Book of Abstracts

Indigenous Astronomy in the Space Age

Melbourne, Australia 2025

7–11 July 2025

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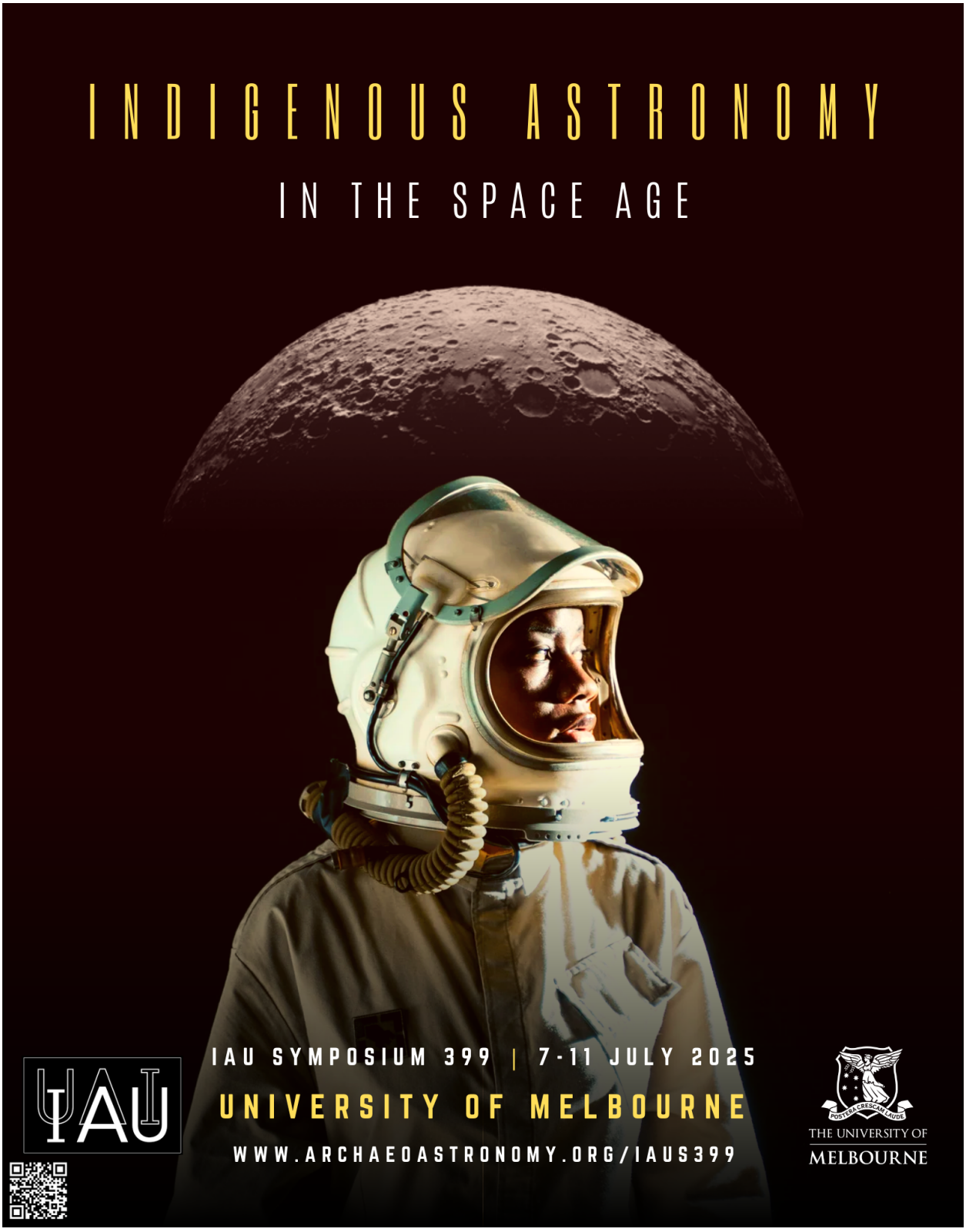
INDIGENOUS ASTRONOMY
IN THE SPACE AGE
IAU SYMPOSIUM 399 | 7-11 JULY 2025
UNIVERSITY OF MELBOURNE
WWW.ARCHAEOASTRONOMY.ORG/IAUS399
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MELBOURNE

CULTURAL ASTRONOMY SCHOOL, July 2, 2025

History, Theory & Professional Development

09:10 – 10:30 - July 2, 2025

The Last 50 Years of Cultural Astronomy

Clive Ruggles
University of Leicester, UK

11:00 – 11:45 - July 2, 2025

Theories that Every Cultural Astronomer Should Know

Jarita Holbrook & Emilia Pasztor
Harvard–Smithsonian Center for Astrophysics, USA/UK
Türr István Museum, Hungary

Abstract:
In the realm of interdisciplinary research, methods are often straightforward but theories and theorizing is difficult. For Cultural Astronomy, there is only Anthony Aveni's Tropical Archaeoastronomy Theory; all others are borrowed from other disciplines. Holbrook, who works with living people introduces two Feminist theories: Positionality / Reflexivity and Feminist Standpoint Theory. When studying people that have more knowledge and possibly more power than you do, a couple of theoretical frames that are helpful are Laura Nadar's Studying Up and Pierre Bourdieu & Jean-Claude Passeron's Capitals for Class Mobility. Intersectionality is the bedrock for studying women, Indigenous people and those embodying multiple identities. Indigenous methods that make theoretical frames include non-extractive research and the C.A.R.E. principles. Pasztor, who works on archaeological sites and archaeological remains, introduces five theories: 1) the Cultural Historical Approach, Complexity theory, Cognitive Landscapes, World System Theory and the Direct Historical Approach.

References:

Bourdieu, Pierre. 'THE FORMS OF CAPITAL'. Edited by J. Richardson. *Handbook of Theory and Research for the Sociology of Education*, 1986, 241–58.

Harding, Sandra. 'Rethinking Standpoint Epistemology: What Is "Strong Objectivity"?' In *Feminist Epistemologies*, edited by Linda Alcoff and Elizabeth Joy Potter, 1st ed., 49–82. United Kingdom: Routledge, 1993.

11:45 – 12:30 - July 2, 2025

Indigenous astronomy and Science

Gerhard Wiesenfeldt
University of Melbourne, Australia

13:30 – 14:30 - July 2, 2025

Integrating Indigenous Knowledges into STEM Curricula

Tim Patston
University of Melbourne, Australia

Keywords: Indigenous Astronomy, Indigenous STEM, Teaching STEM, STEM Curricula

Abstract:
Indigenous and Torres Strait Islander Histories & Cultures are a prescribed component of the Australian Curriculum. However, many educators are uncertain as to how to respectfully and successfully integrate Indigenous Knowledges, particularly in STEM subjects. This lecture provides teaching examples, tied to Curriculum Descriptors, which utilise Indigenous Sky Knowledges in Science, Technology, Engineering and Maths. The lecture will explore appropriate and respectful language in Indigenous STEM education, and guide teachers to relevant and useful resources.

References:

Naputa, G., Patston, G., & Patston, T., 'Indigenous Astronomy Starwheel', 2018. Melbourne, Creative Actions

Patston, T., Kaufman, J., Cropley, D., Creative Actions - 'Embedding Creative Competencies into Every Classroom', 2023. Melbourne, Creative Actions

CULTURAL ASTRONOMY SCHOOL, July 3, 2025

Quantitative Methods and Archaeoastronomy

09:00 – 10:30 - July 3, 2025

Fieldwork and Statistical Analysis in Archaeoastronomy

César González-García
INCIPIT, Spain

Keywords: Data gathering; Analysis; Astronomical relevance; Statistical Significance

Abstract:
In this lecture we will review the basic ways of data gathering, both in the field with different tools, as well as at the desk, with other tools such as remote sensing. Then, we will review how to treat the archaeoastronomical data to assess its potential astronomical relevance and verify the possible statistical significance. Finally, we will review the different ways of presenting such data so that our results are reproducible, and understandable by most researchers.

References:

Magli, G., 2016, Archaeoastronomy. Introduction to the Science of Stars and Stones. Springer: Cham.

Prendergast, F., 2015, Techniques of Field Survey, in C.L.N. Ruggles (ed.) Handbook of Archaeoastronomy and Ethnoastronomy. 389-410. Springer: Cham.

Ruggles, C. N. L., 2015, Best Practice for Evaluating the Astronomical Significance of Archaeological Sites, in C.L.N. Ruggles (ed.) Handbook of Archaeoastronomy and Ethnoastronomy. 373-388. Springer: Cham.

Ruggles, C. N. L., 2015, Analyzing Orientations, in C.L.N. Ruggles (ed.) Handbook of Archaeoastronomy and Ethnoastronomy. 411-426. Springer: Cham.

11:00 – 12:30 - July 3, 2025

An introduction to the digital visualisation of past skies and landscapes

Gail Higginbottom
Bournemouth University and Flinders University, UK and Australia

Abstract:

This course introduces students to the advantages of recreating natural visual-scapes observed by people in the past and the software applications that are used to do this. It will demonstrate how, by placing past people into their fuller visual contexts, we can generate clearer hypotheses about their lives and belief systems. This will include hands-on training in two primary digital applications: one that can topographic horizon lines (basic online) and the other re-creates past land- and sky-scapes (*Horizon)*. Horizon is a package that builds 2 and 2.5/3D models of landscapes upon which you can layer astronomical information as seen in the past. Unlike Stellarium it has the ability to output landscape and astronomical data that can be used for qualitative and quantitative assessments.The landscapes you learn to create in this course can be uploaded into Stellarium for a fuller immersive visual experience, taking you to the next level of understanding of what it was like to be under the skies in the past (as taught by Georg Zotti in another of these Classes.

16:00 – 17:30 - July 3, 2025

Orientations and Illumination: Time-lapse photography (and related methods) for recording seasonal solar illumination and other light and shadow phenomena.

Morgan Saletta
University of Melbourne, Australia

Abstract:
In this workshop, participants will explore the use of photography and video—particularly time-lapse techniques—to document the seasonal illumination of monuments, such as megaliths, and the dynamic interplay of light and shadow. We will examine how these techniques can document light and shadow plays and reveal patterns that may not be evident in real time. The workshop will also introduce the use of drones for capturing establishing shots and for enhancing our visual understanding of monuments within their broader landscape context.

14:00 – 15:30 - July 3, 2025

Stellarium: Desktop Simulation of Past and Present Skies

Georg Zotti
VRVis Vienna, Austria

CULTURAL ASTRONOMY SCHOOL, July 4, 2025

Qualitative Methods and Ethnoastronomy

09:00 – 10:30 - July 4, 2025

Ethnoastronomy as a perspective

Alejandro Martín López
CONICET-University of Buenos Aires, Argentina

Keywords: ethnoastronomy; methodology; theory

Abstract:

This lecture offers a contemporary and updated approach to the subfield of ethnoastronomy, focusing not only on its concrete practices but also on its theoretical and methodological contributions to the broader field of cultural astronomy.

