Scenographies of the ‘Coast of Death’ NW Iberia

Gail Higginbottom^{a,c}, A. César González-García^a, Benito Vilas-Estévez^b, Víctor López-López^a & Felipe Criado-Boado^a

a. Instituto de Ciencias del Patrimonio, (Incipit), Consejo Superior de Investigaciones Científicas (CSIC), Avda. de Vigo s/n, 15705 Santiago de Compostela, A Coruña, España, b. University of Vigo - Pontevedra Campus, Circunvalación ao Campus Universitario, 36310 Vigo, Pontevedra, A Coruña, España. c. *Corresponding author* gail.higginbottom@incipit.csic.es.

(i) GH 0000-0002-1818-7024, <https://csic.academia.edu/GailHigginbottom>

(ii) ACGG 0000-0003-1831-8562, <https://csic.academia.edu/ACesarGonzalezGarcia>

(iii) BVE <https://lamp.academia.edu/BenitoVilas>; <https://www.researchgate.net/scientific-contributions/Benito-Vilas-Estevez-2105318424>

(iv) FCB 0000-0003-4235-706X; https://www.incipit-csic-es.translate.google.es/persona/felipe-criado-boado?_x_tr_sch=http&_x_tr_sl=es&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=sc

Abstract

This paper investigates the extended landscapes surrounding dolmens in the area of Costa da Morte (Coast of Death), Galicia. Having previously uncovered that the megalithic monuments in this coherent area of the south-eastern side of the Atlantic Façade are visually situated in relation to complex topographical variables, we now reveal our investigations into the connections between the chosen topography of these same sites combined with astronomical phenomena. We will see how the detailed shape of the horizon coincides with specific risings and settings of the Sun and Moon, providing further support for the notion that the creators of these monuments selectively drew upon variables found in their natural world that included astronomical bodies.

Keywords: Megaliths, Iberia, GIS models, Landscapes, Cultural Astronomy

Introduction

This paper is part of our ongoing reports on the EU funded project SHoW: Shared Worlds (project no 800236) and we continue in the same region, Costa da Morte, as that for our most recently completed piece (Higginbottom et al., submitted). Costa da Morte is part of Galicia (Fig. 1), located on the south-eastern side of the Atlantic Façade. Our research here focuses upon all of the exposed dolmens within this area.

Background – previous quantitative approaches to horizon choices

Previously, we performed quantitative analyses to confirm whether or not the horizons surrounding the monuments were unique to the location of the monuments and thus possibly chosen by the dolmen builders. For these analyses, we created 2D, 360°-horizon profiles surrounding 31 of our 32 sites in Costa da Morte ($n=31/32$) and the concomitant ascii data files of these profiles. Two sites were essentially located on the same co-ordinate, as one was hidden in the mound of the other, therefore this site was counted only once to ensure that the horizon profiles are independent and we can rely on the

fairness of our statistical treatment. This also ensured that the distances between any of the observed sites was always larger than 750 meters. For the first approach (Analysis 1), we calculated the mean altitude of every one of the azimuths around the horizon for these 31 sites (36,000 azimuth points taken

Figure 1: Map created with LiDAR data of Galicia using the software *Horizon* (<http://mapas.xunta.gal/centro-de-descargas>). Yellow points represent dolmens with little or no earth covering, that is, the mound has been removed via excavation, deliberate damage or weathering. Insert shows the area of Iberia (Google Earth Pro 20-6-2021) and the location of Galicia.

for the creation of each horizon profile built from a digital terrain model with high resolution; Higginbottom et al., *submitted* fig. 5, dashed-line; azimuth is the number of degrees from north and altitude is the value in degrees given to the height of the horizon as viewed from the dolmens or rather angular height measured in degrees). We then calculated the standard deviation of these altitudes and added this to the mean azimuth of the profiles to give us the 1-sigma dispersion of the 31 profiles. The 1-sigma dispersion indicated that there is a larger variation of horizon qualities in terms of altitude (linked to direction) for the western horizons found at our sites than found for the eastern horizons of these same monuments, which are more similar to one another (Higginbottom et al., *submitted* fig. 5). This means that there are likely very high horizons as well as very low horizons in the west, while such variations seem to be smaller in the east. Analyses 2, a K-means analysis, illustrated that there were

unique classes of shared horizon profile shapes or horizon topography found at the Costa da Morte dolmens (as measured by the horizons' directions and altitudes). A second K-means analysis revealed that there were two major clusters seeming to behave as complementary profiles: a close profile to the monument towards the eastern half of the horizon, which gets farther away from the site along the western horizon, versus a profile form that is a further away in the East and relatively closer in the West. These two groups represented the more typical profiles in this region and ($n=24/31$).

For the third analysis, we produced horizon profiles for 320 randomly selected locations within Costa da Morte. We found that the observed profiles of the case-study sites are systematically lower than the random sites' profiles and that profiles are statistically unlike one another for a broad range of directions eastwardly from NE to SE (values systematically lower than $p=0.05$), while for the western part of the horizon the profile is not statistically different from the random sample (Fig. 2). We then repeated the test with all those profiles that explained the majority of data in terms of horizon altitude linked to direction ($n=21/31$) with the 320 randomly selected locations within Costa da Morte. The result was that the profiles are even lower than for the previous test and the statistical significance was greater for both eastern and western horizons, indicating specific ranges that are significantly different from random sites in Costa da Morte (Fig. 3). It also became evident that the remaining two clusters as a single group ($n=10$) did not differ significantly from the random horizon in terms of altitude and direction. We then looked at all of the sites in terms of horizon distance and direction again through the application of K-means cluster analyses. We then combined the two clusters that explained the majority of the horizon populations and compared these to the random sites ($n=24/31$). Interestingly, many of these 24 sites were not the same as the previous 21 sites. Suggesting that, whilst some sites may not have been different in terms of horizon altitude linked to direction, they may have still been different in terms of horizon distance connected to direction compared to the random sites. Overall, our results demonstrated that for the majority of sites in Costa da Morte particular horizon qualities were sought and the choice of location determined this (Higginbottom et al., *submitted*).

We also noticed other possible qualities of these profiles. The average profiles of the observed sites show fairly symmetrical topographical features which centre on east and west. Further, these topographic features appear to constrain the entire range of solar sunrise & sunset along them. *However*, these last two qualities were not *specifically* tested for. This indicated to us 'the *possibility* to investigate whether or not such topographical features actually occur at individual sites, and whether or not they contain the area for the entire solar sunrise range in the east and west' as seen on the average profile ranges (Higginbottom et al., *submitted*)

Figure 2: Top panel, random (solid) and observed (dotted) mean horizon profiles of the exposed dolmens in Costa da Morte. The lower frame shows the statistical significance. In this same frame the dashed horizontal line shows the value of $p=0.05$. Black dashed vertical lines indicate the cardinal directions. From left to right the yellow lines are: Sun rise at the summer solstice, equinox and winter solstice: then the Sun set at the winter solstice, equinox and summer solstice. After Higginbottom et al *submitted*, fig. 11.

