



HAL
open science

Architectural wood remains and climatic variations in early 2nd millennium CE, northwest Alaska: reflections on the possibilities and limits of Dendroarchaeology

Juliette Taïeb

► To cite this version:

Juliette Taïeb. Architectural wood remains and climatic variations in early 2nd millennium CE, northwest Alaska: reflections on the possibilities and limits of Dendroarchaeology. *IdeAs: idées d'Amérique*, 2024, 24 (En ligne), 10.4000/12hsc . hal-04809262

HAL Id: hal-04809262

<https://hal.science/hal-04809262v1>

Submitted on 28 Nov 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution - NonCommercial - NoDerivatives 4.0 International License

Architectural wood remains and climatic variations in early 2nd millennium CE, northwest Alaska: reflections on the possibilities and limits of Dendroarchaeology

Vestiges architecturaux en bois et variations climatiques au début du II^e millénaire de notre ère, nord-ouest de l'Alaska : réflexions sur les possibilités et les limites de la dendroarchéologie

Vestigios de arquitectura en madera y variaciones climáticas a principios del segundo milenio e.c., noroeste de Alaska: reflexiones sobre los alcances y limitaciones de la dendroarqueología

Juliette Taïeb

Acknowledgements

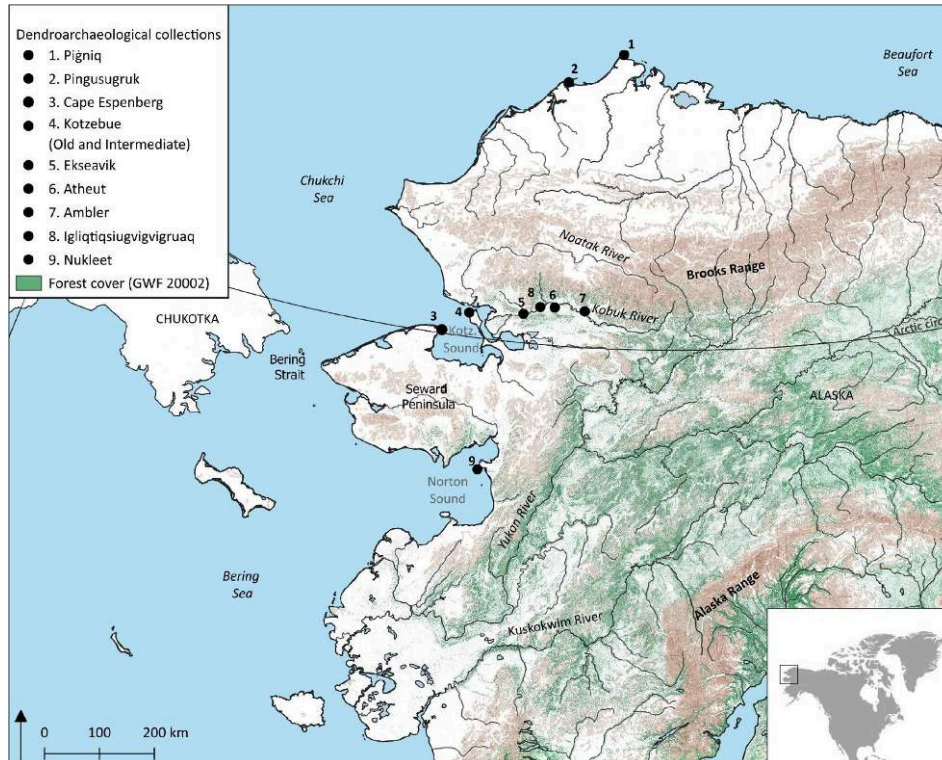
This manuscript benefits from the insights and remarks of two anonymous reviewers and of Glenn P. Juday and Claire Alix that I thank very much.

Introduction

- 1 In the tundra coasts of northwest Alaska, humans collected timbers from driftwood. This coastal driftwood originated in the interior Alaska boreal forest and was carried by major rivers, such as the Yukon and the Kuskokwim in the Interior, and the Noatak and Kobuk rivers in Northwest Alaska, to coastal beaches (Fig. 1; Giddings J. L., 1943, 1952a; Alix C. and K. Brewster, 2004; Alix C., 2005). Therefore, archaeological timbers found in coastal sites may come from various regions of Alaska, and potentially from other areas, carrying climatic information of their geographic region of origin. The

development of chronologies in these driftwood source regions could also be used to trace the provenance of the archaeological wood remains, providing environmental information on past sea currents (Giddings J. L. 1943, 1952a).

Figure 1. Map of Alaska showing a non-exhaustive list of Iñupiat archaeological sites of the 2nd millennium CE where tree-ring samples from architectural wood remains were collected



Giddings J. L., 1948, 1952b, 1964; Rye O., 1950; Sheehan G. W., 1997; Griggs C. *et al.*, 2019; Taïeb J. *et al.*, 2022, 2023, 2024). Credits: J. Taïeb; GIS data: Global Forest Watch 2000, Alaska Geospatial Office.

- 2 The chronometric and climatic potential of these architectural wood remains was assessed in 1940s by archaeologist and Alaska dendrochronology pioneer James Louis Giddings (Nash S., 2000). He built a 1000-year-old chronology (978-1948 CE) in the Kobuk Valley, Northwest Alaska, from standing white spruce trees, driftwood, historic cabins, and archaeological sites (Figure 1; Giddings J. L., 1948, 1952b). This chronology enabled absolute dating of arctic archaeological sites for the first time. However, dendroarchaeology was mostly abandoned in Alaska in the 1950s, with the arise of radiocarbon dating (Nash S., 2000; Taïeb J. *et al.*, 2022). Today, this legacy chronology remains the yardstick for dendrochronology, archaeology and paleoclimatic inferences in Northwest Alaska (Murray M. S. *et al.*, 2003; D'Arrigo R. *et al.*, 2005; Griggs C. *et al.*, 2019; Taïeb J. *et al.*, 2022). However, while the chronology was revised by dendroclimatologists in the 1990s and 2000s (Graumlich L. and K. King, 1997; D'Arrigo R. *et al.*, 2005), the replication of the early part of the chronology remains low before the 12th century, limiting dendroclimatic analyses for the early 2nd millennium CE.
- 3 Along the coasts of western Alaska, wooden architectural remains are well preserved in archaeological sites of the last two millennia (Alix C., 2016). At the intersection of archaeology, palaeoclimatology, and ecology, these organic remains offer an annual and local resolution rarely accessible to archaeologists and make the region especially

suitable for dendrochronology (Giddings J. L., 1940, 1943a, 1952b; Griggs C. *et al.*, 2019; Taïeb J. *et al.*, 2022). This archaeological wood provides invaluable information about past climatic variations at various temporal (annual to multi-centennial) and geographical (local to regional, even sometimes hemispheric) scales.

- 4 In a context where past and present Iñupiat cultural variations are often interpreted as responses to climatic and environmental changes, this paper provides an overview of current knowledge of the dendroclimatic possibilities and limits of archaeological architectural wood remains, with a view to exploring their contribution to the broader understanding of the climatic framework of the early 2nd millennium CE and socio-ecological dynamics of the early Iñupiat in Northwest Alaska (Liu J. *et al.*, 2007; Lagadeuc Y. and R. Chenorkian, 2009). Dendroclimatology examines climate variations and reconstructs them statistically from tree parameters (Fritts H. C., 1976; Speer J. H., 2012). The main climatic parameters controlling tree growth are known as limiting factors, mainly air temperature and nowadays precipitation in the subarctic environment of Alaska, which controls where a species grows. Building upon recent knowledge since the 2000s, we first introduce the climatic data recorded in white spruces in Interior and Northwest Alaska and then consider the study of past climate based on Alaskan architectural wood remains is considered. Finally, we focus on the Medieval Climate Anomaly frame [MCA] (9th-13th centuries) in Northwest Alaska and the question of past socio-environmental dynamics in archaeology.