Since the synthesis process that began in the 1980s and led to the consolidation of cultural astronomy as an interdisciplinary umbrella in the 1990s, ethnoastronomy has often been treated as the "little sister" within this family of subfields. This lecture aims to present an updated definition of ethnoastronomical practice that reflects both its current forms, its interdisciplinary relationships and their transformative potential for all cultural astronomy. We approaches ethnoastronomy as a perspective: an ethnographic, ethnological, and socio-anthropological way of examining knowledge, practices, and materialities related to the sky in any contemporary social unit (such as an ethnic group, a social class, a family, a professional group, or an institution—including contemporary academic astronomy). These forms of knowledge and practice are understood as integral parts of social and cultural life, and are situated within both regional and global contexts, as well as historical trajectories. This perspective explores both general, shared, and largely implicit forms of celestial knowledge (such as lifeworlds, logics of practice, and worldviews) and more explicit, often specialist-associated constructions (cosmologies). All of these are treated as articulated yet unfinished and continuously changing systems.

With this framework, we will examine the range of techniques employed in ethnoastronomical research, with particular emphasis on the integrative role of participant observation. Ethical considerations, spatial and temporal dimensions of fieldwork, the relationship between ethnoastronomy and other subfields of cultural astronomy, and the application of an ethnoastronomical perspective to historical and archaeological materials will also be discussed.

References:

Barth, F. (1987) *Cosmologies in the making: A generative approach to cultural variation in inner New Guinea.* Great Britain: Cambridge University Press.

Bloor, D. (1991) *Knowledge and Social Imagery*. Chicago: University of Chicago Press.

Bourdieu, P. (1977) *Outline of a Theory of Practice* Cambridge: Cambridge University Press.

Casumbal-Salazar, I. J. A. (2014) *Multicultural Settler Colonialism and Indigenous Struggle in Hawai'i: The Politics of Astronomy on Mauna a Wākea*. Ph.D. Thesis. Hawai'i: University of Hawai'i at Mānoa.

Haraway, D. (1988). "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." Feminist Studies 14, 3: 575-599.

Kopenawa, D. y Albert, B. (2013) The Falling Sky. Words of a Yanomami Shaman. London: Harvard University Press.

López, A. M. (2011) Ethnoastronomy as an academic field: a framework for a South American program. En Ruggles, C. L. N. (ed.) *Archaeoastronomy and Ethnoastronomy: Building Bridges between Cultures, proceedings of the International Astronomical Union Symposium Nº 278, Oxford IX International Symposium on Archaeoastronomy.* Cambridge: Cambridge University Press. 38-49.

López, A. M. (2014a) Cultural interpretation of ethnographic evidence relating to astronomy. En Ruggles, C. (ed.) *Handbook of Archaeoastronomy and Ethnoastronomy.* Vol. 1. New York: Springer Science and Business Media. 341-351.

López, A. M. (2014b) Interactions between `indigenous´ and `colonial´ astronomies: Adaptation of indigenous astronomies in the modern world. En Ruggles, C. (ed.) *Handbook of Archaeoastronomy and Ethnoastronomy.* Vol. 1. New York: Springer Science and Business Media. 197-211.

López, A. M. (2021) Cultural Astronomy: A scientific frame to understand academic astronomy as part of the Social World. En Ros, R. M., Garcia, B., Gullberg, S., Moldon, J. y Rojo, P. (eds.) *Proceedings of the International Astronomical Union, 15(S367).* Cambridge, UK: Cambridge University Press. 235-244.

11:00 – 12:30 - July 4, 2025
Memory, Mnemonic and Cultural Astronomy

Lynne Kelly
University of Melbourne, Australia

Keywords: Indigenous knowledge systems, memory methods, archaeology

Abstract:
Human societies need a great deal of pragmatic knowledge to survive. For most of human existence, there was no writing. People stored a vast amount of information in memory. Imagine retaining enough observational data in memory to identify the 18.6 year lunar standstill cycle, as the Ancestral Pueblo people did. The landscape and skyscape acted as complex memory palaces, with story, art and music as critical components. We know this because most, if not all Indigenous cultures use the same suite of memory technologies to achieve these feats, including Aboriginal Australian cultures which date back over 60,000 years of continuous knowing. Since the advent of writing, these methods have been sidelined, yet we are genetically encoded to use them. Current evidence dates many robust stories of First Nations peoples to well over 10,000 years. Indigenous knowledge systems offer an invaluable lens to explore the purpose of ancient monuments such as Stonehenge (a mere 5,000 years old), Chaco Canyon, Rapa Nui (Easter Island), Poverty Point and the Ice Age painted caves. Many 'enigmatic objects' also gain a purpose as portable mnemonic devices using this approach. During this workshop, we will explore these methods, even practice a few that you can use. Then we'll look at the archaeology of some Neolithic and Archaic monuments to show how their chronology and complex of artefacts fit the purpose of knowledge spaces beautifully.

References:

Kelly, L. (2015). *Knowledge and Power in Prehistoric Societies: orality, memory and the transmission of culture.* New York: Cambridge University Press.

Kelly, L. (2016). *The Memory Code.* Crow's Nest, NSW: Allen & Unwin.

Neale, M., & Kelly, L (2020). *Songlines: the power and promise (First Knowledges Series)*. Melbourne: Thames and Hudson.

Kelly, L. (2024). *The Knowledge Gene.* Crow's Nest: Allen & Unwin

14:00 – 14:45 - July 4, 2025
Rethinking Science, Culture, and Power

Thilina Heenatigala
Earth-Life Science Institute (ELSI), Japan

Abstract:
Science is often regarded as a universal endeavour, yet its dominant frameworks have been shaped by colonial legacies that continue to influence whose knowledge is valued, what questions are asked, and how research is conducted. These power dynamics are not just historical—they are ongoing, embedded in the institutions, languages, and logics of contemporary science. This lecture offers a critical reflection on current practices through the lens of decolonisation, drawing from the Decolonize Science to Bridge Worlds dialogues at the UN Science Summit 2024. At the same time, it is a hopeful invitation: to imagine science as a more plural, relational, and inclusive practice—one that honours diverse ways of knowing and reconnects knowledge to responsibility, community, and place. By rethinking the relationships between science, culture, and power, we can begin to reshape not only what science is, but who it is for.

14:45 – 15:30 - July 4, 2025

Legal frameworks for Indigenous Knowledge, Space, and Dark Skies

Shea Esterling
University of Canterbury I Te Whare Wānanga o Waitaha, Aotearoa/New Zealand

Keywords: indigenous rights, heritage, space law, dark skies

Abstract:
Indiscriminate light is a growing outcome of unconsidered human activity in our planetary environment. Above Earth, the build-out of satellite constellations is steadily forming a global net of moving points of light while on Earth we are experiencing a rapid increase in urban lighting. This light pollution drastically reduces the visibility of the night sky for most of humanity- threatening cultural connections, together with impacts on both human and ecological health. In this session, we will take a broad overview of both international law and domestic law in Aotearoa New Zealand and consider whether its regulatory frameworks are sufficient to protect the night sky from light pollution. Concluding that these frameworks are not sufficient, in this session we will then explore what protection of dark skies might look like through the indigenous lens of te Ao Māori (Māori worldview), which integrates ecocentrism and anthropocentrism.

16:00 – 17:00 - July 4, 2025

Building a Career in Cultural Astronomy

Duane Hamacher
University of Melbourne, Australia

18:00 – 19:00 - July 4, 2025

Pacific Sky Knowledge - July Lectures in Physics

Clive Ruggles
University of Leicester, UK

Key words: Hawaiian Islands; Polynesians; Pacific navigation. Pacific star names.

Abstract:

An archaeological and archaeoastronomical project focusing on the design and orientation of temples (heiau) in the Hawaiian islands of Maui and Moloka‘i has revealed a good deal about their connections with astronomy and the calendar, and how these operated in practice. Of particular interest are those dedicated to Lono, god of dryland agriculture, which not only faced the rising of the Pleiades but also incorporated sighting devices that would have aided priests seeking to fix the acronychal rising and hence the start of the Makahiki season over which Lono presided. Such connections and the practices linked to them served to regulate social activity and reinforce social control (Kirch and Ruggles 2019; Kirch et al. 2024). Studying temple orientations is, however, only one way to find out more about Hawaiian astronomical knowledge. In order better to understand its use in Pacific navigation, by priestly sects who constructed whole social hierarchies in the sky, or for astrological prognostication, we must turn instead to ethnohistory and ethnography. In a parallel project that has developed over 25 years, I have been working in collaboration with Hawaiian scholars Rubellite Kawena Johnson and John Kaipo Mahelona to develop a comprehensive synthesis of Hawaiian astronomical knowledge starting from a re-examination and re-translation of the earliest primary sources, articles that were appeared in Hawaiian-language newspapers in the mid-19th century.

An integral part of the project from conception has been a comparative study of astronomical knowledge in other parts of the Pacific combining information from historical and ethnographic sources and linguistic analysis (Johnson et al. 2015). A side benefit from this project is that extensive new catalogues of Hawaiian, Polynesian and Austronesian star names will be published as part of the new edition of our book Nā Inoa Hōkū (star names) (Johnson et al., in press). In this paper I shall describe some of the issues and challenges that have arisen during this work—conceptual, epistemological, and methodological. Many of these reflect the need to deconstruct assumptions made by European ethnographers and to weed out the propagation of errors and misunderstandings and secondary and subsequent scholars. For example, how can we be sure that a name like “Red star” has been correctly interpreted an actual name as opposed to simply being a description? How

do we (and should we) distinguish between a star and an asterism when the same term (and concept) is commonly used for both? A deeper problem is the fundamental fallacy of any catalogue of "indigenous star names", which is that it carries the expectation of being able to provide a unique identification of an indigenous star name with a Western one. On the contrary, as the ethnohistorical and ethnographic data illustrate very well, is that there was no single fixed system—in Hawai'i or anywhere else—of the naming of stars that existed prior to European contact. Rather, conceptions of the heavens, and the naming of stars, were dynamic and constantly changing, continually reflecting social needs and developments. Even the naming of a star in a particular perceived "visibility"). I will describe how we have attempted to take all this into account in the new catalogues. I will finish by describing why I believe this work has impacts, both constructive and cautionary, on the work of the IAU's Star Names Working Group.

References:

Johnson, Rubellite K., Mahelona, John K. and Ruggles, Clive (2015). Nā Inoa Hōkū: *Hawaiian and Pacific Star Names*, 2nd. edn (Ocarina Books).

Johnson, Rubellite K., Mahelona, John K. and Ruggles, Clive (in press). Nā Inoa Hōkū: *Hawaiian and Pacific Star Names*, 3rd. edn (University of Hawai'i Press).

Kirch, Patrick V. and Ruggles, Clive (2019). Heiau, 'Āina, Lani: *The Hawaiian Temple System in Ancient Kahikinui and Kaupō*, Maui (University of Hawai'i Press).

