Education and Heritage in the era of Big Data in Astronomy
Proceedings IAU Symposium No. 367, 2020
R. M. Ros, B. Garcia, S. R. Gullberg, J. Moldon & P. Rojo, eds.
doi:10.1017/S1743921321000740

Our Sky, the Sky of Our Ancestors

A. César González-García

Instituto de Ciencias del Patrimonio, Incipit-CSIC
Avda. de Vigo s/n, 15705, Santiago de Compostela, Spain
email: a.cesar.gonzalez-garcia@incipit.csic.es

Abstract. When we talk about Astronomy, we normally do not take into account that we are using a cultural specific way of understanding the sky. Astronomers, either professional, amateur or just lovers of the sky nowadays tend to approach the sky from the point of view of modern science. There, we approach the sky as something that needs to be explored, understood and explained.
However, this vision was not always like that, or even in other cultures is/was completely different. For centuries, the human being has comprehended the sky, its changes and constancies, as part of their world, as part of the environment, as part of their everyday life.
In this paper, I review a few of these different ways of approaching the sky in several cultures, from the Near East to Rome or the Andes and how we can use them today for education, outreach and heritage management.

Keywords. Cultural Astronomy, Archaeoastronomy, Past Astronomies, Heritage, Astrotourism, Petra, Rome, Peru

1. Introduction

It is common ground in our days that the Western society lives away from the Sky. This seems true if we take into account important issues such as light pollution. We assume that past societies lived much more attached to the sky because they 'used' the sky to know when it was the time for harvesting or sowing. It was also used to know the route in long distance travels, either at sea or in land. And it was in several cases used as repository or as source of explanations, of metaphysics, for the everyday life.

I would argue that Western society is still very much attached to the sky. Perhaps in a different fashion than in other societies, and perhaps as another commodity to be consumed. It is today common that astronomical discoveries make it to the headlines, to be aware by the news of the next solar eclipse, the pass of a fireball, a singular planetary conjunction or a blue-moon. If we think about it more closely we might come into a paradox: the society that shatters the sky with sheer amounts of light at the same time asks astronomers for new and renewed knowledge about the Universe.

In a sense, Fig. 1 might be as a good example of such paradox. TA first look into this signpost in the Mediterranean island of Ibiza (Spain) might indicate that if we need such a signpost it is because we are indeed detached from the sky. Such reading does not take into account where this signpost is located or why it was placed there. The signpost is at the entrance of San Antonio, a population on the west shore of the island, world known for the sunset views. Watching a summer sunset at one of the famous bars near the seashore, while listening chill-out music composed for the occasion has become such a tourist attraction that this small population had to manage huge traffic jams every summer evening. To overcome the situation the town-hall decided to open a number of public parking lots, and installed these signposts to direct the drivers there.

Figure 1. Signpost in the Mediterranean island of Ibiza (Spain). Is this a clear sign of the lack of interest of our Western society on the Sky, or not?

In fact, then, the signpost could mean the contrary than we were arguing before: it appears as a necessary reaction by the local authorities to one of the ways our modern society interacts with the sky.

The study of how a society relates to the sky in general, taking into account the cultural context, is done by a discipline called Astronomy in Culture (González-García & Belmonte (2019), Iwaniszewski (2009), Ruggles (2015)). Particular ways to study such relationship could be gained by means of the material record, in particular that found at archaeological sites. Then we may talk of what has been called archaeostronomy(García Quintela & González-García (2009)). Another way is done through the ethnographic record, observation and participation on the actions of a given society. Then we talk of ethnoastronomy (López (2015)).

One example of the social interest of astronomy in culture and its usefulness for other disciplines, is the new visitors center at Stonehenge. This center presents the recent discoveries at Stonehenge and neighbouring sites, using the famous alignments towards summer solstice sunrise and winter solstice sunset as narrative vectors to reach the audience.

