from centres of domestication is now well-understood. Until recently, archaeological studies of this expansion were based primarily on archaeobotanical and zooarchaeological data relating to the distribution of plants and animals. However, new approaches using isotopic and biomolecular archaeology are now enabling us to study questions of ecological 'adaptation' in farming dispersals in more detail. Three aspects are relevant here: the ways in which farmers adapted their crops and domesticated animals to different environments as they expanded into novel territories; the extent to which farmers made use of wild resources such as nuts and fish; and their responses to environmental change over both the short- and long-term. This perspective acknowledges that, while farming was economically more productive than hunter-gathering, it was also associated with high risks. In fact, the most productive peasant economies (such as Late Imperial China) were often associated with the highest level of risk: when something went wrong, it had very serious impacts on the livelihoods of huge numbers of people. Yet another recent approach in Neolithic studies is a greater focus on traces of violence resulting from new methods aimed at identifying cranial trauma. This work has shown that warfare and inter-personal violence were common in Neolithic societies, raising further questions about risk and resilience in early agriculture.

The first part of this presentation will summarise recent research on the cultural and environmental adaptations of early farmers, using examples from Europe, Japan and Island Southeast Asia. The discussion considers how such adaptations worked to enhance risk buffering and resilience. In the process of settling in to a territory, language must have been a key element of social learning, yet new evidence that has become available over the past decade or so shows that while Neolithic farmers expanded in a dynamic fashion, their lifeways were frequently subject to high risk and low resilience. Greater globalisation of food crops and increased exchange and commercialisation of foods were associated with more resilient agropastoral systems in the Bronze Age. This paper will explore the implications of these findings for the farming/language dispersal hypothesis, analysing the spread of Austronesian, Indo-European and Japonic as case studies.

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