Exploring the climate records of white spruce in Alaska for Dendroarchaeology

- 5 In Alaska, dendroclimatology, while rooted in dendroarchaeology, progressed significantly in the latter half of the 20th century due to methodological—statistical and numerical—advancements. Studies predominantly focus on white spruces (*Picea glauca* [Moench] Voss) in the Alaskan interior boreal forest and along the northern tree line, i.e. the latitudinal limit of the boreal forest, in northwest Alaska and the Brooks Range. White spruce is the dominant species of the Interior Alaskan boreal forest, growing in valley bottoms, floodplains, and along riverbanks (Viereck L. A. and E. L. Little, 2007), and therefore makes up a large proportion of driftwood along Alaska's coastlines and in archaeological sites (Alix C., 2005, 2009).
- 6 The growth of white spruces trees (max. ages 200/400 years) is influenced by various environmental, physiological, health and above all climate parameters (Fritts H.C., 1976; Speer J. H., 2012). Because of the legacy of research on white spruce trees located at altitudinal and latitudinal tree line, there is a widespread perception that most of these trees in Alaska are limited by cold temperatures. However, recent studies have shown drought to be a major limiting factor in interior Alaska (Barber V. A. *et al.*, 2000; Juday G. P. and C. Alix, 2012). This suggests that architectural white spruce remains may reflect a broad range of environmental influences, depending on where they come from. Understanding the origin-specific environmental signals within white spruce samples is essential for accurate interpretation. In Alaska, variations in white spruce ring widths are primarily associated with summer temperatures and, to a lesser degree, with spring precipitations (Giddings J. L., 1941, 1943b; Wilmking M. R. *et al.*, 2004, 2005; Juday G. P. and C. Alix, 2012; D'Arrigo R. *et al.*, 2014; Juday G. P. *et al.*, 2015). White spruce trees demonstrate sensitivity to mean monthly temperatures in June and July of the

current season of growth and two previous seasons, highlighting the need to examine climate conditions over the preceding 36 months to understand what controls the growth.

- 7 Historically, dendroclimatic studies in Alaska focused on ring widths, wood anatomy, and wood density (maximum latewood cells density). Tree growth variations occurred at three climate frequencies: a high frequency corresponding to interannual-scale variations, a medium frequency that corresponds to decadal-scale variations and a low frequency corresponding to multi-decadal-scale variations (Lebourgeois F. and P. Merian, 2012). Ring-widths variations indicate short- and long-term trends that can correspond to favorable or unfavorable climate for white spruce growth. Tree-ring chronologies can also document extreme climate events that influenced tree growth, such as volcanic eruptions, floods, and severe droughts. Wood anatomy and maximum latewood density can be of particular interest for analyzing intra-annual variations and climate extreme events at a seasonal scale (Barber V. A. *et al.*, 2000; Lange J. *et al.*, 2019; Edwards J. *et al.*, 2021; Leland C. *et al.*, 2023).
- 8 Recent decades have seen an expansion of dendroclimatic studies based on stable isotopes compositions and Blue Intensity in Alaska (among others: Sullivan P. F. *et al.*, 2017; Muldoon L. A., 2019; Wilson R. *et al.* 2019). Stable isotopes can be used to reconstruct past climatic variations and the ecological conditions under which trees grow (Daux V., 2013). Stable isotopes represent the result of internal physiological controls of the growth process and help unravel the tree's ecophysiological mechanisms and its interactions with the environment. Studies on carbon $\delta^{13}\text{C}$ and oxygen $\delta^{18}\text{O}$ compositions of white spruce trees in interior Alaska and northwest Canada have demonstrated their relationship to spring and summer temperatures, precipitation, moisture indices and water vapor deficit (Barber V. A. *et al.*, 2004; Porter T. J. *et al.*, 2014; Churakova O. V. *et al.*, 2022). To date, moisture and drought indices have only been established in regions further south than Alaska. Therefore, these reconstructions may not reflect a complete picture of past moisture variations in Alaska (Bhuyan U. *et al.*, 2017; Walston J. M. *et al.*, 2023).
- 9 In connection with global warming that began in the 20th century, three different white spruce tree growth responses to increasing temperatures have been observed in Alaska: positive, negative or no response. Trees with a positive response increase in growth with increasing temperatures, while trees with a negative response decrease in growth with increasing temperatures. The positive responders are found primarily in cool moist environments in northern and western Alaska and the negative responders in warm dry interior portions of Alaska (Barber V. A. *et al.*, 2000; Wilmking M. R. and G. P. Juday, 2005; Juday G. P. *et al.*, 2015). It is therefore very important for ring-widths studies of past climatic variations to identify growth response types in the analyzed population in order to not bias the dendroclimatic reconstruction. It has also been shown that some white spruces which had a positive response to temperatures, crossed a threshold in the 20th century and now have a negative response (or vice versa). This phenomenon is known as the "divergence phenomenon" (D'Arrigo R. *et al.*, 2008 : 289-305).
- 10 Analyzing dendroclimatic data involves standardizing tree series (to remove non-climatic trends), assessing climatic signals, and correlating tree variables with meteorological data, over the period for which instrument data exist. In Alaska, the first weather stations to provide reliable instrument data back to the early 20th century,

and initially recorded monthly temperatures and precipitations (Shulski M. and G. Wendler, 2007). Calibration and validation periods then ensure the reliability of climatic reconstructions. Trees can either provide a quantitative reconstruction—numerical and metric information—or a qualitative reconstruction—warmer or colder period, wetter or drier—, (Degroot D. *et al.*, 2022).

- 11 Methodological choices influence the reconstruction of climatic variations, at high, medium, and low frequencies (Sheppard P. R., 2010; Cook E. R. and N. Pederson, 2011; Büntgen U. *et al.*, 2021). For example, reconstruction linear models tend to reduce amplitudes in reconstructed variations compared to instrument data and therefore to minimize extremes. It is also important to note that trees are not direct records of past climate variations. Dendroclimatic reconstructions generally achieve 40% of climatic variance of the reconstructed parameter (Guiot J. and A. Nicault, 2010). Because of the organic nature of wood, there is a percentage of variability and unknowns specific to each tree, each context, and each case study.
- 12 In archaeological context in Alaska, the multiple geographic regions of origin of architectural wood add an uncertainty to dendroclimatic studies (Giddings J. L., 1943a, 1943b; Taïeb J. *et al.*, 2022, 2023, 2024). When conducting a contemporary dendroclimatic field study, researchers can select which trees to sample based on their apparent climate sensitivity (Cook E. R. and L. A. Kairiukstis 1990). But, in archaeology, only a limited amount of selectivity is possible. It is important that the chronologies are well replicated over time and space, based on numerous trees that show a consistent and coherent signal from several site chronologies over a region.
- 13 In Alaska, well-replicated chronologies allow documentation of climatic variations of the Little Ice Age [LIA] (14th-19th centuries), such as variations linked to volcanic eruptions or cooling of the atmosphere (e.g. Edwards J. *et al.*, 2021; Leland C. *et al.*, 2023), as well as climatic oscillations such as the Pacific Decadal Oscillation (D'arrigo R. *et al.*, 2005). As the spatial and temporal replication of white spruces chronologies decreases backward in time, dendroclimatic analyses of prior periods, such as the Medieval Climate Anomaly, become less certain. The availability of the millennial length master chronology first built by J.-L. Giddings, pioneer of dendrochronology in Alaska, can allow the successful cross-dating of trees that grew in Northwest Alaska. However, if the tree originated in interior Alaska, cross-dating is generally limited by the length of available chronologies (maximum 350-450 years), limiting climate reconstructions to this period.