Such social demand often derives into popular conceptions (Krupp (2015)) and sometimes into trivialized and stereotypical images of the past (Iwaniszewski (2015)). One such could be the baseless claims at certain spots for alleged connections with the skies in the past. Penas de Rodas (Lugo, Spain; Vilas Estévez (2015)) is an example of that. This is a natural site near the ancient Roman town of Lucus Augusti (present day Lugo), were each summer solstice people crowds to witness summer solstice sunset between two large boulders, supposedly placed there by ancient people. The mixture of commoditization and consumption of the past with a lack of critical information or at least an answer from the academic world can be a fertile ground to fall into esoteric proposals as it was recently the case with the Maya end of the world in 2012. All these argues in favour of the interest to build the right discourse to be brought to our society to provide an answer to this demand.

One way IAU has been doing so in the past decade is the initiative 'Astronomical World Heritage', together with UNESCO (Ruggles & Cotte (2011), Ruggles (2017)). This initiative searches for human heritage, materials, knowledges and values, related to the sky at any epoch. In the past years a number of sites recognized as UNESCO World

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

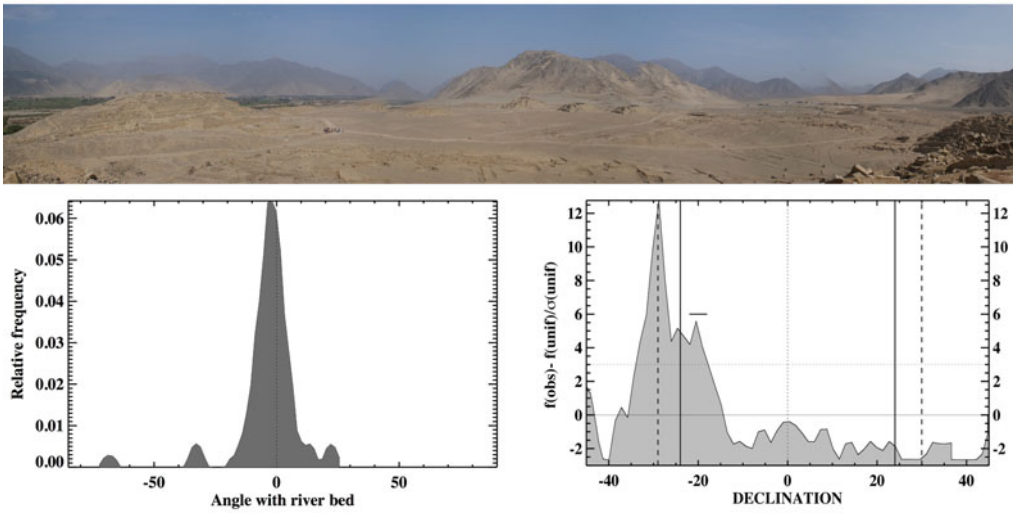

Figure 2. Top: panoramic view of the central part of Caral. The pyramidal buildings seem to bring the mountains to the urban space. At the same time, they are accommodated to the valley by following a line parallel to the river, as indicated by the angle of the buildings to the nearby river -bottom left-. The orientation of the buildings towards the eastern horizon seems to be the most important one, and concentrates at areas consistent with the southern rising of the moon -bottom right; vertical dotted lines indicate the equinoxes, vertical solid lines the solstices and vertical dashed lines the lunar extremes-. For details see text and González-García *et al.* 2021.

Heritage do include among the Universal Outstanding Values their relation to how the societies that built them understood the sky. Examples are not only modern observatories such as Jodrell Bank (UK), or ancient ones like Jantar Mantar (Jaipur, India) but also cultural landscapes like Risco Caído in Gran Canaria (Spain). Astronomy in Culture then provides new value to already existing cultural heritage, but also in some cases discovers new heritage to be valued and protected.

All these aspects make astronomy in culture a key vector to produce materials to be used by educators, outreach actors or heritage managers to their own goals. In the present paper we will review how this interest of our society in the Sky, in general, but in the past as well, can be used to the advantage of education, outreach and heritage management. In particular, we will see this from the results of three research programs I have been involved in together with my collaborators in the past decades.

2. Cultural Astronomy and Education, Caral

Allegedly the oldest city in the Americas (c. 3000 BC; Shady (2006)), Caral together with a number of pre-ceramic sites in the Supe and neighbouring valleys in the north central coast of Peru houses one of the earliest examples of astronomy and geometry in an ancient city (González-García *et al.* (2021)).

