American Antiquity (2026), 1–10
doi:10.1017/aaq.2026.10219

SAA
Society for American Archaeology

FORUM

Archaeology's Golden Opportunity: Transforming the Science of Global Environmental Change

Sarah Klassen[1], Erle Ellis[2], Scott Ortman[1] and Torben Rick[3]

[1]Center for Collaborative Synthesis in Archaeology, University of Colorado, Boulder, CO, USA; [2]Department of Geography and Environmental Systems, University of Maryland Baltimore County, Baltimore, MD, USA and [3]Anthropology, Smithsonian Institution National Museum of Natural History, Washington, DC, USA
Corresponding author: Sarah Klassen, Email: sarah.e.klassen@gmail.com

(Received 17 April 2026 UTC; revised 2 June 2026 UTC; accepted 3 June 2026 UTC)

Abstract
Earth and other natural scientists frequently depict human-caused global environmental change as a recent development, a perspective exemplified by the proposal to formalize a human epoch in the Geologic Time Scale—the Anthropocene—beginning in 1952. Yet the science of archaeology offers abundant evidence of anthropogenic planetary change over thousands of years, from land clearing using fire to early methane emissions from agriculture, preindustrial lead pollution, and long-sustained Indigenous practices that continue to shape ecosystems and biodiversity. Even though archaeology is the only science dedicated to investigating human social and environmental change from its very beginnings up to the present day, its empirical evidence and theoretical understandings are largely absent from the datasets, models, and theories of global environmental change. We argue that this situation represents both a missed opportunity for scientific discovery and a rare opportunity for archaeologists. Archaeology can and should play a central role in the science of global environmental change. By mobilizing and integrating regional datasets globally, standardizing metadata, and aligning them with Earth-system data frameworks and models, archaeologists could revolutionize the science of global environmental change through empirically based, culturally grounded insights into the deep history of planetary transformation by human societies.

Resumen
Los científicos de la Tierra y otros científicos naturales suelen describir el cambio ambiental global de origen humano como un fenómeno reciente; una perspectiva ejemplificada por la propuesta de formalizar una época humana en la Escala de Tiempo Geológico —el Antropoceno— con inicio en 1952. Sin embargo, la ciencia de la arqueología ofrece abundante evidencia de cambios planetarios de origen antropogénico a lo largo de miles de años: desde el desmonte de tierras mediante el uso del fuego hasta las primeras emisiones de metano derivadas de la agricultura, la contaminación por plomo en la era preindustrial y prácticas indígenas sostenidas a largo plazo que continúan modelando los ecosistemas y la biodiversidad. A pesar de que la arqueología es la única ciencia dedicada a investigar el cambio social y ambiental humano desde sus primeros albores hasta la actualidad, su evidencia empírica y sus marcos teóricos están, en gran medida, ausentes de los conjuntos de datos, modelos y teorías sobre el cambio ambiental global. Sostenemos que esta situación representa, simultáneamente, una oportunidad perdida para el descubrimiento científico y una oportunidad excepcional para los arqueólogos. La arqueología puede —y debe— desempeñar un papel central en la ciencia del cambio ambiental global. Al movilizar e integrar conjuntos de datos regionales a escala global, estandarizar los metadatos y alinearlos con los marcos de datos y modelos del sistema terrestre, los arqueólogos podrían revolucionar la ciencia del cambio ambiental global, aportando perspectivas empíricamente fundamentadas y culturalmente contextualizadas sobre la historia profunda de la transformación planetaria impulsada por las sociedades humanas.

© The Author(s), 2026. Published by Cambridge University Press on behalf of Society for American Archaeology. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (http://creativecommons.org/licenses/by/4.0), which permits unrestricted re-use, distribution and reproduction, provided the original article is properly cited.

Keywords: archaeological synthesis; Earth-system science; global environmental change; human–environment interactions

Palabras clave: síntesis arqueológica; ciencia del sistema terrestre; cambio ambiental global; interacciones humano-medio ambiente

Global-change science—the study of planetary-scale alterations of the Earth system—has embraced the Anthropocene as a framework for understanding human impacts on the planet, often defined as beginning with the "Great Acceleration" of global environmental changes in the 1950s (Steffen et al. 2015). This framing overlooks a deep and growing body of archaeological evidence documenting significant anthropogenic environmental change long before the mid-twentieth century or the advent of the Industrial Revolution (Kirch 2005; Nogue et al. 2025; Roberts et al. 2021; Silva et al. 2022; Stephens et al. 2019). Despite its relevance, archaeology remains largely absent from the science of global environmental change (Smith 2021). Why is this?

We argue that archaeology has an opportunity to transform global-change science by building on its local and regional strengths to produce robust evidence at planetary scales. It brings essential tools, theoretical models, and material evidence for understanding not only the long-term dynamics of an Earth system that includes humans but also the ways in which societies navigate major transitions, including the Great Acceleration itself (Boivin et al. 2016; Smith and Zeder 2013). Most importantly, archaeology brings a perspective that acknowledges that different human groups impact the Earth System to differing degrees, to help move the Earth sciences beyond oversimplified and actively misleading portrayals of Earth's transformation as a species-level phenomenon—the result of "humans" or "humanity."