Figure 3: Top panel, random (solid) and observed (dotted) mean horizon profiles, where the observed are the combined profiles of Clusters 1 & 4 from the K-means test for horizon height & direction ($n=22$ sites). Vertical lines as for Fig. 2. After Higginbottom et al *submitted*, fig. 12..

Other studies that have focused on astronomical qualities of Galician dolmens have been carried out by Vilas-Estévez et al. (in preparation), Vilas-Estévez (2015, 2016) González-García et al. (2017, 2019) and González-García (2018). These studies predominantly concentrate on dolmen orientations. Vilas-Estévez (2015, 2016), in particular, demonstrated that 17/25 of A Coruña's dolmens with measurable orientations, came from Costa da Morte and that these orientations clustered together in azimuth, located to confined areas of the 360-degree horizon. The orientations are systematically facing the eastern side, and more specifically a narrow sector ranging from east to winter solstice (WS) sunrise, and a fraction after this (Fig. 4). González-García et al's works (2017, 2019), include the consideration of an individual site from Costa da Morte, Dombate, highlighting that there was a complex system of relations making this monument part of a cultural landscape which included the connection between the dolmen's orientation and sunrise during the period of WS.

Figure 4: Polar plot with the orientations for the 17 Costa da Morte dolmens.

With such support for possible interests in dolmen orientations, along with our *distinctive and shared properties* of dolmen landscapes that include possible astronomical qualities, we deemed it necessary to examine the matter of coincident properties of landscape shape and astronomy for the dolmens of Costa da Morte, in particular for those sites from which it was possible to obtain an orientation, using a number of different strategies.

Method background

Our previous geographical area and associated dolmens choices were adopted from the mamoa or mound clustering models created by Carrero-Pazos & Rodríguez Casal for Galicia (2019: figs. 6A&B), which used a Kernel density analysis to determine the level and form of clustering of all known mounds in Galicia, to create a map that illustrates core areas of this monument clustering (Higginbottom et al., submitted). We chose the cluster in the most NW corner of Galicia from fig. 6B (Carrero-Pazos & Rodríguez Casal for Galicia 2019). This is a satisfactory form of model to apply because all dolmens in Galicia are associated with some kind of mound. Further, in the cases of formally excavated burial mounds, it is very rare that they do not have a stone chamber (eg San Cosme excavated by Cesar Parcero-Oubiña), though there are a few that have a single stone in the centre; sometimes only a pit (P. Mañana Borrazás *pers comm* 19/11/2021). However, for some mounds damaged or destroyed in the past, it is difficult to know if the stone has been looted or if it was originally a pit. There is no work that discusses the state of play in this regard, but Criado-Boado postulated that at least 80% of mounds are likely to have a dolmen (Criado-Boado, *pers comm* 22/11/2022).

To determine the periphery of our case-study area, we modelled the river catchment zones in this area (Fig 7; Higginbottom et al., submitted; fig. 2). The underlying assumptions of this are:

areas where water is captured and maintained within and by the natural environment could potentially be considered as viable areas for human congregation and habitation, and megaliths would be a kind of territorial marker as they tend to locate *close to the watershed edges*, in areas with high visibility (Martín-Torres 2001; Carrero-Pazos et al., 2019 in Higginbottom et al., submitted).

We then identified all of the exposed dolmens within this area and these became our monument data base for this study region of Costa da Morte ($n=32$; Fig. 5). We highlight, here, that every site has been visited by at least one of the authors, the majority have been visited by each of us. It was especially important to visit them for us to get a sense of their surroundings and relationships to landscape features and other monuments in the vicinity.

Issues of visibility for our case-study area

In our last paper on dolmens of this region, we discussed the possible visual influence of the surrounding vegetation of the dolmens (Higginbottom et al., submitted). It was demonstrated that those areas of Galicia without mountains or sierra, like Costa da Morte, were likely primarily covered with mixed deciduous forest, dominated by oak (*Quercus*) with a light under-story of shrubs and herbs during the 5th to 4th millennium BC (Kaal et al., 2013: 1522, fig 4). As well as dolmens possibly being erected within these open, deciduous forests, there is evidence for the reduction of forest and the creation of pockets of grasslands at the beginning of the first half of the 5th millennia B.C (López

Figure 5: Pictorial representation of cluster analyses of mounds used for area choice (left) and the final inclusive area after catchment area calculations with monument locations included (right). After Carrero-Pazos & Rodríguez Casal 2019.

Saez et al., 2010), coinciding with the earliest dates we have for dolmens in A Coruña, like Forno dos Mouros 5a (Ua 20009 5635±50 BP, 4590 - 4350 cal BC, 95.4%). Added to these lines of evidence, is the idea that there were also natural open aspects within such forests for about 6 months of the year due to their deciduous nature (late Spring-early Summer), and together it suggests that the horizons were likely visible for at least half the year, and possibly more.

Method

For this paper, we use 17 of our 32 2D horizon profiles previously created as part of our last investigation and their concomitant ascii data files, where 17 horizons equate to 17 different dolmens (Table 1). The number 17 equals the number of sites from which we could obtain an orientation due to their structural indicators ($n=17/32$ sites). Note that 2 of these dolmens have the same horizon profile because they were built within a few metres of each other (Dombate). We also created 17 3D landscape panoramas. These, and the 2D profiles, use the observation point of an individual standing at the tomb. All of these profiles and data were created using the software *Horizon* (Smith 2013).

We note that it can be difficult to observe some differences in the 3D landscapes found herein. To overcome this issue, there are magnified images highlighting various topographical details further in the paper, connected to the appropriate discussion (see Fig. 16) and all of the 3D landscapes will be made available separately online as open access files. We also created 17 simple viewsheds as viewed from above the location and a second, more complex, version of these. All of these outputs were created as described below.

Dolmen Name	UTMX	UTMY
Dombate New	502487	4781930
Pedra Moura do Monte Carnio	501803	4769844
Dolmen Arca da Piosa	501573	4765872
Mina de Recesindes	494026	4777221
Mina Folias	494309	4774664
Mina d'Aquela banda	493685	4776030
Pedra da Arca Malpica	514780	4793766
Dombate Antigo	502487	4781930
Anta da Gándara de Baiñas 1	500077	4762161
Pedra Cuberta	501256	4770760
Pedra da Arca de Regoelle	498823	4761922
Casota de Freans	492966	4766132
Arca de Rabós	498363	4764983
Necropole das Caxadas	496334	4769533
Fornela dos Mouros	499409	4779427
Mina da Parxubeira	505178	4754164
Dolmen de Cabaleiros	536590	4771671

Table 1: Site list of 17 monuments with orientation [UTM (N29)] locations in our broader Costa de Morte study.