Kirch, Patrick V., Swift, Jillian, and Ruggles, Clive (2024). "The Pre-Contact Temple System of Hālawa Valley, Moloka'i, Hawaiian Islands", *Archaeology in Oceania*, 59, doi.org/10.1002/arco.5309

IAU SYMPOSIUM 399, July 7, 2025

Archaeoastronomy, Theory, Method

09:00 – 09:10 - July 7, 2025

Welcome to IAUS399

Duane Hamacher & Jarita Holbrook

IAUS399 co-Chairs

09:10 – 09:20 - July 7, 2025

Welcome to Country

Aunty Annette Xiberras

Wurundjeri Elder

09:20 – 09:35 - July 7, 2025

Supporting Indigenous Endeavours

Prof Barry Judd

Deputy Vice-Chancellor (Indigenous), University of Melbourne, Australia

09:35 – 09:50 - July 7, 2025

Why Indigenous Astronomy Matters

Prof Marcia Langton

Associate Provost (Indigenous), University of Melbourne, Australia

Session 1: Frameworks & Theory
09:50 – 10:10 - July 7, 2025
Astronomical Heritage's Cosmopolitics: Shamanism and Hegemonic Modernity

Alejandro Martin–Lopez
University of Buenos Aires, Argentina

Abstract:
One of the least explored aspects of indigenous participation in the management of astronomical heritage is how their conceptions are involved and simultaneously redefined throughout these processes. This situation is linked to the general perception among academics and state agents of indigenous cosmologies as immutable and inherently tied to the past. Similarly, it is often assumed that the experiential framework of all involved actors is one of hegemonic modernity. However, the recognition that the stakes for indigenous participants may diverge significantly from the assumptions held by state and academic institutions has important implications.

To examine the general dynamics of such situations, aiming to contribute to a decolonial theoretical-methodological debate, and building on previous research (López 2011), this study will analyze the case of "Nauecqataxanaq," a training program for young Moqoit indigenous guides related to the Campo del Cielo Meteoric Dispersion in Chaco, Argentina. This program was established in the context of Moqoit claims for participation in the heritage processes associated with this meteoric scatter. The initiative aimed to facilitate the training of young Moqoit through intergenerational exchanges with elders from various rural and peri-urban Moqoit communities, as well as engagement with experts in cultural astronomy, tourism, and cooperative management. Initiated in 2022, Nauecqataxanaq, for which I served as the "Expert Coordinator," has successfully trained a cohort of ten young Moqoit, who are now conducting guided tours in the Campo del Cielo provincial park. Our analysis will include reflections on my role in the program, as well as on the relationships between Moqoit communities and project participants, both Moqoit and non-Moqoit.

In this context, we will explore the emergence of practices and experiences shaped by elements of Moqoit shamanic cosmology during both the training process and the guided tours, utilizing Sahlins' (1988) concept of "mythopraxis" as a theoretical framework. Additionally, we will analyze the symbolic redefinition processes involved and the transformations in categories that these changes imply. Furthermore, considering the prevailing power dynamics, we will interrogate the role of "border objects" (Huvila 2011) or border "things" (Ingold 2010) in these meteorites. This latter analysis aims to reveal how, thanks to the role of meteorites as "frontier things," a "loose articulation" of actions and meanings, and a complex series of cosmopolitical disputes, are simultaneously deployed (De la Cadena 2010; Viveiros de Castro 2010; Blaser 2016). In this sense, meteorites exemplify the role that we understand many forms of astronomical heritage to play today in the relationships between indigenous peoples, the state, academia, and international consortia. This invites us to think more deeply about the power dynamics, tensions, and disagreements that exist beneath the appearance of consensus in the management of astronomical heritage and astro-tourism.

References:

Blaser, M. (2016) Is Another Cosmopolitics Possible? Cultural Anthropology 31 (4), 545–570.

De la Cadena, M. (2010) Indigenous Cosmopolitics in the Andes: Conceptual Reflections beyond Politics. Cultural Anthropology 25 (2), 334–370

Huvila, I. (2011) The Politics of Boundary Objects: Hegemonic Interventions and the Making of a Document. Journal of the American Society for Information Science and Technology 62 (12), 2528–2539

Ingold, T. (2010) Bringing Things to Life: Creative Entanglements in a World of Materials. Realities Working Papers #15

López, A. M. (2011) New words for old skies: recent forms of cosmological discourse among aboriginal people of the Argentinean Chaco. In Ruggles, C. L. N. (ed.) Archaeoastronomy and Ethnoastronomy: Building Bridges between Cultures, Oxford IX International Symposium on Archaeoastronomy. Cambridge: Cambridge University Press. 74-83.

Sahlins, M. (1985) Islands of History. Chicago: University of Chicago Press.

Viveiros de Castro, E. (2010) Metafísicas Caníbales. Líneas de Antropología Postestructural. Buenos Aires, Madrid: Katz editores.

10:10 – 10:30 - July 7, 2025
New Directions in Cultural Astronomy: Researching the Past

Wayne Orchiston1, Darunee Lingling Orchiston2

1. *University of Science and Technology of China & USQ, Australia*
2. *Private Scholar, Mae Taeng, Thailand*

Abstract:

One of the stated aims of this conference is to "… focus on cultural astronomy and its impact on astrophysics and the space sector." This very much focusses on contemporary cultural astronomy and its linkages with the present and the future. However, contemporary ethnographic studies merely provide instant chronological snapshots of evolving systems where the astronomical knowledge base, as part of culture, is evolving through time. It is therefore important to examine the past and see if we can identify occasions when changes must have occurred in indigenous astronomical beliefs and practices.

In his paper we introduce the concept of 'Multidiscplinary Ethnoastronomy' to explain this diachronic approach, and we outline our research in this new field through our studies in India, SE Asia and Oceania

Session 2: Tools & Methods
11:00 – 11:20 - July 7, 2025
Introducing the All-Skies Encyclopaedia

Susanne M. Hoffmann
IAU Working Group on Star Names, Germany

Abstract:
In the past years, the need for a large knowledge base on various aspects of cultural astronomy has been pointed out to me from various directions. I was involved in the ”digital humanities”- part of several research projects on specialised and illustrated dictionaries for ancient Greek meteorology in Aristotle and Babylonian astral science, and learned about IAU-needs for this and similar sorts of knowledge for their naming groups. Initial thoughts that we would need one or several database(s) were quickly recognized as inappropriate because they would also need to come with a standalone GUI and a query API for common planetarium software such as Stellarium Vickers et al. (2022). Still, the general desire for the FAIR (findable, accessible, interoperable, reusable) principles in general scientific data management Wilkinson et al. (2016) is countered by respect for the cultures’ or subculture’s intellectual and cultural property Ravindran (2024). The requirements for a global data collection were collected in a scientific meeting of software developers, computer scientists and cultural astronomy researchers organized by the PI in Jena 2023.

In the ongoing research project ”Planetarium Babylonicum 2.0” that deals with a philologically accurate dictionary of ancient Mesopotamian astral science Gossmann (1950); Kurtik (2007), the system is designed also to host the data of other cultures. It is also used by selected other scholars for their research data. The resulting venture of an ”All Skies Encyclopaedia” will be presented at this conference, and the Babylonian part is almost complete then. With the multilingualism of the Mesopotamian area, and the changes to the terms and meanings over the 2000 years of cuneiform writing, this part could serve as an example for contributions from other cultural research.

References:

Gössmann, F. (1950). *Planetarium Babylonicum oder Die sumerisch-babylonischen Stern-Namen*. Verlag des Päpstl. Bibelinstituts, Rom, Italy.

Kurtik, G. (2007). *The Star Heaven of Ancient Mesopotamia: Sumero-Akkadian Names of Constellations and Other Heavenly Bodies.* Aletejja, St. Petersburg, Russia.

Ravindran, S. (2024). ‘not a free-for-all’: Indigenous communities want limits on how their data are shared. Title of the publication associated with this dataset: AAAS Articles DO Group.

11:20 – 11:40 - July 7, 2025
Introducing Stellarium Skycultures 2.0

Georg Zotti
VRVis Vienna, Austria

Abstract:

Over the recent years, Stellarium has become a de-facto standard tool for cultural astronomy [Zotti et al., 2021, Zotti, 2021, Zotti and Neubauer, 2024]. One of its original features is to provide the user with the choice of several ”sky cultures”. These datasets describe the patterns (stick figures) and artwork of all sorts of recognizable asterisms, from small groups of stars to huge constellations, and proper name labels for them, individual stars, planets, and naked-eye star clusters. These datasets are defined culture-wise.

All branches of Stellarium, the classical desktop application and the newer ”Stellarium-web” and ”Stellarium mobile”, aim to provide their users with profound and reliable information in a well-digestible way. Our ongoing project ”Sky Cultures 2.0”, therefore, aims to better present the huge amount of material, and to solve shortcomings identified earlier [Zotti and Wolf, 2021, Zotti et al., 2021, Vickers et al., 2022] and discussed in a meeting of Stellarium developers with sky culture experts in Jena 2023 [Hoffmann et al., 2023].

Unified File Format. The original format, technically defined in the early 2000s with the 20th-century standard constellation definition in mind, describes each sky culture with files in plain text and HTML. The later project, ”Stellarium mobile”, by some of us, uses sky culture descriptions based on the newer JSON standard, implying that the programs diverged. We work on the usability of JSON in both widespread apps, the classical Stellarium Desktop planetarium and the newer Stellarium Mobile targeted at the smartphone market. This will also merge the two diverging data sets on sky cultures.

Different Cultural Concepts. Some Indigenous cultures do not use stars (dots) for the definition of recognizable patterns, but bright or dark clouds of the Milky Way [Gullberg et al., 2020], and in other cultures, so-called “single-star asterisms” were used. While some contributors found workarounds, we would like to offer the possibility of defining Indigenous constellations mathematically correctly.

Digital Humanities Research tools. Historical alternatives to coordinate systems, such as Indian nakshatras, Chinese ”lunar mansions”, Arabic ”lunar stations”, or the Late Babylonian zodiac as a division of the ecliptic should be properly displayed. They are currently implemented instead of the IAU ”boundaries”, but require more careful descriptions [Hoffmann, 2017, Hoffmann, 2022].

Labelling. The versions of didactically reduced versus culturally correct labelling of all definitions (star names, constellations etc.) also cause challenges for the software. Original glyphs, transliterations etc. require specific fonts, and future audio examples of the original pronunciation will enlarge the educational value. Furthermore, the educational value is only given with profound translations beyond the arbitrary outcome of a community project. Translating sky cultures may need more insightful translators.

One Sky (Culture), many Options. As the IAU names are made for global communication on research but not for casual languages, the default sky culture in Stellarium should allow the display of alternative names for stars and constellations. A query tool developed by one of us [Zotti et al., 2023] can finally be linked to proper data sources that did not exist until 2023. In our presentation, we will introduce important changes concerning the curating, maintaining, and distribution of sky cultures and the new file format to be used in both desktop and mobile versions of Stellarium that address the identified shortcomings.