Archaeology's material approach complements and challenges global narratives, providing context for how and why other Earth systems—from the biosphere to the atmosphere, hydrosphere, and lithosphere—changed so drastically in the twentieth century and how deeper coevolutionary relationships shaped that trajectory (Redman 1999). Moreover, archaeology's traditional focus on local and regional scales—especially in collaboration with local, Indigenous, and descendant communities—is not a limitation but a strength. Archaeological evidence and Indigenous and traditional ecological knowledge often provide complementary perspectives on long-term environmental change, linking material records with enduring cultural understandings of landscapes, ecosystems, and stewardship practices. Synthesizing these records at continental and global scales will reveal patterns and variation in human–environment interactions, challenge the "pristine myth" (Denevan 1992), and contribute to ongoing efforts on climate justice, historical accountability, and biodiversity (Ellis et al. 2021). Achieving this will require archaeologists to invest actively in synthetic approaches, develop shared data infrastructures, and align outputs with the needs and formats of Earth-system models (Altschul et al. 2017). By critically engaging with global-change science, rather than operating in parallel, archaeology can elevate its relevance, influence public narratives, and secure new streams of funding.

The Epochal Divide Narrative and Its Shortcomings

A brief discussion of a few key concepts emanating from Earth-system / global-change science brings the opportunity we see for archaeology into focus. The most fundamental concept is the Anthropocene itself. Despite being recently voted down as a formal geologic epoch by the International Commission on Stratigraphy, the Anthropocene remains a core concept for understanding global change and contemporary environmental challenges (Rockström et al. 2026; Zalasiewicz, Thomas, et al. 2024). Bauer and Ellis (2018) discuss the history of the Anthropocene concept, noting that, although it necessarily represents a chronological period, it has been defined differently across disciplines, leading to differing arguments about when it began. For many social scientists and ecologists, the Anthropocene refers to the period of climate change and mass extinction associated with modernity; among Earth-system scientists, it references the period during which the human system began to impact other Earth systems; and among geostratigraphers, it is conceived as a horizon in the rock and sedimentary record where anthropogenic materials (aka archaeological

remains!) have left unambiguous and permanent signatures. For example, Ruddiman's (2003) proposal that the Anthropocene began in the Middle Holocene, as human agricultural activities began to affect other Earth systems, was controversial in part because it concerned only one specific conceptualization.

Global-change science has settled on the "Great Acceleration" of the 1950s as the onset of the Anthropocene. This is indeed a period during which there was a rapid increase in human-driven environmental impacts, greenhouse gas emissions, industrial expansion, and population growth, which were reflected in numerous Earth-system indicators (Bauer and Ellis 2018; Steffen et al. 2015). However, this framing implies that a phase transition from a "natural" Earth to an "anthropogenic" one took place around 1950, reinforcing the idea that the human species had a trivial impact on other Earth systems until very recently. This framing is visible in major publications and initiatives, including the "Planet under Pressure" conference series (CGIAR Research Program on Climate Change, Agriculture and Food Security 2012), which emphasizes global metrics that only became comprehensible after World War II. Crucially, the paucity of standardized environmental data before this period has led to the implicit assumption that human impacts were negligible or insignificant prior to this time (Head et al. 2022; Zalasiewicz, Head, et al. 2024). This framing overlooks the fact that the Great Acceleration is the outcome of a long-term coevolutionary process involving humans and other Earth systems, and that we are unlikely to solve the new problems it has created in the absence of deeper knowledge of these more basic processes (see Renn 2022). This is precisely the kind of knowledge that archaeology generates.

A second key concept is the technosphere. This was first developed by Peter Haff (2014), who drew on complex systems science to recognize that, at a global scale, human technology is an emergent, self-organizing system not under anyone's control. He suggested that the dynamics of the technosphere are quasi-autonomous, in that many of its components do not directly influence the behavior of individual humans; that most humans cannot significantly influence its dynamics; that most humans are obligated to perform at least some tasks that support its metabolism; and that its only requirement is that it provide an environment in which humans can survive and function. Haff's (2014) view acknowledges, for example, that the knowledge needed to create complex products and services is not stored in individual minds but is distributed through a network of interacting individuals, with sufficient redundancy that no single person can control it.

It is true that various Earth spheres (lithosphere, hydrosphere, atmosphere, biosphere) have emerged separately in Earth's history and that their evolutions are interrelated. It is also worthwhile to consider humanity as an additional sphere that has become entangled in the evolution of the others (Renn 2022). However, the technosphere concept frames humans as a single, undifferentiated species—a geological force with uniform psychology and values—rather than as members of diverse societies with varying practices, technologies, political and military power, and environmental relationships (Boivin et al. 2024; Malm and Hornborg 2014). The concept makes human impacts comprehensible at the species level and on a planetary scale, often by flattening history into eras defined by species-level properties. As a result, archaeological research on the distribution of human–environment relationships across various world regions over time is often ignored. This is a serious shortcoming because, as every archaeologist knows, societies vary in their contributions to global change, both in the past and in the present.

A deeper shortcoming of the technosphere concept is the notion that accelerating human impacts are a simple byproduct of an expanding technosphere that no one controls (Zalasiewicz et al. 2017). Although it is appropriate to view humanity's expanding technological knowledge as increasing the scale and scope of Earth-system impacts, recent reviews of time-series data on air quality, energy production, deforestation, food production, biodiversity, plastic pollution, and fisheries paint a more nuanced picture. In many cases, humans have not only decreased their per capita environmental impacts but also reduced the overall impact of their activities, despite continued population growth, through the combined application of technological innovation, regulation, and changes in land use (Ritchie 2024). The rapid decrease in the cost of renewable energy sources, to the point that they are now less expensive than fossil fuels, demonstrates that technological change and human relationships with other Earth systems

are directed by human agency and values. In light of this, a robust and mature approach to global-change science needs to consider how all dimensions of human systems—not just technology—interact to improve or degrade the functioning of other Earth systems. The only way to achieve this is through studies of interrelating human and Earth systems over long time scales and across heterogeneous societies. This is what archaeologists do. And it is what global-change science needs.