Horizon profile construction

The primary aim of the software *Horizon* is to combine topographical data with atmospheric and astronomical calculations to produce accurate two and three dimensional landscape information to aid archaeoastronomical surveys and data analysis (Smith 2013). This includes the ability to create 2D horizon profiles and rendered 3D landscape panoramas for each site, along with an *ascii* data file containing calculations of the distance and direction between the point of origin or monument to paths of astronomical phenomena like the sun on the longest day and the shortest day along with all points on the horizon and the altitude of each of these horizon points measured every 0.05 of a degree. Apart from the location, *Horizon* allows you to choose epochs (dates) and astronomical phenomena. We have chosen to map the Moon at the times of its most extreme rising and setting points in its cycle, as well as the solstitial rising and setting of the Sun, and the equinoctial points, onto the landscapes.

Monument orientations

We obtained the list of the directions of the dolmens' corridor or entrance axes (not all tombs are made with corridors). These dolmen orientations were measured in the field from magnetic north (azimuth) and corrected to True North readings by Vilas-Estévez (2016: 41), 2017; Table 2). Vilas-

Estévez, had to use different methods of measurement in accordance with the dolmen's original construction or remains, such as Method "D", where dolmens without a corridor (original construction or through ruination), were measured from the middle point of the backstone and the middle point of the chamber's entrance; for those with a corridor, he took the middle point of the backstone and the middle point of the entrance corridor to create and measure the axis line (Method A). Method "B", in dolmens without a backstone, he took the middle point of the chamber and the middle point of the corridor. These measurement approaches can produce differing results when applied to the same dolmen. For instance, for the *Dolmen Rego da Murta (Alvaiazere Portugal)*, Vilas-Estévez found a 7.5° range between D and B, with A being 2.5° from Axis D and 5° from Axis B (2016: 42, fig. 7). An alignment, therefore, is made up of the defining physical characteristics from which we can measure an orientation, like 'the middle point of the backstone and the middle point of the chamber's entrance'.

Furthermore, if we consider using Method A as the axis of symmetry for dolmen Dombate in Costa de Morte, the size of its corridor and width indicates that the window of observation of the corridor entrance as seen from the back stone is $7\frac{3}{4}^{\circ}$ (González-García et al., 2018: 334). This viewing position along the axis of symmetry, was considered for the possible purpose of illuminating effects *within* the dolmen by González-García et al., 2018, but it can also direct the viewer at the back stone to a particular view of the outside world. Nevertheless, González-García et al., 2018 explain that, depending on the orientation and shape of the megalithic structure, natural light could penetrate the dark inner areas, creating different illumination effects. So whilst entrances appear wide they are also restrictive and the window of observation (looking out) becomes the window of illumination ('looking' inwards), where particular areas of the interior of the megalith could be illuminated on several days, whilst other parts remain in shadows and darkness. Indeed, perhaps 'the illuminated part ... (is) made special by the use of light inside the monument (César González-García et al., 2018: 332)'. For Dombate, the illumination would occur for one month before and after the rising Sun at the winter solstice within clearly defined areas within the tomb, as indicated by the interior painted decoration.

Arising out of this discussion directs us to consider a possible plausible level of accuracy for dolmen orientations of $\pm 4^{\circ}$ if the purpose might include illumination of the back stone(s). If such illumination is not the (only) purpose, such as a clear alignment with an astronomical body as dictated by a ritual obligation or constraint, then the integrity and potency of such an orientation is likely connected to its precision. Here orientations with an accuracy within $\pm 1^{\circ}$ might be expected. However, given the state of some of the dolmens today and possible error margins of equipment use and so forth, as discussed in César González-García et al. (2018: 333-334), orientations with an

accuracy within $\pm 2^\circ$ are required for it to be categorized as one that is ‘constrained’, for this paper. Therefore, orientations will be categorised as ‘illumination’ orientations or alignments only where they are greater than $\pm 2^\circ$ and less than or equal to $\pm 4^\circ$ from an astronomical target, to distinguish them from those possibly containing stricter orientation constraints.

Data for 2D and 3D *Horizon* creations

For this project, we use a be-spoke version of the software *Horizon* to create our horizon profiles. It was created to use 25m and 5m LiDAR data made freely available by the Galician Xunta (<http://mapas.xunta.gal/centro-de-descargas>). These data had to be converted and tested for use with this version of *Horizon*, by the software engineer and designer of the program, Andrew Smith (University of Adelaide; Smith 2013).

The creation of the 2D and 3D landscape panoramas was done by merging different elevation data sets: 5m data extending out from the viewing point to 2.5km, after which it is replaced with 25m data to speed up the processing time. Then 90m STRM data are used to fill all the areas not covered by the LiDAR data. These 3D landscape panoramas are essentially 360°-viewsheds created from the eye-height of 1.5m above local ground level. As *Horizon* also has the capacity to add a variety of astronomical paths to the 3D landscape panorama output, we used this to create sky-landscape panoramas with paths of the Sun and the Moon. In particular, those connected to their extreme rising and setting points on the horizon (solstitial paths and the Moon at the major standstill), along with those closest to the equinox for the Sun and to the minor standstill for the Moon. We then added the dolmen orientations as a layer to these created 3D sky-landscape panoramas, to investigate any possible coincident occurrences of landscape shape, astronomical bodies and orientations. We made a note of the number of degrees in azimuth that each orientation was from the possible target along the horizon for each monument.

The Polar plots

We used the ascii data of our horizon profiles created by *Horizon* to make our ‘God’s-eye’ viewsheds in the form of polar plots and layered onto these the relevant monument orientation. This was done using the software IDL. We created two types of polar plots. The simpler version included the entire viewshed up until the furthest point seen from each monument location. Thus the outer circle of these polar plots will equate to a different distance for each monument. However, for the second polar plots, the outer circles all equate to the same distance of 10 km and allow us to see the shape (volume in terms of distance and direction) of the viewshed closer to the monuments more clearly. The second polar plots also include the shape of 2D horizon-line derived from the DTM (*Horizon* software, see above), which represents, of course, the farthest points seen.

Analyses and outcomes

2D *Horizon* Profiles and solar ranges

By examining the individual dolmen 2D horizon profiles of our 17 sites we can now confirm that there are fairly symmetrical topographical features for the majority of sites which *centre* on cardinal east *and* west and clearly drop off towards the north and south (Fig. 6). There are 8/17 sites like this and also 7/17 sites that centre on cardinal east *or* west, most often with the opposite side of the horizon containing a half ridge, for instance spanning from the south east to just past east. Also, for the majority of sites, the eastern horizon is statistically shown to be lower than the western for all of the confirmed dolmens in Costa de Morte (n=32; Higginbottom et al., submitted). These topographic features were often visible in the field (see Fig. 7 – Pedra Cuberta).

In archaeoastronomical terms, we can also confirm that for those sites with eastern and western ridges that they coincide with the ranges for the solar sunrise and sunset, respectively. In fact, the solstitial points appear close to the flanks or edges of the highest horizon elevations in these directions and the central position of these eastern and western ridges tends to coincide with cardinal east and cardinal west – near the equinoctial points of the Sun (Fig. 7). Here we can clearly see that both the landscape and the astronomy emphasize each other.

