How Deep Do We Dig?

A Methodological Note on Global Overburden Modeling and Archaeological Prospecting

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Methodological Note, Version 0.1

Abstract

Archaeological fieldwork often begins with survey, surface visibility assessment, and contextual judgment before excavation or remote sensing. Yet many field teams, students, and interdisciplinary researchers lack a generalized visual framework for estimating how much accumulated material may overlie cultural remains across broad temporal windows. **How Deep Do We Dig?** is a global overburden and burial-depth visualizer designed as a planning instrument and heuristic visualizer for archaeological prospecting. It models broad accumulation processes—including atmospheric dust, volcanic ash, alluvial deposition, colluvial slopewash, coastal/marine sedimentation, glacial/periglacial sediment, organic accumulation, anthropogenic fill, and regolith development—across a temporal range of 0 to 1,000,000 years.

The tool does not claim to determine actual site depth at a specific location. Instead, it produces generalized depth-to-potential-cultural-surface estimates by environmental regime and time window. Its purpose is to help archaeologists, geoarchaeologists, students, remote-sensing teams, GPR teams, and interdisciplinary researchers develop better depth intuition before designing survey, excavation, coring, or geophysical strategies. Tool 1 is intentionally global and accumulation-focused. A second tool, **How Deep Do We Dig Here?**, will address regional refinement, erosion, truncation, compaction, local sedimentation, GPR constraints, and calibrated field data.

1. Introduction: The Depth Problem in Archaeological Prospecting

Archaeological training emphasizes survey, context, stratigraphy, and excavation control. However, a persistent problem remains: before excavation or subsurface testing begins, researchers often lack a generalized sense of how much material may have accumulated above the surface they hope to investigate. This matters because the absence of surface material is not the same as the absence of archaeology. Cultural deposits may be deeply buried beneath alluvium, loess, volcanic ash, colluvium, organic growth, anthropogenic fill, or other surface-blanketing processes.

The question **"How deep do we dig?"** is therefore not a crude excavation question. It is a planning question. It asks how deep a field team may need to think, test, scan, core, trench, or excavate before reaching a plausible surface of cultural visibility. The question also concerns **depth granularity**: the level of vertical resolution needed to decide whether surface survey is sufficient, whether shovel testing or augering is appropriate, whether trenching should be planned, or whether a remote-sensing method requires a deeper target window.

This methodological note introduces a first-pass tool for visualizing global accumulation processes over archaeological and deep-time intervals. It is designed to stimulate better survey planning, not replace local stratigraphic analysis.

2. Intended Audience

The tool is intended for:

Field archaeologists
Academic archaeologists
Geoarchaeologists
Students
Remote-sensing teams
GPR teams
Interdisciplinary researchers
Researchers developing early-stage prospecting strategies
Educators teaching stratigraphy, site formation, or archaeological visibility

Because the first version is global and generalized, it is especially useful for teaching, field planning, comparative reasoning, and methodological discussion. It is not intended to replace field observation, local geomorphology, sediment cores, soil profiles, regional geological maps, or excavation data.

3. Methodological Status of the Tool

How Deep Do We Dig? should be understood as both:

1. A **planning instrument**, because it helps researchers think through possible depth ranges before choosing field methods.
2. A **heuristic visualizer**, because it translates broad accumulation processes into a visual and numerical form without claiming site-specific precision.

The most appropriate technical phrase for the primary output is:

generalized depth-to-potential cultural surface

The public interface may also use:

recommended starting-depth band

These two phrases should be understood together. The first is the more precise methodological concept. The second is the field-facing interpretation.

4. Core Problem Statement

Archaeologists often begin with surface survey, but surface visibility is strongly conditioned by the history of deposition, burial, disturbance, and exposure. In depositional landscapes, older cultural surfaces may be masked by accumulated material. In other settings, cultural remains may remain shallow or exposed. Tool 1 addresses the first side of that problem: **gross accumulation**.

This is not a claim that every landscape continuously accumulates material. Rather, Tool 1 asks: if a generalized environmental regime is treated as an accumulation setting, how much overburden might a researcher need to anticipate over a selected time window?

A finer-grained regional model is required for net burial, erosion, deflation, truncation, surface stripping, compaction, and GPR visibility. Those functions are reserved for Tool 2.