A final concept is the technofossil. Zalasiewicz and others (2014) note that artifacts created by humans are a form of "trace fossil" that allows geologists to characterize and date sedimentary deposits, complementing more conventional fossils. But they note that because artifacts have other properties, they are better characterized as "technofossils, a biological innovation that may be exploited to provide ultra-high resolution geological dating and correlation in technostratigraphy, after the concept of the technosphere," which "may be of use to help characterize the deposits of a potential Anthropocene epoch" (Zalasiewicz et al. 2014:35–36). In other words, Earth-system scientists are reinventing the archaeological record in their own language so they can have their own conversation about it and use their own funding to study it, without input from archaeologists. They note, for example, that artifacts are often produced using materials that are rare in nature, such as the decomposed materials themselves, which can be used to date sedimentary deposits (aka geoarchaeology). They also note that artifacts change in form over time, making it feasible to date deposits based on these changes (aka seriation). And they note that the rate of change in human material culture has accelerated over time and now outpaces biological evolution (aka evolutionary archaeology). The authors seem to believe they are the first to notice these properties of the archaeological record, and frustratingly, they do not cite any archaeological studies in their bibliography.

Why do some global-change scientists feel the need to reinvent archaeology from scratch instead of partnering with archaeologists to advance their work? Despite important advances by archaeologists in understanding human–environment interactions around the world on local and regional scales, archaeologists need to do more to apply their knowledge and skills toward a better understanding of the planetary-scale challenges of the Anthropocene.

Deep-Time Anthropogenic Change

Archaeologists are already doing work that is relevant to global-change science. Archaeologists have long emphasized how preindustrial people transformed biodiversity and altered atmospheric gas concentrations and other environmental variables (Boivin et al. 2016; Kirch 2005; Redman 1999; Ruddiman 2003). This work has accelerated during the past two decades, particularly in response to debates over the date of onset of the Anthropocene (Zalasiewicz, Thomas, et al. 2024). For example, archaeologists and other researchers have drawn on archaeological data demonstrating an onset of continental-scale impacts to biodiversity associated with the (1) initial spread of humans (Andermann et al. 2020) and global human impact approximately 10,000 years ago, associated with plant and animal domestication (Smith and Zeder 2013); or (2) at 5,000 years ago, with methane greenhouse gas emissions from rice farming and livestock tending (Ruddiman et al. 2020). Others have argued that the archaeological record forms a global anthropogenic or archaeological stratigraphy formed over thousands of years (Edgeworth et al. 2015), or that megafaunal extinctions (Barnosky et al. 2004; Braje and Erlandson 2013), other anthropogenic soil types (Erlandson 2013), and the Columbian exchange / Orbis spike (Lewis and Maslin 2015) all provide evidence of human impacts prior to 1950 that are detectable on a global scale.

From a global-change perspective, a few key studies clearly demonstrate that anthropogenic global impacts predate the Great Acceleration. Recent work on lead pollution documented in Arctic ice cores shows the strong influence of Roman silver and other metal and ore mining that was present throughout Europe and detectable as a global phenomenon over 2,000 years ago (Hong et al. 1994; McConnell et al. 2025). Rice agriculture in regions such as China, Thailand, and India significantly transformed local ecosystems through practices such as forest clearance, controlled burning, and the widespread adoption of domesticated rice, contributing to atmospheric methane increases between 6,000 and 4,000 years ago (Fuller and Weisskopf 2011; Ruddiman et al. 2008). Over the last 10,000 years, Indigenous peoples around the world have used fire to enhance the biodiversity of local and regional ecosystems, with cumulative global effects on terrestrial ecosystems that continue to accelerate today (Ellis et al. 2021; Kelly et al.

2020; Thompson et al. 2021). These patterns and processes are also apparent on a global scale in coastal and marine ecosystems, such as evidence of human overfishing, sustainable resource management, and aquaculture that accelerated over the past 3,000 to 4,000 years (Erlandson and Rick 2010; Rick et al. 2013; Rogers 2024). These cumulative local and regional impacts are also evidenced in the tremendous ways that people shaped past animal populations through overhunting, habitat alteration, displacement, and other variables (Boivin et al. 2016). Despite these and numerous other examples, the archaeological record of preindustrial global change continues to be ignored by scholars in the global-change-science community (Bauer and Ellis 2018; Braje 2015).

Central but Sidelined

Archaeology is uniquely positioned to contribute to global-change science, and there have been calls for archaeologists to do so for over 20 years (e.g., van der Leeuw and Redman 2002). Archaeology offers a deep-time perspective on human–earth-system dynamics, emphasizing not just that humans impact the planet but that different societies have done so in radically different ways (Ellis et al. 2021). This perspective also builds on decades of work in historical ecology, which has emphasized the coproduction of landscapes by human and environmental processes across multiple spatial and temporal scales (Balée 2013; Crumley 1994). Archaeology's focus on the interaction of social, political, economic, and environmental systems also allows for a more complete understanding of how environmental change is produced, experienced, and managed across cultures and time periods (Smith 2011).

Site-based and regional archaeological data, accumulated over decades of research, provide high-resolution insights into past land use, subsistence strategies, settlement patterns, and resource management. These datasets are often spatially and temporally precise, and in many cases, they are exactly the kinds of records needed to calibrate and validate Earth system models. For instance, several studies have shown that long-term patterns of anthropogenic methane emissions from agriculture and stock rearing cannot be fully understood without archaeological data (Fuller et al. 2011; Ruddiman et al. 2008). Whether or not these early emissions had a major effect on global climate remains debated, but their existence is no longer in question. Despite this potential, with notable exceptions (e.g., Morrison et al. 2021), archaeological evidence remains largely absent from the frameworks and datasets driving global environmental change research (Smith 2021). This disconnect is due in part to disciplinary barriers. Archaeological research has traditionally focused on local and regional scales, and efforts to synthesize data across broader spatial and temporal ranges have often been hindered by inconsistent data standards and limited data sharing, especially in regions where concerns about looting or misrepresentation of the heritage of colonized peoples are acute (Gupta et al. 2023; Smith 2021).

