

Overview of a numerical modelling approach of Neolithic settlements

The instance of the Pointe de la Tranche (Vendée, France)

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Introduction

Digital modelling is a valuable addition to field observations, especially for construction techniques, as highlighted by a number of studies on prehistoric megalithic architecture [Cou23]. This method is still rare in the study of Neolithic settlements in western France, despite architectural similarities and previous research in other regions [PKG*13]. As a result, recent surveys have been conducted at some of these sites, leading to the creation of extensive digital archives that have yet to be fully explored.

Exploiting digital archives

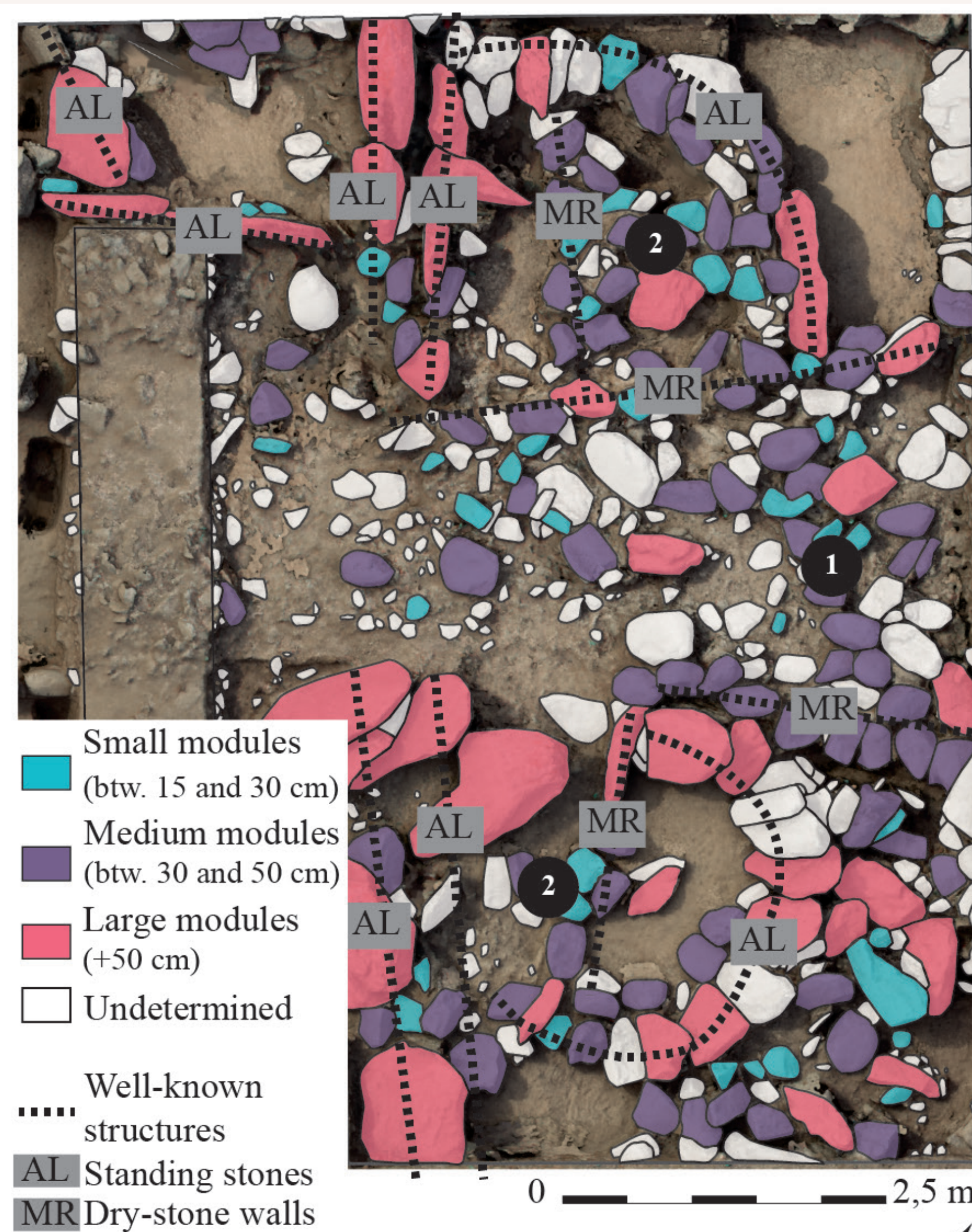
A. Blanchard's excavations at Pointe de la Tranche (Île d'Yeu) in 2010-2013 uncovered a Late Neolithic site (ca. 3800-2900 BC) featuring two enclosures with dry-stone walls and standing stones. The main challenge was to determine which archives could be used in a digital modelling process and what further insights could be gained from them. Only 60% of the digital archive (over 900 images) was used for 3D reconstruction, due to discrepancies between field methods and 3D modelling standards, and following a rigorous image selection process [1]. To provide a basis for comparison, an additional model was created from a 2022 drone survey.