Figure 6: Six 2D Horizon Profiles illustrating the ridges or higher profiles that usually appear along the horizons in the east and west for the majority of our sites in Costa da Morte: Cuberta, Dombate, Pedre da Lebre, Pedra Moura do Monte Carnio, Pedra da Arca de Regoelle, Casota de Freans. For the first three of these sites we have added the angled paths of the Sun *for each specific location* layered on top and we can see how the eastern & western ridges coincide with the ranges for the solar sunrise and sunset, respectively. Here the *general* pattern is for the solstitial points to appear close to the edges of the higher horizon elevations. In the NE & NW is the path of the Sun closest to the SS, In the east, the path of the Sun closest to the Equinox; IN the SE

SW the path of the Sun closest to the WS. n.b. Lebre does not have a measurable orientation and is added purely as another example of this horizon pattern found in Costa da Morte.

Figure 7: The eastern ridge in front of Pedra Cuberta. Photographer Gail Higginbottom.

Polar plot viewsheds and individual orientations

The simpler polar plots of the complete viewsheds seem to indicate that, regardless of the direction of the most open and distance views, the orientation of nearly every tomb faces the closer rather than the most distant horizons (Fig. 8). So views towards the most distant landscape are not the priority from the chamber, corridor or the front of the monument in line with the orientation, with only 2/17 having clearly distant horizons: Fornela dos Mouros and Pedra de Arca Regoelle. Also, overall, the majority of the horizon surrounding each dolmen tends to be relatively close. This was something we also noticed in the field, but couldn't initially confirm as the horizons were often blocked by closely grown forestry plantations. Using horizon distance plots, we found that 13/17 sites have more than half the horizon less than 3km away for a length or range of 185-320° out of the entire 360°, with their most distant horizons ranging from 17-52km. Of these, 8/13 have a most distant horizon greater than 28 km and 11/13 sites have more than half the horizon less than 3km away for range of 200-320°. Of the 4 sites which had less than half of their horizons at less than 3km distant, their most distant horizons reached 80km, though, as with the sites above, they did not have a great degree of their horizons more than 10km distant (ranges varied from 30°-90°). The polar plots in Figure 8 are an invaluable tool for the comparative conceptualization of these overall distance patterns surrounding the dolmens. However, the maximum distance of each of these simple polar plots constrains and designates the outer rim of the plot such that we lose detailed visual information of the behaviour of the closer horizons. For this reason, we also created a second form of viewshed polar plot that somewhat disregards the full distance information of the most distant horizons for each site, but indicates the shape of the horizon profile related to altitude (curved line on the outer part of each plot). In this way, we have a better sense of horizon distance connected to horizon altitude and more detailed comparative distance information of the closer horizons (Figs. 9-11). In this way we can also observe potential patterns between sites more readily, which can

Figure 8: Simple viewshed polar plots for every single monument that has an orientation. The viewsheds have been loosely ordered, from the more distant northern views first then moving to an easterly focus to south, then west and the north. The orientations have been layered onto these plots in red.

Figure 9: Panel 1 of second group of polar plot viewsheds with orientations. The undulating outer circles indicate the shape of the horizon profile related to altitude and the dashed lines in the SE quadrants represent the orientations of the chambers or corridors of the dolmens.

Figure 10: Panel 2 of second group of polar plot viewsheds with orientations. The undulating outer circles indicate the shape of the horizon profile related to altitude and the dashed lines in the SE quadrants represent the orientations of the chambers or corridors of the dolmens.

Figure 11: Panel 3 of second group of polar plot viewsheds with orientations. The undulating outer circles indicate the shape of the horizon profile related to altitude and the dashed lines in the SE quadrants represent the orientations of the chambers or corridors of the dolmens.

10. Dombate (New) 3000 BC MCP

Figure 12: Full 2D graphic of horizon information for the site of Dombate. Top section denotes profile shape and altitude of the horizon. Bottom section denotes the concomitant horizon distances for each point on the horizon profile (A. G. K:Smith 2013)

be confirmed by a close study of the 2D profiles and their data (Figure 12). These polar plot viewsheds have been ordered according to the orientation groups (i.e. orientations of the dolmens). The first panel groups those with orientations between 95° and 105° (Figure 9). The second panel includes dolmens with orientations between 105° and 115° (Figure 10) and the final panel those with orientations greater than 115° (Figure 11).

In the first panel, it is interesting to notice that all dolmens seem to face a relatively close eastern horizon, with the exception of Mina das Folias. Therefore, the general pattern observed for the simple polar plots seems to occur here, with the majority of sites having orientations towards closer horizons rather than those that are the most distant. Whilst 4/5 of these eastern horizons associated with orientations are less than c.1.2 km away, most of these are not *the closest horizon ranges to the monuments*, and for Parxubeira and Pedra Cuberta, west is the closest horizon.

Moving onto the second panel, there seems to be a transition from close eastern horizons to those that are more distant, the majority of which are further than those found in the west. In this panel, four of the six dolmens have orientations towards, or very close to, a break in the horizon distance: this is clearly seen in Recesinde where the orientation of the dolmen coincides with a sharp jump in the distance profile. Four out of six horizons, in the directions of the orientations, are less than 2.2 km distant, but Recesinde is on the exact cusp of 0.38 km and 5km. Dramatic shifts in horizons distances occur clearly only once in panel 1, Arca Piosa, though the orientation of Mina Folias is also close to such a shift. The western horizon is overall closer than the eastern for all of these sites.

The qualitative description found in the second panel is reinforced in this third group, with 3/6 monument orientations right on the cusp of a dramatic shift in horizon distance, from close horizons to clearly further distanced ones. Using Pedra de Arca Malpica as an example, this dolmen was found to face a horizon that is only 900m distant, with a dramatic shift just c. 0.2° to east of this point of c. 6.5 km. Four out of six (4/6) have closer horizons in the west. Five out of six horizons, in the directions of the orientations to the east, are less than 3.5 km distant, starting at 0.95 km, and 1/6 is greater than 10 km distant). For 2/6 sites, east is the overall closer horizon.

Noticeably, only one tomb (Fornela dos Mouros) is clearly aligned along the direction of the immediate slope in the downward direction of the surrounding land, and it was facing a very distant and open horizon (Fig. 13) whilst the rest are positioned across the down slope. Only three sites (3/17) are oriented towards horizons greater than 4.5 km and these fall between 10.3 and 14.7 km.

Figure 13 - Fornela dos Mouros facing the downhill slope. Photographer Gail Higginbottom.

Viewing individual orientation targets on the 3D landscape panoramas

These are the results of the visualization assessments of individual orientations clarifying both the target area and the situation of each orientation in terms of horizon position. We do this by checking the azimuth of each orientation and examining its position on the models, remembering that the azimuths for the entire horizon are marked out on each model (Figs. 14 a-q; where Fig. 14a labels the paths of Sun and Moon seen on all of the Figure 14 images).