At the same time, Earth science concepts define humanity as a monolithic force, abstracting away cultural and historical variation in favor of generalized metrics. In doing so, they often bypass the socially contextualized insights that archaeology provides. Rather than engaging with archaeological method and theory, these concepts offer simplified proxies for human activity that are legible to Earth system scientists but detached from the lived histories and social dynamics that produced them. Bridging this gap will require intentional efforts to scale up archaeological data, align formats and standards with Earth system science, and foster genuine interdisciplinary collaboration on a global scale. The conceptual and empirical foundations are already in place; what is needed now is a shared framework for integration.

Integrating Archaeology into Global-Change Science

To realize the full potential of archaeology in global-change research, archaeology needs a bit of reinvention, including some basic changes in the culture of data production and sharing. Although archaeological research has long been rich in site-level detail, there are few mechanisms for scaling up these insights in ways that align with the data infrastructure and modeling needs of Earth system science. Other disciplines offer useful examples: paleontology, for instance, benefits from large-scale databases such as the Paleobiology Database (PBDB), which aggregates fossil records to support analyses of biodiversity and climate change through time (Paleobiology Database 2000). The emergence of bioinformatics as a distinct subfield of biology, largely to handle the torrent of new genetic information, is also instructive.

Although archaeoinformatics exists, global-change science has yet to fully embrace it as an essential component of their discipline. Concerns over data sovereignty, misuse, and looting—which to us seem increasingly misplaced in our interconnected, high-information world—have fostered a culture of caution that limits data sharing and inhibits global-scale synthesis (Nicholson et al. 2023). These concerns, especially long overdue issues surrounding Indigenous data sovereignty (Walter et al. 2021), should be addressed. But without new strategies for responsibly aggregating and contextualizing archaeological data, archaeology risks continued marginalization in high-stakes global research that will impact how humanity moves forward (Ortman and Altschul 2023). Meeting this challenge will require investment not only in research infrastructure but also in professional training. Data stewardship, digital standards, and archaeological informatics should become core components of archaeological education and practice, including within cultural resource management, where much of the world's archaeological data are generated.

Promising models for synthesis do exist within the field. The Coalition for Archaeological Synthesis (CfAS) has been instrumental in supporting collaborative, data-driven projects that cross regional and thematic boundaries (Altschul et al. 2017). A notable example is the Global Dynamics of Inequality (GINI) Project (Bogaard et al. 2024), which brought together researchers from across the globe to analyze patterns of economic inequality reflected in housing. The resulting synthesis not only advanced comparative understanding of inequality across ancient societies but also culminated in a high-profile special issue in *Proceedings of the National Academy of Sciences* (Kohler et al. 2025). Another good example is the recent integration of cyberSW (www.cybersw.org), a data service that provides information on Indigenous settlement history in the greater US Southwest, with SKOPE, a data service that provides paleoenvironmental reconstructions. As a result, it is now possible to directly examine relationships between settlement and climate history across the entire US Southwest, building from site-level data and the network of regional tree-ring chronologies. In the realm of plant domestication, archaeologists and other researchers have built robust, searchable databases that allow global studies of crop origins, dispersals, and environmental impact (Fuller et al. 2015), and similar calls have been made for zooarchaeology (LeFebvre et al. 2019). Other collaborations, such as the ArchaeoGLOBE project, offer other paths forward for global synthesis and analysis (Stephens et al. 2019). These examples demonstrate both the feasibility and the potential of structured archaeological synthesis and serve as compelling templates for future work at the intersection of archaeology and global-change science.

The path forward involves standardizing metadata and aligning archaeological data formats with the requirements of Earth system models. This requires close collaboration with climate scientists, geographers, and computational modelers to ensure compatibility and usability. Building international consortia, much like those that exist for global biodiversity or land-use research, can help ensure spatial and temporal coverage while respecting local expertise and ethical considerations. Equally important is reframing archaeology's relevance to pressing social and ecological challenges. Archaeological records reveal that human impacts on the environment have always been uneven: different societies have altered landscapes in different ways, with varying consequences for biodiversity, sustainability, and resilience (Boivin and Crowther 2021; Fisher et al. 2009; Kirch 2005; Rick and Sandweiss 2020). Recognizing this diversity is essential not only for refining climate models but also for challenging both the persistent myth of a "pristine" preindustrial world and the idea that all human societies have contributed equally to planetary degradation (Boivin and Crowther 2021; Malm and Hornborg 2014).

By centering social justice and cultural variability in its contributions, archaeology can offer a powerful corrective to the dominant, homogenizing narratives in global-change science—narratives that often obscure the political, historical, and economic conditions that shape environmental outcomes. The task ahead is not just technical. It is intellectual and ethical. And it is one that archaeology is well equipped to take on.

Opportunities and Challenges Ahead

Integrating archaeology into global-change science offers substantial benefits for both fields. For archaeology, the opportunities are both intellectual and practical. Engaging with global-change frameworks can provide access to major funding streams typically reserved for climate science, artificial intelligence,

and computational modeling. These are resources that have historically been out of reach for much of the archaeological community. More importantly, this integration enhances the relevance of archaeological research, positioning it as a core contributor to interdisciplinary efforts to understand and respond to environmental change. It also opens the door for deeper collaboration with Earth and environmental scientists, building bridges across disciplines that have often operated in parallel rather than in concert.