References:

Gullberg, S. R., Hamacher, D. W., Mart´ın-Lopez, A., Mejuto, J., Munro, A., and Orchiston, W. (2020). A Cultural Comparison of Dark 'Constellations' of the Milky Way. *Journal of Astronomical History and Heritage*, 23(2):390–404.

Hoffmann, S. M. (2017). *Hipparchs Himmelsglobus*. Springer, Wiesbaden, New York.

Hoffmann, S. M. (2022). Comparison of some general concepts. In Hoffmann, S. M. and Wolfschmidt, G., editors, *Astronomy in Culture – Cultures of Astronomy*, volume 57 of *Nuncius Hamburgensis*, chapter 5.5, pages 540–558. tredition, Ahrensburg.

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11:40 – 12:00 - July 7, 2025
Using Stellarium to Obtain Star Position Data

Elizabeth Brooker
James Cook University, Australia

Keywords: Torres Strait, Astronomy, Quantitative analysis, Ethnoastronomy, Stellarium

Abstract:
Often, embedded in indigenous traditions are generations of astronomic observations. These traditions correlate the motions of celestial objects with times of animal migrations, times of agricultural cultivation, star positions for navigating, and predicted motions to indicate seasonal weather changes. Often oral traditions, these ethnographic evidence is best understood when combined with demonstrated celestial motion position using Stellarium paired with recorded patterns of animal migration and behavior, and documented weather patterns. Data collected from the scripting feature in Stellarium can be used to produce star position graphs which create a visual method to verify the ethnographic traditions of indigenous astronomers and to better understand indigenous terminology. Evaluation of ethnographic knowledge by deciphering embedded data in indigenous knowledge allows for quantitative data analysis and further understanding of astronomic knowledge. Position data for individual stars throughout the year are combined with ethnographic information to better understand indigenous celestial objects, and correlate them to Western star identities. These studies also help archaeoastronomers better understand the reasons for the cultural significance of the traditions that describe the patterns of sky motion that have been passed down for generations.

12:00 – 12:20 - July 7, 2025
"arcAstro–VR" for Archaeoastronomy

Kazuhiro Sekiguchi[1], Kuninori Iwashiro[2], Yoshitaka Hojo[3]

[1]National Astronomical Observatory of Japan, Japan. [2]scienceNODE, [3]Tokai University

Abstract:

Many archaeological remains exhibit positions and orientations that suggest a connection with astronomical phenomena. We can gain deeper insights into their spatial awareness and cultural practices by empirically analyzing these relationships and exploring how ancient people perceived celestial bodies. However, the celestial landscape we observe today differs from the past's. Due to Earth's precession, the apparent declinations of stars shift over decades to centuries. Similarly, the rise and set positions of the Sun, Moon, and planets change subtly over time due to gradual variations in the ecliptic tilt.

Archaeological studies have examined interactions between light, shadow, and celestial events—such as solstices, equinoxes, and specific alignments with stars and planets— by analyzing azimuth angles of structures, both human-made and natural. However, such observations often require extended periods and can be hampered by the deteriorated state of the remains. To address these challenges, a virtual reconstruction system that combines archaeological data with astronomical simulations offers a powerful tool for exploration and analysis.

We are developing arcAstro-VR, a computer system designed to virtually reconstruct archaeological sites and simulate past astronomical phenomena in a 3D virtual reality (VR) space. Built on Stellarium, an open-source planetarium software, arcAstro-VR reproduces historical skies with high accuracy. This platform allows users to explore the spatial relationship between archaeological remains and celestial phenomena in an immersive VR environment with customizable settings for enhanced analysis.

The latest version, Ver0.20.3, supports Meta Quest (Oculus Quest) headsets via PC connection with MetaLink. New features include a compass map display centered on a user-defined marker, dome master output for 360-degree dome projection using a fisheye lens, and water reflection simulation for any surface location. arcAstro-VR is open source, licensed under the GNU General Public License v3, and is available for Windows (Windows 8 and later) and macOS (macOS 10.14 and later). For more details, visit arcAstro-VR's official website.

For example, I will highlight virtual reproductions of two sites in Japan: the Yoshinogari ruins in Saga Prefecture and the Tsukuriyama Kofun Tumulus in Okayama Prefecture. These sites showcase the capabilities of arcAstro-VR.

12:20 – 12:40 - July 7, 2025
Using Machine Learning to Interpret the Insights into Borobudur's Celestial Reliefs

Irma Hariawang
TB Astronomy Alumni Association, Indonesia

Keywords: Borobudur, machine learning, Javanese ancient sky, Ursa Major, Pleiades

Abstract:
This work implements Recurrent Neural Networks (RNNs) to interpret the astronomical significance of a specific relief on Borobudur Temple's sixth floor, depicting a crescent moon, seven circles, and the sun. By reconstructing the ancient sky, we aim to identify the celestial configurations observable during Borobudur's construction, particularly the positions of Ursa Major or Pleiades relative to the crescent moon. This study reveals a correlation between the relief and ancient celestial phenomena, offering new insights into the astronomical knowledge of the ancient Javanese people. It is expected that implementing machine learning method can help on offering new idea to give solution on archaeoastronomy study.

12:40 – 13:00 - July 7, 2025

Pathways to the Oases: Introducing machine learning to archaeoastronomical study of funerary structures in Northwest Arabia

Maitane Urrutia–Aparicio

Universidad Europea de Canarias, Spain

Abstract:

Archaeoastronomical data analysis has proven to be a unique tool for the construction of narratives in cultural land- and skyscapes, reinforced by material evidence. However, when archaeological prospections are scarce or not accessible, the weight of this type of data increases.

This is the case of the pathways in the north-west Arabian regions leading to the oases of Khaybar and Al-Hait, which are surrounded by a myriad of drystone funerary structures (Dalton et al. 2022), dating to the third millennium BCE (Kennedy et al. 2021). Due to the vast number of them, their individual identification in situ or through transects in high-resolution satellite imagery becomes laborious and time-consuming. Therefore, it constitutes a potential case for applying new techniques which may facilitate and accelerate their detection and, moreover, extract useful information such as the orientation of a comprehensive and large sample, the basic data of archeoastronomy.

So far, the studies carried out in the Khaybar Harrat monuments state that most of these 'keyhole' and 'pendant' tombs are perpendicular to the pathways (Kennedy et al. 2015), but no systematic analysis on the topic has been performed. The present work attempts to identify the funerary structures and their orientations through machine learning and afterwards, explore possible patterns perhaps related to local topography or astronomical targets. Preliminary results suggest a predilection for cardinal directions, predominantly close to the East-West line, indicating a preference for the solar range. Besides, orientations towards South-Southeast have been identified to a lesser extent. A putative target for such orientation could be the bright star Canopus, whose long-lasting importance in the Arabian Peninsula is well documented. However, substantial evidence supporting these hypotheses, is indeed lacking.

This work not only underscores the advantages of using machine learning in archaeoastronomical research but also lays the groundwork for future studies that need the extraction of large-scale orientation data unattainable through conventional approaches. Nonetheless, these data ought to be corroborated by archaeological, topographic, and eventually, ethnographic evidence.

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Session 3: Archaeoastronomy I
14:00 – 14:20 - July 7, 2025
Lunar observations at Stonehenge

Clive Ruggles
University of Leicester, UK

Keywords: Stonehenge, Lunar standstills, Monumental Architecture.

Abstract:
Stonehenge's architectural connection to the sun is well known, but its link with the moon is less well understood. The rectangle of four small Station Stones surrounding the sarsen circle and trilithon horseshoe broadly align with the southernmost rising and northernmost setting positions of the moon, and it has long been debated whether this was deliberate, and—if so—how this was achieved and what might have been its purpose (Ruggles and Chadburn 2024). Through a combination of archaeological and archaeoastronomical research including first-hand observations of extreme moonrises and sets on suitable dates between February 2024 and May 2025 (Ellingson and Silva 2024), we set out not only to assess not only if the lunar alignments at Stonehenge were indeed deliberate and, if so, what was their intended precision, but also to obtain insights into the practicalities of making observations of the extreme moon and how such observations
might have operated as part of the ceremonials that likely accompanied them. The ultimate goal has been to throw some light on the possible purpose of such observations in relation to Stonehenge (Sabire and Chadburn 2024). In this paper we explain our approach and methods in detail and present our overall conclusions.

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14:20 – 14:40 - July 7, 2025
Astronomy before Chankillo: insights from Landscape Field

Ivan Ghezzi (Clive Ruggles)
UE Chankillo, Peru

Keywords: Archaeoastronomy, Peruvian Coast, Landscape Analysis, Monumental Architecture, Mountain Worship

Abstract:
The Chankillo Solar Observatory in Casma, Peru, is a 2,300-year-old instrument designed for landscape timekeeping, capable of determining specific dates throughout most of the year with an error margin of just 1-2 days. While similar sites are used to mark key dates such as solstices and equinoxes, Chankillo operates daily at sunrise and sunset, making it a "complete horizon calendar." The region surrounding Chankillo is characterized by significantly less cloud cover and thus better visibility than much of coastal Peru, which explains in part the title of "the cradle of pre-Inca astronomy." Despite the wealth of prehistoric sites in the region, many of which represent millennia of monumental construction prior to Chankillo, these sites had not previously been systematically analyzed using modern archaeoastronomical methods. During 2024 and 2025 we have measured specific architectural features at several pre-Hispanic sites across the Casma, Sechín, and Nepeña valleys with the aim of uncovering evidence of the long process of experimentation, learning, design, and knowledge transmission that ultimately led to the creation of the Chankillo Solar Observatory. In this presentation, we share the results of our archaeoastronomical research, focusing on the use of plazas and platforms— specifically, axes of symmetry and diagonals—as representations of different "axes mundorum" within the pre-Hispanic worldview of the region (3500 BC - 200 BC).