5. Gross Accumulation, Net Burial, and Starting-Depth Bands

The methodology distinguishes three concepts:

Gross accumulation

Gross accumulation refers to the total material potentially deposited over a given time interval by atmospheric, volcanic, hydrological, biological, geological, and human processes.

Net burial

Net burial refers to the material that remains above a cultural surface after deposition has been modified by erosion, truncation, compaction, bioturbation, human disturbance, and landscape change.

Field-relevant starting-depth band

The field-relevant starting-depth band is a heuristic depth range at which cultural surfaces, features, artifacts, architecture, or remains may begin to become archaeologically visible through excavation, coring, trenching, or subsurface testing.

Tool 1 focuses on gross accumulation and field-relevant starting-depth bands. Tool 2 will refine net burial.

6. Environmental Regimes

Tool 1 organizes generalized accumulation through broad environmental regimes. The current regime classes are:

Arid/desert
Semi-arid steppe
Temperate woodland/grassland
Tropical humid
Alluvial basin
Volcanic province
Coastal plain
Glacial/periglacial
Peat/wetland
Urban/anthropogenic fill

These regimes are intentionally coarse. They are not substitutes for regional geomorphology, but they provide archaeologists with a starting framework for thinking about how surface blanketing may vary across environmental contexts.

7. Primary Accumulation Layer: Atmospheric Dust

The first methodological emphasis is **atmospheric dust**, including dustfall, loess, fine aeolian sediment, and long-term airborne mineral deposition. Atmospheric dust is important because it can accumulate quietly and gradually across wide areas, forming a subtle but persistent blanket over older land surfaces.

For archaeological planning, atmospheric dust is valuable as a generalized layer because it does not require a single catastrophic event. It can accumulate incrementally over centuries, millennia, and glacial-interglacial cycles. In the visualizer, atmospheric dust should be treated as a baseline global accumulation process, modulated by environmental regime.

Atmospheric dust does not by itself determine site depth. It is one contributor to generalized overburden.

8. Additional Accumulation Layers

Although atmospheric dust is the primary layer for the initial methodological emphasis, the tool includes other process layers to help users understand how multiple blankets of matter may build over time.

Volcanic ash / tephra

Volcanic ash can create discrete, sometimes widespread stratigraphic horizons. Tephra deposits may be sudden, regionally extensive, and chronologically useful when geochemically identified. In the tool, tephra should be visualized as episodic accumulation rather than slow background deposition.

Alluvial / flood deposition

Alluvial deposition occurs when rivers, streams, floodplains, and overbank events place sediment over existing surfaces. Archaeological surfaces in alluvial basins may be deeply buried even when nearby uplands remain shallow.

Colluvial slopewash

Colluvial deposition occurs when gravity, slope processes, runoff, and hillwash move sediment downslope. This can bury cultural materials at the base of slopes, along terraces, or within landscape depressions.

Coastal / marine sedimentation

Coastal plains and marine margins may experience sedimentation through shoreline movement, storm deposition, estuarine processes, deltaic growth, and sea-level change. These processes can bury or rework cultural surfaces.

Glacial / periglacial sediment

Glacial and periglacial contexts may produce complex depositional histories involving till, outwash, loess, freeze-thaw movement, and post-glacial landscape reorganization.

Organic / peat accumulation

Wetlands and peat environments may accumulate organic material over time, sometimes preserving archaeological remains but also burying them beneath thick organic deposits.

Anthropogenic fill

Human activity can rapidly create overburden through construction, rebuilding, refuse disposal, terracing, landscaping, urban growth, and the placement of fill. In some cultural contexts, new structures are built directly over earlier surfaces.

Weathering / regolith development

Weathering and regolith development transform surface materials in place and can alter the vertical visibility of cultural deposits. This is not simply “material falling from above”; it is a surface-formation and transformation process.

9. Climate-Mediated Sediment Redistribution

The tool should formalize “weather movement” as:

climate-mediated sediment redistribution

This includes wind, water, slopewash, coastal storm deposition, freeze-thaw processes, and weather-driven surface transformation. This phrase is preferable because it captures the broader process without reducing the model to rainfall or storms alone.