Insights on climate dynamics and human interactions in Northwest Alaska: a multidisciplinary perspective

- 14 At the onset of the 2nd millennium CE, the Bering Strait and northwest of Alaska witnessed major cultural variations during which the Inuit culture arises in North American Arctic and the Iñupiaq culture in Northwest Alaska. During the Medieval Climate Anomaly and the transition to the Little Ice Age, the Thule/Iñupiaq culture (13th-18th centuries) emerged in continuity from the Birnirk (8th-13th centuries) and Punuk (9th-13th centuries) cultures in the Bering Strait region and/or along the coasts of northwest Alaska (Mason O. K., 2020). During the 13th century, coastal Thule/Iñupiat groups settled in the inland portion of the Kobuk and Noatak rivers region (Giddings J. L., 1952b; Mason O. K. and P. M. Bowers, 2009), while others began their migration

eastward to Greenland, inhabiting most of the North American Arctic (Friesen T. M., 2016; Mason O. K., 2020). Until the late 1990s, these cultural changes were theorized in part as responses to the climate and environmental variations of the MCA and LIA, as well as subsequent changes in distribution and abundance of resources (Mason O. K. and S. C. Gerlach, 1995; Dixon J. C., 2003; Mason O. K. and Barber V.A., 2003; Mason O. K., 2020). This includes the Thule eastward migrations in the 13th century and the Thule/Iñupiat cultural dynamics in northwest Alaska, between the coasts and the interior (among others: Bockstoe J., 1973; McGhee R., 1984; Ackerman R. E., 1988; Minc L. D. and K. P. Smith, 1989). A major question remains as to what degree changes in climate conditions contributed to cultural changes besides other multiple factors.

Documenting major climate variations in Alaska over the last millennium

- 15 The Medieval Climate Anomaly and the Little Ice Age are globally perceived temperature anomalies spanning a few centuries, the first one as warm and the second one as cold (Hughes M. K. and H. F. Diaz, 1994). The amplitude, frequency, and timing of these anomalies vary from region to region and to some extent according to internal climate variability (Nicolle M. *et al.*, 2018; Degroot D. *et al.*, 2021, 2022). For example, the LIA exhibits several alternating episodes of cold and warm temperatures, with various amplitude and persistent effects. Severe volcanic eruptions resulted in cooling episodes during the MCA and the LIA, as well as 1783 during the Laki eruption in Iceland and in 1815 when the Tambora erupted in Indonesia (among others: Oswalt W. H., 1957; Jacoby G. C. *et al.*, 1999; Stoffel M. *et al.*, 2015; Edwards J. *et al.*, 2021).
- 16 The major outlines of the MCA and LIA are documented in northwest Alaska based on climatic and environmental data from natural and, in some cases, archaeological contexts, such as tree rings and dune and lake sediments in northwest Alaska (Mann *et al.*, 2002; D'Arrigo R. *et al.*, 2005), beach ridges along the Bering Strait coastlines (Mason O. K. *et al.*, 2020), moraines and cores of glacial, marine and lacustrine sediments in central, southern and southeast Alaska (Calkin W. and Barclay D. J., 2001; Anderson L. *et al.*, 2007; Wiles G. C. *et al.*, 2008, 2010; Bird B. W. *et al.*, 2009; Barclay D. J. *et al.*, 2009; Jaeger J. M. and B. Kramer, 2014; Vachula R. S., 2015). Zooarchaeological data are available for some archaeological sites, with varying degrees of confidence depending on the excavation and analysis period (Moss M. and P. Bowers, 2007; Crockford S. J., 2008; Jordan J. W., 2009; Norman L. E. Y. *et al.*, 2017, 2018; Mayeux C. *et al.*, 2022).
- 17 While the LIA is well-documented in the region, drawing from several climate indicators at local and regional scales and presenting consistent climatic outcomes, the same cannot be said for the MCA. Both the lack and inconsistency of climatic indicators characterizing MCA variations complicate efforts to fully understand how the MCA affected ecosystems and people in northwest Alaska. These climatic indicators are associated with many diverse ecosystems, from Arctic to Subarctic, from tundra to forest, from marine to terrestrial. Available climate indicators have different temporal resolutions, ranging from annual to decadal, or even multi-centennial. The climate information derived from these indicators also documents different seasons in terms of climate and environmental variability, such as tree rings sensitive to spring and summer conditions and beach ridges documenting fall storms activities. It is clear that these major changes in climate affected the resources (distribution, abundance,

productivity) used by human groups (Mason O.K. and S. C. Gerlach, 1995; Mason O. K. and V. A. Barber, 2003). However, the daily life strategies that humans adopted in relation to their local conditions and to these climatic changes remain only generally understood, partly because of the spatio-temporal resolution of the archaeological data. We can question which indicators derived from archaeological wood would contribute to understanding past variations in this complex system of human and environmental interactions.

- 18 Today, there are not enough reliable indicators in Alaska and northwestern Alaska to propose an annual reconstruction of temperatures for the Medieval Climatic Anomaly. Two of the most promising perspectives to achieve spring and summer resolutions are varve and tree-ring chronologies (D'Arrigo R. *et al.*, 2005; Bird B. W. *et al.*, 2009). A plausible combination of the millennial annual varve chronology of Blue Lake in the Central Brooks Range and the millennial tree-ring chronology of northwest Alaska may eventually provide insights into past annual summer temperature variations. In the case of tree ring dendrochronology in northwest Alaska, early MCA growth remain insufficiently reproduced and are related to a complex summer temperature signal that does not yet allow for a quantitative temperature reconstruction. In the future, it might also be possible to harmonize the isotopic records at the regional scale between white spruce stable isotope and lake sediment oxygen isotope sequences from Marcella Lake in the southwest Yukon Territory, hundreds of kilometers away (Anderson L. *et al.*, 2007; Bird B. W. *et al.*, 2009; Taïeb J., 2023).

Socio-ecological dynamics and climate perception in archaeological research: a multi- and interdisciplinary approach

- 19 For a long time, the relationships between humans and their environment have been perceived in archaeology through the lens of a somewhat environmental determinism (Contreras D., 2016; Magny M., 2017; Arponen V. P. J. *et al.*, 2019; Ion A., 2019; Kristiansen K., 2019). In archaeological research, establishing correlations and causal relationships between climatic, environmental, and cultural variations tended to rely on an oversimplified understanding of climatic and environmental mechanisms, as well as on archaeological data with low spatiotemporal resolution, leading to simplistic hypotheses (Ion A., 2019; Degroot D. *et al.*, 2021), sometimes only based on the contemporaneity of climatic and cultural variations (Kuzucuoğlu C. and Z. Tsirtsoni, 2016; Arponen V. P. J. *et al.*, 2019).
- 20 Many researchers emphasize the importance of multi- and interdisciplinary approaches to understand the articulation and mechanisms between humans, the environment, and climate (Arponen V. P. J. *et al.*, 2019; Kristiansen K., 2019; Jones J. and K. Britton, 2019; Britton K. *et al.*, 2020). Establishing more complex and comprehensive models from an environmental and ecological perspective, with numerous well-dated climatic, ecological, and archaeological data, would allow for better insights into the complexity of climatic variations, ecosystem functioning, and human societies (Contreras D., 2016; Ion A., 2019; Crabtree S. A. and J. A. Dunne, 2022). To avoid incorrect determinism resulting from the use of data from one discipline by another, it is necessary to assess how data sets, whether climatic or archaeological, were produced and what uncertainties remain (Kristiansen K., 2019; Degroot D. *et al.*, 2021). Finally, the

question of what natural indicators and ecofacts represent in terms of their possible impacts on people and their environment must be resolved.