Orientation targets - looking out to the east (Figure 14, Table 2)

It is to be remembered that all of these orientations sit within a specific clustered arc running approximately E to SE on the horizon. On examination of the 3D landscape panoramas, we can confirm that four dolmens (4/17) are aligned to within 4° of the event of the rising Sun at the WS, with the great tomb of Dombate being within 1° of accuracy (Fig. 14; Table 2). However, the orientation targets of two of these tombs, Pedra da Arca de Malpica and Caxadas, (Fig. 14; Table 2) sit between the Sun at the WS and one of the foremost Moon targets. Specifically, Pedra da Arca de Malpica is 2.2° in azimuth from the Sun's position and only 3° from the Moon at the time of the minor standstill (also referred to as the minor lunar standstill, MinLS), and Caxadas, 2° from the Solstitial Sun and 4° from the Moon (MinLS). Most of these orientations sit to the north of the winter rising Sun at the solstice, and one to the south. Only one other tomb in all of A Coruña also faces the rising Sun at the WS: Forno dos Mouros (121°N, 2.3° south of the rising WS Sun; supported by González García et al., 2017).

Our landscape model assessments show that there are a further five out of 17 sites (5/17) are within 4° of the MinLS, with two of these four (2/4) are precisely on target (Gándara BaiSas, Aquela Banda; Table 2). This gives a total of seven with some kind of focus on the Moon around the time of the MinLS.

There are also five monuments within 4° of the Sun rise closest to the equinox, ranging from 1° to 4° away from the exact location on the horizon (Parxubeira, Pedra Cuberta, Arca da Piosa, Mina de Folias and Cabaleiros). Finally, we have two sites whose orientation sits *exactly* mid-point between the equinox sunrise and the WS sunrise. With both sites in quite different geographical locations, it is interesting that both orientations 'sit square-on', with the equinoctial and solstitial points exactly 12° either side (early farming almanacs and cultural celebrations mark these solar days, these we now call cross-quarter days).

In sum, we have 8/17 constrained orientations (3 lunar, 5 solar) that are within 2° of a target as well as two dead-on solar cross-quarter targets (2/17), so potentially 10/17 constrained targets (we have included 2.2°, Pedra da Arca Malpica). We also have six individual illumination orientations (6/17; 2 lunar, 3 solar). What is of some fascination is that two of the constrained solar orientations from the first group come from monuments that also have lunar illumination orientation, because the orientations sit between the Sun at the winter solstice and the Moon at the time of the Minor standstill Pedra da Arca Malpica & Caxadas). We note that there is one orientation 4.6° away from the Moon at the lunar standstill (1/17).

Dombate Antigo & Recent (x2)

Pedra Cuberta

Mina da Parxubeira

Casota de Freans

Pedra Moura do Monte Carnio

Mina de Recesindes

Necropole das Caxadas

Fornela dos Mouros

Arca de Rabos

Pedra da Arca de Regoelle

Gándara de Baiñas

Arca da Piosa

Mina Folias

Mina daquela banda

Dolmen de Cabaleiros

Pedra da Arca de Malpica

Figure 14 a-q: 3D landscape panoramas of sites with orientation measurements taken from chambers or corridors (towards the east) indicated by vertical lines on the right, the orientations in the opposite direction indicated by the vertical lines to the left. The first image contains the labels of the paths of the Sun and the Moon at significant times in the cycles of these bodies in order to understand the images that follow. The next 11 have closer western horizons and the last 5 have a close eastern horizon. Dombate has two orientations as there are two dolmens at the same location with different orientations. Software and 3D landscape created by Andrew Smith. Based upon the Ordnance Survey 1:50,000 Landform PANORAMA map with permission of the Controller of Her Majesty's Stationery Office © Crown.

Name of dolmen	Most close horizon (east=Grp 1; west Grp 2)	Azimuth of dolmen orientation	Topographical descriptive position of orientation	Distance Horizon in direction of orientation Approximate distances read off plots using top of the plotting line	Possible Target Time	Degrees from phenomena in azimuth	Opposite Azimuth of dolmen orientation	Topographical position of orientation	Possible Target Time	Degrees from phenomena in azimuth
Arca da Piosa	East	95	2° from small notch , & base of trough (centre), Equinox bottom of same trough	0.65	Equinox	3	275	Top of hill (nearby edge of slope)	Equinox	5
Prado de Mina – Mina de Folias	East	94	Top of small mountain peak , RHS of also Equ Sun (edge of slope, but a body would be on the peak as well))	4.5	Equinox	2	274	Possibly seen to set into sea (depends on atmospheric refraction on the day), but the body would be seen to set towards the change in slope). The Equinox sets on the other side of this same hill into the sea (above top of range).	Equinox	3
Dolmen Cabaleiros	East	92.5	RHS slope of most distinct eastern mountain (mid-slope of this angle)	0.46	Equinox	1	272.5	Top of small peak/hill , north of the Sun at the Equ	Equinox	2.5
Pedra Cuberta	West	98	Little hillock Top edge of change in slope	1.2	Equinox	3.8	278	Close to top of hill (but also mid-mild slope)	Mid-point SS set & Equ	16.1 & 18 either side c. 1° from midpoint
Parxubeira	West	97	Marks out distinct Nth slope , Near beginning of Est range	0.68	Equinox	4	277	Near base of RHS of hillock; Near base of slope, small notch in horizon West Equinoctial Sun near base of LHS of same hill	Mid-point Equ & MinLSn	13 & 12.5 either side
Casota de Freans	West	110	Change in slope	2.2	Mid-point WS & Equ	16.2 & 17.1 either side 0. 5° from midpoint	290	Exactly mid-slope (5 fr SS set)	MinLSn	1.5 (5 fr SS)
Dombate Antigo	West	110	Base & centre of trough	2.2	Mid-point WS & Equ	15.8 & 16.9 either side 0.5° from midpoint	290	Minor change in slope. Edge of plateau	MinLSn	1.0
Casa Dos Mouros – Pedra Arca Regoelle	West	112	Small notch (edge of notch)	0.5	MinLSs	4.6	292	Base of tiny hillock, centre of shallow trough	MinLSn	Dead-on
Mina de Recesindes	West	115	Small peak but can only be seen at zoom of 300% which is closer to real vision in the field; lower end of slope	0.5 (closest of two distances on cusp of break in horizon)	MinLSs	4	295	Mountain top, the phenomenon is halfway up the same side of same mountain	MinLSn	0.05
Anta da Gandara de Baiñas (BaiSas)	West	117	Near base of slight trough	14.7	MinLSs	Dead-on	297	Base of angular slope	Midpoint?	MinLS (4) SS set (5)

