

A Tomb with a View

New Methods for Bridging the Gap Between Land and Sky in Megalithic Archaeology

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ABSTRACT

The orientations of European prehistoric structures have been studied independently by landscape archaeologists and archaeoastronomers. Despite their similar interests, the two fields have failed to converge primarily because of their differing epistemologies. This paper argues that archaeology has much to gain by integrating the two fields to provide a fuller and more balanced exploration and understanding of the location and orientation of the European megaliths. It is suggested that prehistoric archaeoastronomy needs to become more grounded on the archaeological record and context of the prehistoric structures it studies. If it is to generate knowledge of value to archaeology it needs to become a “skyscape archaeology.” This paper looks at current archaeoastronomical approaches through the lens of archaeological practice. It identifies some limitations and discusses how landscape archaeology can inform archaeoastronomy on overcoming them. A methodology that attempts this necessary cross-fertilization, by shedding unfounded assumptions and developing a more phenomenological approach to pattern-recognition, is proposed. This methodology is applied to a case study in central Portugal. The emergent narrative, linking a cluster of dolmens to a local mountain range and the star Aldebaran, not only fits the archaeological record, but is mirrored by local folklore, lending further support to the validity of this methodology.

El estudio de las orientaciones de las estructuras prehistóricas europeas se ha llevado a cabo de forma independiente por los arqueólogos del paisaje y por los arqueoastrónomos. A pesar de sus intereses similares, los dos campos no han podido converger, sobre todo, debido a sus diferentes epistemologías. Este trabajo sustenta que, la arqueología tiene mucho que ganar con la integración de los dos campos, al proporcionar una exploración y comprensión más completa y equilibrada de la localización y orientación de los megalitos europeos. La arqueoastronomía prehistórica, como se sugiere, necesita apoyarse más en el registro arqueológico y en el contexto de las estructuras prehistóricas que estudia. Si se trata de generar conocimiento de valor para la arqueología, ésta debe convertirse en una “arqueología del skyscape”. Este trabajo examina los planteamientos de la arqueoastronomía a través de la práctica arqueológica. Este mismo identifica algunas limitaciones y analiza cómo la arqueología de paisaje puede indicar a la arqueoastronomía el cómo superarlas. Una metodología que intenta esta necesaria hibridación, desechando suposiciones infundadas y el desarrollo de una perspectiva más fenomenológica al reconocimiento de patrones, es la propuesta. Esta metodología se aplica a un caso de estudio en el centro de Portugal. La narrativa que surge y que relaciona a un conjunto de dólmenes con una cadena montañosa local y con la Estrella Aldebarán, no sólo se presenta en el registro arqueológico, sino que está reflejada en el folklore local, dándole un mayor apoyo a la validez de esta metodología.

The rise of interpretative archaeology, with its focus on the beliefs and practices of past peoples, has opened up a new avenue for the study of the orientation of megalithic European structures. The European landscapes are punctuated by thousands of monumental structures built out of stone during the Neolithic and Bronze Age periods (roughly 5000–1400 cal B.C., depending on country). Some of these, such as the stone rows of Cork-Kerry in Ireland or of Carnac in Brittany, are oriented in

such a way as to indicate a clear direction (Ruggles 1999:102–111; Scarre 2011:117–134). Others, such as the passage graves of Scandinavia, the Scottish and Welsh chambered cairns, or the Iberian dolmens, share as many similarities as differences. They all consist of an artificial mound—a tumulus or cairn—that includes inner megalithic structures, usually one or more chambers and/or a passage leading to an entrance.

Some of these entrances and passages seem not to have been laid at random, as they follow general trends. This potential intentionality betrays a meaning or function behind the orientations, which has interested scholars since at least their realization of it. The seminal work of Tilley (1994) on the phenomenology of the landscape opened up the study of the orientation of the chambered cairns of the Black Mountains of Wales within the field of landscape archaeology. Tilley found that, despite the lack of regularity in the orientation of these megalithic structures, there were two general principles guiding them: cairns closer to the rivers were oriented with their axes running parallel to the river, whereas cairns in higher grounds “connect up with prominent topographic features of the landscape” (Tilley 1994:127). Subsequent studies have continued a similarly phenomenological approach to megalithic monuments, further noticing relationships between their orientations and their landscapes (e.g., Cummings 2001; Cummings et al. 2002).

A different approach has been taken by archaeoastronomers, who are interested in “the beliefs and practices concerning the sky in the past [...] and the uses to which people’s understanding of the sky was put” (Ruggles 2005:11); in other words, they are interested in the “skyscape” (Silva and Campion 2014). After the dispute in the 1960s and 70s between archaeologists and astronomers over the intentionality behind identified high-precision alignments such as those at Stonehenge (Hawkins 1965), the modern discipline of archaeoastronomy found its feet deeply rooted in fieldwork and statistical tests for validity (e.g., Ruggles 1999). The main aim of the current generation of archaeoastronomers interested in prehistoric Europe has been to disprove the null hypothesis, showing that the alignments of megalithic structures to astronomical events are statistically significant and not due to chance. This involved collecting orientation data for large numbers of similar monuments, sometimes across vast regions and statistically analyzing their results in search of broad patterns, most often to the detriment of archaeological contextualization and attention to regional variation. In this, the work of Ruggles (1999) in Great Britain and Ireland and Hoskin (2001) in the Mediterranean region was instrumental in establishing the methodologies for the archaeoastronomical study of different monuments spanning most of European late prehistory.

However, megalithic archaeoastronomy is currently at an impasse. Although thousands of structures have now been surveyed for alignments, and statistical analyses do demonstrate astronomical intentionality in some cases, only very rarely have these been successfully interpreted and integrated into the archaeological narrative. In short, we know that some Neolithic and Early Bronze Age Europeans were aligning their monuments to astronomical targets, but we have failed to fully grasp which celestial objects were being targeted, what the alignments meant for prehistoric people, or why they decided to incorporate them into their structures. This impasse might be one of the reasons why archaeologists have for so long kept their distance (Campion 2014; Henty 2014a). Another important factor in maintaining the distance between the two fields was the fact that “astronomers knew little of archaeology and archaeologists were largely ignorant of astronomy” (Parker Pearson 2012:47).

Considering these points, it is the author’s contention that the practice of prehistoric archaeology has much to gain if the two

fields come together to a fuller and more balanced exploration and understanding of the location and orientation of the European megaliths. Among archaeology’s many subfields, landscape archaeology is the “closest parallel” to archaeoastronomy (Ruggles 2011:7). However, as discussed above, their core epistemologies were different from the start, and this has hindered their convergence. To bring them together, landscape archaeology could learn from a more statistical approach (e.g., Steele et al. 2003; Wheatley 1995). Conversely, archaeoastronomers should become more phenomenological and grounded on the archaeological record and context of the prehistoric structures they study. In a sense, archaeoastronomy should become more of a “skyscape archaeology.”

This paper focuses on the latter point. It looks at current archaeoastronomical approaches through the lens of archaeological practice. It identifies some of their limitations and discusses how landscape archaeology can inform archaeoastronomy on overcoming them. It then proposes one methodology that attempts this necessary cross-fertilization by developing a more phenomenological approach to pattern-recognition at local scales. The proposed methodology has already been applied to a megalithic cluster in central Portugal (Silva 2013a, 2014a). The approach taken and key findings are summarized in support of the methodology. The paper ends with a discussion of the wider applicability of the presented method and its potential to uncover new patterns, thus furthering the understanding of the European prehistoric structures.