- 21 As environmental archaeology studies continue to assemble data sets, perform analyses, and develop interpretations, it will be particularly important to focus on local evidence when examining the question of past socio-environmental dynamics in Northwest Alaska. Local resolution may allow for discerning human intentionality and possible local responses to climate variations (Kuzucuoğlu C. and Z. Tsirtsoni, 2016; Ion A., 2019). On a human scale, climate change and variability are experienced daily through meteorology, representing short-term conditions.
- 22 In the North American Arctic, traditional ecological knowledge (TEK) and oral traditions offer insights into climate, meteorology, changing landscapes, and how people interacted in their daily life with these environmental factors over recent centuries. TEK also provides a localized human perspective on how climatic and environmental variations can be perceived, enhancing the understanding of the diversity of possible responses to these climate variations (Armstrong C. G. *et al.*, 2017; Lavrillier A. and S. Gabyshev, 2018; Crabtree S. A. and J. A. Dunne 2022; Degroot D. *et al.*, 2022). Early archaeology on environmental and cultural dynamics in the Bering Strait region sometimes associated the notions of favorable and unfavorable climate to the development of human societies. For many, a warm climate in the Arctic was seen as favorable to human societies. In the early 2000s, archaeologist O. K. Mason alternatively proposed that a cold climate may have been more favorable to human coastal settlements, whose diet was based mainly on marine resources—the productivity of which improves with cold conditions (Mason O. K. and V. A. Barber, 2003). This stresses the importance of indigenous perspectives on climate, meteorology, and ecosystems, which are inseparable from the understanding of socio-environmental dynamics that often result in western research as a dichotomized view of nature and humans. However, in Arctic and subarctic regions, TEK are scarce for periods prior to the 18th century.
- 23 Aligning the spatio-temporal resolution of climatic data with archaeological data often poses challenges (Nash D. J. *et al.*, 2021). In Northwestern and Northern Alaska, it was pointed out in the 1990s that numerous archaeological data from early 20th-century excavations either present an uncertain archaeological context with poor chronometric information or come from collections that are yet to be fully studied and published. While climatic variations may have affected the availability and distribution of animal and plant resources used by humans, the connection between climatic and environmental variations relies on indirect relationships that are difficult to determine for the early 2nd millennium CE. This is without considering human factors, such as demography, social, and political interactions, that are as difficult to reconstruct for the region during this period. Since the 1990s, some archaeologists pointed out that the proposed correlations proposed between humans, environment, and climatic variations are rarely at appropriate temporal and spatial scales to confidently grasp the socio-environmental dynamics of this key period in the development of Iñupiaq culture (Mason O. K. and S. C. Gerlach, 1995; McGhee R., 1994 in S. J. Langdon, 1996).
- 24 To better perceive the potential role of climate in human-environment interactions and cultural variations, rather than asking whether a hypothesis is plausible, it seems more relevant to assess whether the available climatic, environmental, and archaeological evidence allows for the development of acceptable hypotheses.

Historian D. Degroot recently proposed a model of questions to guide researchers in this direction, entitled "A process for undertaking research into past climate-society" (Degroot D. *et al.*, 2021, see Figure 3, p. 543). He suggests answering binary questions related to data quality, confidence and uncertainties, spatio-temporal scales, and the articulation of causality (Degroot D. *et al.*, 2021).

Concluding thoughts on the challenges and perspectives of architectural wood remains for climatic research

- 25 Despite challenges such as low replication and reliability of climate indicators across time and location, recent methodological and technological advancements enhance the accuracy of chronologies derived from climatic ecofacts in archaeological contexts (Jones J. and K. Britton, 2019). Cross-dating tree-ring chronologies from coastal archaeological wood to reference chronologies and determining their provenance requires careful attention to methodological questions, given the diverse origins of wood in Thule/Iñupiat sites. If today conventional dendrochronology methods may not be feasible due to the absence of contemporary tree-ring chronologies for the early 2nd millennium CE in most of the presumed driftwood sources regions, architectural wood may help develop this network of chronologies over time. New techniques offer promise in resolving uncertainties about the origin of archaeological wood, such as wood anatomy, cell density (e.g., Blue Intensity and Latewood Density), and more recent methods like organic chemical components and molecular biology. For example, DNA mapping of wood, combined with long-term reference chronologies, could resolve questions about the origin of archaeological wood samples (Lowe A. J. and H. B. Cross 2011; Bridge M. C., 2012; Wilson R. *et al.*, 2017; Drake B. L., 2018; Traoré M., 2018; Akhmetzyanov L. *et al.*, 2019; Domínguez-Delmás M. *et al.*, 2020). Architectural wood remains offer the dual advantage of refining both archaeological and paleoclimatic frameworks. As observed in many other archaeological contexts, these remains have significant potential for extending tree-ring chronologies and their spatial networks into the early 2nd millennium CE, shedding new light on socio-environmental dynamics in the region.
- 26 By addressing methodological constraints and enhancing contextual understanding through an interdisciplinary approach, future research can unlock further insights into the climatic and ecological history of northwestern Alaska's inhabitants. Collecting numerous wood timbers from archaeological sites is essential for developing extensive datasets and understanding past climatic conditions comprehensively. Over time, this approach will expand chronological information and enable reliable interpretation of climatic and environmental data based on the regions of origin of the wood. Eventually, long chronologies based on architectural wood may provide valuable local insights into summer temperatures and hydroclimatic variations that influence the ecosystems of Northwest Alaska. These improved chronologies will offer new insights at a fine temporal scale, enhancing our understanding of the environment inhabited by people of the Iñupiat homeland (e.g. Edwards J. *et al.*, 2021; Leland C. *et al.*, 2023; Taïeb J., 2023) and their daily interactions with their surroundings.