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14:40 – 15:00 - July 7, 2025
Revealing ancient Indigenous astronomies through their architecture

Juan Antonio Belmonte
Instituto de Astrofísica de Canarias, Spain

Abstract:
Just two decades ago, the Orientatio ad Sidera (OAS) project was launched with the support of the Spanish scientific institutions to develop cultural astronomy studies with special emphasis on the ancient Mediterranean civilizations, from the Canary Islands to the Arabian deserts. For 20 years now, the project's researchers have traveled the five continents studying indigenous architectures in numerous archaeoastronomical fieldwork campaigns and defending astronomical heritage, including the support to three new UNESCO World Heritage properties in Spain (Marín and Belmonte, 2023). In the last decade, two PhD theses were made under this framework in an attempt to understand how the Roman and Christian worlds expressed their respective cosmovisions in their cities and temples (Rodrígez-Antón et al. 2018, Urrutia-Aparicio et al. 2022). In this talk, we will briefly present some of the project's highlights, including our most recent findings. Caral, the oldest city in the Americas, will be analyzed and how their buildings can help us understanding the important role that the moon may have played in their culture (González-García et al. 2021). In a jump to contemporary ancient Egypt, how the pyramid fields of the Old Kingdom recreated a landscape imbricated in the skyscape and the control of time will be discussed (Belmonte and Lull 2023).In Rapa Nui, we will study how indigenous traditions about the sky, which still persist, can help to reveal some of the complex ahus and their elaborated moais (Marín and Belmonte 2023: 237-71).Finally, we will explore how Arabian landscapes inspired the Nabataean ingenuity to erect the extraordinary monuments of Petra and Hegra, orientated to the peak moments of their feast calendar (Belmonte et al. 2020, Belmonte et al. 2024). OAS is possibly the longest-running cultural astronomy continuously funded research project in the world. Its recently approved sixth edition will continue to explore ancient skies, with renovated synergies, on the indigenous cultures of the Mediterranean world and beyond

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15:00 – 15:20 - July 7, 2025
Cultural Astronomy of a Pai Tavyterã (Guaraní) ceremonial house in Amambay

A. César González-García[1], Gustavo G. Politis[2], Felipe Criado Boado[1], Mirtha Alfonso Monges[3], Márcia L. Hattori[1], Luis Martínez Otero[4]

[1] INCIPIT-CSIC, [2] INCUAPA-CONICET; [3] Museo de Itaipú Tierra Guaraní; [4]IN-CSIC

Abstract:

Large rectangular, oval, or sub-oval communal houses are a common feature of Amazonian settlements and are also found elsewhere in the South American lowlands, associated with various ethnic groups (Steward, 1948). Such structures are commonly associated with a variety of ritual practices, with the tembetá being a notable example among the Guaraní.

These structures were also common in these large area in the past. Archaeology of lowland South American settlements is generally characterized by the appearance of postholes and hearths and the lack of stone-built structures. In order to interpret such findings, archaeologists often recourse to comparison with present day indigenous houses (Deboer and Lathrap, 1979; Zeidler 1983, Rostain et al. 2011). The objective of this talk is to present the preliminary findings of a series of observations and studies conducted among the indigenous population of the Ita Guasu community, which is inhabited by the Pai Tavyterã people in the northeastern region of Paraguay.

In particular, we will present the study and analysis of a substantial ceremonial architectural structure, the óga guasu, which is employed on an annual basis for the celebration of Kunumi Pepy or Mitã Pepy, the rite of passage for male adolescents known as kunumi pepy. The initiation ceremony is centred on the piercing of the lower lip for the insertion of the tembetá or lip button. However, it also encompasses a complex series of other ritual activities, including dancing, feasting on special foods and ceremonial singing.

The ethnographic study includes the recording of the ritual, including both filmic and written records. This is complemented by an archaeoastronomical evaluation of the times and architectures involved. The overall picture resulting provides insights that may facilitate a more comprehensive understanding of the characteristics and functions that these large communal houses, and perhaps enhance the comparison for the archaeological remains.

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15:20 – 15:40 - July 7, 2025

The Cultoon stone circle: investigations continue

Gail Higginbottom
University of Bournemouth, UK

Keywords: megaliths, stone circle, archaeoastronomy

Abstract:

In a moorish area on the peninsula of Rhinnes on the island Islay, about 5.5 miles North East of Portnahaven (Port-nah-abhainne) lies the stone circle of Cultoon. The Cultoon circle is the largest of three on the island of Islay. Of 14 stones, currently two are more or less standing upright, the others have fallen, or have never been standing on their envisaged positions. Excavated in 1974 and 1975 by the Islay Historical Works Group (Euan MacKie), their conclusion was that it was abandoned in the middle of construction. Richards, in his book 'Building the Great Stone Circles of the North' (2013), puts the emphasis of such circles on the actual building process, instead of the finished result. However, as the actual building process was not completed we theorise a different possibility. Namely, that this incomplete monument is a possible reference to, and provides clues of, cultural change in the region. In this way, the littered and cluttered site is a memory-scape of a dramatic event(s), encapsulating the failure of the construction as well as the changes that occurred externally. Whilst previously intended, but not yet done so, we include data about the uniqueness of Islay's standing stone astronomical orientations with the newest landscape and astronomical information we have created for the site of Cultoon. Combining these things with archaeological and genetic information about cultural changes occurring in Britain at the time of Cultoon's creation we reveal something of Cultoon's place in the changing world of the Late Bronze Age. Our digital landscape and astronomical tools are Horizon and Stellarium, along with the 10m elevation data available from the Ordnance Survey in Britain.

Session 4: Archaeoastronomy II

16:10 – 16:30 - July 7, 2025

How Indigenous is ancient Egyptian astronomy?

Jose Lull

Universidad Autónoma de Barcelona, Spain

Abstract:

The astronomical tradition of the Pharaonic period must have been forged, at least in its most basic aspects, between the predynastic and the first dynasties. However, these centuries present a great difficulty for study, due to the scarcity of written and iconographic documents susceptible to being interpreted from an astronomical perspective and the uncertain significance that some of those found may show. Some predynastic rock engravings and ceramic decoration from the 4th millennium BC could already refer to celestial divinities and the idea of the supraterrestrial watery world. The celestial world must have already been very present in Egyptian culture, since it was precisely at that time that some of the most specifically Egyptian religious and funerary beliefs must have developed and consolidated, many of which are already detectable in the Pyramid Texts from the end of the 5th Dynasty.The Egyptians' special relationship with Sirius is due to a purely indigenous origin, which was also able to endure for millennia, even in spite of the changes that local astronomy underwent during the Greco-Roman period, since even in the early days of astrology in Egypt, unlike in Mesopotamia, this star was undoubtedly important. No other written culture in the Near East had this relationship with Sirius, even though it was the brightest star in the celestial vault. Of course, we do not know what the situation was in the 3rd and 2nd millennium BC in African cultures close to Egypt, since all of them lacked writing.The topographical and landscape context in which Egyptian civilization developed, as well as the behavior of the Nile River with its dry and flood phases subject to an approximately predictable annual cycle, must also have been essential in the development of the most basic concepts about the origin of the world, its end or its structure. These concepts can be traced especially from Egyptian cosmogonies and religious compendia such as the Pyramid Texts, the Book of Coming Forth by Day and other texts. Both the celestial vault and the earthly world surrounding the Egyptian territory could be understood from the observation of what was closest and most common, so this thought also obeyed its own and particular conditions.From the 3rd millennium BC, Egyptian priest-astronomers were the key figures in the development of Egyptian astronomy. They were the ones who catalogued the stars that served as time references and who invented systems of time measurement with them by observing their rising, transit through the meridian or their position in relation to the celestial north pole. These systems are typically Egyptian, as are some instruments, such as the shadow clock. The analysis of the figure of the Egyptian astronomer, through prosopography, his position in the social hierarchy and his possible interaction with Egyptian society, is also key to answering the question we pose.

References:

J. A. Belmonte and J. Lull (2023), *Astronomy of Ancient Egypt: A Cultural Perspective*, Springer

16:30 – 16:50 - July 7, 2025

Reconstructing the Skyscape on the Island of Mountains: An Overview of the Astronomical Knowledge of Taiwan’s Indigenous Peoples

Po-Sheng Ou
National Taiwan University, Taiwan

Abstract:
Taiwan is widely regarded as the homeland of Austronesian expansion, making the study of its indigenous peoples (Austronesian Taiwanese) crucial for understanding Austronesian cultural diversity. Among the many facets of their cultural heritage, their astronomical knowledge stands out as an area of profound importance that has received limited scholarly attention. This knowledge is deeply embedded in their religious practices and cosmological views and is shaped by their interactions with the natural environment.

In cultural astronomy, the "skyscape" is understood as the product of human agency in its interplay with the heavens and the surrounding landscape. Generally, for Taiwanese indigenous peoples, who inhabit an island characterized by towering mountain ranges, their skyscape reflects a worldview deeply influenced by the mountains and forests surrounding them, offering a stark contrast to the maritime navigation traditions observed in many other Austronesian cultures.

This presentation provides an overview of the astronomical knowledge of Taiwan's indigenous groups, as expressed in their myths, religious beliefs, rituals, architecture, hunting practices, and calendar systems. Special emphasis will be placed on the Bunun people, drawing from both literature and field research conducted in Nantou and Taitung. The Bunun possess constellation names and symbolic systems for calendars inscribed on wooden plates, offering a unique perspective on their understanding of the cosmos. By examining this indigenous knowledge, we aim to reconstruct the skyscape within the traditional worldview of Taiwan’s indigenous peoples and highlight its cultural significance.

16:50 – 17:10 - July 7, 2025

Testing the connection between the appearance of Comet 1P/Halley in 760 CE

Ide Nada Imandiharja
Bandung Institute of Technology, Indonesia

Abstract:

Astronomical knowledge has been attached to the ancestors of the Indonesian people since ancient times. The assumption raised in this study is that the Dinoyo Inscription is a response from the Kanjuruhan community to the phenomenon of the arrival of comet 1P/Halley which was identified in the same year as the year the inscription was issued. This research was conducted from the point of view of archeoastronomy. In this study, three types of tests were carried out, namely tests in chronological, geographical, and cultural aspects. Tests on chronological and geographical aspects use inscription data reviewed with the Stellarium astronomy application. Meanwhile,testing on cultural aspects is carried out by interpreting the symbols contained in the contents of the inscriptions. The results of these tests are used to strengthen the argument about the existence of a relationship between the contents of the Dinoyo Inscription and the arrival of comet 1P/Halley. The lack of data hampers the validity of the arguments that have been developed. However, based on the results of the tests that have been carried out, the behavior of the Kanjuruhan people on the Dinoyo Inscription is a response to the phenomenon of the return of comet 1P/Halley in 760 CE.