CURRENT ARCHAEOASTRONOMICAL APPROACHES AND THEIR LIMITATIONS

One of the key figures in launching the post-seventies field of archaeoastronomy was Michael Hoskin who, through his extensive fieldwork across the Mediterranean, inspired (and essentially trained) a large contingent of the current generation of scholars. In Iberia alone, Hoskin collaborated with local archaeologists and archaeoastronomers in surveying over 1,500 dolmens (Hoskin 2001). Hoskin’s strict methodology and statistical insight were key in amassing the data required to disprove the null hypothesis.

Hoskin’s data show that there was a patent interest in orienting megalithic monuments toward preferential directions, which could have an astronomical intention behind it. However, the data for Iberia, for example, does not show any patterns that could be readily identifiable as well-defined astronomical events, such as a solstice or a lunar standstill. Instead, it displayed variability of bearing while keeping to general trends—e.g., facing the southeast quarter of the horizon. Hoskin could justify his observations only via a lax solar interpretation: the megaliths would have been aligned to sunrise or sun-climb on the day of the beginning of their construction, which would have varied widely (2001:213). In but a few cases did this interpretation find a place within local archaeological narratives (e.g., Senna-Martinez et al. 1997), perhaps not surprisingly since many monuments do not fit this interpretation (Silva 2010). However

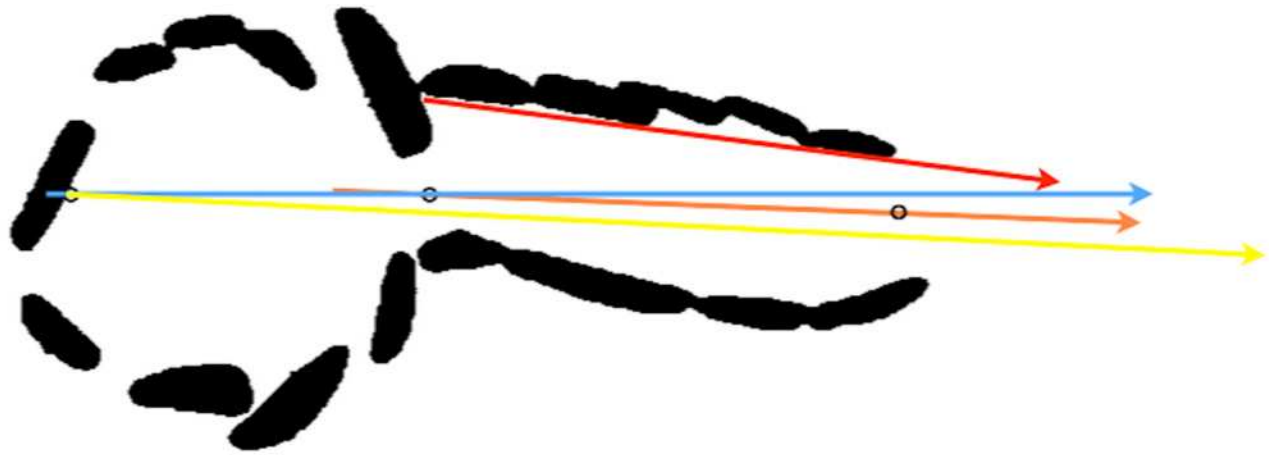


FIGURE 1. Simplified plan view of a typical dolmen with corridor (orthostats in black), with several differently defined “axes of symmetry” or orientations marked (colored arrows). The black circles indicate the position of the ranging poles used to define the directions to measure (arrows).

far-reaching and ground-breaking Hoskin’s work has been to archaeoastronomy, it is important to be aware of its limitations. Here we identify two, namely a field presumption and an analytical assumption, which will be contrasted to what happens in the field of landscape archaeology.

First, Hoskin’s field methodology presumes that the measurement of a single orientation is enough. Hoskin measured the orientation of the dolmens he surveyed by laying out ranging poles along what he called their “axis of symmetry” (2001:12). This was defined by the direction “from the centre of the backstone to the centre of the entrance or passage” (2001:12). However, taking into account the present state of the archaeological sites, as well as the rough architectural style of some of them, several different such axes can be defined, with bearings differing by as much as 10 degrees (Figure 1; Silva 2010). Although for statistical purposes it is important to ensure that the same measurement is taken on all structures, it is impossible to say if the direction one is measuring is the one that truly reflects the megaliths’ orientation as perceived by its builders.

Moreover, one should not assume that modern Western notions of symmetry, axis, or even precision were relevant several thousand years ago. The intention of the dolmen builders might have been a very different one. For instance, and apart from the primary purpose of access, it is possible that the corridor was intended only to indicate a general direction, and that a topographic or other feature, visible from within the chamber would mark the precise point of the alignment. If a celestial event was meant to be observed, the dolmen users needed only to make sure that the event was visible within the window formed by the corridor and chamber entrance (Figure 5b). That is, they would require only a “loose” alignment, without any concern for precision. Without any independent confirmation that precision was of importance to the megalith builders, one might be effectively reducing one’s chances of identifying any patterns if one measures a single orientation. This more phenomenological approach would be much more in line with the less precise, but no less meaningful, topographic alignments and intervisibility patterns identified by landscape archaeologists.

Secondly, in the presentation and analysis of his extensive survey data, Hoskin clustered the data into semi-arbitrary groups. In some regions of Iberia the clustering was based on river basins, whereas in others it was based on modern political provinces. In either case, there is an assumption that the dolmens belonging to the same group should share some characteristics and that any statistical patterning should be sought within such groups. This logic seems valid, as monuments sharing several characteristics, including geographical location and radiocarbon dating, are likely to have been built by the same, or nearby, communities sharing similar worldviews. However, modern-day political boundaries are clearly meaningless for the Neolithic hunting, gathering, and pastoralist Iberians of 6,000 years ago.

Landscape archaeologists, on the other hand, have focused on smaller sets of monuments, which are spread over smaller areas but share several characteristics, such as landscape and monument typology, and have synchronous dating. Tilley’s largest case study of the orientations of Neolithic monuments was that of the long barrows of Cranborne Chase, in southern England, which consisted of 40 monuments in a roughly 600-km² area (Tilley 1994:150–166). By comparison, Hoskin’s Iberian groupings went up to a maximum of 177 monuments over an area of roughly 15,000 km², most of them in Alentejo, Portugal (Hoskin 2001:95–100). Over such wide areas, different communities would have built different monuments, clustered around different regions, which could also display different intentions behind the orientations of their monuments. Such microscopic variation could prevent a general pattern from being observed in the wider dataset.