A reproducible methodology

To enhance the visibility of each block's shape and provide information on its inclination, Normal Map, Shadeless, Ambient Occlusion (AO), and Contour Lines (PETRA) were applied to the 3D models [GC19]. In addition, complementary treatments were carried out [1], including the direct measurement and analysis of the height, width and length of each block. For statistical analysis, the recorded data were integrated with the archaeological excavation dataset. The aim was to ensure comparability with existing datasets from burial contexts, by using established modelling techniques familiar to archaeologists. The main focus of the 3D reconstruction was the entrance area at various stages of the excavation.

Approach of construction techniques

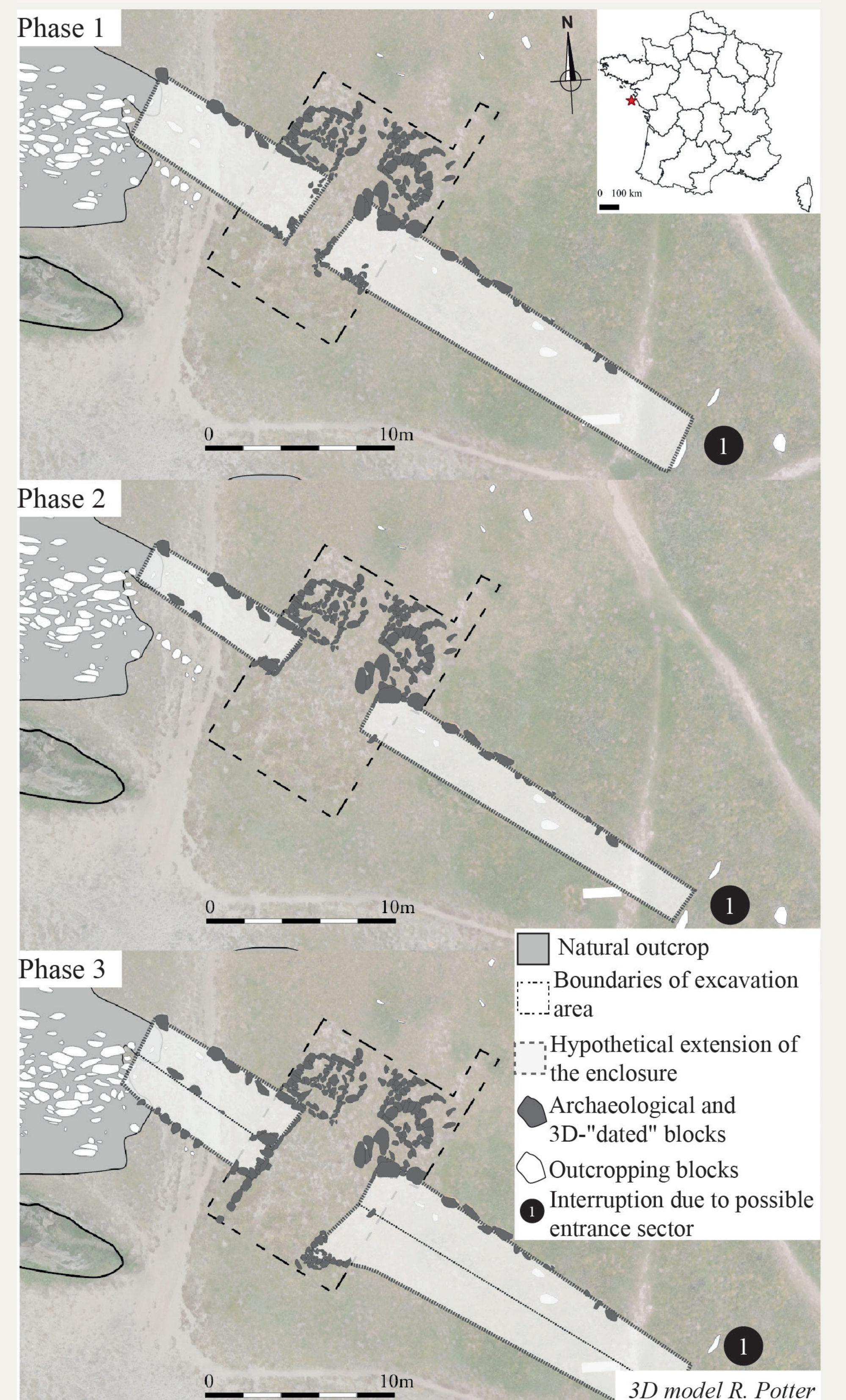
The data from the mesh measurements in the entrance sector have provided new insights into the stages of the architectural project, particularly the design and material preparation. This has enhanced our understanding of the distribution of architectural modules and construction units [2]. It has shown that there are consistent structural templates across different structures, aligning with observations from the excavations and detailed studies of each block's inclination. These observations could be applied to all blocks currently exposed by erosion by applying the same treatments to a large model of the entire point. Hypotheses about the morphological evolution of the architectures are supported by statistical and visual data combined with stratigraphic data [3].