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17:10 – 17:30 - July 7, 2025

Tracing the Ancient Indonesian Javanese Inscriptions on the Appearance of Supernovae: An Archaeoastronomical Review of the Turun Hyang B and Jaring Inscriptions

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Keywords: Archaeoastronomy, Supernova, Turun Hyang B Inscription, Jaring Inscription, Dating Reconstruction

Abstract:

There were recorded history in ancient time about the occurrence of Supernovae, documented in various part of the world, such China, Japan, and Europe which recorded Supernova phenomena that occurred in 1054 and 1181 AD. In this work we attempt to find the ancient record in the form of inscriptions and manuscripts used by the people of Ancient Java in the 10th and 11th centuries AD, since there numerous recorded evidence found on the event of war, government politics, or social activities. While the Supernova that occurred on 1054 AD (SN 1054) that occurred in the Taurus constellation which had a duration of 22 months from 4 July and it has a visual magnitude (mv = –6). This visual magnitude is quite bright compared to the limit of human vision, which can only perceive the brightness of celestial objects at (mv = 6). Furthermore, in 1181 AD, there was also a supernova phenomenon or SN 1181 that occurred in the Cassiopeia constellation with a probability of (mv = –1) and a duration of 185 days from 6 August. This paper attempts to reveal the results of the search on ancient records in Indonesia, which are based on the Turun Hyang B inscription and the Jaring inscription, both of which have the same year of inscription with the occurrence of the supernova phenomenon. An archaeoastronomical approach was used to analyses the research data and the Stellarium application was used to provide support for the depiction of sky simulations in the 10th and 11th centuries AD. This research is analytical-descriptive to trace the evidence of recording in the inscriptions of the Ancient Javanese period by using secondary data sourced from previous records. The results of this study show that the Kediri area, Indonesia, can observe the phenomenon of SN 1054 when it is at the celestial meridian with an altitude of +61°24'01.9‘ and SN 1181 at an altitude of +30°13'04.6’. However, a preliminary review of the contents of the Turun Hyang B and Jaring inscriptions shows that there is no specific mention of a ‘guest star’ or any other meaning related to supernovae. This study also produced data that the constellations in the Jaring inscription have an angular distance difference of 116.69°, which is the distance between the constellation Sagittarius and the constellation in SN 1181, Cassiopeia. Furthermore, in the Turun Hyang B inscription, dating reconstruction using naksatra and

dewata data based on the position of the Moon when it was in the constellation of Aries resulted in the possibility of this inscription was made on 3 July 1054 AD and close to the occurrence of SN 1054. We discuss the possibility of the whether the ancient people did not record the occurrence of the opportunity, or other possibility explanation which were recorded on other inscriptions and manuscripts that we might overlooked.

Videos

What is above is Below: Celestial representations in the architecture at Quilcapampa La Antigua

Luis Gonzalez
University of British Columbia, Canada

Abstract:

This presentation presents a brief discussion of the architecture from the archaeological site of Quilcapampa La Antigua, which focuses on spatial analysis and the architectural unit of patio groups. We discuss these patio groups, habitation spaces and the access patterns between architectural units. The site is oriented around an asymmetric principal plaza, breaking the classic pattern of rectangular or circular plazas in other parts of the Andes. Patio groups are oriented alongside the perimeter walls of the plaza. In this presentation we suggest that the construction of Quilcapampa La Antigua begins and expands from the plaza, since its peculiar shape is associated with a very important constellation in the Central Andes, the Southern Cross or Chakana. The significance of the stars and other celestial bodies is well known for travelers, such as among navigators. During the 9th century CE, Quilcapampa was an axis of interaction between other sites in the southern valleys of Peru as an enclave that could bring together settlers from multiple places. We argue that the plaza at Quilcapampa in the shape of the Southern Cross is evidence for the role of this site as an axis mundi for roads that cross the pampas in the Siguas Valley, the geoglyphs that serve as guides to the roads, the petroglyphs being marks or a signature of the passage of travelers or merchants. We posit that for the people of Middle Horizon Quilcapampa La Antigua, monumental constructions were linked to important points in the sky. We reinforce our argument with analyses revealing alignment among the vertices of the plaza with three Apus, or mountain deities, indicating directions that travelers would follow after passing through Quilcapampa La Antigua. The talk suggests that the construction of Quilcapampa was part of an ongoing negotiation between the Wari settlers, local groups and visitors guided by alignments of celestial bodies of the starry night.

Archaeoastronomy Among Shell Mounds

Leandro De Paula Neto
Universidade Federal de Santa Catarina, Brasil. UFSC – Federal University of Santa Catarina. Email: leandropaulaneto@gmail.com

Abstract:

The original peoples left enduring marks on the landscape through shell mounds, earthworks, sand formations, rocks, and rock art, forming a remarkable cultural legacy along the South Atlantic coast of Brazil. This study, conducted in the municipality of Laguna, State of Santa Catarina, in southern Brazil, aimed to document the rock art traces present among archaeological shell mound sites (sambaquis). The purpose was to contribute to the archaeological record of these sites, which remain overlooked by heritage protection agencies, suffering from inadequate identification, signage, and educational initiatives. The methodology involved a bibliographical review, analyzing works by Latin American authors and researchers on topics such as shell mounds, rock art, archaeoastronomy, geology, socio-environmental studies, and the history of fishing along the coast of Santa Catarina. Fieldwork included astronomical observation during the summer and winter solstices as well as the autumn and spring equinoxes, capturing images, videos, geographic coordinates, and astronomical data from each site at specific moments defined by the research. This study highlights a profound understanding of the landscape and the deliberate selection of specific territories for diverse social purposes. It reveals probable alignments of the sites with celestial bodies and features of the horizon, underscoring the intricate relationship between cultural practices and the natural environment.

An archaeoastronomical overview of Hittites geography

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Abstract:

The Hittites, who appeared on the stage of history at the beginning of the 2nd millennium BC, is an important Anatolian empire that left its mark both with its written documents and monumental architectural remains and arts. Although it is known that the Hittites, who became stronger with the reign of Hattusili I and his successor Mursili I from approximately 1650 B.C. onwards, ruled in the 2nd millennium B.C. in the capital city of Hattusa, the origin of this people is still unknown. When both mythological texts and feast texts of the Hittites are analyzed, it is seen that the people of the Hatti country attach great importance to seasonal cycles. The cult ceremonies and festivals organized by the Hittites to please their gods included specific periods, routes and days. The festivals were organized according to a specific calendar and certain calculations were made based on seasonal cycles. The written documents describing the cult trips on certain days of the year and the celebration of certain festivals actually describe a distinct celestial and seasonal route. In the Hittite geography, the Sun god manifests itself in monumental architecture as an effect of the Sun cult. In the Eflatun Pınar monument, the solar emphasis of the Hittite cosmogony manifests itself most clearly. The gates of important Hittite settlements such as the capital Hattuša and Alaca Höyük, were used for purposes other than defense. At the Yerkapı in the Upper City of Hattuša, the inclination of the two southern corners of the building is precisely 32°. This corresponds to the maximum height of Sirius in the sky at the time the city was built. The 32° angle used on both the horizontal and vertical axes shows that the northern entrance of Yerkapı was determined by the position of Sirius in the sky. When the directions and angles of the north entrance of Yerkapı and the southeast and southwest corners were measured, it is seen that the other buildings of the city were also positioned according to the annual apparent motion of the Sun. The southern corners of the Yerkapı were oriented according to the rising and setting points of the Sun at the summer solstice and winter solstice, and the eastern gate of the city, the King's Gate, and the western gate, the Lion Gate, were also built to be located on these directions. A similar connection is also found at Alaca Höyük. The Sphinxed Gate of Alaca Höyük is the southern gate of the city and it is thought to be connected to the position of the North Star Polaris based on our measurements.

Moonrise at Chimney Rock

Erica Ellingson
University of Colorado at Boulder, USA

Abstract:
Chimney Rock, located on a narrow ridge in southwestern Colorado, is the site of an important ancestral Puebloan settlement, with a multistoried Great House and ceremonial structures dating to a thousand years ago. Views from these buildings towards the northeastern horizon are framed by dramatic rock pinnacles, but in a direction slightly too far north to capture the northern solstice. However, the northernmost lunar positions during the Major Lunar Standstill season create spectacular moonrises between the pinnacles. Tree ring dating from the buildings at Chimney Rock shows activity linked to the lunar standstill cycle a thousand years ago. The area holds deep spiritual significance for the 26 modern Native American Pueblo and Tribal communities that have cultural and traditional ties to the region. Today, descendants of the ancestral Puebloans return to this important place of cultural continuity for ceremonial and traditional purposes.

The Major Lunar Standstill season in 2024-2025 offers a unique opportunity for education and observances by Native American groups and the general public. A collaboration between the San Juan National Forest, the University of Colorado, Lowell Observatory, Griffith Observatory, the Chimney Rock Interpretive Association and affiliated Tribes and Pueblos has designed a series of events and educational materials about the lunar standstill. The film we are submitting includes a 10 minute film narrated by Lieutenant Governor Cordelia Hooee of the Zuni Tribe, “Moonrise at Chimney Rock,” plus a short additional segment about the collaboration and public events.

Ancient astronomy in Mexico and its hierophanies

Cuauhtemoc Mendez
TRIBU cultura astronómica / Tec de Monterrey, Mexico

Abstract:
To speak of Astronomy in ancient Mexico is to evoke the Maya, Aztec, Olmec, and many other cultures. All of them with some characteristics in common, besides inhabiting the territory known today as Mexico. All these great ancient cultures stood out for being avid observers of the sky, even performing analyses that seem mathematical to know the positions that different stars would have at different times. Today we know that the main reason for these activities was to have an agricultural calendar; to prepare the land before the rainy season arrived and thus achieve food and sustenance for the entire village. This led to the construction of astronomical markers to know precisely important dates related to the cycle of their crops. These markers were presented to the settlers as temples, and the phenomena observed on certain dates is what is known as Hierophanies; “the presence of the divine”.

In this presentation I will share some hierophanies found in different parts of the Mexican territory; in the southeastern part with the Mayas and the very famous pyramid of Chichen Itzá, in the central part in Malinalco and a very interesting marker of solstices and equinoxes, in the northern part in which their substrates were not fertile and the calendars were used for the location of herds and the respective hunting, and finally in the western part of the country with the less known circular pyramids.

This talk seeks to share with the public the close relationship that stargazing, the worship of the divine, and the procurement of food, had in these ancient cultures. We hope that this in itself explains the Deep curiosity that observation of the stars generates in people, not only in this region but also in the planet we inhabit and call home.

Posters
Envisioning the Cultural Landscapes of the Greater American Southwest

Gregory Munson
Society for Cultural Astro. in the American Southwest, USA

Abstract:
The Society for Cultural Astronomy in the American Southwest, Inc. (SCAAS) is a professional and avocational scientific and educational non-profit member organization. Our members developed a Cultural Landscape/Skyscape Survey Program functioning to enhance and standardize
site recording in a spatial, visual, landscape and astronomical context. It is our goal to develop a repeatable high-fidelity procedure using currently available data capture and processing tools to document site conditions, local and adjacent topography, building and feature orientation, and line of site access to both horizon and astronomical phenomena.

Recent advances in spatial and photogrammetric data processes now give us unprecedented documentation and visualization tools. Our region of interest is the lower Intermountain West of the United States. We deploy rigorous archaeological documentation methodologies, US Geological Survey LiDAR and geophysical data, drone-based imaging technology, high-resolution panoramic photo imagery and desktop Planetarium software to study archaeological sites in our region.

These technologies are currently in use by archaeologists and cultural astronomy researchers around the world. We are seeking to systematize and codify the use of this entire suite of tools to produce useful two- and three-dimensional report standards to add to the archaeological record. The power of statistical research is dependent on the capture and documentation of a range of distinct standardized qualifications and quantifications. It is our intent that our standardized documentation methods can be useful to students and adopted by Cultural Resource Management firms with minimal training.