The inhabitants of the Supe Valley cultivated cotton, gourd and pumpkin for storing food making drinking vessels and waving fishing nets. The main protein supply was the fish from the near-by sea. They had networks of long distance trade, and carried out a heavy investment in building some of the earliest stone architecture (Burger & Rosenswig (2012); Haas & Creamer (2004). After a thousand years, the Supe society progressively diminished perhaps due to changing environmental conditions (Shady *et al.* (2001)).

According to the results of a campaign to measure a comprehensive set of buildings at the ten largest sites in the valley, the pyramidal buildings are mostly located either parallel or perpendicular to the local riverbed (see Fig. 2, bottom left). In this sense, the

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

Supe society accommodated to the terrain and the circumstances in a peculiar way that could parallel what has been advocated for at other areas in the world in the past (like ancient Egypt, see e.g., Belmonte (2012)). This is indeed a reflection of the understanding of the landscape by this society and possibly an example of geometry, understood in its Greek original meaning, as land measurement.

Besides, the ten sites are located within the valley in such a way that the main public buildings of these cities face the rising of the local winter full moon (González-García & Belmonte (2019); see Fig. 2, bottom right). To do so, they had to take into account the local landscape, as most buildings face a high mountainous landscape.

These winter full moons coincided with the period of sowing the cotton, and the end of one of the two fishing seasons in the near-by sea. Therefore, it appears as a propitious moment for performing social activities, like gathering for rituals at the central plazas.

The location and orientation of the pyramidal buildings do appear as a reflection of the understanding of the inhabitants of the Supe valley of their environment. Such included the local landscape, the terrain, but also the sky, through a proper orientation towards an important rising of the moon. This defined the right moments to carry out rituals, and all of these items provide a glimpse on the world-view of the Supe and Caral inhabitants.

The sites at the Supe valley, and particularly Caral, have had a long and difficult research history. Fist identified very early, they were finally investigated in their full right by prof. Ruth Shady. She had to face a number of threats and overcome the fierce resistance of part of the local population of present day Supe Valley. Despite being away of the arable lands, the archaeological prospections and the expropriation of lands for the archaeological works were often very difficult to explain.

The archaeological team engaged in an ambitious program of popular science and education, to bring their discoveries to the local population. They opened a number of small communal museums at the different communities. They celebrate several open doors days at the sites, with recreations of the ancient lifestyle, feasts and other events. Finally, Caral was recognized as a World Heritage Site in 2009 that has attracted an increasing number of tourists to the area, constituting a vector of development in the region. However, not all local people are thus engaged with the finding and the material remains.

In several instances, one of the problem is that the local population has moved to these areas in recent times due to the attractiveness of the indicated development. The uprooted population value their heritage as a tool to make a living, which is not a minor thing, but they do not consider it yet as their own heritage. It is perceived as the heritage of the archaeologists, despite the effort of the last.

One way the break this barrier is education, and the incorporation of the astronomical discourse as a guiding thread to provide a meaning to the material remains recovered by the archaeologists. The astronomical findings and their ritual interpretation provides a meaning, a value, the local people can get attached to from below as opposed to other discourses from the top. They can see the people of the past as their equals. People who had to face problems as they have to, and who recurred to rituals as they do today.

By using these results, and others, for education it would be easier to get the local population engaged and value their heritage. By using such approach from below new ideas on how to profit from the heritage they have could appear from the local population.

3. Cultural Astronomy, (astro-)Tourism and Outreach, Petra

Petra was the main city of the Nabataean realm for some centuries before and after the change of Era (Alpass (2013)). The Nabataeans were a nomadic people of alleged Arab ancestry, that by the first century BC had settled on the plateau east of the Jordan river. There, they controlled the end of the caravan routes that crossed the Arabian

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

dessert and which brought incense, among other goods, to the Mediterranean shores. Besides, they developed sophisticated irrigation techniques for a dedicated agriculture in their harsh lands. They developed an original culture with a clear Hellenistic flavour that mixed with the Near Eastern and Arab elements. They were finally incorporated into the Roman Empire by Trajan in 106 AD. After that Petra still flourished for several centuries, until its final decay in the Middle Ages (Alpass (2013), Healy (2000)).