For global-change science, the inclusion of archaeological data and perspectives enriches the foundation on which models and projections are built. Archaeology can provide improved historical baselines that extend beyond the narrow window of instrumental or documentary records, revealing how diverse human societies have shaped and adapted to environmental conditions over millennia (Boivin and Crowther 2021; Braje 2015). This allows for more culturally informed models and richer causal narratives—ones that reflect not only the scale of human impact but also its variability and complexity.

This is especially critical for climate modeling, which depends on accurate historical data to "train" models and generate reliable future projections. Earth system models such as IMAGE, which uses the HYDE (History Database of the Global Environment) land-use model, require highly structured and consistent inputs (PBL Netherlands Environmental Assessment Agency 2026). In one recent project, a member of the HYDE team explicitly outlined the format and parameters needed to incorporate archaeological data (Stephens et al. 2019). Adapting archaeological data to fit those needs was technically demanding, but it worked. And it demonstrated that, although challenging, this kind of integration is both possible and productive when archaeologists and modelers collaborate directly. The lesson is clear: archaeological insights can, and should, inform the future-oriented work of global-change science. Achieving this goal requires new tools, shared standards, and a willingness to step outside disciplinary comfort zones. The payoff is a more complete, grounded, and socially attuned understanding of how humans shape the planet and how we might shape its future.

Conclusion: From the Margins to the Mainstream

Archaeology now faces a rare opportunity—one of its most consequential ever—to shape how anthropogenic global change is understood and addressed. As funding and attention continue to flow toward climate, sustainability, and AI-driven modeling, archaeology stands to contribute essential insights into the long-term human dimensions of planetary change. However, archaeologists must be ready to engage at scale, with the tools, standards, and partnerships necessary to participate in global data frameworks and modeling platforms.

A natural next step is to launch a pilot project that links existing site- and regional-scale archaeological data to Earth-system-level data systems and related models and that provides ways to transcend historical concerns around data sovereignty, looting, et cetera. This would not only demonstrate archaeology's technical capacity to contribute but also establish the protocols and collaborations needed for broader integration. Doing so would also make it harder for global-change science to overlook the human past and easier for it to incorporate archaeology's more nuanced, culturally informed, and deeply grounded understandings of long-term environmental change.

At present, much of global-change modeling is conducted at a distance, operating in a space where people are numbers and landscapes are raster grids. Modelers and data scientists, usually working far from field contexts, make high-level decisions—such as how different human populations interact differently with different ecosystems (e.g., the use of fire)—that increasingly influence public policy and global action (Smith et al. 2025). In contrast, archaeologists work face-to-face with the material traces of past lives, sometimes literally holding human remains in their hands. They contend with the emotional, ethical, and historical weight of human experience and their connections with people living today. This grounding gives archaeology a fundamentally different relationship to the past—one that is urgently needed as we plan for the future.

When politicians seek answers to global change, they rarely turn to archaeologists. Archaeology's relevance is not questioned; it is simply not considered. The discipline is absent from the room in which decisions are made—not because it lacks insight, but because it has not yet claimed its seat at the table.

Kohler and Rockman (2020) discuss this issue with respect to the Intergovernmental Panel on Climate Change reports, and we believe many of the same issues apply here. Given the realities of anthropogenic global change, the world needs archaeology, and archaeology needs to make its value legible, its data accessible, and its voice heard.

Acknowledgments. This research was made possible through support from the Coalition for Archaeological Synthesis and the Center for Collaborative Synthesis in Archaeology at the University of Colorado Boulder. We are especially grateful for their commitment to collaborative, synthesis-driven research, which provided the intellectual and organizational framework for this project. The authors used artificial intelligence tools (e.g., Grammarly) to assist with language editing and manuscript preparation. These tools did not contribute to the development of the ideas, analysis, or interpretations, which remain solely those of the authors.

Funding Statement. This work was supported by the Center for Collaborative Synthesis in Archaeology at the University of Colorado Boulder through institutional salary support provided to the lead author. No specific external grant funding was received for this research.

Data Availability Statement. No new data were generated or analyzed in support of this article. Data sharing is therefore not applicable.

Competing Interests. The authors declare none.

References Cited

Altschul, Jeffrey H., Keith W. Kintigh, Terry H. Klein, William H. Doelle, Kelley A. Hays-Gilpin, Sarah A. Herr, Timothy A. Kohler, et al. 2017. Fostering Synthesis in Archaeology to Advance Science and Benefit Society. *PNAS* 114(42):10999–11002. https://doi.org/10.1073/pnas.1715950114.

Andermann, Tobias, Søren Faurby, Samuel T. Turvey, Alexandre Antonelli, and Daniele Silvestro. 2020. The Past and Future Human Impact on Mammalian Diversity. *Science Advances* 6(36):eabb2313. https://doi.org/10.1126/sciadv.abb2313.

Balée, William. 2013. *Cultural Forests of the Amazon: A Historical Ecology of People and Their Landscapes*. University of Alabama Press, Tuscaloosa.

Barnosky, Anthony D., Paul L. Koch, Robert S. Feranec, Scott L. Wing, and Alan B. Shabel. 2004. Assessing the Causes of Late Pleistocene Extinctions on the Continents. *Science* 306(5693):70–75. https://doi.org/10.1126/science.1101476.

Bauer, Andrew M., and Erle C. Ellis. 2018. The Anthropocene Divide: Obscuring Understanding of Social-Environmental Change. *Current Anthropology* 59(2):209–227. https://doi.org/10.1086/697198.

Bogaard, Amy, Scott G. Ortman, Jennifer Birch, Gabriela Cervantes Quequezana, Shadreck Chirikure, Enrico R. Crema, Pablo Cruz, et al. 2024. The Global Dynamics of Inequality (GINI) Project: Analysing Archaeological Housing Data. *Antiquity* 98(397):e6. https://doi.org/10.15184/aqy.2023.188.