It is important to add that there is merit in Hoskin’s method, particularly given his aims. The statistical approach employed to show that European megaliths were intentionally aligned to celestial events requires a standardized measurement (Hoskin’s crude “axis of symmetry”) and a large sample size (Hoskin’s groupings). To this effect, his work was instrumental. However, our present concern is with the identification and interpretation of patterns in orientation and, on this front, his approach and data have proved elusive. His extensive dataset has since been

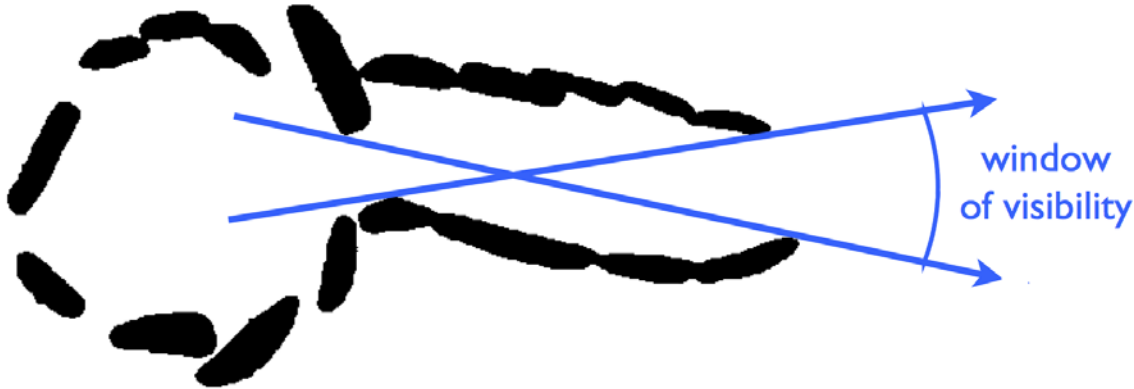


FIGURE 2. Plan view of a typical dolmen with corridor (orthostats in black), with the window of visibility orientations measured (blue arrows)..

analyzed using more powerful statistical toolsets (e.g., Belmonte and González-García 2012; González-García and Belmonte 2010; González-García et al. 2007). However, these analyses transfer the limitations of the dataset unto themselves so that, for example, cluster analyses have used Hoskin's semi-arbitrary groups. In addition, such methods can test only interpretative hypotheses that have already been suggested. The meaning and intentionality behind the megaliths' orientations are not emergent; that is, new interpretations of the orientations are not forthcoming by the application of such methods.

This critique, then, calls for a new approach that, first, does not impose a priori a single direction to be surveyed in the field and, second, seeks pattern-recognition at smaller scales. Such a methodology should continually be grounded on the material record, take a more phenomenological approach to the landscape and the skyscape, and, hopefully, allow new testable hypotheses to emerge from the data.

METHODS

With this in mind, a new methodology that encompasses both field techniques and an analytical approach was devised. The original aim was the study of the orientation of clusters of Iberian dolmens (see case study below) and therefore these methods are particularly useful for the study of chambered monuments with passages or corridors. Such monuments have more constrained fields of view and orientation than simpler monuments without corridors or passages, making the former better suited to the identification of patterns in orientation.

Field Survey

To study the orientation of structures with respect to the skyscape of their builders, it is important to measure two quantities in the field: the azimuth and the horizon altitude along a given direction (Ruggles 1999:164–171). Both measures are important because the azimuth where an astronomical event occurs changes for different horizon altitudes. These quantities can be measured using a compass (whose values must be corrected to true north) and a clinometer, or a theodolite for increased precision. It is, however, necessary to establish in advance which directions are to be measured. This can be done by placing two

carefully levelled ranging poles (black circles in Figure 1), which are used as backsight and foresight. The surveyor is situated so that the two poles overlap in the field of vision, thus defining a straight line (the arrows in Figure 1). The surveyor's chosen instrument can then be used to measure the azimuth and the horizon altitude. Following the discussion above, however, one should avoid a priori assumptions on which direction to measure. For megalithic monuments with passages or corridors, it is suggested here that the range of horizon azimuths visible from within the chamber, the "window of visibility," be surveyed.

Window of Visibility

This is defined as the region of the horizon that, given the structure's corridor and entrance geometry, can be seen from within its chamber. This amounts to a range of azimuth bearings between a minimum and a maximum value defined by the diagonals of the corridor/passage and chamber entrances (see Figure 2). These diagonals can be established using ranging poles and their azimuth bearing and horizon altitudes measured as described above. Ideally, the height of this window should also be measured. However, in some cases, and certainly in Iberia, the corridor's cover-stones are no longer extant, leaving some uncertainty as to the exact height of this window of visibility. For the purpose of searching for possible alignments with topographic features or celestial events, the focus is on the horizon. It is therefore sufficient to confirm, in situ, that the horizon line is well within the window.

Virtual Horizon Reconstruction

In order to "contextualize" the window of visibility, it is convenient to have a representation of the entire 360° horizon panorama around the site. Landscape archaeologists have used panoramic photos to reconstruct the landscape around a site. Cummings, for example, developed schematic representations of this in a concise format that allows for comparison across multiple sites (Cummings 2001; Cummings et al. 2002). In addition, archaeoastronomers also require azimuthal and horizon altitude readings to be able to later match key topographic features or structural orientations with celestial objects and events. Ruggles (1999:167–168) has, for instance, suggested that fieldworkers draw the visible horizon and measure key topographic features. An integrated approach, allowing one to explore potential land-

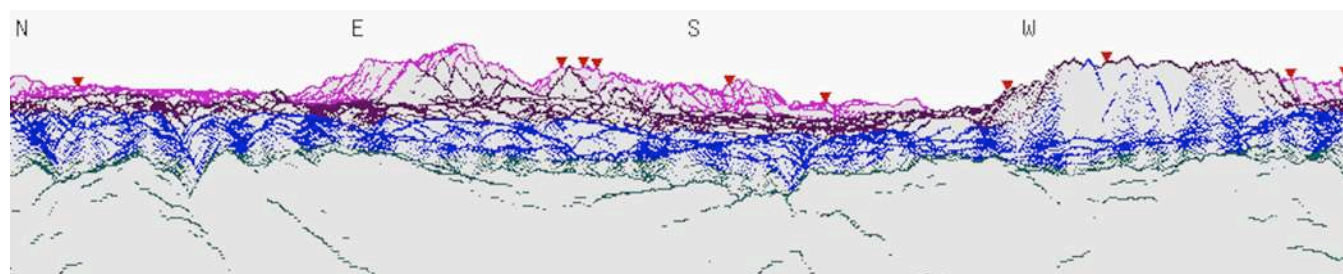


FIGURE 3. The view from Anta da Arquinha da Moura, reconstructed using a Digital Elevation Model. Horizon images are Copyright © 2013 Michael Kosowsky. Used with permission.

scape and skyline alignments, would thus require complete immersion in the landscape, via a 360° panorama, and also include azimuthal and altitude measurements.

Today, Geographic Information System (GIS) software and digital elevation data allow this to be done systematically and in a portion of the time taken to do it using panoramic photography. An added advantage is that it allows for landscapes of sites in recently forested areas to be reconstructed and made accessible to the researcher. This turned out to be a key factor in the case study below, since the horizon was not visible in most of the sites due to the dense canopy from trees planted in the 1980s. However, as Cummings (2001:102) pointed out, setting up GIS software to do this can be time consuming, even though the software has evolved considerably since her work was published. Alternatively, HeyWhatsThat (Kosowsky 2013) is a free online utility that uses Shuttle Radar Topography Mission (SRTM) digital elevation data to create horizon panoramas automatically, requiring only the latitude and longitude of the archaeological site.

Figure 3 shows a 360° virtual panorama around *Anta da Arquinha da Moura* (Tondela, Portugal). The different colors represent different distances to the horizon and provide a sense of depth. The cardinal points are marked, but it is also possible to read the azimuth and altitude directly from the reconstructed digital panorama using the online utility. This methodology proved to be quite accurate by direct comparison between photography, field measurements, and the respective virtual reconstructions (Silva 2013a).