We have several ancient informations on the cultic calendar of the ancient Nabataeans and about their spiritual life, gods and goddesses. However, they come mostly for Graeco-Roman writers. They tell us that the main god was called Dushara, and possibly had a solar character among other attributes. Dushara was the son and at the same time consort of goddess Al-Uzza, aka Allat, who according to Panarion (Alpass (2013)) had a singular connection to Venus. There are also strong indications that there was a lunar god (or goddess) not yet fully identified, although there are a number of good candidates (Roche (1995)). All this information, pictures a religion where the heavenly bodies had a prominent role (Healy (2000)).

In fact, we know that the Nabataeans had a ritual calendar very similar to others found in the area (Belmonte *et al.* (2019)). It was a luni-solar calendar, where the moths followed the moon somehow, but had to introduce intercalary months now and then to keep the festivities in step with the sun and the seasons. The calendar possibly started at the month of Nissan, with the first crescent after the Spring Equinox. Other relevant moments were possibly the Winter Solstice and the Autumn equinox.

For the past decade, we have been investigating the astronomical aspects of the Nabataean life (see e.g. Belmonte *et al.* (2013); Belmonte & González-García (2017); Belmonte *et al.* (2020)). In particular, Petra is one of the focal points of our research so far. There we have discovered that the main public buildings related to ritual activities, such as temples, sanctuaries, tombs and cenotaphs, open such that they cluster in three main directions that are related to the equinoxes, and the two solstices.

In Petra, we argue that there was a main gathering and processions during winter solstice that may have involved several monuments, processional routes and moments along the whole city (see Fig. 3). It may have started at dusk on the full moon next to the winter solstice. At that time, the rising full moon could have been seen on top of the final end of the Gorge of the Siq from the magnificent façade of the Treasury (González-García & Belmonte (2019)). In fact, during major lunar standstill such full moon could illuminate the inner parts of the excavated chamber of these site. The procession could have started then moving to the central parts of the city through the colonnade street, with the next stop at the main temple of the city, the Winged Lions Temple, devoted to goddess Al-Uzza. Here, at dawn, and before sunrise, the people could witness the setting of the bright star Canopus. This is a prominent star in the southern skies used as a guiding beacon by the Bedouin to cross the dessert. The setting of these star heralded the moment to depart from the city center to climb an excavated processional route to one of the cities upper areas. Along the way, a small group, perhaps a chosen one, could witness an illumination effect only at winter solstice sunrise at the Lionś Triclinum. Finally, the procession ended in front of the huge façade of the Monastery. This was possibly the cenotaph of one of the Nabataean Kings, but it could have housed as well one of the main worship sites to Dushara. There the setting sun would have illuminated only at this time the inner parts of the excavated chamber in a most peculiar way (Belmonte & González-García (2017)).

The entangled nature of these events, mixing ritual times, with astronomical events, and light and shadow displays do recall the spiritual minds of the inhabitants of this place in a way that might be a magnificent tool to engage a new and more sustainable type of tourism.