BIBLIOGRAPHY

- Ackerman, Robert E., "Settlements and Sea Mammal Hunting in the Bering-Chukchi Sea Region", *Arctic Anthropology*, vol. 25, n° 1, 1988, p. 52-79.
- Akhmetzyanov, Lina, Buras, Allan, Sass-Klaassen, Ute *et al.*, "Multi-Variable Approach Pinpoints Origin of Oak Wood with Higher Precision", *Journal of Biogeography*, vol. 46, n° 6, 2019, p. 1163-1177.
- Alix, Claire, "Deciphering the impact of change on the driftwood cycle: contribution to the study of human use of wood in the Arctic", *Global and Planetary Change*, vol. 47, 2005, p. 83-98.
- Alix, Claire, "Persistence and Change in Thule Wood Use, AD 1100-1450" in Herbert D. G. Maschner, Owen K. Mason, Robert McGhee (eds.), *The Northern World, AD 900-1400: The Dynamics of Climate, Economy, and Politics in Hemispheric Perspective*, Salt Lake City, University of Utah Press, 2009, p. 179-205.
- Alix, Claire, "A Critical Resource: Wood Use and Technology in the North American Arctic" in Owen K. Mason, Max T. Friesen (eds.), *The Oxford Handbook of the Prehistoric Arctic*, New York, Oxford University Press, 2016, p. 109-129.
- Alix, Claire and Karen Brewster, "Not All Driftwood is Created Equal: Wood Use and Value along the Yukon and Kuskokwim Rivers, Alaska", *Alaska Journal of Anthropology*, vol. 2, n° 1, 2004, p. 2-19.
- Anderson, Lesleigh, Abbott, Mark B., Finney, Bruce P. *et al.*, "Late Holocene moisture balance variability in the southwest Yukon Territory, Canada", *Quaternary Science Reviews*, vol. 26, n° 1, 2007, p. 130-141.
- Armstrong, Chelsey G., Shoemaker, Anna C., McKechnie, Iain *et al.*, "Anthropological Contributions to Historical Ecology: 50 Questions, Infinite Prospects", *PLOS ONE*, vol. 12, n° 2, 2017.
- Arponen, V. P. J., Dörfler, Walter, Feeser, Ingo *et al.*, "Environmental Determinism and Archaeology. Understanding and Evaluating Determinism in Research Design", *Archaeological Dialogues*, vol. 26, n° 1, 2019, p. 1-9.
- Barber, Valerie A., Juday, Glenn P., Finney, Bruce P., "Reduced growth of Alaskan white spruce in the twentieth century from temperature-induced drought stress", *Nature*, vol. 405, n° 6787, 2000, p. 668-673.
- Barber, Valerie A., Juday, Glenn P., Finney, Bruce P. and Martin R. Wilmking, "Reconstruction of summer temperatures in interior Alaska from tree-ring proxies: evidence for changing synoptic climate regimes", *Climatic Change*, vol. 63, 2004, p. 91-120.
- Barclay, David J., Wiles, Gregory C. and Parker E. Calkin, "Holocene glacier fluctuations in Alaska", *Quaternary Science Reviews, Holocene and Latest Pleistocene Alpine Glacier Fluctuations: A Global Perspective*, vol. 28, n° 21, 2009, p. 2034-2048.
- Bhuyan, Upasana, Zang, Christian and Annette Menzel, "Different responses of multispecies tree ring growth to various drought indices across Europe", *Dendrochronologia*, vol. 44, 2017, p. 1-8.

- Bird, Broxton W., Abbott, Mark B., Finney, Bruce P. and Barbara Kutchko, "A 2000 Year Varve-Based Climate Record from the Central Brooks Range, Alaska", *Journal of Paleolimnology*, vol. 41, n° 1, 2009, p. 25-41.
- Bockstoce, John, "A Prehistoric Population Change in the Bering Strait Region", *Polar Record*, vol. 16, n° 105, 1973, p. 793-803.
- Bridge, Martin C., "Locating the origins of wood resources: a review of dendroprovenancing", *Journal of Archaeological Science*, vol. 39, 2012, p. 2828-2834.
- Britton, Kate, Knecht, Rick, and Charlotta Hillerdal, "The Past in the Yup'ik Present: Archaeologies of Climate Change in Western Alaska", *Études Inuit Studies*, vol. 43, n° 1-2, 2020.
- Büntgen, Ulf, Allen, Kathy, Anchukaitis, Kevin J. *et al.*, "The Influence of Decision-Making in Tree Ring-Based Climate Reconstructions", *Nature Communications*, vol. 12, n° 1, 2021.
- Calkin, Parker E., Wiles, Gregory C. and David J. Barclay, "Holocene coastal glaciation of Alaska, Quaternary", *Science Reviews*, vol. 20, 2001, p. 449-461.
- Churakova, Olga V., Porter, Trevor J., Kirilyanov, Alexander V. *et al.*, "Stable Isotopes in Tree Rings of Boreal Forests" in Rolf T. W. Siegwolf, J. Renée Brooks, John Roden, Matthias Saurer (eds.), *Stable Isotopes in Tree Rings: Inferring Physiological, Climatic and Environmental Responses*, Springer International Publishing, 2022, p. 581-603.
- Contreras, Daniel, "Correlation is Not Enough – Building Better Arguments in the Archaeology of Human-Environment Interactions" in Daniel Contreras (ed.), *The Archaeology of Human-Environment Interactions*, London: Routledge, 2016, p. 17-36.
- Cook, Edward R. and Leonardest A. Kairiukstis (eds.), *Methods of Dendrochronology: Applications in the Environmental Sciences*, Kluwer Academic, Dordrecht, The Netherlands: Kluwer Academic Publishers, 1990.
- Cook, Edward R. and Neil Pederson, "Uncertainty, Emergence, and Statistics in Dendrochronology", *Dendroclimatology: Progress and Prospects*, vol. 11, 2011.
- Crabtree, Stefani A. and Jennifer A. Dunne, "Towards a science of archaeoecology", *Trends in Ecology & Evolution*, vol. 37, n° 11, 2022, p. 976-84.
- Crockford, Susan J., "Be careful what you ask for: Archaeozoological evidence of mid-Holocene climate change in the Bering Sea and implications for the origins of Arctic Thule" in Geoffrey Clark, Foss Leach, Sue O'Connor (eds.), *Islands of Inquiry: Colonisation, Seafaring and the Archaeology of Maritime Landscapes*, ANU Press, Terra Australis, vol. 29, 2008, p. 113-131.
- D'Arrigo, Rosanne D., Davi, Nicole K., Jacoby, Gordon C. *et al.*, *Dendroclimatic Studies: Tree Growth and Climate Change in Northern Forests*, AGU, John Wiley&Sons, 2014.
- D'Arrigo, Rosanne D., Mashig, Erika, Frank, David *et al.*, "Temperature variability over the past millennium inferred from Northwestern Alaska tree rings", *Climate Dynamics*, vol. 24, 2005, p. 227-236.
- D'Arrigo, Rosanne D., Wilson, Rob and Beate Liepert, "On the 'divergence problem' in northern forests: a review of the tree-ring evidence and possible causes", *Global and Planetary Change*, vol. 60, 2008, p. 289-305.
- Daux, Valérie, "Reconstructing climate variations from the oxygen and carbon isotopic composition of tree-ring cellulose", *La Météorologie*, n° 80, 2013, p. 14-22.