For the last three years we tested these technologies through conducting documentation projects at Escalante Pueblo, Lowry Pueblo and the Jackson's Castle Complex in Canyons of the Ancients National Monument near Dolores, Colorado USA. We are working with grant funding under Bureau of Land Management permit at these sites to study building and feature orientation to landscape and horizon features like mountain peaks and the rise/set positions of the sun, moon, stars and constellations. Each of these sites are Ancestral Pueblo, dating to the Classic Pueblo Period from 1100 – 1300 CE. Our initial project at Escalante Pueblo revealed that the south walls are aligned to Hesperus Mountain, likely forming an eastern horizon calendar effective for determining seasonal changes in socio-ceremonial systems.

Hesperus Mountain is sacred to the Pueblo and Navajo peoples. The Bears Ears, Abajo, La Plata and Sneffles mountain ranges are visible from Lowry Pueblo where we found architectural and horizon feature alignments for determining both solstices and the equinox.

Previous studies of the Jackson's Castle Complex revealed associations with the observation of equinox and seasonal social changes (Bernhart and Ortman 2014).

Each of these cases involves distant horizon calendars which have a greater potential for demonstrating cultural intent as revealed in the historic Hopi pueblos (McClusky 2010). Ute Mountain is a peak visible from all three sites. We expect that as we add more archaeological sites with views to these same horizon features, we will begin to see common patterns that may bind together this shared cognitive map into the sacred cultural landscape we see here today (Bernardini and Peeples 2015).

References:

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Introducing: Stellarium Sky Culture Maker

Youla Azkarrula & Susanne M Hoffmann
Independent Scholar, Indonesia & Independent Scholar, planet Earth

Abstract:
The excellent desktop planetarium software Stellarium (Zotti et al., 2021) allows researchers to contribute their own ”sky cultures” (The Global Stellarium Team, 2022). A sky culture consists of line patterns (stick figures), constellation artwork, labels for these compounds, their parts (e. g. star clusters and associations) and individual stars, and a description file that
explains the culture to a broader public (with illustrations, reference etc.). The definition of these sky cultures has always required a lot of patience and some technical expertise, which appears challenging for many cultural researchers with academic backgrounds e. g., in ethnology, philology, anthropology, or history (of science and culture).

Our new tool aims to bridge the gaps between software developers and researchers from the humanities who would like to contribute their data. It is a browser-based application with which the researcher can visually define line patterns (per mouse click), add labels, and adjust artwork. It automatically outputs the set of files from the historical sky culture definition protocol and the new JSON-file that the Stellarium software package needs to display and distribute the sky culture publicly.

This new means in the toolbox of the digital humanities is currently developed and tested by us with an own study on an Indigenously Balinese sky culture, and it will be released in 2025 together with the new ”Sky Cultures 2.0” definition package of the Stellarium Team.

References:

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Investigating the Ethno Geometric Pattern of Positional Astronomy in the Archaeoastronomical Research Site of the Oromoo Calendar

Mulugeta Markos Tediso[1], Abdusalem Mohammid Yasin[2], Gemechu Berhanu Kerorsa[3]

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[3] School of Veterinary Medicine, Dambi Dollo University, Dambi Dollo, Ethiopia
Keywords: Namoratonga, Oromoo, positional astronomy, Yayyaba Gadaa, Calendar

Abstract:

Astronomy encompasses the study of celestial bodies such as planets, moons, stars, and the sun, influencing various aspects of daily life and intersecting with diverse cultures. In Oromoo culture, the five Yayyaba Gadaa—Sun, Moon, Stars, Earth, and Water—constitute a worldview that reflects this connection to the cosmos. Notably, celestial elements account for approximately 60% of this framework, while Earth and Water comprise only 40%. Research focused on the Borena Calendar has been unraveling aspects of ancient Oromoo astronomy since the 1970s, particularly at sites like the Namoratonga Pillar II in northern Kenya. The previous of studies regarding the Borena Calendar indicates that the stone pillars of Namoratonga pillars serves as critical evidence of early celestial knowledge and sky-watching practices of the Oromoo community in the Cushitic family. This study explores the ethno-geometric dimensions of spherical astronomy (positional astronomy) within the archaoeastronomical framework of the Oromo calendar's seven star system. By examining ancient astronomical alignments and their cultural implications, we aim to reveal the complex relationship between the Oromo people's cosmology and their agricultural practices. Our research employs a blend of field surveys, geometric modeling, and ethnographic interviews to identify significant celestial events that align with seasonal agricultural activities. The findings indicate that the Oromo calendar serves not just as a temporal tool, but as a sophisticated system that intricately connects celestial observations with socio-cultural practices of the Oromoo community. This research significantly contributes to the broader field of archaeoastronomy by underscoring the value of indigenous knowledge systems in interpreting astronomical phenomena and their practical applications in daily life, with implications for contemporary discussions on cultural heritage and the preservation of traditional astronomical knowledge. Our study further investigates the mathematical principles underlying these cultural expressions, revealing a hidden constant related to spherical objects that we called the sphere constant, for clarity.

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Opening African Astronomical Heritage Research Division at the Qellem Wallaga Zone

Mulugeta Markos Tediso[1], Abdusalem Mohammid Yasin[2], Gemechu Berhanu Kerorsa[3]

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Keywords: Keplar Star, Astronomical event, Space age

Abstract:

It is obvious that the Ethiopian Space Science Society was established in 2004. ESSS main office has also been creating both national and international collaboration. Today, ESSS has 31 branch Association and above ten thousand individual members. ESSS Dambi Dollo Branch Association (ESSSDDBA) is one of its present branch Association. We established it in 2020, after we attended IAUS356 that took place at Addis Ababa in 2019. From IAUS356 astronomical event, we obtained experiences of famaus international astronomers while we also contributed poster presentation of our previous research we conducted on Kepler Star System. We also observed Solar eclipse astronomical event at Lalibela on June 21, 2020. Then, we proposed the establishment proposal of ESSS Dambi Dollo Branch Association and submitted to Dambi Dollo University in 2020.Three research division were proposed in the establishment of the branch Association. The proposed three research Divisions are: African Astronomical Heritage and Diplomacy, Kepler Star System, as well as Innovation and Software research Division. In 2022 we heard the presence of un-investigates cave in the West Wallaga (Ethiopia) from local people. Nowdays, we are investigating the cave with follow up of the University. The current Stage of our investigation shows that Bollo Cave promotes the African Astronomical Heritage and Diplomacy Research Division in the physics department of the Dambi Dollo University. Consequently, we will present the current Stage research division of this Cultural astronomy we are opening in this space age.

IAU SYMPOSIUM 399

Indigenous Astronomy, July 8, 2025

Session 5: Indigenous Astronomy in Australia and Oceania

09:00 – 09:20 - July 8, 2025

Australia's Cultural Night Sky

John Goldsmith
Space Science and Geophysical Institute, Australia

Abstract:
Our project aims to provide an intergenerational experience on country to enable a group of Aboriginal youth aged 12 – 15 years to experience the splendours of a truly dark night sky and cultural storytelling, which will take place at a very special landscape at Lake Ballard in the Goldfields region of WA. This site is home to acclaimed international artist Sir Antony Gormley's "Inside Australia" project, with 51 alien-like metal statues widely located across the Lake Ballard salt lake. The major outcome envisaged from this project is to significantly advance and enhance community attitudes and valuing of cultural astronomy. We will achieve this via the creation and field testing of a positive cultural learning experience for Aboriginal youth. Our project is funded by the IAU via the international Astronomy for Development programme (Astro4dev.org) which is administered in Cape Town, South Africa.

Dark night skies are a vital prerequisite to preserve, maintain and communicate Australian Aboriginal sky knowledge. Several sky patterns originating from ancient Aboriginal culture in Australia, are recognized from dark areas in the Milky Way. Visibility of these "dark nebulae" are drastically affected by urban light pollution. This prevents or severely restricts their appreciation by those who live in urban, light polluted areas. Maintaining dark skies for the benefit of all, is a vital goal. Western Australian Aboriginal astronomical knowledge is intimately based on awareness and experience of dark night skies. Many Indigenous and Aboriginal communities throughout the world are focussed on caring for our own planet, via relationships, awareness, responsibility and care. This approach contrasts sharply with ego based exploitive approaches of modern space exploration. Faced with multiple threats including light pollution and massive increase is satellite traffic, these negative effects can be countered via awareness, experience and community learning. The inspiration behind our project comes from several sources, including (1) Western Australian Museum astrophotography exhibit "Western Australia by Night" (2) PhD Thesis "Cosmos, Culture and Landscape" (2014) (3) "Visions of the Cosmos, Landscape Astrophotography from Western Australia" (2023), (4) recent documentary films including "The Borderless Sky, The Aboriginal Sky of Australia" and "Fireball, Visitors from Darker Worlds" and (5) experience and learnings from the 2023 Total Solar Eclipse, Exmouth, Western Australia.

The direct management, control and direction of the project by Koya Aboriginal Corporation in partnership with Celestial Visions (www.celestialvisions.com.au) is a vital part of our future success story and we hope that our story will help to inspire others to develop socially responsible, positive ventures into the future.

09:20 – 09:40 - July 8, 2025

Aboriginal Astronomy of the Sydney Basin

Robert Fuller
University of Western Sydney, Australia

Abstract:
The Sydney Basin may have thousands of Aboriginal engraving sites. MacDonald (2008) examined over 700 sites with more than 14,000 engravings. To date, very little cultural astronomy has been attached to those engravings previously recorded and those still visible, mainly due to the long-ago loss of the knowledge holders and Traditional Owners for those sites. Due to the eroded state of many engravings, and the vast number to be examined, a new methodology using the latest technology was needed to examine individual engravings and to connect engravings over large areas through thematic approaches. Due to the need to examine engravings and other possibly man-made items from the microscopic to the macroscopic, a technical approach using multiple sensors has been developed. Field microscopy is used to examine engravings for methodology, but particularly for the difficult question of determining whether any of the numerous cupules in the Hawkesbury Sandstone are man-made, as they may fit into the larger engraving motifs. Photogrammetry using held-held and pole-mounted DSLR cameras is used to provide high-resolution 3D images of individual engravings. Metashape and MeshLab processing is used to develop solid images and to manipulate lighting to 'recover' engravings. To create cultural heritage maps and to connect engravings into significant relationships, maps of the rock art platforms/sites were created using a high- resolution mapping drone. Imaging from the drone was processed using ArcGIS Pro and Metashape to create Ortho maps, Digital Surface Models, and 3D objects. All these processes have been developed into a workflow which has begun to tease previously undetectable connections between engravings and other phenomena on engraving sites, some of which may be significant in connections to stories and the cultural astronomy of the Aboriginal peoples who originally used these sites. This process of methodology development and research has been carried out with the support and cooperation of the local Aboriginal community and the National Parks and Wildlife Service NSW.