10. Pedogenesis, Compaction, and Bioturbation

Tool 1 includes these processes in the methodological note as cautions but does not model them directly.

Pedogenesis

Soil formation is both accumulation and transformation. It modifies surfaces through weathering, organic cycling, horizon formation, microbial activity, root action, and mineral alteration. Pedogenesis affects the visibility and preservation of archaeological materials.

Compaction

Over long timeframes, sediments may compact. A thick loose deposit may compress, reducing its present thickness. Tool 1 does not model compaction because doing so globally would imply false precision. Compaction should be developed in Tool 2.

Bioturbation

Roots, burrowing animals, insects, worms, and other biological processes can move artifacts and sediments vertically. Bioturbation should be included as a methodological caution, but not as a Tool 1 modeled variable. It will be more appropriate in Tool 2, where local soil and ecological regimes can be considered.

11. Archaeological Time Windows

The slider runs from 0 to 1,000,000 years. It should move in 100-year increments, while visible interpretive labels emphasize larger steps.

The methodological note should emphasize both archaeological periods and planning windows, including:

100 years
1,000 years
10,000 years
23,000 years
30,000 years
50,000 years
100,000 years
250,000 years
500,000 years
1,000,000 years

The 10,000-year range is especially relevant to Holocene archaeology and post-Pleistocene landscape development. The 23,000-year range is important because of current debates around early human presence in the Americas, including the White Sands evidence. The 30,000-year range should be treated as an exploratory deep-time planning window rather than a universally settled consensus date. The 100,000-to-1,000,000-year range moves the tool into deep-time archaeology, paleoanthropology, paleosurface modeling, and geoarchaeological prospecting.

The tool should therefore support both conventional archaeological planning and deep-time paleoanthropological imagination.

12. Surface Invisibility Threshold

A central concept for this methodology is the:

surface invisibility threshold

This refers to the amount of accumulated material above a cultural surface at which ordinary surface survey becomes increasingly unlikely to detect that surface.

The surface invisibility threshold does not mean the archaeology is absent. It means the archaeology may have become invisible to surface methods. This concept is important because it reframes negative surface evidence. A landscape with few or no visible artifacts may still contain buried cultural surfaces if accumulation has exceeded the threshold of surface detectability.

13. Depth Granularity

Depth granularity refers to the vertical resolution required to choose an appropriate archaeological method.

For example:

Surface survey may be appropriate when expected burial is minimal.
Shovel testing may be appropriate when expected burial is shallow.
Augering or coring may be appropriate when expected burial is moderate or unknown.
Trenching may be appropriate when buried surfaces are expected below ordinary test depths.
Remote sensing may require knowledge of likely target depth before method selection.
Full excavation may require a stratigraphic expectation before unit placement.

The tool's purpose is to improve depth granularity before field decisions are made.

14. Relation to Survey

This tool does not replace survey. It strengthens survey planning by asking what survey may be missing.

Surface survey is highly valuable, but surface survey is conditioned by visibility. Older cultural surfaces may be underrepresented in depositional landscapes because they are buried beneath later accumulation. The tool helps archaeologists ask whether absence at the surface reflects absence of archaeology or simply burial beneath accumulated material.

15. Relation to Remote Sensing and GPR

Tool 1 includes remote-sensing and GPR users in its intended audience, but it does not model GPR performance. GPR depth visibility depends on soil moisture, conductivity, salinity, clay content, disturbance, antenna frequency, target contrast, and stratigraphic conditions. Including these factors in a global tool would overstate what can be known.

Tool 1 therefore provides only a generalized depth expectation. Tool 2, **How Deep Do We Dig Here?**, will address regional GPR constraints and local subsurface visibility.

16. Interface Logic

The visualizer should include:

A 3D spinning globe
Click-and-drag rotation
Detailed continental outlines
Land-only heatmap rendering

Layer checkboxes
Stacked-layer display
Single-layer isolation mode
A layer legend
A temporal slider from 0 to 1,000,000 years
100-year slider increments
Visible interpretive labels at larger intervals
Editable year textbox
Global summary panel
Generalized depth-to-potential-cultural-surface output
Depth in centimeters, meters, and range bands
A recommended starting-depth band
A methodological PDF section
A local annotation/commentary section

The globe should look like a professional scientific instrument rather than a simplified educational toy. Heatmap rendering should be fine-grained, land-focused, and visually restrained. Continental outlines should be sufficiently detailed to communicate global geography without overwhelming the accumulation data.