- Degroot, Dagomar, Anchukaitis, Kevin J., Bauch, Martin *et al.*, “Towards a Rigorous Understanding of Societal Responses to Climate Change”, *Nature*, vol. 59, n° 7851, 2021, p. 539-550.
- Degroot, Dagomar, Anchukaitis, Kevin J., Tierney, Jessica E. *et al.*, “The History of Climate and Society: A Review of the Influence of Climate Change on the Human Past”, *Environmental Research Letters*, vol. 17, n° 10, 2022.
- Dixon, John C., “Environment and environmental change in the Western Arctic: Implications for whaling” in A. P. McCartney (ed.), *Indigenous Ways to the Present: Native Whaling in the Western Arctic*, Canadian Circumpolar Institute Press, 2003, p. 1-24.
- Domínguez-Delmás, Marta, Rich, Sara, Traoré, Mohamed *et al.*, “Tree-Ring Chronologies, Stable Strontium Isotopes and Biochemical Compounds: Towards Reference Datasets to Provenance Iberian Shipwreck Timbers”, *Journal of Archaeological Science: Reports*, vol. 34, n° 102640, 2020, p. 1-17.
- Drake, Lee B., “Source & Sourceability: Towards a Probabilistic Framework for Dendroprovenance Based on Hypothesis Testing and Bayesian Inference”, *Dendrochronologia*, vol. 47, 2018, p. 38-47.
- Edwards, Julie, Anchukaitis, Kevin J., Zambri, Brian *et al.*, “Intra-Annual Climate Anomalies in Northwestern North America Following the 1783–1784 CE Laki Eruption”, *Journal of Geophysical Research: Atmospheres*, vol. 126, n° 3, 2021.
- Friesen, T. Max, “Pan-Artic populations movements: The early Paleo-Inuit and Thule Inuit Migration” in T. Max Friesen, Owen. K. Mason (ed.), *The Oxford Handbook of the Prehistoric Arctic*, 2016, p. 673-692.
- Fritts, Harold C., *Tree rings and Climate*, New York, Academic Press, 1976, p. 582.
- Giddings, James-Louis, “The Application of Tree Ring to Arctic sites”, *Tree-Ring Bulletin*, vol. 7, n° 2, 1940, p. 10-14.
- Giddings, James-Louis, *Dendrochronology in Northern Alaska*, Laboratory of Tree-Ring Research Bulletin, University of Arizona Bulletin, vol. 12, n° 4, 1941.
- Giddings, James-Louis, “A plan for mapping Arctic Sea Currents”, *Geographical Review*, vol. 33, 1943a, p. 326-327.
- Giddings, James-Louis, “Some climatic Aspects of Tree Growth in Alaska”, *Tree-Ring Bulletin*, vol. 9, n° 4, 1943b, p. 26-32.
- Giddings, James-Louis, “Chronology of the Kobuk-Kotzebue Sites”, *Tree-Ring Bulletin*, vol. 14, n° 4, 1948, p. 26-32.
- Giddings, James-Louis, “Driftwood and Problems of the Arctic Sea Currents”, *American Philosophical Society Transactions*, vol. 96, 1952a, p. 129-42.
- Giddings, James-Louis, *The Arctic Woodland Culture and the Kobuk River*, University of Pennsylvania, University Museum Monograph, 1952b.
- Giddings, James-Louis, *The archeology of Cape Denbigh*, Brown University, Bicentennial Publications, Providence: Brown University Press, 1964.
- Graumlich, Lisa J. and John C. King, “Late Holocene Climatic Variation in Northwestern Alaska as Reconstructed from Tree-Ring”, *Final Unpublished Report to the Cooperative Research with the National Park Services*, University of Arizona: Tree-Ring Laboratory, 1997.
- Griggs, Carol, Kocik, Cynthia, Urban, Thomas and Sturt Manning, “Dendrochronology of Swift Water Place and other tree-ring samples from Northwest Alaska” in Doug. D. Anderson, Wann.

- W. Anderson (eds.), *Life at Swift Water Place: Northwest Alaska at the Threshold of European Contact*, Fairbanks, University of Alaska Press, 2019, p. 129-53.
- Guiot, Joël and Antoine Nicault, “Méthodes de dendroclimatologie à l’échelle continentale : fonctions de réponse et fonctions de transfert” in S. Payette, L. Filion (eds.), *La Dendroécologie : Principes, méthodes et applications*, University of Laval Press, Quebec, 2010, p. 225-49.
- Hughes, Malcolm K. and Henry F. Diaz, “Was There a ‘Medieval Warm Period’, and if so, Where and When?”, *Climatic Change*, vol. 26, n° 2, 1994, p. 109-42.
- Ion, Alexandra, “Beyond determinism. A case for complex explanations and human scale in framing archaeological causal explanations”, *Archaeological Dialogues*, vol. 26, n° 1, 2019, p. 10-12.
- Jacoby, Gordon C., Workman, Karen and Rosanne D. D’Arrigo, “1783 Laki eruption, tree rings and catastrophe for northwestern Inuit”, *Quaternary Science Review*, vol. 18, 1999, p. 1365-1371.
- Jaeger, John M. and Branden Kramer, “A continental shelf sedimentary record of Little Ice Age to modern glacial dynamics: Bering Glacier, Alaska”, *Continental Shelf Research*, vol. 86, 2014, p. 141-156.
- Jones, Jennifer and Kate Britton, “Multi-Scale, Integrated Approaches to Understanding the Nature and Impact of Past Environmental and Climatic Change in the Archaeological Record, and the Role of Isotope Zooarchaeology”, *Journal of Archaeological Science: Reports*, vol. 23, 2019, p. 968-972.
- Jordan, James W., “Arctic climate and landscape ca. AD 800-1400” in Herbert D.G. Maschner, Owen. K. Mason, Robert McGhee (eds.), *The northern world AD 900-1400: The dynamics of climate, economy, and politics in hemispheric perspective*, Salt Lake City, University of Utah Press, 2009, p. 7-29.
- Juday, Glenn P. and Claire Alix, “Consistent negative temperature sensitivity and positive influence of precipitation on growth of floodplain *Picea glauca* in interior Alaska”, *Canadian Journal of Forest Research*, vol. 42, 2012, p. 561-73.
- Juday, Glenn P., Alix, Claire, Grant III, Thomas A., “Spatial coherence and change of opposite white spruce temperature sensitivities on floodplains in Alaska confirms early-stage boreal biome shift”, *Forest Ecology and Management*, vol. 350, 2015, p. 46-61.
- Kristiansen, Kristian, “Who is deterministic? On the nature of interdisciplinary research in archaeology”, *Archaeological Dialogues*, vol. 26, n° 1, 2019, p. 12-14.
- Kuzucuoğlu, Catherine and Zoï Tsirtsoni, “Changements climatiques et comportements sociaux dans le passé : quelles corrélations ?”, *Les nouvelles de l’archéologie*, n° 142, 2016, p. 49-55.
- Lagadeuc, Yvan and Robert Chenorkian, “Les systèmes socio-écologiques : vers une approche spatiale et temporelle”, *Natures Sciences Sociétés*, vol. 17, n° 2, 2009, p. 194-96.
- Langdon, Steve J., “Increments, ranges, and thresholds: Human population responses to climate change in northern Alaska” in David L. Peterson, Darryll R. Jonhson (eds.), *Human Ecology and Climatic Change*, New York, Taylor & Francis, 1996.
- Lange, Jelena, Carrer, Marco, Pisaric, Michael *et al.*, “Moisture-driven shift in the climate sensitivity of white spruce xylem anatomical traits is coupled to large-scale oscillation patterns across northern treeline in northwest North America”, *Global Change Biology*, vol. 26, 2019, p. 1-15.
- Lavrillier, Alexandra and Semen Gabyshev, “An Emic Science of Climate. Reindeer Evenki Environmental Knowledge and the Notion of an ‘Extreme Process’”, *Études Mongoles et Sibériennes, Centrasiatiques et Tibétaines*, n° 49, 2018.