Name of dolmen	Most close horizon (east=Grp 1; west Grp 2)	Azimuth of dolmen orientation	Topographical descriptive position of orientation	Distance Horizon in direction of orientation Approximate distances read off plots using top of the plotting line	Possible Target Time	Degrees from phenomena in azimuth	Opposite Azimuth of dolmen orientation	Topographical position of orientation	Possible Target Time	Degrees from phenomena in azimuth
Pedra Moura Carmeo (Carnio)	West	117	Tip of Slope, right edge of a small plateau (=change in slope)	2.2	MinLSs	1.5	297	Midpoint btw hill (E) and hillock at 325.	MinLS set	Between MinLS (2) SS set (5)
Aquela Banda	East	124	Mid-slope of horizon/ridge, behind centre of valley floor	0.7 (closest of two distances on cusp of break in horizon)	MinLSs	Dead-on	304	Beginning/Top of Distinct slope of hillock (close to change in slope)	SS set	0.02
Caxadas	West	124	Near edge of slight slope	1.0	WS rise	Between MinLS (4) WS (2)	304	Edge of slope	SS set	1.0
Rabós M1	West	120	End of mountain range? Base of basin	3.5	MinLSs	3	300	Near base of slope	SS set	0.05
Dombate New	West	126	Centre of small plateau –basin-shaped ?	0.95	WS rise	1	306	Top of hillock	MajLS	Dead-on
Pedra da Arca Malpica	East	122.5	Edge of change in slight slope , Sun comes out at the very low change in slope.	2.4	WS rise	Between MinLS (3) WS (2.2)	302,5	LHS bottom /base of slope of distinct close peak/hill in NW	SS set	1.5
Fornela dos Mouros - Aprazadoiro	West	128	Base of slope	10.5	WS rise	Between WS (2.6) MajLS (5.4)	308	Top of hill behind tomb	N/A	X

Table 2: Lists of sites with eastern & western orientations and their concomitant topographical positions along the horizons. The topographical information was gained using the 5 m, 3D panoramic landscapes. MinLSs=Rising Moon at the minor standstill in the south; MinLSn=Setting Moon at the minor standstill in the north.

Targets in the west - the other side (Figure 14, Table 2)

Considering an idea of Belmonte, that researchers should contemplate investigating landscape features that may indeed be in the *opposite direction of the corridor or tomb opening*, such as mountain peaks that are essentially siting 'behind' the tomb (Belmonte 1999: 52-57), we consider the idea of astronomical targets in the opposite directions of our eastern orientations (Table 2; Fig. 14). If we consider the two forms of error windows as we did above, we find that we have in total 15/17 western targets hit compared with 16/17 for the orientations facing outwards from the monument towards the east. So nothing yet distinguishes these east versus west orientations until we begin to consider other issues.

Most notably, in the west we have 10/17 constrained targets (6 lunar, 4 solar) that are within 0-2° of target as well as two mid-targets (2/17): one a solar cross-quarter target (Pedra Cuberta) and possibly the Moon between the time of the Spring Full Moon (near/at the time of the equinox) and the Moon at the MinLS or the Sun between the time of the equinox and MinLS (Parxubeira). So essentially there are 12/17 constrained orientations. We have three illumination orientations (3/17), two at the time of the Equinox (2/17; +/- 4°; Cabaleiros, Mina Folias) and one at the time of the Moon at the minor standstill (1/17; Gándara). For the sake of thoroughness, we note that there are also four sites that are within 5° of the Sun. The three closest to the solstice setting are from the same alignments for the constrained (2/3, Casota de Freans, Moura Carneio) or illumination (1/3, Gándara) lunar orientations mentioned above. The fourth has an individual orientation towards the western equinoctial point (1/17). There is also a site whose western orientation faces the top of the hill behind tomb, but it out of the solar and lunar ranges (1/17; Fornela dos Mouros).

More specifically, for the westerly orientation targets, four of the possible constrained orientations (4/12) are within 0 to 1.5° of the Sun at the SS setting, four (4/12) are within 0° to 1.5° of the setting Moon at the MinLS and one within 2° (1/12), and one orientation within 1° of the Moon setting closest to the extreme lunar standstill in the north (major standstill; 1/12). The two midpoints: are 0.5° away from their mid-point targets (2/12).

Targets - west versus east - Table 2

Whilst not statistically determined, the fact that there is a higher number of constrained orientations which 'hit' targets towards the west with a greater degree of precision ($\pm 1.5^\circ$) than towards the east is very intriguing: 9:5, and when we go to 1° or less it becomes 7:4. If we count the midpoints mentioned above, it would be 11:7 for $\pm 1.5^\circ$. So, essentially the constrained orientations in the west appear more accurate.

Target discussion

Clearly there is a variety of orientations in both directions, but significantly they cluster within just a few groups which have narrow ranges of about 5° in azimuth and are thus tightly contained, especially

given that there is a choice of the entire horizon measuring 360° (Fig. 15). There appears to be a greater accuracy of orientation to the west. To some extent, what some of the actual targets are is still an issue of uncertainty, yet we are drilling down closer and closer to an answer and there is a possibility that some alignments may well be created for both solar and lunar orientations, sometimes where one is constrained and the other is more likely for illumination, especially in the east. In the

Figure 15: Polar plot of orientations with azimuths in the opposite direction located on the western horizons.

west, using our criteria, only a single site contains an alignment towards the Sun and the Moon using our pre-defined criteria and both of these are categorised as an illumination form (Gándara BaiSas). In the east, on the other hand, there are three sites like this, plus seven sites with individual illumination orientations towards the back stone(s). Perhaps, too, for the two sites with orientations that miss the Sun or Moon targets by more than 4°, there was a consideration of the opportunity for light to still enter the dolmen chamber or corridor, where the essential purpose was not a focus the backstone. One of these two already has a solar illumination orientation.

Interestingly, in our initial examination at least, tomb form cannot be linked to a specific astronomical focus. So whilst it is *possible* that the three great tombs of Dombate, Pedra da Arca Malpica and Caxadas have a solar reference in the SE (WS), two of these include a possible lunar focus (Table 2). Other architecturally similar tombs also seem to lack a similar definitive astronomical focus, for instance: Casa Dos Mouros (Pedra Arca, Regoelle) = unknown but within 5° of the MinLS. Also, the Sun at the Equinox has been considered an unlikely target for prehistoric cultures north of the equatorial regions (Ruggles 1999), so if the illuminative qualities of this Sun is not the point, what might be the focus of Pedra Cuberta (4° south of the Sun at the equinox) and Arca da Piosa (2.8° south the equinox). However, we do note that Pedra Cuberta and Parxubeira have close structural

similarities and both face the same direction (their azimuths are almost identical, 98° and 97° respectively, and both are essentially 4° away from the rising Sun at the equinox). It is possible that differences in tomb structure are hard to perceive and a much closer study is intended to relate form to other dolmen qualities along with orientations in these monuments. As an addendum to this topic, we would add that Prado de Mina (Mina de Folias) and Anta Zarramaceda o Derramadas (the latter of which we find in another area of Coruña, namely Santiago), are of similar type - small polygons with small corridors, yet one faces the Sun at the equinox and the other dead-on the Moon at the MinLS, respectively.