2 - Distribution of the various modules in the northern part of the entrance area on the 3D model

Conclusion

The aim of this research is to develop the aforementioned techniques for all types of Neolithic settlements: open or ditched enclosures, as well as for the architecture of barred spurs. It is hoped that this approach will significantly enrich the data on the architectural projects of these archaeological remains.



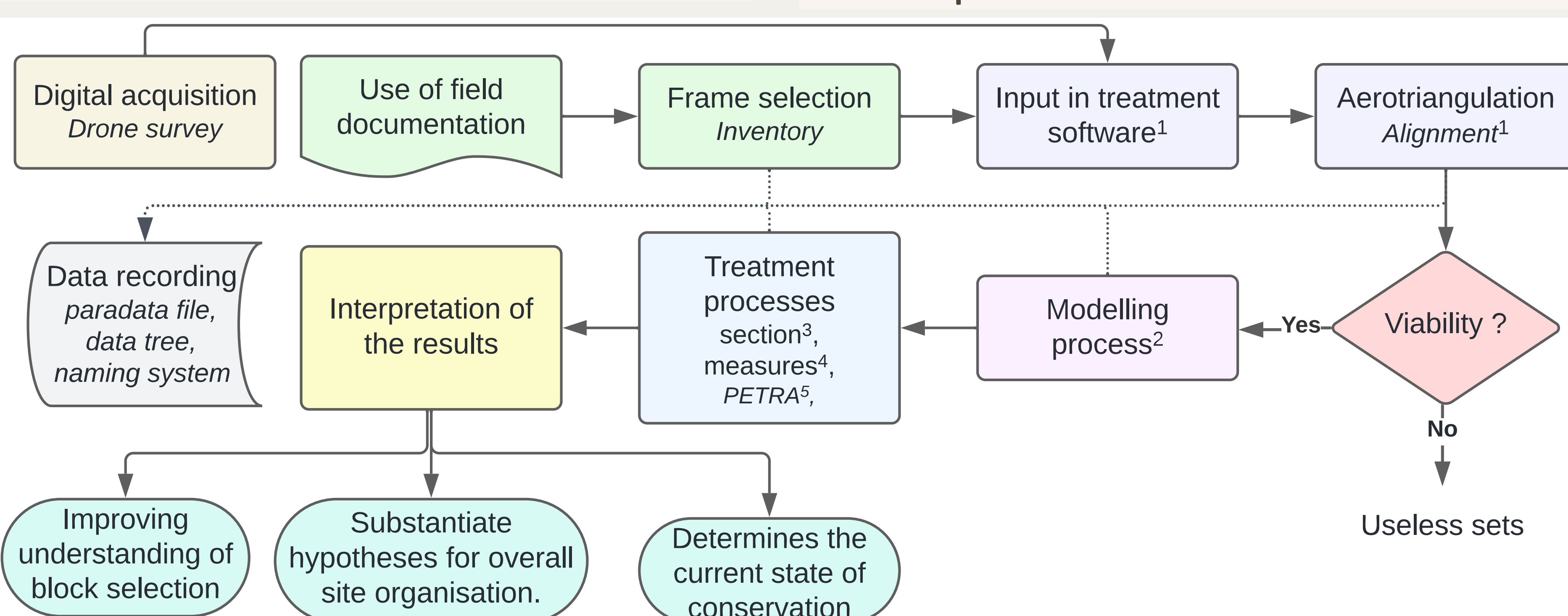
3 - Hypothesis of the morphological evolution of Neolithic architecture

These morphological interpretations are based on archaeological and statistical data derived from 3D models combined with current outcrop blocks.

References

- [Cou23] COUSSEAU F.: *Bâtisseurs de mégalithes. Un savoir-faire néolithique dévoilé par l'archéologie du bâti*. Archaeopress, 2023. doi : 10.32028/9781803276342.
- [GC19] GRIMAUD V., CASSENS.: Implementing a protocol for employing three-dimensional representations in archaeology (PETRA) for the documentation of neolithic funeral architecture in Western France. *Digital Applications in Archaeology and Cultural Heritage*, 13 (June 2019). doi : 10.1016/j.daach.2019.e00096.
- [PKG*13] PATIAS P., KAIMARIS D., GEORGIADIS Ch., STAMNAS A., ANTONIADIS D., PAPANIMITRAK D.: 3D mapping of cultural heritage: special problems and best practices in extreme case-studies. *ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.*, II-5/W1 (July 2013). doi : 10.5194/isprsannals-II-5-W1-223-2013.

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1 : Agisoft Metashape Pro 2.00 ; 2 : CloudCompare 2.13 Poisson reconstruction algorithm & MeshLab 2021.10 ; 3 : CloudCompare Cross Section 4 : MeshLab measuring tool ; 5 : Protocol for the use of three-dimensional representations in archaeology - Blender 2.93.6 PETRA Plug-in

1 - Workflow Methodology