Data Analysis and Pattern-recognition

The approach taken to analyze the field data was decidedly qualitative and phenomenological. Patterns should be sought at archaeologically established scales, such as those of a megalithic cluster or necropolis, for which there is independent evidence of shared characteristics. A megalithic cluster has been defined in different ways, depending on the approach of the researcher. However, it can be broadly said to consist of monuments that are located nearby, share similar landscapes, display a high coefficient of intervisibility, are contemporaneous, and share similar material culture (Andrade 2013). Monuments that display several of these characteristics are likely to have been built by the same, or nearby, communities sharing ideologies and intentions. It is thus at this scale that patterns should be initially searched.

The protocol to search for patterns using the window of visibility measurements consists of:

- (i) laying out the reconstructed horizon panoramas for all structures in a cluster or necropolis;
- (ii) overlaying the measured windows of visibility for each structure;
- (iii) identifying the range of azimuths found within the window of visibility of several, if not all, structures in the cluster.

A final step entails the interpretation of the patterns, if any are found. This step should be open-ended—that is, one shouldn't presume any topographic and/or celestial hypothesis, but keep a "phenomenologically open" mind. Interpretations should be argued with recourse to the archaeological context of the cluster.

CASE STUDY: THE CARREGAL DO SAL CLUSTER

This section focuses on a group of monuments in the Mondego River basin area, also known as the Mondego platform. Data gathered using Hoskin's methodology displayed a range of orientations spanning the horizon between east and southeast but with no other clear pattern (Hoskin 2001:104–105; Silva 2010, 2013a). However, the megaliths in this area are either clustered or appear in isolation further up along the river basin (see Figure 4). To apply the proposed methodology, one should start to look for patterns within the Carregal do Sal cluster and, only later, tentatively expand the approach to the wider region. The following summarizes this case study's archaeological context, field data, analysis, and interpretation relevant to the demonstration of the methodology delineated above. For more details, the reader is directed to the original publications where this case study is treated in full (Silva 2013a, 2014).

The Archaeological Record

Discoveries of the past 20 years, especially of Neolithic settlements in the Mondego basin, have allowed a picture of local life during the fifth millennium B.C., the Early Neolithic, to emerge (Senna-Martinez et al. 2008a:318–319; Valera 1998). The

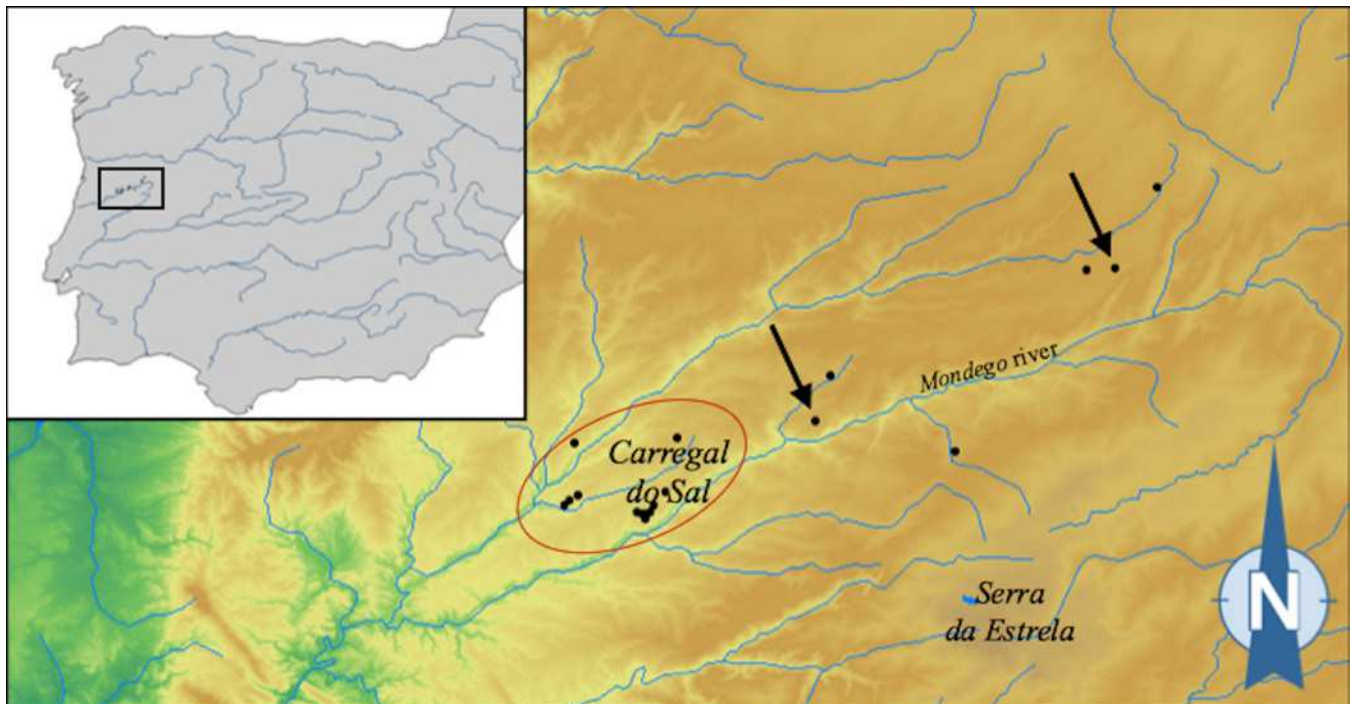


FIGURE 4. Map of the case study region, with location of megalithic sites (black dots). The cluster of Carregal do Sal is circled in red and labeled. The two arrows indicate the two surveyed dolmens in the Mondego platform that do not fit the Carregal do Sal orientation pattern.

evidence indicates that small communities sustained themselves primarily by small game hunting and the gathering of acorns and other winter fruits. Agriculture would have played only a minor role in the subsistence of these communities, if at all (Senna-Martinez et al. 2008a:327). On the other hand, the raising of ovicaprids (sheep and goats), introduced to the region by the first Neolithic settlers, suggests that winters were spent on low grounds and the spring and summer seasons on the high pastures of Serra da Estrela, a local mountain range (Cruz 2001:313; Senna-Martinez et al. 1997:663–664). In fact, both Neolithic material culture and palynological and antracological evidence attest to the presence and impact of humans in Serra da Estrela (Araújo et al. 2012; Cardoso and González 2002).

The first megalithic monuments were built roughly a thousand years later (Cruz 1995). The most common type of monument in this region is the dolmen, or *antas* in the original Portuguese. These dolmens are not dissimilar to the chambered tombs and passage graves of northwest Europe: they are centered around a polygonal chamber made out of megalithic orthostats, typically seven, nine, or eleven. The chamber then has an entrance with or without a corridor or passage, also megalithic in nature. Both the chamber and the passage were roofed with cover-stones, and the whole construction was surrounded by a tumulus covered in stone (see Figure 5). At its prime, a typical dolmen would look like an artificial mound with a stone shell and a single opening. There are several instances of surviving paintings and carvings in the chamber and in the corridor's orthostats. Radiocarbon dates indicate that the dolmens in this region of Portugal were built between 4300 and 3700 cal B.C., even though there is evidence for their continued use beyond this date (Cruz 1995:104).

Senna-Martinez and colleagues feature the monuments in their economic model for the local Neolithic: the megalithic cluster, by marking the winter territory, would legitimize its occupation. In fact, Neolithic settlements in the Mondego basin appear in close proximity to the dolmens and suggest an autumn and winter occupation, as evidenced by the presence of central hearths and earth ovens where acorns were roasted (Senna-Martinez et al. 2008a). These monuments can then be seen as “true anchors in the landscape for populations that, on the other hand, have a high seasonal mobility” (Senna-Martinez et al. 2008b:82).