Despite these uncertainties at this point, we have more of an idea of what people could see from the dolmens. Importantly, given the high number of target hits in the west, we can confirm that this direction appears to have been as relevant as that towards the east. We have also addressed important methodological issues. Yet we still haven't examined the horizon shapes *in detail* and how these details interact with the locations and the orientations of the dolmens.

Landscape features connected to orientations and cardinal points

A study of the *horizon target locations coincident with the 17 orientations* for each site on the 3D landscape panoramas within an image viewer (like Irfan View) show that there are distinct horizon markers for the orientation targets. These markers or topographical qualities are described in Table 2 using sets of key words. The key words that came up for describing the area where the orientations fell on the horizon were as follows: for adjectives or verbs - top, edge, bottom, base, midway, centre, end, change in; for nouns - hillock, hill, mountain (range), plateau, notch, basin, slope and valley.

As local horizon features are too small to view on the manuscript figures some 'close-up' examples of these specific horizon features targeted by the orientations are provided (Figs. 16a – i). For instance, we can see for Arca Piosa, that both cardinal east and the point of the rising Sun at the equinox are located within a wide basin, where the latter is essentially at the centre of this feature (Fig. 16e). The dolmen entrance's orientation lies 3° south of this astronomical point within the same basin. Looking west, the opposite orientation sits on top of a distinct small hill, 5° north of the setting Sun at the equinox (Fig. 16f). Recesindes' western orientation hits the **edge of mountain** top, the upper southern slopes of which contain the setting Moon at the MinLS, this phenomenon sits only 0.05° from the orientation (Fig. 16d). Similarly, Caxadas' western orientation falls at the top of a slope on **the edge of a ridge** or mountain range at 304°, it is only 0.05° from the setting summer solstitial Sun, which is situated half way up the same slope (Fig. 16c). Parxubeira orientation sits at 277° west, near the base of a distinct angular slope (northern side of a hill), which is the exact **mid-point between the setting equinoctial Sun and Moon at the MinLS** (Fig. 16g). **Interestingly, at the base of the** southern side of the same hill sets the Sun at the equinox and at the top of the slope

Figure 16 a-d: A magnified view of sections of the landscapes to observe features that coincide with astronomical phenomena and dolmen orientations (a) Aquela Banda, (b) Carnio, (c) Caxadas, (d) Recesinde. Orientations indicated by arrows.

Figure 16 e-i: A magnified view of sections of the landscapes to observe features that coincide with astronomical phenomena and dolmen orientations (e & f) Arca Piosa – east horizon followed by western, (g) Parxubeira, (h) Mina Folias, (i) Dombate (Antigo & New). Orientations indicated by arrows.

in the north sits the Moon at the time of the MinLS. So the target is the lowest point between the two. For Mina Folias, the orientation target hits the top of a small hill at 94o, to the east, rising out of the slopes of the next small hill, 2o away, is the equinoctial Sun. Finally, Carnio's eastern orientation sits at the top of a slope and is 2° north of the rising Moon at the standstill, which sits at the base of this same slope. According to our results for the horizon shapes (n=32; Figs. 2 & 3; Higginbottom et al., submitted) there seems to be a statistical difference between the horizons of dolmen sites and those of random sites towards the meridional directions (north and south). For the 17 sites with orientations, at least 12 sites have distinct features at cardinal North (Fig 14). Thus, looking at the 3D landscapes we can observe the following: at Cuberta there is a small peak in the north (1); the North at Carnio (2) sits near top of a distinct hill in this direction. For Piosa (3), North sits mid-slope on the eastern side of an angular hill. The point here is that this angular hill dominates the northern horizon. For Pedra de Arca Regoelle (4) and Parxubeira (5), North sits in a notch; at Freans (6), North sits on the slopes close to the top of a mountain; at the site of Arca de Rabós (7), North sits on the northern slopes of the only hill in the north; at Caxadas (8), North sits squarely in a notch which may also include the only view of the sea from our sites in Costa da Morte. Like Piosa and Caxadas, at Mina de Recesindes (9), North is situated on the steeper slopes of the clearest feature in the north and at Gándara de Baiñas (10) north is situated in the centre of a low basin. North as seen from Dolmen Mina d'Aquela Banda (11) and Mina Folias (12) is located on the western slopes of a distinct peak that straddles the cardinal point, where the peak is relatively much further away at the former site and closer and relatively 'larger' at the latter.

Note that this analysis is complementary to that of the circular plots above, where, for instance, the coincidence (or closeness) of the orientation to a 'jump' in the distance, might correspond to an orientation close to a break, valley, notch or slope in the horizon profile.

Horizon distance and dolmen targets – some observations

Here we must remember that in Figures 14a-p, the 3D landscape panoramas have been arranged into the dominant two groups of relative horizon profile patterns: those with the closer horizons in the west than the east first (Group 1, n=12) and then those with closer horizons in the east than the west (Group 2, n=5), following.

The five dolmens of Group 2 (Table 2; Figs. 14 m–q), do not contain any clear mid-point phenomena unlike Group 1 (Table 2; Figs. 14 b–l), and only 1/5 sits closely between two phenomena in the SE (Pedra da Arca Malpica). Looking towards their closest eastern horizon we observe that the monuments are made up of four constrained and two illumination orientations, where one site contains one of each (Pedra da Arca Malpica). Due to astronomical logistics, Group 1 dolmens also do not contain mid-point orientations towards the west. In that direction, two out of five (2/5) have

illumination orientations (Mina de Folias & Cabaleiros) and two that have constrained orientations (2/5, Pedra da Arca Malpica & Aquela Banda).

There are some striking observations for the Group 1 sites when we compare their eastern and closer western orientations. The eastern orientations for these sites are made up of the following: 4/12 constrained or 6/12 if we count the midpoints, and 4/12 illumination, or five if we count Caxadas' possible double purpose orientation. Looking west, on the other hand, including the midpoints we have 10/12 constrained orientations and 1/12 which might have the main purpose of illumination (Gándara). We noticed that, not including the midpoints, seven of the ten orientations were accurate to within 1.5° . So we calculated whether or not the probability of our 12 orientations having seven such precise hits onto one of the possible seven major astronomical targets was by chance (namely, the Sun at the equinox or the two solstices, or the Moon at the time of one of the four standstills – no midpoints were included). Using the probability formula offered by Ruggles (1999: 42), we found that the likelihood that these 7 hits were due to chance was 0.0096, indicating that their appearance was unlikely due to chance factors.

As the numbers are rather low, we understand that we should take care in interpreting this statistical result and use it rather as a possible guide or indicator, for the outcome might change if in the future new data can be added to the calculations. Nevertheless, all of the above information on orientations so far suggests to us two most interesting observations. In the direction of the *closer* horizon along the alignment (east to west), there is a possible tendency for a more accurate alignment. So, Group 1 towards the west, we have 10/12 constrained orientations and for Group 2, towards the east there are 4/5 (including Pedra da Arca Malpica). Further, if you look at the higher precision azimuths of $\pm 1.5^\circ$ or less, for all of eastern orientations versus all of those towards the west, we see that there are 4/17 for the major astronomical targets in the east versus 9/17 for the west. There are 6/17 for the east and 11/17 for the west when we include the cross-quarter alignments. Finally, looking at the orientations towards the east, we find are 8/17 that can be categorized as illumination only forms, but facing the west, there are only 3/17. Is it possible that this difference in numbers for east and west orientations is due to the fact there is no entrance or chamber to illuminate on the western side of the dolmen?