17. Proposed Workflow for Use

1. Define the target age window.
2. Select the closest generalized environmental regime.
3. Activate relevant accumulation layers.
4. Review the global overburden estimate.
5. Review the generalized depth-to-potential-cultural-surface band.
6. Translate the range into field-method expectations.
7. Decide whether surface survey, shovel testing, augering, coring, trenching, remote sensing, or excavation is appropriate.
8. Record all assumptions.
9. Treat the result as a first-pass planning guide.
10. Move to regional modeling when local data are available.

18. Case-Study Mapping

Future versions of the note should map the visualizer to real case studies. These may include:

Alluvial burial of archaeological surfaces
Loess-covered Paleolithic landscapes
Volcanic ash horizons and tephra-marked occupation surfaces
Peat/wetland preservation contexts
Coastal plain burial and shoreline movement
Urban stratigraphy and anthropogenic fill
Deep-time paleoanthropological surfaces

White Sands-style buried trackways and paleosurface preservation
Regional GPR comparison cases for Tool 2

Each case study should ask whether the tool improves starting-depth intuition, survey design, or method selection.

19. Community Annotation

The page should invite scholarly questions and additions. Suggested contribution categories include:

Regional correction suggestions
Field observations
Citation leads
Deposition-rate references
Known exceptions
Case studies
GPR/excavation comparisons
Methodological critiques
Feature requests for Tool 2
Suggested environmental regimes
Suggested time windows
Suggested layer calibrations

The comment system should function as a methodological annotation log rather than a casual comment thread.

20. Limits of Tool 1

The tool is designed for generalized orientation and comparative planning. It should be interpreted as a first-pass accumulation heuristic, not as a substitute for local stratigraphic observation, coring, geomorphological mapping, excavation data, or geophysical testing.

Tool 1 intentionally remains general because local precision belongs in Tool 2. This separation prevents the global tool from overstating its authority while preserving its value as a depth-orientation instrument.

Tool 1 does not directly calculate:

Erosion
Deflation
Truncation
Compaction
Bioturbation
Local sedimentation rates

Local soil conductivity
GPR performance
Hydrological variability
Tectonic uplift or subsidence
Human disturbance at site scale

These will be candidates for **How Deep Do We Dig Here?**

21. Tool 2: How Deep Do We Dig Here?

The second tool should be titled:

How Deep Do We Dig Here?

It will refine the global model by adding:

Regional environmental data
Net burial estimates
Erosion and truncation
Compaction
Bioturbation
Known sedimentation rates
Local landform type
Hydrology
GPR suitability
Soil conductivity
Clay/salinity/moisture constraints
Local geomorphological maps
User-entered site parameters
Field-observation calibration
Regional case-study comparison

Tool 2 will transform the generalized planning model into a regional prospecting and subsurface-method planning tool.

22. Conclusion

How Deep Do We Dig? addresses a practical and conceptual gap in archaeological prospecting: the lack of a fast, global, visually interpretable framework for thinking about overburden and depth before field methods are selected. By modeling generalized accumulation through time, the tool helps researchers develop depth intuition, identify possible surface invisibility, and better understand why surface survey may underrepresent older or deeply buried cultural surfaces.

The tool's strength lies in its generality. It does not pretend to know the local ground. Instead, it gives archaeologists a disciplined first-pass way to ask whether they are looking deeply enough.

Appendix A: Preliminary Citation Categories

Geoarchaeology and site formation
Archaeological stratigraphy
Pedology and soil formation
Aeolian dust and loess deposition
Tephrochronology and volcanic ash stratigraphy
Alluvial archaeology and floodplain burial
Colluvial deposition and slopewash
Coastal sedimentation and shoreline change
Peat, wetland archaeology, and organic accumulation
Anthropogenic fill and urban stratigraphy
Bioturbation and vertical displacement
Remote sensing and geophysical prospection
GPR constraints and soil conductivity
Early human migration and deep-time prospecting
White Sands and Pleistocene paleosurface preservation