A Pattern Emerges

The author surveyed all extant dolmens in the Mondego platform, some of which Hoskin hadn't visited, as part of an ongoing project to study the orientation of dolmens in western Iberia (Silva 2010, 2013a). The field survey methodology followed that delineated in the Methods section above. Azimuths were measured using a Suunto KB-13 compass, and a Suunto PM-5 clinometer was also used. Geographical coordinates were obtained using a Garmin Global Positioning System (GPS) handheld unit. In total twelve dolmens were visited, but only eight had corridors (for one of which it was impossible to measure the window of visibility). All the data collected in the field by the author is already in the public domain (Silva 2010, 2013a). The remainder of this section will focus on the search for a pattern in the orientation of the dolmens in this cluster and its interpretation from both a landscape and skyscape archaeology point of view.

Figure 6 shows the reconstructed panoramas for all corridor dolmens of the Carregal do Sal cluster with the window of visibility



FIGURE 5. (a) Dolmen da Orca, a typical dolmenic structure in western Iberia; (b) view of the passage and entrance while standing within the dolmen's chamber: the window of visibility; (c) Orca de Santo Tisco, a dolmen with a much smaller passage or corridor.

overlaid. The extent of the horizon that is not visible from within the chamber is grayed out.

The corridors of these dolmens are all oriented toward a single mountain range on the horizon: Serra da Estrela, the mountain range where the dolmen builders would have spent their summers. The fact that this pattern applies to all dolmens in this cluster highlights the role of the mountain range in the cosmology of these communities and even suggests a link between

the function of the dolmens and the mountain range. Besides primarily having potential ritual and funerary functions, the dolmens of the Mondego Valley also marked the winter territories of their builders, whereas Serra da Estrela, on the horizon, marked their summer pastures. Consequently, it seems that both man-made and natural landscape markers were anchoring the seasonal movement of these Neolithic communities. This relationship between topographic features and megalithic monuments is in line with others suggested by landscape

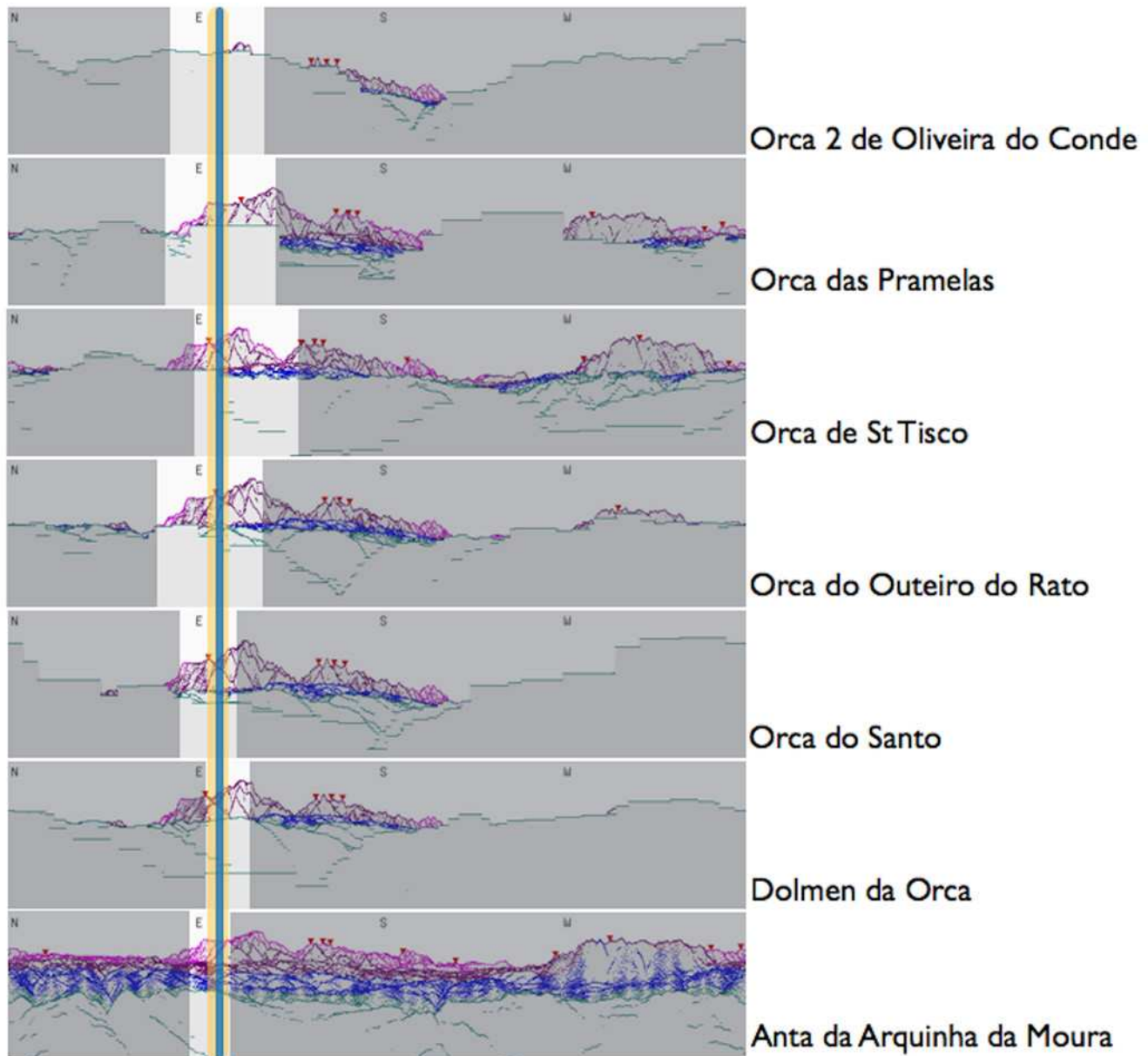


FIGURE 6. The view from all surveyed corridor dolmens, reconstructed using a Digital Elevation Model. What cannot be seen from within the dolmen's chamber has been grayed out, thus highlighting the window of visibility. The vertical yellow ribbon marks the region of the horizon that is visible from within all dolmens, whereas the blue one marks the rising position of Aldebaran between 4300 cal B.C. and 3700 cal B.C. Horizon images are Copyright © 2013 Michael Kosowsky. Used with permission.

archaeologists for other megalithic clusters, such as those of the Black Mountains.

Within this mountain range there is a particular region that was specifically targeted by the dolmen builders. This region, marked by the vertical yellow ribbon in Figure 6, is visible from within all dolmen chambers and does not correspond to the peak of the mountain range, which in at least four cases, is to the south of the field of view. The extent of this "pattern" is given by the windows of Dolmen da Orca and Anta da Arquinha da Moura, the two largest dolmens in this cluster. This suggests

that, besides a broad interest in orienting their monuments to Serra da Estrela, these Neolithic Iberians might also have a different motivation to narrow down that particular region of the horizon.