- Lebourgeois, François and Pierre Merian (eds.), *Principes et méthodes de la dendrochronologie*, LERFOB, AgroParisTech, Centre de Nancy, 2012.
- Leland, Caroline W., D'Arrigo, Rosanne, Davi, Nicole K. *et al.*, "A Spatiotemporal Assessment of Extreme Cold in Northwestern North America Following the Unidentified 1809 CE Volcanic Eruption", *Paleoceanography and Paleoclimatology*, n° e2022PA004581, 2023.
- Liu, Jianguo, Dietz, Thomas, Carpenter, Stephen, Alberti, Marina, Folke, Carl, Moran, Emilio, Pell, Alice *et al.*, "Complexity of Coupled Human and Natural Systems", *Science*, vol. 317, n° 5844, 2007, p. 1513-16.
- Lowe, Andrew J. and Hugh B. Cross, "The Application of DNA Methods to Timber Tracking and Origin Verification", *IAWA Journal*, vol. 32, n° 2, 2011, p. 251-62.
- Magny, Michel, "Paléoclimats et sociétés : Du local au global, du passé au futur" in Sophie A. de Beaune and Henri-Paul Francfort, *L'archéologie à découvert : Hommes, objets, espaces et temporalités*, Paris, CNRS Éditions, À découvert, 2017, p. 136-43.
- Mann, Daniel H., Heiser, Patricia A. and Bruce P. Finney, "Holocene History of the Great Kobuk Sand Dunes, Northwestern Alaska", *Quaternary Science Reviews*, vol. 21, n° 4, 2002, p. 709-31.
- Mason, Owen K., "The Thule Migrations as an Analog for the Early Peopling of the Americas: Evaluating Scenarios of Overkill, Trade, Climate Forcing, and Scalar Stress", *PaleoAmerica*, vol. 6, n° 4, 2020, p. 1-49.
- Mason, Owen K. and Valerie A. Barber, "A paleogeographic preface to the origins of whaling: cold is better" in A. P. McCartney (ed.), *Indigenous Ways to the Present: Native Whaling in the Western Arctic*, Edmonton: Circumpolar Institute, University of Alberta, and Salt Lake City, University of Utah Press, 2003, p. 69-108.
- Mason, Owen K. and Peter M. Bowers, "The Origin of the Thule Culture is Always Elsewhere: Early Thule within Kotzebue Sound, "Cul-de-Sac" or Nursery?", in Bjarne Gronnow (ed.), *On Track of the Thule Culture from Bering Strait to East Greenland*, Copenhagen, Publications from the National Museum, Studies in Archaeology&History, 2009, p. 25-44.
- Mason, Owen K. and Craig S. Gerlach, "Chukchi Hot Spots, Paleo-Polynyas, and Caribou Crashes: Climatic and Ecological Dimensions of North Alaska Prehistory", *Arctic Anthropology*, vol. 32, n° 1, 1995, p. 101-30.
- Mason, Owen K., Jensen, Anne M., Rinck, Brandy *et al.*, "Heightened Early Medieval Storminess across the Chukchi Sea, AD 400-1100: A Proxy of the Late Antique Little Ice Age", *Quaternary International*, vol. 549, 2020, p. 98-117.
- Mayeux, Camille, Alix, Claire, Petit, Christophe and Michelle Elliott, "Quels sont les apports des analyses conjointes archéontomologiques et archéobotaniques dans les contextes arctiques ?", *Les Nouvelles de l'archéologie*, 2022.
- McGhee, Robert, "The timing of the Thule Migration", *Polarforschung*, vol. 54, n° 1, 1984, p. 1-7.
- Minc, Leah D. and Kevin P. Smith, "The Spirit of Survival: Cultural Responses to Resource Variability in North Alaska" in P. Halstead and J. O'Shea (eds.), *Bad Year Economics: Cultural Responses to Risk and Uncertainty*, Cambridge: Cambridge University Press, 1989, p. 8-39.
- Moss, Madonna and Peter R. Bowers, "Migratory Bird Harvest in Northwestern Alaska: A Zooarchaeological Analysis of Ipiutak and Thule Occupations from the Deering Archaeological District", *Arctic Anthropology*, vol. 44, 2007, p. 37-50.

Muldoon, Laurel Ann, Understanding Site Specific Climate-Growth Relationships for Ring Widths and $\delta^{13}\text{C}$ Values of White Spruce (*Picea glauca*) in the Interior Alaska, Thesis, Nipissing University, Faculty of Arts and Science, 2019.

Murray, Maribeth S., Robertson, Aaron C. and Rachel Ferrara, "Chronology, Culture, and Climate: A Radiometric Re-evaluation of Late Prehistoric Occupations at Cape Denbigh, Alaska", *Arctic Anthropology*, vol. 40, n° 1, 2003, p. 87-105.

Nash, David J., Adamson, George C. D., Ashcroft, Linden, Bauch, Martin, Camenisch, Chantal, Degroot, Dagomar, Gergis, Joelle *et al.*, "Climate Indices in Historical Climate Reconstructions: A Global State of the Art", *Climate of the Past*, vol. 17, n° 3, 2021, p. 1273-1314.

Nash, Stephen E., "James Louis Giddings' Archaeological Tree-Ring Dating in the American Arctic: A Forgotten Legacy", *Arctic Anthropology*, vol. 37, n° 1, 2000, p. 60-78.

Nicolle, Marie, Debret, Maxime, Massei, Nicolas *et al.*, "Climate Variability in the Subarctic Area for the Last 2 Millennia", *Climate of the Past*, vol. 14, n° 1, 2018, p. 101-16.

Norman, Lauren E. Y., Alix, Claire and Owen K., Mason, "Birnik and Early Thule Maritime Hunter-Gatherer: Variability in Subsistence Practices and Tool Technologies at Cape Espenberg, Alaska" in XVIIIe Congrès mondial de l'Union Internationale des Sciences Préhistoriques et Protohistoriques (UISPP), vol. 2, Paris, 2018.

Norman, Lauren E. Y., Friesen, Max T., Alix, Claire, O'Rourke, Michael J. E. and Owen K. Mason, "An Early Inupiaq Occupation: Observations on a Thule House From Cape Espenberg, Alaska", *Open Archaeology*, vol. 3, 2017, p. 17-48.

Oswalt, Wendell H., "Volcanic Activity and Alaskan Spruce Growth in A.D. 1783", *Science*, New Series, vol. 126, n° 3279, 1957, p. 928-29.

Porter, Trevor J., Michael F. J. Pisaric, Robert D. Field, Steven V. Kokelj, Thomas W. D. Edwards, Peter deMontigny, Richard Healy, and Allegra N. LeGrande, "Spring-Summer Temperatures since AD 1780 Reconstructed from Stable Oxygen Isotope Ratios in White Spruce Tree-Rings from the Mackenzie Delta, Northwestern Canada", *Climate Dynamics*, vol. 42, n° 3, 2014, p. 771-85.

Sheppard, Paul R., "Dendroclimatology: Extracting Climate from Trees", *Wiley Interdisciplinary Reviews: Climate Change*, vol. 1, n° 3, 2010, p. 343-52.

Rye, Owen, "Archaeological and dendrochronological field trip to point Barrow, Alaska", Unpublished report - Alaska and Polar Regions Collections & Archives (APRCA), Rasmuson Library, University of Alaska Fairbanks, 1950.

Sheehan, Glenn W., "Pingasagruk: A Prehistoric Whaling Village on Point Franklin, Alaska", report prepared for Alaska Maritime National Wildlife Refuge, US Fish and Wildlife Service, Contract # 14-16-0007-86-6612. SJS Archaeological Services, 1991.

Shulski, Martha and Gerd Wendler, *The Climate of Alaska*, University of Alaska Press, Fairbanks, 2007.

Speer, James H., *Fundamentals of tree-ring research*, University of Arizona Press, 2012.

Stoffel, Markus, Khodri, Myriam, Corona, Christophe, Guillet, Sébastien, Poulain, Virginie, Bekki, Slimane, Guiot, Joël *et al.*, "Estimates of Volcanic-Induced Cooling in the Northern Hemisphere over the Past 1,500 Years", *Nature Geoscience*, vol. 8, n° 10, 2015, p. 784-88.

Sullivan, Patrick F., Pattison, Robert R., Brownlee, Annalis H., Cahoon, Sean M. P. and Teresa N. Hollingsworth, "Limited Evidence of Declining Growth among Moisture-Limited Black and White Spruce in Interior Alaska", *Scientific Reports*, vol. 7, n° 15344, 2017, p. 1-14.

Taïeb, Juliette, Alix, Claire, Juday, Glenn P., Jensen, Anne M., Daux, Valérie and Christophe Petit, “Dating coastal archaeological wood from Pingusugruk (15th–17th CE), Northern Alaska: Preliminary results and methodological perspectives in Dendrochronology”, *International Journal of Wood Culture*, vol. 2, n° 1-3, 2022, p. 89-116.