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

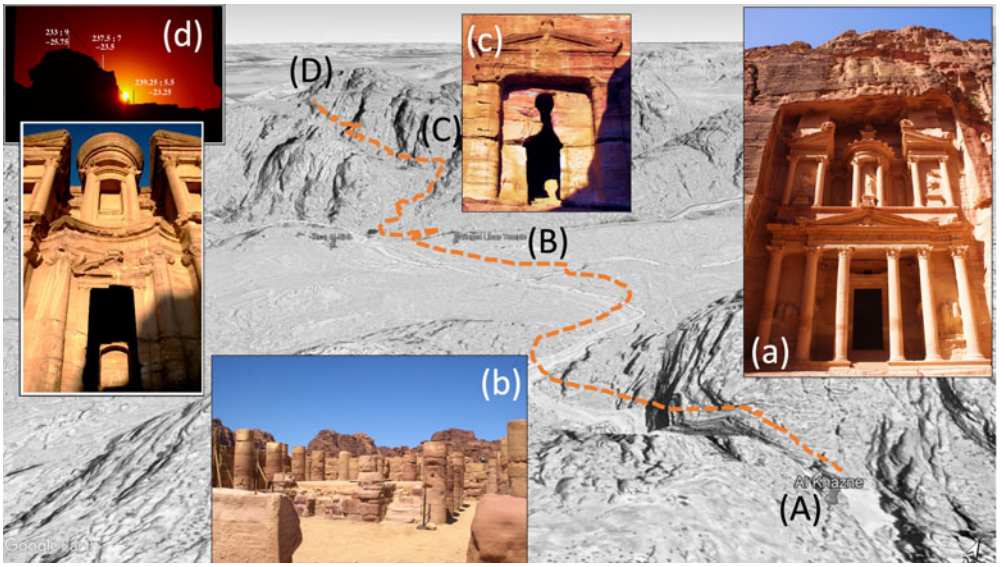

Figure 3. Some of the most prominent monuments in Petra could be connected to a processional route crossing the whole city. Such procession might have taken place at times close to winter solstice, possibly at the time of full moon. At dusk, the rising full moon would illuminate the façade and the inner parts of the Treasury (a-A). The procession then proceeded to the Winged Lionś temple at the city center. Before dawn, and heralding the new day, the setting of Canopus might have marked the start of the ascension through the excavated route towards the Monastery. A few hours after sunrise, a beam of light enters the Lions Triclinum illuminating the niche with an image of the deity. Finally, at the end of the day the procession would reach the Monastery to witness the double sunset event that illuminates the inner parts of this magnificent façade.

Petra, declared World Heritage Site in 1985, is nowadays literally flooded with hordes of tourists to capture selfies at the Treasury after a promenade by the Siq, in a perfect example of consumption of the past. Most tourists stop there before returning to their hotels. However, in this case, astronomy could be a new way to engage a different kind of tourism.

A trendy type of tourism these days is astro-tourism: the kind of tourism that searches the clearest skies to observe and perhaps photograph the stars. In a sense, we could advocate from astronomy in culture, a new kind of 'cultural astro-tourism', where the tourists may engage in the observation of the sites at particular moments like the winter solstice in Petra.

This type of tourism has already been active at many other sites worldwide (see e.g. **?** for a review). To prevent manipulation, it would be desirable that this kind of tourism should naturally be more restricted, respectful to the different sites, it should engage the visitants more closely to the sites, and I would argue it could be more sustainable.

Indeed, the astronomical and cultural astronomical communities should engage in promoting such kind of tourism as alternatives to mass tourism in several areas. Mass tourism has one very damaging side effect for astronomy, as it is the building of huge tourist resorts next to the sites, with the possible direct impact on the night skies. A sustainable development of this tourism should imply an attention to the diversity, both gender and cultural, inclusion of non-western interpretations of the world and an outreach effort to attract the local communities. A high quality tourist, as a (cultural) astro-tourist, is likely to engage emotionally to the site and spend more time (and money) in the area per capita, than an average normal tourist. Finally, such tourist is likely more aware and respectful to the local environment than the average tourist.

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

4. Cultural Astronomy and Heritage Management, Cartago Nova

Heritage management related to cultural astronomy is experiencing a steady increase in several sites, especially thanks to the efforts of the promoters of the UNESCO-IAU Astronomical World Heritage initiative (Ruggles & Cotte (2011); Ruggles (2017)).

Heritage initiatives related to astronomy in culture are getting momentum. Stonehenge was already a World Heritage Site before the initiative took place, but the recent project to build a tunnel to divert the highway traffic at the area collided particularly with the protection of the site. Although the tunnel was planned to be built several kilometres away from the archaeological sites, one of its ends was designed to open directly in the solstitial alignment that has made Stonehenge famous worldwide. The cultural astronomical community, coordinated by Clive Ruggles, put a lot of effort to push the end to other area that had a lower visual impact on the site.

Another example of the fruitful interaction of the cultural astronomy community, the local astronomical amateur societies, and local academic and heritage management authorities comes from Cartagena (Spain).

In 2013 we were invited by the local authorities to develop a research program at the recently excavated areas of the ancient Carthaginian and Roman remains. Cartagena, a former industrial pole of the Spanish south-west, had suffered a profound industrial reform in the last decades that had left a deep fingerprint of unemployment and poverty. Local authorities tried to promote tourism, but the town had little tourist attractiveness at the time. However, Cartagena is one of the oldest towns in Iberia and with such a rich and long history, they designed a program of cultural development of the city. One of the key aspects of that development was the investigation of the archaeological remains.