Aldebaran as a Seasonal Marker

The highlighted region, the pattern, corresponds to azimuth range 98–111°. As discussed elsewhere, there are no established and visually well-defined solar or lunar events around this part of the horizon (Silva 2013a, 2014). However, there was an astro-



FIGURE 7. The view toward the east from the Carregal do Sal cluster, at dawn at the end of April around 4,000 B.C., as reconstructed using a Digital Elevation Model and Stellarium (Stellarium Development Team 2013). Aldebaran, the last star to rise before the sun, is rising directly above Serra da Estrela—the “Mountain Range of the Star.”

nomical object in this region of the sky that might have served as a robust trigger for the seasonal movement of the dolmen builders: Aldebaran, the brightest star of Taurus, and one of the brightest stars in the night sky (average apparent magnitude of .87). At the time of dolmen construction, ca. 4300–3700 B.C., Aldebaran would have risen exactly within the band of the horizon that is visible from within all these corridor dolmens. Figure 6 shows this band, marked by the thin vertical blue ribbon.

Even though stars, whenever visible, are always seen to rise in the same place on the horizon throughout the year, stars that lie this far from the celestial pole go through a period in which they are not seen in the night sky. After this period of invisibility, their first appearance is at dawn, rising just before the sun; this is what is known as the “heliacal rising” (Brady 2014; Schaefer 1987). For the epoch under consideration, the heliacal rising of Aldebaran occurred around April 18–27 (Silva 2013a). These dates may not be truly representative, as visibility and climatic and other observational criteria might not permit the star to be seen so close to the horizon on a given day. Generally, however, one can say that Aldebaran first appeared in the eastern sky in late April/early May (see Figure 7).

The material evidence suggests that in the spring and summer, the dolmen builders would take their ovicaprids to the high pastures of Serra da Estrela to take advantage of its grazing grounds. If these Neolithic communities were observing the heliacal rise of Aldebaran, as the dolmenic alignments suggest, they could have used it as a temporal marker for this movement to high pastures. Aldebaran’s period of invisibility—from late February to late April—would provide the perfect length of time to make preparations for whatever rituals were going to be enacted at the dolmens, as well as to prepare for the move to higher grounds. Megalithic art is not as widespread in Carregal do Sal as it is in neighboring regions, but the one clear case of an ochre painting within a dolmen’s chamber displays what can be interpreted as a red star (Figure 8).

The use of the heliacal rising of a star as a marker for ritual, a new season, and the new year is not without historical and eth-

nographic precedent. For instance, the ancient Egyptians timed their ritual calendar by the heliacal rise of Sirius (Schaefer 2000; Steele 2007) and, in the ethnographic present, South American Indians mark the heliacal rise of the Pleiades (Lévi-Strauss 1986 [1964]). As is the case with the dolmen builders of the Mondego Valley, the heliacal rises of the chosen stars coincide with important events in the subsistence economies of these peoples. In Egypt it coincided with the flooding of the Nile, rebooting the agricultural cycle; in South America it coincides with the shift from wet to dry season.

Support from Local Folklore

This narrative finds support from folktales that explain the name of Serra da Estrela, which translates as “Mountain Range of the Star.” There are many versions of this folktale, but they all share the same common elements (see Silva 2013a). They tell of a shepherd living somewhere in the Mondego Valley who spotted a star so bright that it illuminated the top of a nearby mountain range. One day he decides to take his dog and follow that light. After several days they reach the top of the mountain, where the shepherd, impressed by the luminosity of the star, decides to name both the mountain range and the dog (*cão Serra da Estrela*, or Portuguese Shepherd Dog) after it.

This tale seems to replicate, in different words, the hypothesis that emerges from the archaeological data. The hero of the tale is a shepherd living in the Mondego Valley, from where he would see a particular star atop a mountain range. This triggered him to “follow” this star, taking his dog, a shepherd dog, with him. The comparison with the Neolithic people of Carregal do Sal is very suggestive. First, they also inhabited the same river valley, where the megalithic cluster and settlements are found. Second, they too, like the hero of the tale, seem to have been pastoralists. Finally, the evidence indicates that they would take their ovicaprids to graze on the high fields of Serra da Estrela. In the toponymical tale, the transhumantic movement of the shepherd is triggered by the appearance of a star over the mountain range. In the case of the megalithic builders, the heliacal rising of Aldebaran above Serra da Estrela could have served the same purpose.

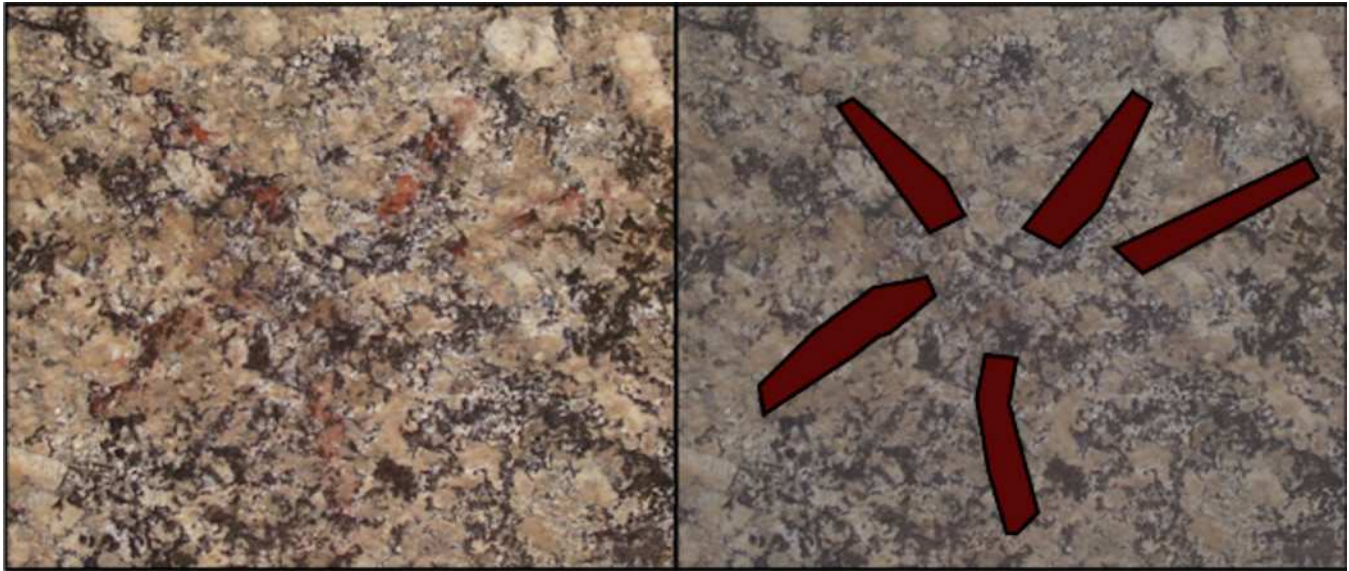


FIGURE 8. Five red ochre rays painted in one of the chamber orthostats of Orca de Santo Tisco, possibly representing the sun or a red star, such as Aldebaran.

WIDER APPLICATIONS

The Mondego Platform

The pattern identified for the Carregal do Sal cluster can now be tentatively extended to other dolmens in the Mondego platform to verify its breadth of applicability. The first such test should involve comparing this pattern to the orientation of the simpler dolmens that do not possess a corridor or passage. By their very nature, it is virtually impossible to measure a window of visibility for such simple dolmens. At best, one can get a crude orientation, which is imprecise in light of the discussion above about measuring single orientations and assuming “axes of symmetry.” This is why they cannot be used to search for any discernible pattern, but one can verify whether they also follow the local trend. In addition, dolmens that include a corridor but whose window of visibility was impossible to measure, for whatever reasons, can also now be checked.