Taïeb, Juliette, Daux, Valérie, Alix, Claire and Christine Hatté, “Contribution of 14C Wiggle-Matching to Dendroarchaeology of coastal Birnirk and Thule sites in Northern Alaska”, *Archéologie, Société et Environnement*, vol. 3, n° 1, 2023, p. 57-77.

Taïeb, Juliette, Variations climatiques et sociétés dans le Nord-Ouest de l’Alaska (XIe-XIIIe siècles de notre ère) : apports des approches dendrochronologiques et dendroisotopiques, Thesis in Archeology, Université Paris 1 Panthéon-Sorbonne, 2023.

Taïeb, Juliette, Daux, Valérie and Claire Alix, “Dendroarchaeology of Birnirk and Thule Architectural Timbers (10–13th Centuries): Preliminary Results on Oxygen Isotope Cross-Dating”, *International Journal of Wood Culture*, vol. 1, 2024, p. 1-22.

Traoré, Mohamed, “Potential biomarkers of provenance of the wood from iberian typology shipwrecks (15th to 17th centuries)”, Universidad de Santiago de Compostela, 2018.

Vachula, Richard S., “Holocene Climatic Changes in the Alaskan Arctic as Inferred from Oxygen-Isotopic Analysis”, Thesis in Geology, Bachelor of Science in Geology, Urbana-Champaign: University of Illinois, 2015.

Viereck, Leslie A., Elbert Luther Little, *Alaska Trees and Shrubs*, 2nd edition, Fairbanks: University of Alaska Press, 2007.

Walston, Joshua M., McAfee, Stephanie A. and Daniel J. McEvoy, “Evaluating Drought Indices for Alaska”, *Earth Interactions*, vol. 27, n° 1, 2023, p. 1-17.

Wiles, Gregory C., Barclay, David J., Calkin, Parker E. and Thomas V. Lowell, “Century to Millennial-Scale Temperature Variations for the Last Two Thousand Years Indicated from Glacial Geologic Records of Southern Alaska”, *Global and Planetary Change*, vol. 60, n° 1, 2008, p. 115-25.

Wiles, Gregory C., Barclay, David J., Young, Nicolás E., “A review of lichenometric dating of glacial moraines in Alaska”, *Geografiska Annaler: Series A, Physical Geography*, vol. 92, n° 1, 2010, p. 101-109.

Wilmking, Martin R., D’Arrigo, Rosanne, Jacoby, Gordon C., Juday, Glenn P., “Increased temperature sensitivity and divergent growth trends in circumpolar boreal forests”, *Geophys. Res. Lett.*, vol. 32, n° L15715, 2005, p. 1-4.

Wilmking, Martin R. and Glenn P. Juday, “Longitudinal variation of radial growth at Alaska’s northern treeline—recent changes and possible scenarios for the 21st century”, *Global and Planetary Change*, vol. 47, 2005, p. 282-300.

Wilmking, Martin R., Juday, Glenn P., Barber, Valerie. A. and Harold J. Zald, “Recent climate warming forces contrasting growth responses of white spruce at treeline in Alaska through temperature thresholds”, *Global Change Biology*, vol. 10, 2004, p. 1724-36.

Wilson, Rob, Anchukaitis, Kevin J., Andreu-Hayles, Laia *et al.*, “Exorcising ‘divergence’ using Blue Intensity in the southern Yukon”, *Holocene Draft*, 2019, p. 2-25.

Wilson, Rob, Wilson, David, Rydval, Miloš *et al.*, “Facilitating tree-ring dating of historic conifer timbers using Blue Intensity”, *Journal of Archaeological Science*, vol. 78, 2017, p. 99-111.

ABSTRACTS

Architectural wood elements are well-preserved in cold soils and archaeological Thule/Iñupiat sites of the early 2nd millennium CE in northwestern Alaska. These organic remains, at the intersection of archaeology, palaeoclimatology, and ecology, offer an annual and local resolution rarely accessible to archaeologists, providing insights on past climate variations. In a context where cultural variations of past arctic people are often interpreted as responses to climatic and environmental changes, this paper is a state-of-the-art examination of the dendroclimatic potential of Iñupiat architectural wood remains based on current knowledge. The focus is especially on current possibilities and limits of early Iñupiat architectural wood remains and the need to build a finer sequence for the period of the Medieval Climate Anomaly [MCA] (9th-13th century) to contribute to a broader understanding of the climatic framework of the early 2nd millennium and of early Iñupiat socio-ecological dynamics in Northwest Alaska for future research.

Les vestiges d'architecture en bois préservés dans les sols gelés des sites archéologiques Thulé/Iñupiat du début du II^e millénaire de notre ère dans le nord-ouest de l'Alaska représentent une ressource précieuse à la croisée de l'archéologie, de la paléoclimatologie et de l'écologie. Ces vestiges archéologiques offrent une résolution annuelle et locale, rarement accessible aux archéologues, et permettent une compréhension plus fine des variations climatiques passées. Dans un contexte où les variations culturelles des Thulé/Iñupiat ont souvent été interprétées comme des réponses aux changements climatiques et environnementaux, cet article examine le potentiel dendroclimatique des bois d'architecture Iñupiat en se fondant sur les connaissances actuelles. Il s'attache plus particulièrement aux possibilités et aux limites actuelles de ces vestiges à haute résolution et à la nécessité de mieux comprendre l'Anomalie Climatique Médiévale (IX^e-XIII^e siècles) afin d'éclairer le cadre climatique du début du II^e millénaire et les dynamiques socio-écologiques des Thulé/Iñupiat dans le nord-ouest de l'Alaska.

Los vestigios de arquitectura en madera conservados en los suelos congelados de los sitios arqueológicos Thule/Iñupiat de principios del segundo milenio d.C., en el noroeste de Alaska, representan un valioso recurso tanto para la arqueología, la paleoclimatología y la ecología. Estos vestigios arqueológicos ofrecen una resolución anual y local de datos cronométricos y climáticos de los que raramente disponen los arqueólogos, y proporcionan una comprensión más detallada de las variaciones climáticas del pasado. En un contexto en el que las variaciones culturales Thule/Iñupiat se han interpretado a menudo como respuestas al cambio climático y medioambiental, este artículo examina el potencial dendroclimático de las maderas arquitectónicas Iñupiat basándose en los conocimientos actuales. Se centra en particular en la evaluación de los alcances y limitaciones actuales de estos restos de alta resolución y en la necesidad de comprender mejor la Anomalía Climática Medieval (siglos IX-XIII) para aportar nuevos datos en torno al marco climático de principios del segundo milenio y las dinámicas socioecológicas de los Thule/Iñupiat en el noroeste de Alaska.

INDEX

Keywords: Dendroarchaeology, Dendroclimatology, Architectural wood, Medieval Climate Anomaly, Northwest Alaska

Palabras claves: Dendroarqueología, Dendroclimatología, Madera arquitectónica, Anomalía Climática Medieval, Noroeste de Alaska

Mots-clés: Dendroarchéologie, Dendroclimatologie, bois d'architecture, Anomalie Climatique Médiévale, Nord-ouest de l'Alaska

AUTHOR

JULIETTE TAÏEB

Juliette Taïeb is a postdoctoral fellow at the Laboratory of Archaeology of the Americas. Calling on an interdisciplinary approach combining dendrochronology, dendroclimatology, and archaeology, Juliette is working on refining the chronological and climatic framework of the early 2nd millennium CE in Alaska to better apprehend the links between past climate variations and surroundings and of early Iñupiat socio-ecological dynamics of this time period in Northern and Northwestern Alaska.

Juliette.Taieb2[at]gmail.com