Boivin, Nicole, Todd J. Braje, and Torben C. Rick. 2024. New Opportunities Emerge as the Anthropocene Epoch Vote Falls Short. *Nature Ecology & Evolution* 8(5):844–845. https://doi.org/10.1038/s41559-024-02392-x.

Boivin, Nicole, and Alison Crowther. 2021. Mobilizing the Past to Shape a Better Anthropocene. *Nature Ecology & Evolution* 5(3):273–284. https://doi.org/10.1038/s41559-020-01361-4.

Boivin, Nicole L., Melinda A. Zeder, Dorian Q. Fuller, Alison Crowther, Greger Larson, Jon M. Erlandson, Tim Denham, and Michael D. Petraglia. 2016. Ecological Consequences of Human Niche Construction: Examining Long-Term Anthropogenic Shaping of Global Species Distributions. *PNAS* 113(23):6388–6396. https://doi.org/10.1073/pnas.1520520113.

Braje, Todd J. 2015. Earth Systems, Human Agency, and the Anthropocene: Planet Earth in the Human Age. *Journal of Archaeological Research* 23(4):369–396. https://doi.org/10.1007/s10814-015-9087-y.

Braje, Todd J., and Jon M. Erlandson. 2013. Human Acceleration of Animal and Plant Extinctions: A Late Pleistocene, Holocene, and Anthropocene Continuum. *Anthropocene* 4:14–23. https://doi.org/10.1016/j.ancene.2013.08.003.

CGIAR Research Program on Climate Change, Agriculture and Food Security. 2012. Planet under Pressure. Electronic document, https://ccafs.cgiar.org/events/planet-under-pressure, accessed June 16, 2026.

Crumley, Carole L. (editor). 1994. *Historical Ecology: Cultural Knowledge and Changing Landscapes*. School of American Research, Santa Fe, New Mexico.

Denevan, William M. 1992. The Pristine Myth: The Landscape of the Americas in 1492. *Annals of the Association of American Geographers* 82(3):369–385. https://doi.org/10.1111/j.1467-8306.1992.tb01965.x.

Edgeworth, Matt, Dan deB Richter, Colin N. Waters, Peter Haff, Cath Neal, and Simon J. Price. 2015. Diachronous Beginnings of the Anthropocene: The Lower Bounding Surface of Anthropogenic Deposits. *Anthropocene Review* 2(1):33–58. https://doi.org/10.1177/2053019614565394.

Ellis, Erle C., Nicolas Gauthier, Kees Klein Goldewijk, Rebecca Bliege Bird, Nicole Boivin, Sandra Díaz, Dorian Q. Fuller, et al. 2021. People Have Shaped Most of Terrestrial Nature for at Least 12,000 Years. *PNAS* 118(17):e2023483118. https://doi.org/10.1073/pnas.2023483118.

Erlandson, Jon M. 2013. Shell Middens and Other Anthropogenic Soils as Global Stratigraphic Signatures of the Anthropocene. *Anthropocene* 4:24–32. https://doi.org/10.1016/j.ancene.2013.12.001.

Erlandson, Jon M., and Torben C. Rick. 2010. Archaeology Meets Marine Ecology: The Antiquity of Maritime Cultures and Human Impacts on Marine Fisheries and Ecosystems. *Annual Review of Marine Science* 2:231–251. https://doi.org/10.1146/annurev.marine.010908.163749.

Fisher, Christopher T., J. Brett Hill, and Gary M. Feinman (editors). 2009. *The Archaeology of Environmental Change: Socionatural Legacies of Degradation and Resilience*. University of Arizona Press, Tucson.

Fuller, Dorian Q., Eleanor Kingwell-Banham, Leilani Lucas, Charlene Murphy, and Chris Stevens. 2015. Comparing Pathways to Agriculture. *Archaeology International* 18(1):61–66. https://doi.org/10.5334/ai.1808.

Fuller, Dorian Q., and Alison Weisskopf. 2011. The Early Rice Project: From Domestication to Global Warming. *Archaeology International* 13(1):44–51. https://doi.org/10.5334/AI.1314.

Fuller, Dorian Q., Jacob van Etten, Katie Manning, Cristina Castillo, Eleanor Kingwell-Banham, Alison Weisskopf, Ling Qin, Yo-Ichiro Sato, and Robert J. Hijmans. 2011. The Contribution of Rice Agriculture and Livestock Pastoralism to Prehistoric Methane Levels: An Archaeological Assessment. *Holocene* 21(5):743–759. https://doi.org/10.1177/0959683611398052.

Gupta, Neha, Andrew Martindale, Kisha Supernant, and Michael Elvidge. 2023. The CARE Principles and the Reuse, Sharing, and Curation of Indigenous Data in Canadian Archaeology. *Advances in Archaeological Practice* 11(1):76–89. https://doi.org/10.1017/aap.2022.33.

Haff, Peter K. 2014. Humans and Technology in the Anthropocene: Six Rules. *Anthropocene Review* 1(2):126–136. https://doi.org/10.1177/2053019614530575.

Head, Martin J., Will Steffen, David Fagerlind, Colin N. Waters, Clement Poirier, Jaia Syvitski, Jan A. Zalasiewicz, et al. 2022. The Great Acceleration Is Real and Provides a Quantitative Basis for the Proposed Anthropocene Series/Epoch. *Episodes* 45(4):359–376. https://doi.org/10.18814/epiiugs/2021/021031.