The Carregal do Sal cluster contains several such dolmens that can be used for comparison. Figure 9 shows the reconstructed horizons for these dolmens, their crudely measured orientation marked by a red vertical line. Unfortunately, of these only one has had its entrance clearly identified by its excavators (*Orca 2 do Ameal*). Another was a more complex dolmen with a passage (*Orca da Palheira*), but its window of visibility was impossible to measure due to its present state. Their orientation is toward Serra da Estrela and not far from the rise position of Aldebaran (the vertical blue ribbon). All others inhabit a similar landscape, with the mountain range clearly visible towards the east. Given the importance of this mountain range for Neolithic life, it is possible that these small dolmens also had their entrances oriented toward it, thus following the identified local pattern.

The next step would be to broaden the scale and verify whether this pattern also applies to the isolated dolmens further up the river. Figure 10 shows the horizons of these other dolmens, of both the simple and the corridor variety. As is clear, the pattern

can be extended to include several other dolmens (top four horizons in Figure 10). Even though Serra da Estrela is not visible from the location of three of them, their orientations are still compatible with the Aldebaran interpretation, suggesting the prevalence of the celestial over the topographic in these cases. On the other hand, two others have their corridors oriented just to the south of the rising position of Aldebaran. This seems to imply that these two sites, Orca do Pinhal dos Amiais and Anta de Cortiço (indicated by the arrows in Figure 4), were built either by different communities or with a different intent from the others. This might be too small a sample to suggest the presence of a different pattern, but the windows of visibility of both dolmens would allow sunrise on winter solstice to be observed, as well as the heliacal rise of the belt of Orion around the summer solstice.

Although the Carregal do Sal pattern seems to extend to most of the dolmens in the Mondego platform, it certainly doesn’t cover all of them. This example demonstrates what was argued before: that such patterns in orientation need not apply across wide regions, and thus that the suggested methodological focus on smaller scales is justified.

Iberia and Beyond

The application of this methodology has allowed a previously unknown pattern, which seems to be universal within its cluster, to be identified. Further work will now focus on the application of this methodology to other megalithic clusters in western Iberia. Preliminary results for northern Portugal indicate that at least two-thirds of the already surveyed windows of visibility allowed the rising of Aldebaran to be observed, even in the absence of any topographic features, such as when the view is restricted. The remaining third can be explained as targeting other specific bright stars in the same region of the sky, in or around the modern constellation of Taurus, particularly Alnath (Silva 2013b). On the other hand, topographic alignments are much rarer outside of Carregal do Sal.

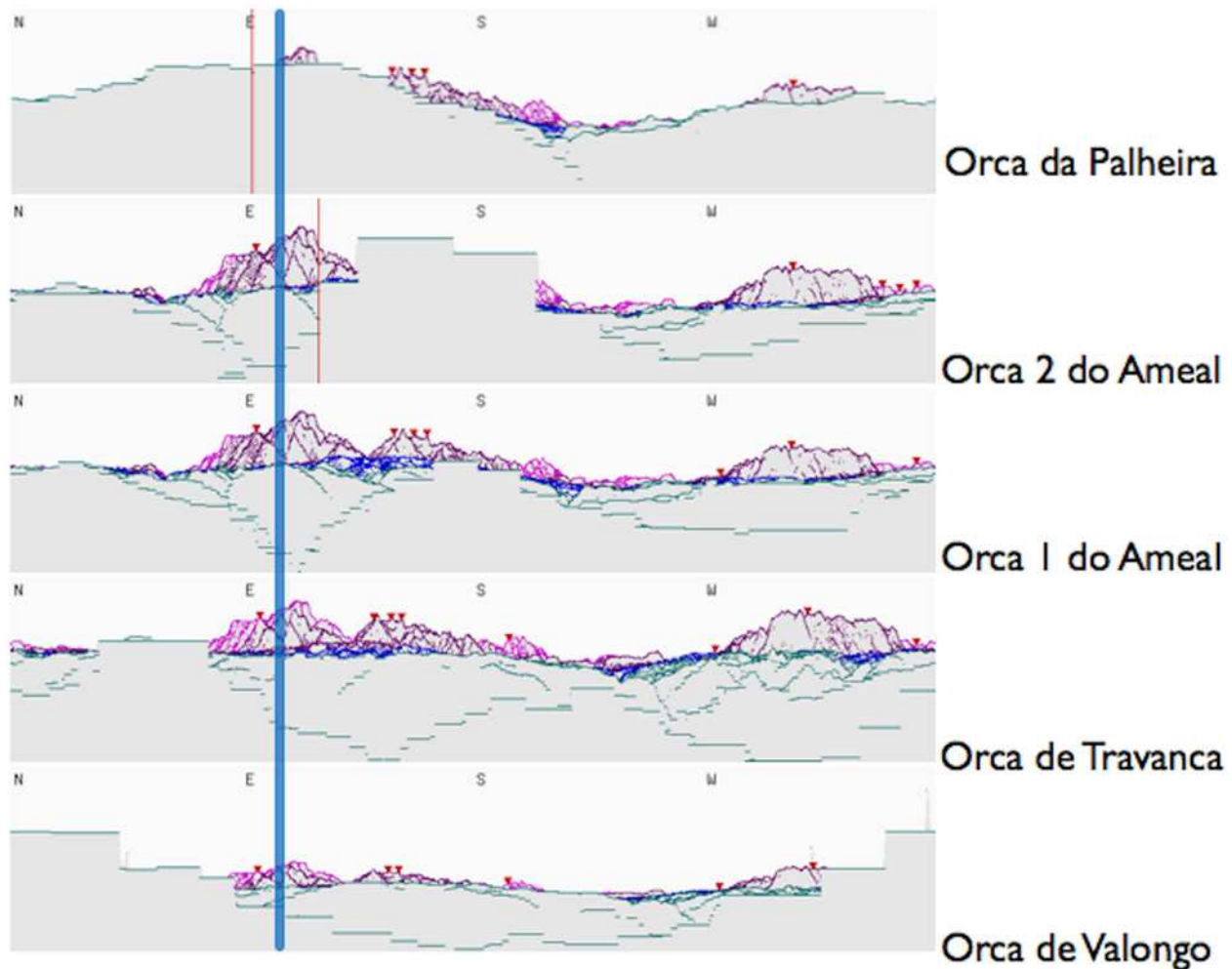


FIGURE 9. The view from the simple dolmens of the Carregal do Sal cluster. The vertical blue ribbon marks the rising of Aldebaran during the dolmen construction period. The red vertical lines indicate the crude orientation of the dolmens. Horizon images are Copyright © 2013 Michael Kosowsky. Used with permission.

Similar approaches that consider not a single measurement of orientation, but a range similar to what has here been called the window of visibility, have been applied to single monuments such as Stonehenge (Sims 2006) and the recumbent configuration of the Tomnaverie stone circle in Scotland (Henty 2014b). It is also important for the exploration of cast sunlight and shadows inside closed structures (Lozano et al. 2014). However, this is the first systematic use of it in the search for patterns among similar monuments. Consequently, this suggests that the methodology presented here has an applicability that extends beyond its present use.