In the last two decades, the archaeologists have recovered the remains of the Roman Theatre, the Roman Forum, the Punic city walls, and ancient temples among many other sites (see e.g. Noguera Celdrán & Madrid Balanza (2014)).

We were able to discover some very interesting links of the ancient Punic and Roman towns to the sky (González-García *et al.* (2015)). One is the orientation of the sanctuary of Athargatis at the ancient citadel. This sanctuary appeared on top of the Ars Hasdrubalis, the palatial complex of the Punic rulers of the cities. It faces one of the hills of the city, Sacred Mount, where the Greek chronicler Polybius says there was another sanctuary devoted to Chronos (Punic Baal-Hammon). We could verify that summer solstice sunrise, a moment particularly connected to the god Baal-Hammon (Escacena (2009)), was seen on the slopes of this hill illuminating the altar at the inner parts of the sanctuary.

The latter Roman city, built after the conquest of the town and its promotion as a Roman colony in the first century BC, followed an orthogonal grid. Such was the customary way of building Roman towns (Gross & Torelli (1994)), with a grid of orthogonal streets (Cardo and Decumanus), with often a central plaza (Forum) with public buildings.

The Romans followed elaborated rituals to establish the timeliness of the foundation, the sacredness of the city, and that it was built following the right directions. For the final step it was of paramount importance the observation of the heavens (see Rodríguez-Antón *et al.* (2019) and references therein). After nearly a decade investigating the orientation of Roman cities, we have discovered that, particularly for the cities built or reformed at the time of Augustus (Rodríguez-Antón *et al.* (2019); González-García *et al.* (2019)), the Decumanus had to follow very specific directions related to the image of the Emperor.

In particular, we have seen that most cities were built according to the equinoxes. This was one of the prescriptions of the Roman surveyors, but at the same time it was a moment of remembrance of the Emperor as he was allegedly born on September equinox (Espinosa-Espinosa & González-García (2017)). A significant number of towns also included orientation towards Winter Solstice sunrise, a moment of particular ritual prominence in the Roman calendar, and that also was connected to Augustus and his idea or restoration of traditional Roman order (González-García *et al.* (2019)).

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

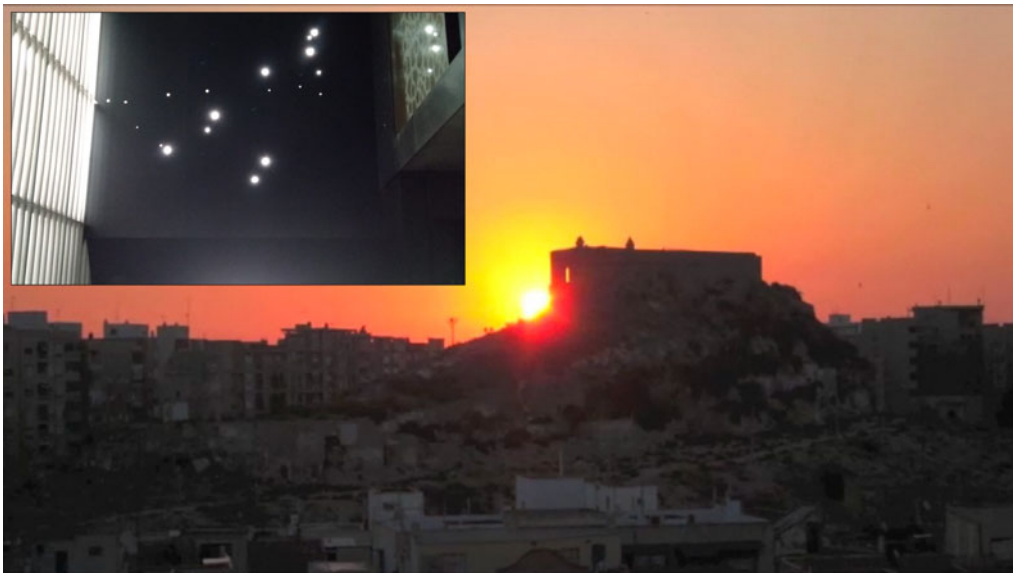

Figure 4. Cartagena (Spain) has endeavoured a major program of recovery and restoration of several Punic and Roman remains in the last decade. Some of the highlights include astronomical events that are now used in Heritage management, outreach and tourism. The main image shows the summer solstice sunrise as seen from the Punic Atargatis sanctuary at the old citadel. This sunrise happens on the slope of present day Pico Sacro, where in antiquity there use to be a temple devoted to Baal-Hammon. Small inset: the Roman remains do include other relevant astronomical orientations, such as the Curia that would have been oriented towards the setting of Capricorn, a constellation liked to Augustus. The newly inaugurated museum incorporates a depiction of this at the main hall.