Hong, Sungmin, Jean-Pierre Candelone, Clair C. Patterson, and Claude F. Boutron. 1994. Greenland Ice Evidence of Hemispheric Lead Pollution Two Millennia Ago by Greek and Roman Civilizations. *Science* 265(5180):1841–1843. https://doi.org/10.1126/science.265.5180.1841.

Kelly, Luke T., Katherine M. Giljohann, Andrea Duane, Núria Aquilué, Sally Archibald, Enric Batllori, Andrew F. Bennett, et al. 2020. Fire and Biodiversity in the Anthropocene. *Science* 370(6519):eabb0355. https://doi.org/10.1126/science.abb0355.

Kirch, Patrick V. 2005. Archaeology and Global Change: The Holocene Record. *Annual Review of Environment and Resources* 30:409–440. https://doi.org/10.1146/annurev.energy.29.102403.140700.

Kohler, Timothy A., Amy Bogaard, and Scott G. Ortman. 2025. Introducing the Special Feature on Housing Differences and Inequality over the Very Long Term. *PNAS* 122(16):e2401989122. https://doi.org/10.1073/pnas.2401989122.

Kohler, Timothy A., and Marcy Rockman. 2020. The IPCC: A Primer for Archaeologists. *American Antiquity* 85(4):627–651. https://doi.org/10.1017/aaq.2020.68.

LeFebvre, Michelle J., Laura Brenskelle, John Wieczorek, Sarah Whitcher Kansa, Eric C. Kansa, Neill J. Wallis, Jessica N. King, Kitty F. Emery, and Robert Guralnick. 2019. ZooArchNet: Connecting Zooarchaeological Specimens to the Biodiversity and Archaeology Data Networks. *PLoS ONE* 14(4):e0215369. https://doi.org/10.1371/journal.pone.0215369.

Lewis, Simon L., and Mark A. Maslin. 2015. Defining the Anthropocene. *Nature* 519(7542):171–180. https://doi.org/10.1038/nature14258.

Malm, Andreas, and Alf Hornborg. 2014. The Geology of Mankind? A Critique of the Anthropocene Narrative. *Anthropocene Review* 1(1):62–69. https://doi.org/10.1177/2053019613516291.

McConnell, Joseph R., Nathan J. Chellman, Andreas Plach, Sophia M. Wensman, Gill Plunkett, Andreas Stohl, Nicole-Kristine Smith, et al. 2025. Pan-European Atmospheric Lead Pollution, Enhanced Blood Lead Levels, and Cognitive Decline from Roman-Era Mining and Smelting. *PNAS* 122(3):e2419630121. https://doi.org/10.1073/pnas.2419630121.

Morrison, Kathleen D., Emily Hammer, Oliver Boles, Marco Madella, Nicola Whitehouse, Marie-José Gaillard, Jennifer Bates, et al. 2021. Mapping Past Human Land Use Using Archaeological Data: A New Classification for Global Land Use Synthesis and Data Harmonization. *PLoS ONE* 16(4):e0246662. https://doi.org/10.1371/journal.pone.0246662.

Nicholson, Christopher, Sarah Kansa, Neha Gupta, and Rachel Fernandez. 2023. Will It Ever Be FAIR? Making Archaeological Data Findable, Accessible, Interoperable, and Reusable. *Advances in Archaeological Practice* 11(1):63–75. https://doi.org/10.1017/aap.2022.40.

Nogué, Sandra, Naia Morueta-Holme, José María Fernández-Palacios, Inger G. Alsos, Anthony Brown, Patrick Roberts, and Josep Peñuelas. 2025. Human Transformation of Past Terrestrial Ecosystems. *Nature Reviews Biodiversity* 1(10):644–656.

Ortman, Scott G., and Jeffrey H. Altschul. 2023. What North American Archaeology Needs to Take Advantage of the Digital Data Revolution. *Advances in Archaeological Practice* 11(1):90–103. https://doi.org/10.1017/aap.2022.42.

Paleobiology Database. 2000. Paleobiology Database. Electronic database, https://paleobiodb.org, accessed October 1, 1999.

PBL Netherlands Environmental Assessment Agency. 2026. HYDE (History Database of the Global Environment). Electronic database, https://www.pbl.nl/en/hyde-history-database-of-the-global-environment, accessed October 9, 2025.

Redman, Charles L. 1999. *Human Impact on Ancient Environments*. University of Arizona Press, Tucson.

Renn, Jürgen. 2022. From the History of Science to Geoanthropology. *Isis* 113(2):377–385. https://doi.org/10.1086/719703.

Rick, Torben C., Patrick V. Kirch, Jon M. Erlandson, and Scott M. Fitzpatrick. 2013. Archeology, Deep History, and the Human Transformation of Island Ecosystems. *Anthropocene* 4:33–45. https://doi.org/10.1016/j.ancene.2013.08.002.

Rick, Torben C., and Daniel H. Sandweiss. 2020. Archaeology, Climate, and Global Change in the Age of Humans. *PNAS* 117(15):8250–8253. https://doi.org/10.1073/pnas.2003612117.

Ritchie, Hannah. 2024. *Not the End of the World: How We Can Be the First Generation to Build a Sustainable Planet*. Little, Brown Spark, New York.

Roberts, Patrick, Rebecca Hamilton, and Dolores R. Piperno. 2021. Tropical Forests as Key Sites of the "Anthropocene": Past and Present Perspectives. *PNAS* 118(40):e2109243118. https://doi.org/10.1073/pnas.2109243118.

Rockström, Johan, Maria A. Martin, Andrey Ganopolski, Jonathan F. Donges, Georg Feulner, Norbert Marwan, and Stefan Rahmstorf. 2026. We Are in the Anthropocene—Now What? *Earth's Future* 14(6):e2025EF007730. https://doi.org/10.1029/2025EF007730.