Finally, the identified similarities between folktale and archaeological narrative suggest that at least some present-day Iberian folklore, practices, and beliefs might relate back to Neolithic life. On the subject of the antiquity of folklore, other scholars have already suggested that folktales preserve pre- and proto-historic realities. Flood (1990) has identified correlates for environmental events that occurred at the onset of the Holocene (roughly 10,000 years ago) in Australian myths. Others have found evidence for even older realities in worldwide contemporary and

historic folktales and myths (e.g., Frank 2007; Knight 1991; Witzel 2012). Focusing on Iberia, Espírito Santo (1988), an ethnographer and religious studies scholar, has suggested that most elements of Portuguese folk religion and associated practices date back to proto-historic times, when the Phoenicians settled most of the country (seventh to third century B.C.). Similarly, Evans (1957) has suggested that Irish rural practices and material culture represent surviving vestiges of Neolithic practices. Once more patterns are identified, through the use of this methodology, it will be interesting to see if other instances of the convergence of folklore and prehistoric archaeological narrative occur in other regions of Iberia and beyond.

CONCLUSION

The study of the orientations of European megalithic structures has fallen under one of two archaeological fields. Landscape archaeologists have focused on small scales and taken phenomenological approaches, whereas archaeoastronomers have applied statistical methods to large-scale studies in search

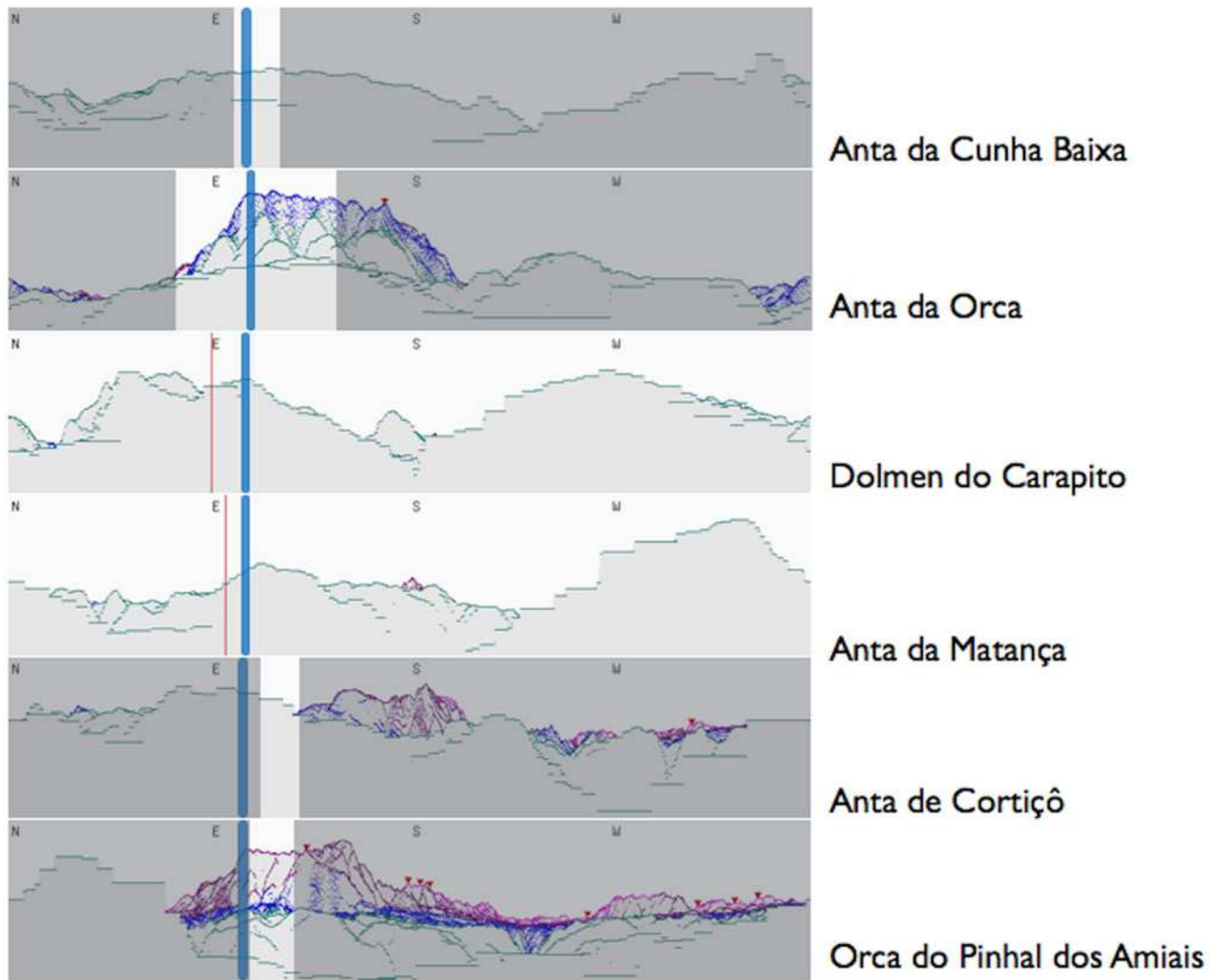


FIGURE 10. The view from other dolmens in the Mondego platform, reconstructed using a Digital Elevation Model. The blue vertical ribbon shows the horizon position of the rising of Aldebaran for each site. Red vertical lines indicate the crude orientation of dolmens without a corridor. Horizon images are Copyright © 2013 Michael Kosowsky. Used with permission.

of broad patterns. Whereas landscape archaeologists have identified local patterns relating the surrounding landscape and topography to the structures, which tells us something about the ideologies of their builders, archaeoastronomers have failed to reach this level of interpretation and value.

This paper has argued for a stronger integration of both fields for a fuller and more balanced exploration and understanding of the orientation of the European megaliths. It has proposed a methodology that addresses this view and that can be easily applied to the study of the orientation of chambered structures with a passage or corridor. The proposed methodology has allowed the identification of a pattern common to all extant dolmens in the case study's region in western Iberia. This pattern was not evident in prior statistical analyses, and therefore the link between these dolmens, the Serra da Estrela mountain

range and the heliacal rising of one of the brightest stars in the sky, has eluded researchers until now. The fact that this interpretation is universal within this cluster, that it fits very well the local archaeological narrative, and also that it seems to have survived in the form of folklore lends support to the employed methodology. In short, and for the benefit of future scholarship, the developed methodology will now be summarized:

- The field methodology cannot restrict, a priori, the data analysis by assuming or presuming modern Western concepts of precision or axis of symmetry unless this can be independently demonstrated. For passage graves, chambered tombs, and dolmens, the measurement of the window of visibility, instead of a single orientation, is recommended.

- b) The analysis of the orientation of structures, both at the archaeoastronomical and landscape archaeology levels, requires the identification of patterns at archaeologically significant scales. Data analysis should therefore begin at the level of the megalithic cluster or necropolis. Only later, and if the evidence supports it, can it be sought at larger, macroscopic, scales.
- c) The interaction between structure, landscape, and skyline should be used to identify said patterns. In the case of dolmens and passage graves, the surveyed windows of visibility, as well as the panoramic horizons, whether photographed (if possible) or GIS reconstructed, help to identify patterns in the way described in this paper.
- d) The interpretation of the orientations should then proceed based on the identified patterns and the wider archaeological context of the structures.

By integrating archaeoastronomical fieldwork with landscape archaeology's phenomenological stance and attention to the wider material record, previously unseen patterns can be identified. By proceeding in this way, the prehistoric monuments, as well as the landscapes and skylines they inhabit, are given a more unified voice in the practice of archaeology.

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Data Availability Statement

Raw survey data collected in the field by the author is already in the public domain in Silva 2010 and 2013a (see References Cited section). Further information can be obtained by request from the author.

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