At Cartagena (Roman Carthago Nova) the new street layout done at the time of Augustus, and prominently the new Forum of the city, that included a temple possibly devoted to the Roman triad, a Curia and an Augusteum, faced Summer Solstice sunrise as seen on top of a hill that Polybius links with a mythical founder of the town. We argue that in this way the local authorities wanted to connect the new ruler and founder (Augustus) with the old one. But also, to the other side, the Curia, for instance would be facing the setting of the constellation of Capricorn (González-García *et al.* (2015)).

Capricorn appears in several material items, such as coins, gems and antefixes, associated to Augustus. It was the constellation that housed the Winter Solstice at the time and according to Augustus himself it was his 'sign' (Barton (1995)).

Interestingly, the local heritage management authorities have intensively used these results for the promotion of the newly found remains and its musealization.

On the one hand, they have promoted a number of activities with the local amateur astronomer association to disseminate among the local population the interesting rise and setting events at particular moment of the year. This has helped to engage the local population in the recovery and appreciation of the newly found heritage.

On the other hand, they are using these results to give new value to the discourses of the archaeological remains. To do so, for example, the new museum at the Forum, that recovers the volumes of the old Roman Curia hold a recreation of the constellation Capricorn with an explanation of the importance of this for the time (see Fig. 4).

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

5. Conclusion

Astronomy can be used in education, not only to introduce concepts of geometry, algebra, physics, chemistry or geology, to name but a few subjects. It can be, and in my view it should be, used as a way to develop a sustainable engagement of local populations to value pro-actively their heritage. Cultural Astronomy produces valuable scientific results that can be used by educators. Indeed, these must be developed further, in collaboration with these communities, so that they can be changed into materials useful for teachers and other actors in the education communities.

Cultural astro-tourism, as a particular type of astro-tourism, appears as a new way of sustainable high-quality tourism that should be promoted among the tourist destinations (see Iwaniszewski (2015)). In my opinion, it is the role of cultural astronomers to contact and engage with local authorities and stake-holders to disseminate their results and possibilities among them taking care of the attention to the diversity in a broad sense. The promotion of this type of tourism would be mutually beneficial. For the local stakeholders they will get a high quality, often engaged, tourism that may help develop the region sustainably. For cultural astronomer, this is a way to keep their areas of research protected for future investigations.

Engaging with local authorities to manage heritage helps conservation, but also provides value to that heritage that can be more easily and deeply understood by the public. Engaging the public in the conservation and preservation of heritage is one of the key issues of heritage management today. One of the few environmental factors that can be still today appreciated or at least modelled with rather high accuracy is the sky. A sunrise alignment today has sifted by a very small amount to what was usual several centuries ago, and can therefore be perceived with our own eyes, providing a touching tool to connect the public to that heritage we want to protect.

These lines of action open new areas where the expertise of our fellow colleagues could be of utmost importance. In this sense, it would be necessary that collegiate societies such as SEAC, ISAAC or SIAC were more active in these grounds following the example of the IAU at different levels (through Division C, the different Commissions and the several Working Groups). Our societies can play an active role by actively engaging in the identification and protection of Astronomical Heritage. Also, we can provide new and revised, bench-marked material for outreach and education. Some of these could be used as well for promoting sustainable tourism, like new programs and tools to visualize relevant astronomical events at particular sites employing augmented reality or virtual reality, that may be used at times when the event is not visible, and can be used by the disable, making the skies more accessible to everyone.