Rogers, Ashleigh J. 2024. Aquaculture in the Ancient World: Ecosystem Engineering, Domesticated Landscapes, and the First Blue Revolution. *Journal of Archaeological Research* 32(3):427–491. https://doi.org/10.1007/s10814-023-09191-1.

Ruddiman, William F. 2003. The Anthropogenic Greenhouse Era Began Thousands of Years Ago. *Climatic Change* 61(3):261–293. https://doi.org/10.1023/B:CLIM.0000004577.17928.fa.

Ruddiman, William F., Zhengtang Guo, Xin Zhou, Hanbin Wu, and Yanyan Yu. 2008. Early Rice Farming and Anomalous Methane Trends. *Quaternary Science Reviews* 27(13–14):1291–1295. https://doi.org/10.1016/j.quascirev.2008.03.007.

Ruddiman, William F., Feng He, Stephen J. Vavrus, and John E. Kutzbach. 2020. The Early Anthropogenic Hypothesis: A Review. *Quaternary Science Reviews* 240:106386. https://doi.org/10.1016/j.quascirev.2020.106386.

Silva, Fabio, Fiona Coward, Kimberley Davies, Sarah Elliott, Emma Jenkins, Adrian C. Newton, Philip Riris, et al. 2022. Developing Transdisciplinary Approaches to Sustainability Challenges: The Need to Model Socio-Environmental Systems in the Longue Durée. *Sustainability* 14(16):10234. https://doi.org/10.3390/su141610234.

Smith, Bruce D. 2011. General Patterns of Niche Construction and the Management of "Wild" Plant and Animal Resources by Small-Scale Pre-Industrial Societies. *Philosophical Transactions of the Royal Society B: Biological Sciences* 366(1566):836–848. https://doi.org/10.1098/rstb.2010.0253.

Smith, Bruce D., and Melinda A. Zeder. 2013. The Onset of the Anthropocene. *Anthropocene* 4:8–13. https://doi.org/10.1016/j.ancene.2013.05.001.

Smith, Cathy, Ol Perkins, Jayalaxshmi Mistry, Bibiana A. Bilbao, Rebecca Bliege Bird, Amy Cardinal Christianson, Kayla M. de Freitas, et al. 2025. A Global Expert Elicitation on Present-Day Human–Fire Interactions. *Philosophical Transactions of the Royal Society B: Biological Sciences* 380(1924):20230463. https://doi.org/10.1098/rstb.2023.0463.

Smith, Michael E. 2021. Why Archaeology's Relevance to Global Challenges Has Not Been Recognised. *Antiquity* 95(382):1061–1069. https://doi.org/10.15184/aqy.2021.42.

Steffen, Will, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, and Cornelia Ludwig. 2015. The Trajectory of the Anthropocene: The Great Acceleration. *Anthropocene Review* 2(1):81–98. https://doi.org/10.1177/2053019614564785.

Stephens, Lucas, Dorian Q. Fuller, Nicole Boivin, Torben C. Rick, Nicolas Gauthier, Andrea Kay, Ben Marwick, et al. 2019. Archaeological Assessment Reveals Earth's Early Transformation through Land Use. *Science* 365(6456):897–902. https://doi.org/10.1126/science.aax1192.

Thompson, Jessica C., David K. Wright, Sarah J. Ivory, Jeong-Heon Choi, Sheila Nightingale, Alex Mackay, Flora Schilt, et al. 2021. Early Human Impacts and Ecosystem Reorganization in Southern-Central Africa. *Science Advances* 7(19):eabf9776. https://doi.org/10.1126/sciadv.abf9776.

van der Leeuw, Sander E., and Charles L. Redman. 2002. Placing Archaeology at the Center of Socio-Natural Studies. *American Antiquity* 67(4):597–605. https://doi.org/10.2307/1593793.

Walter, Maggie, Raymond Lovett, Bobby Maher, Bhiamie Williamson, Jacob Prehn, Gawaian Bodkin-Andrews, and Vanessa Lee. 2021. Indigenous Data Sovereignty in the Era of Big Data and Open Data. *Australian Journal of Social Issues* 56(2):143–156. https://doi.org/10.1002/ajs4.141.

Zalasiewicz, Jan, Martin J. Head, Colin N. Waters, Simon D. Turner, Peter K. Haff, Colin Summerhayes, Mark Williams, et al. 2024. The Anthropocene within the Geological Time Scale: A Response to Fundamental Questions. *Episodes* 47(1):65–83. https://doi.org/10.18814/epiiugs/2023/023025.

Zalasiewicz, Jan, Julia A. Thomas, Colin N. Waters, Simon Turner, and Martin J. Head. 2024. The Meaning of the Anthropocene: Why It Matters Even Without a Formal Geological Definition. *Nature* 632(8027):980–984. https://doi.org/10.1038/d41586-024-02712-y.

Zalasiewicz, Jan, Mark Williams, Colin N. Waters, Anthony D. Barnosky, and Peter Haff. 2014. The Technofossil Record of Humans. *Anthropocene Review* 1(1):34–43. https://doi.org/10.1177/2053019613514953.

Zalasiewicz, Jan, Mark Williams, Colin N. Waters, Anthony D. Barnosky, John Palmesino, Ann-Sofi Rönnskog, Matt Edgeworth, et al. 2017. Scale and Diversity of the Physical Technosphere: A Geological Perspective. *Anthropocene Review* 4(1):9–22. https://doi.org/10.1177/2053019616677743.

Cite this article: Klassen, Sarah, Erle Ellis, Scott Ortman, and Torben Rick. 2026. Archaeology's Golden Opportunity: Transforming the Science of Global Environmental Change. *American Antiquity.* https://doi.org/10.1017/aaq.2026.10219.