Concluding & Interpretive remarks

In our first paper focusing on these dolmens of Costa da Morte, we found that there was a statistically significant difference between random and observed horizons in terms of horizon altitude (angular height) combined with horizon direction, as well as horizon distance connected to horizon direction. We also noted that on examining the average observed horizons there appeared to be striking topographical features centred upon cardinal east and west and that these fairly symmetrical features

appeared to contain the area for the solar sunrise range. (Higginbottom et al., *submitted*: figs. 11, 12 & 14; Figs. 2, 3 & 5).

Investigating these possibilities by examining the individual sites, we can confirm that such topographical features actually occur at individual sites. Added to this, we can see that (i) the equinoctial Sun often sits at the very centre of these ridges and (ii) the solstitial paths tend to be towards the inner edges of the tops of these ridges. Further, on further examination of the 3D landscape panoramas (Fig. 14), we can also now see it is actually the most extreme rising and setting points of the Moon in the east and in the west that *flank these same ridge tops*, either very close to the edges or on the slopes of these ridges. Thus all the risings and settings of the both the Sun and the Moon are contained along such ridges, but how the dynamics between these bodies and the horizon were seen by the prehistoric people who created the dolmens of Costa da Morte is still rather mysterious. Which of these things is the controlling entity or force of the events that take place here? Is it the Moon that contains the landscape and all that is to be observed upon these ridges, or the ridges of the landscapes controlling where these bodies fall?

Added to this, we saw that horizon features seem to have been chosen as the targets of the dolmen orientations in a fairly systematic way, with cardinal points also being a visual feature. Such numerous topographical features along stretches of horizon can assist with tracking astronomical bodies at a site, as well as the monitoring of circumpolar bodies towards the north. Also knowing where north is, allows an individual to position or situate themselves, astronomically and geographically.

We argue, too, that orientations in both directions of the tomb's axis may well be deliberate. The likely significance of this is underscored by the fact that, despite every tomb facing east, there is no unique choice regarding which type of horizon should be closer - the eastern or western, and whichever is the closer horizon there is a tendency to have the more accurate orientations in these directions, as demonstrated in this paper. It is more likely that each orientation has a particular role and that there is no simple conclusion for the behaviour or beliefs attached to the erection of monuments. Despite these things we have found some plausible motives related to the different behavioural foci of east and west.

Our earlier research also upheld that the horizons in the east are shown to be lower in altitude than those in the west, and statistically lower in the east than the random profiles from the same area (Higginbottom et al., *submitted*), two effects result from, or are coupled with, this choice. Firstly, the lower horizons in the east make it possible for the 'rays' of the rising Sun or Moon to enter the tomb *and* such horizons will ensure that the Sun or the Moon can be seen from inside the dolmen entrance or even the chamber (like we see at Dombate, González-García et al., 2019). This supports the idea

of deliberately chosen horizon shapes in the east connected to the visual effects of astronomical phenomena, which themselves are coupled with the dolmens for this is direction that the tomb faces.

Further to this, is the relevance of horizons and the astronomical orientations in the opposite direction, behind the tomb. With higher horizons in the west, a large dolmen or a future mound would not block the horizon views in this direction. Therefore, an observer standing in front of a dolmen in Costa da Morte would be able to see the higher horizon behind the dolmen, and the astronomical bodies setting upon it. An exceedingly interesting feature revealed itself when we chose to examine the possible relevance of the dolmens' orientations in the opposite direction, for this is the direction of the dolmen's back stone. Excavation has shown, for the later dolmens especially, that the back-stone can be the largest, and the capstone usually second in size to this (eg Dombate, Cebrián del Moral & Yáñez-Rodríguez 2011: 223), and regardless of age, the backstone is most often the largest appearing stone of the orthostats (e.g. Forno dos Mouros Aboal & Porto 2012, 55-56: figs 4-6). Further, in relation to orthostat artworks, the back-stone tends to contain the majority of painted or incised works within Galician dolmens (not including superlative types like Dombate). Or indeed are known to usually contain the "stretched hide" or *pele esticada* figure that appears in Galicia and Portugal (e.g. Dombate and Orca dos Jumais). Oliveira Jorge tells us that in terms of decoration and activity, 'the most sacred zone of the chamber was the area near the backstone' and attached areas at the bottom of the chamber (1998: 69). Remembering that in terms of accuracy, the considered astronomical targets towards the west (towards the backstone) outweighed those towards the east. Interestingly, the two western targets which were 5° away from a single target are essentially sitting on top of the hill that sits 'behind' the dolmen (Arca Da Piosa and Fornela dos Mouros [Aprazadoiro]). Therefore, the backstone is defined by the archaeological remains and megalithic art as the most sacred of areas *within the tomb* (Oliveira Jorge 1998: 69). What is also clear is that there are a number of visual phenomena from both within and without the tomb.

Together all these things suggest that east and west are both significant but they are considered somewhat differently. They have different meanings and that is likely why they are connected somewhat differently to the sky. Using the tomb of Dombate as an archetypical example combined with the discussions above and archaeological evidence from other dolmens, perhaps all of these things come together in this way:

The west is the realm of the ancestors, of the dead, the chosen area within the entire structure in which their bodies are laid out with emblematic objects, close to the main arcane 'lithographs'; 'lithographs' which are seen to be bathed with the light of the Sun or the Moon from the east for a short time at least once a year, warming or welcoming the ancestors into the world of the living at this time. Thus looking east, out of the dolmen, with the ancestors, the light of the world and times of the cosmos can be seen. Those standing outside, along with the Statuettes, looking to the west, on the same or a different day, can see the significant Moon or Sun set on the higher horizons behind the

dolmen, setting into the realm of the ancestors. And when the people have left, the Statuettes remain in position, on the side of the living, as witnesses of the ancestors and the cosmic realms binding all these things together.

We conclude, then, that all together, these landscape, astronomical and architectural elements presented and discussed here, form a raft of complex characteristics used to create the ‘ideal’ dolmen location. Further research is required to further uncover why the dolmen orientations in the east are consistently less accurate than those in the west, given all of the other careful considerations given to monument. Do lower horizons in the east, which ensure light entering, mean you don’t have to be so careful with your alignments, as suggested above? Are they pointing to something else entirely that is not yet investigated here within this paper? Much more work on the connections between internal dolmen structures and the placement of material culture within and around dolmens is also a priority, and farther in the future we look forward to uncover rituals that may have taken place in the vicinity of such monuments.

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