References

Alpass, P. 2012, *The Religious Life of Nabataea* (Leiden: Brill)
Barton, T. 1995, *Journal of Roman Studies* 85, 33
Belmonte, J.A. 2012, *Pirámides, Templos y Estrellas* (Barcelona: Crítica)
Belmonte J.A., González-García, A.C. & Polcaro, A. 2013, *Nexus Network Journal* 15, 497
Belmonte J.A. & González-García, A.C. 2017, *Culture and Cosmos* 21, 131
Belmonte J.A., González-García, A.C. & Rodríguez-Antón, A. 2019, in: G. Magli, A.C. González-García, J.A. Belmonte, & E. Antonello (eds.), *Archaeoastronomy in Roman World* (New York: Springer), p. 123
Belmonte J.A., González-García, A.C. Rodríguez-Antón, A. & Perera Betancor, M.A. 2017, *Nexus Network Journal* 22, 369
Burger, R. L. and Rosenswig, R.M. 2012, *Early New World Monumentality. University Press of Florida* (Gainsville: University of Florida Press)

https://doi.org/10.1017/S1743921321000740 Published online by Cambridge University Press

Browning, I. 1989, *Petra* (London: Chatto and Windus)
Escacena, J. L. 2009, *Complutum* 20(2), 95
Espinosa-Espinosa, D. & González-García, A.C. 2017, *Numen* 64(5-6), 545
García Quintela, M.V. & González-García, A.C. 2009, *Complutum* 20(2), 39
González-García, A.C. et al. 2015, *Zephyrus* 75, 141
González-García, A.C. & Belmonte, J.A. 2019, *Sustainability* 11(8), 2240
González-García, A.C. & Rodríguez-Antón, A., Espinos-Espinos, D., García-Quintela, M.V. & Belmonte J.A., 2019, in: G. Magli, A.C. González-García, J.A. Belmonte, & E. Antonello (eds.), *Archaeoastronomy in Roman World* (New York: Springer), p. 85
González-García, A.C. & Belmonte, J.A. 2020, *Journal of Skyscape Archaeology* 5(2), 177
González-García, A.C. et al. 2021, *Latin American Antiquity* in press
Gros, P., & Torelli, M. 1994, *Storia dell'Urbanistica. Il Mondo Romano.* (Roma: Editori Laterza)
Haas, J. & Creamer, W. 2004, in: H. Silvermann (ed.) *Cultural Transformations in the Central Andean Late Archaic. In Andean Archaeology* (Oxford: Balckwell), p. 35
Healy, J.F. 2000, *The religion of the Nabataeans: a conspectus* (Boston: Brill)
Iwaniszweski, S. 2009, *Complutum* 20(2), 23
Iwaniszweski, S. 2015, in: C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ehtnoastronomy* (New York: Springer), p. 287
Krupp, E.C. 2015, in: C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ehtnoastronomy* (New York: Springer), p. 263
López, A.M. 2015, in: C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ehtnoastronomy* (New York: Springer), p. 341
Laurence, R., Esmonde Cleary, S., & Sears, G. 2011, *The City in the Roman West c.250 BC-c.AD 250* (Cambridge: Cambridge University Press)
Noguera Celdrán, J.M. & Madrid Balanza, M.J., 2014 *Espacio, tiempo y forma* 7, 13
Roche, M.-J. 1995, *Transeuphratène* 10, 57
Rodríguez-Antón, A., González-García, A.C. & Belmonte, J.A. 2018, *Journal for the History of Astronomy* 49(3), 363
Ruggles, C.L.N 2015, in: C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ehtnoastronomy* (New York: Springer), p. 353
Ruggles, C.L.N 2017, *Heritage Sites of Astronomy and Archaeoastronomy in the context of the UNESCO World Heritage Convention: Thematic Study no.2.* (Paris: ICOMOS)
Ruggles, C.L.N & Cotte, M. 2017, *Heritage Sites of Astronomy and Archaeoastronomy in the context of the UNESCO World Heritage Convention*(Paris: ICOMOS)
Shady, R. 2006, in: W.H. Osbell and H. Silvermann (eds.), *Andean archaeology III: north and south* (New York: Springer), p. 28
Shady, R., Haas, J. and Creamer, W. 2001, *Science* 292, 723
Vilas Estévez, B. 2015, in: F. Silva, K. Malville T. Lomsdalen, & F. Ventura (eds.), *The Materiality of the Sky* (Bath:Sofia Center Press), 23