09:40 – 10:00 - July 8, 2025

"It's not a Horoscope" – A Māori system of celestial observation and implementation for achieving Indigenous well-being

Isaac Warbrick[1] & Jade Kameta[2]

[1]Taupua Waiora Māori Research Centre. Auckland University of Technology, Auckland, New Zealand,

[2]Healthy Families East Cape, Whakatane, New Zealand

Abstract:

The Maramataka, often referred to as the 'Māori lunar calendar,' is a sophisticated Indigenous system of observing the moon, stars, and other celestial bodies, alongside their relationships with natural phenomena such as bird migration, fish movements, plant flowering, and human behaviour. These observations, refined over generations and preserved through oral traditions, enabled our ancestors to align their activities with the environment—identifying optimal days for planting, harvesting, fasting, meditation, fishing, and other activities. While our access and engagement with the environment has changed because of colonisation, the Maramataka continues to be a vital tool for fostering well-being and optimizing energy and time in contemporary contexts.

This presentation shares the insights of two Māori researchers whose work is guided by the oral traditions of Māori astronomy. Kameta will present lessons from his role as a community health system innovator, integrating the Maramataka and Māori astronomy into community practices as a transformative model for systems change. His PhD research expands on these innovations, offering new frameworks for applying traditional knowledge in modern contexts. Warbrick will share findings from a three-year study investigating the Maramataka as a means of reconnecting with the environment to achieve holistic well-being. This study combines narratives from interviews with expert Māori practitioners and knowledge holders, quantitative measures of environmental health, and the cultural encoding of astronomical knowledge in contemporary Māori compositions and chants as research tools.

While Indigenous astronomy once guided our ancestors in securing physical sustenance, this presentation highlights its broader role in providing spiritual, cultural, and psychological healing. Through the Maramataka, we see the enduring potential of Indigenous knowledge systems to address modern challenges and restore balance between people and the environment.

10:00 – 10:20 - July 8, 2025

Indigenous Astronomy and Ancient Constellations in the Pacific places

Exodus Chun-Long Sit
IAU NAEC, Hong Kong–China

Abstract:
This presentation will delve into firsthand investigations of indigenous astronomy, showcasing ancient astronomical instruments from China displayed at Beijing institutions and Hong Kong Astropark. It will also detail experiences from a visit to the Helan Mountain National Forest Park in Ningxia, China (2023), featuring ancient rock paintings and petroglyphs symbolizing the sun, dating back to the Paleolithic era and the Western Xia civilization. Furthermore, insights will be shared from astrophotography expeditions in Inner Mongolia, China (2024), and Tasmania, Australia, (2023) about observations of ancient Chinese and Australian Indigenous constellations during the same months. These endeavors highlight the distinctions between the Milky Way galaxy and constellations in the southern and northern hemispheres from the astronomical observation perspective.

10:20 – 10:40 - July 8, 2025

Calendrical Diversity on a Small Island: Sabu Raijua Traditional Calendar

Regina Indah Syalaisha, Chatief Kunjaya
Bandung Institute of Technology, Indonesia
Faculty of Mathematics and Natural Sciences, Bandung Institute of Technology

Abstract:
The Regency of Sabu Raijua, located in East Nusa Tenggara Province, comprises three islands and six districts, spanning an area of approximately 460.47 km² with a population of 89,327 in 2020, according to the Regency's Central Statistics Agency. Sabu island is one of the driest islands in Indonesia. Combined with very low light pollution, it is one of the best Indonesian sites for astronomical observation and astrotourism. Despite its modest size, Sabu Raijua is rich in cultural heritage, notably its traditional calendrical system. Sabu's Calendrical system is more than just a tool for timekeeping, it is a cultural framework that governs agricultural activities, fishing schedule, and ritual practices integral to the Sabu way of life. What sets Sabu's traditional calendar apart is the diversity of its interpretations across different regions of the regency. Geographical conditions and limited interregional interaction–despite its small area– have led to distinct local adaptations of the calendar. This study highlights how the traditional calendar reflects the diverse cultural practices and ecological adaptations of Sabu Raijua's communities, despite its relatively small geographic area, providing insight into the relationship between geography, tradition, and timekeeping. This diversity demonstrates how geographic factors and limited interregional interactions play a key role in shaping the variations in the calendar system.

Session 6: Indigenous Astronomy in Asia

11:10 – 11:30 - July 8, 2025

Predicting seasonal changes in a community village in southern Benin Republic (West Africa): A Case Study from the Lake Ahémé Region

Dafon Aimé Segla, Jean-Eudes Missikey, Prudence Ayivi
Université d'Abomey–Calavi, Benin

Keywords: Astrophysics; indigenous knowledge: the Fon (Benin); cultural astronomy-innovation studies.

Abstract:
The study focuses on traditional agricultural calendars used by the ancient fon farmers in southern Benin Republic before the introduction of the Gregorian calendar. These calendars derived from the knowledge extracted from the reading of celestial bodies. This study aims to study how the knowledge of the farmers from Kpomassè region in southern Benin, influences the organization and the planning of agricultural activities. The methodology consisted of conducting a survey among farmers who belong to families and communities where the transmission of traditional knowledge is still perpetuated. The results have indicated that the Fon divide the year into two agricultural seasons, the big season called in xwe from December to mid-august and the small season zo from mid-August to November. The two are announced by certain signs such as the appearance and disappearance of stars, birds or some particular rain falls. For example, the groups of stars called in fongbè «azo» /the work/ and « atin aton » /the three trees/ - which alludes to the three major stars between over three thousands of the Orion Belt - known respectively in the history of astronomy as the Pleiades and the Constellation of Orion, serve to indicate to fon farmers the imminence of the arrival of the great season when the stars move towards the west in march. This is an alert to prepare for work before the first rain-falls thus justifying the given name azo to the season. Another example is that of the presence of the bird called « gangan » /partridge/ simultaneously with the group of stars named « da », known in the history of astronomy as Antares or the Constellation of Scorpio, during the month of August. It indicates the beginning of the small rain season. The disappearance of Antares during the month of November corresponds to the end of the small rain season and the beginning of the dry season. In conclusion the study states that the original coders in the sphere of agriculture have shown sufficient accuracy of knowledge producing and innovation skills before western contact and influence. The knowledge of the sky and elements of biodiversity might thus serve to conceive new approaches and astronomical technologies to adapt for people in Africa in their agricultural business.

11:30 – 11:50 - July 8, 2025

Investigating the Indigenous Names of the Seven Days in Ethiopia's Week of the Borena Calendar

Abduselam Mohammed, Habtamu Fekadu Etefa

Department of Physics, College of Natural And Computational Science, Dambi Dollo University, Ethiopia

Keywords: Indigenous, Nomoratonga, Calander, Ayyaana, Oromo

Abstract:

The Borena Calendar is esteemed in the realm of Oromo cultural and practical astronomy, recognized globally for its heritage value. This ancient calendar, which reflects the rich knowledge systems of the Oromo people, has captivated historians and astronomers alike. Studies have focused on the Nomoratonga Pillar found near Lake Turkana in northern Kenya, which provides key insights into this calendar's origins. While previous researchers have revealed the indigenous names for the 30 days in each month of the Borena Calendar, a gap remains: the specific names used for the seven days in the week have not been thoroughly investigated. In contemporary Oromo society, each weekday is given a familiar name in Afaan Oromoo, as follows: Dafinoo (Monday), Facaasaa (Tuesday), Roobii (Wednesday), Kamisa (Thursday), Jimaata (Friday), Sanbata (Saturday), and Dilbata (Sunday). These names are widely recognized and commonly used. However, our research shows that these names differ from the original indigenous names used for the seven days in the traditional Borena Calendar, suggesting that changes have occurred over time. Our research also uncovered the deep significance of the Afaan Oromoo term *Ayyaana* in the Borena Calendar. This term appears to closely parallel the concept of "date" in the Julian calendar, serving as a marker of specific times within the lunar cycle. Through a critical review of prior studies, we explored this unique system and its implications, aiming to expand our understanding of how the Borena Calendar interweaves with Oromo cultural practices and community life. At the IAUS399 astronomical conference, we seek to foster a more comprehensive dialogue on the Borena Calendar's indigenous knowledge and its broader implications for cultural heritage.

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11:50 – 12:10 - July 8, 2025

Investigation of Indigenous Astronomical Knowledge in Improving Livelihood for Rural Communities in Tanzania

Ladislaus Batinoluho
DarkSky Tanzania, Tanzania

Keywords: Indigenous astronomical knowledge, astronomy, livelihood, Tanzania

Abstract:
There is inadequate documentation of indigenous astronomical knowledge in improving livelihood among rural communities in Tanzania. Although astronomy is the oldest of all the sciences, African indigenous astronomical knowledge, especially of the rural Tanzanians, has not received the attention it deserves from scholars and researchers. Nevertheless, there is fragmented, scattered, disconnected documentation of aspects of this knowledge studied by scholars in various disciplines. This study followed a case study approach to investigate how the Tanzanian indigenous astronomical knowledge is strengthening livelihood resilience for rural communities. There is an estimated total of 128 ethnic groups in Tanzania, classified into four major ethnolinguistic groups, including Bantu, Cushite, Nilotic, and Khoisan. Each ethnic group has its cultural astronomical application in life. There is a lack of unified information on the way the various ethnic groups utilize their indigenous astronomical knowledge in hustling with life. Using a qualitative approach and indigenous knowledge paradigm. The Afrocentric, phenomenography and appreciative enquiry theories were used as appropriate and relevant frameworks which underpinned this study. Research data was gathered from 16 ethnic groups of Bantu (Nyambo, Chagga, Kerewe, Sukuma, Ha, Zaramo, Rangi, and Zaramo); Cushite (Gorowa and Iraqw); Khoisan (Sandawe and Hadza); and Nilotic (Jaluo, Datoga, Arusha, and Maasai) utilizing key informant interviews, focus group discussions, narratives and document analysis. The data collected from the participants was analysed thematically. The findings of the study revealed that, generally, the Bantu and Nilotics are rich with indigenous knowledge of the stars, moon and other constellations when compared to their counterparts Cushite and Khoisan. The Bantu and Nilotic used their indigenous astronomical knowledge in farming, fishing, reproductive health, time calculation, fortune or misfortune predictions, calendar making, rainmaking, thanksgiving ceremonies, wind direction, and natural disaster management such as locusts, floods, epidemics, wars, and thunderstorms. In addition, arts and crafts, such as songs, and poems were used as conduits to disseminate indigenous astronomical knowledge using their local languages to the targeted audience and younger generations. The elders were the sources, and custodians of this knowledge and used stories and mythology to teach the young about indigenous astronomy. The practical evidence and cases provided in this study can be used to demonstrate that indigenous astronomical knowledge is relevant in modern times and can be interfaced with modern astronomy to improve local communities' livelihoods. In conclusion, the domination of contemporary classroom knowledge undermined the importance of indigenous astronomical knowledge in African communities, including

Tanzania. Despite this undermining, the Bantu and Nilotics, like other African tribal groups in Tanzania preserved this knowledge and used it for their community's livelihood. The study recommends that indigenous astronomical knowledge is an interesting field which needs to be adequately explored, documented, developed and promoted; there is a need to develop a critical mass of indigenous astronomical knowledge researchers and scientists to conduct holistic indigenous research on African indigenous astronomical knowledge, building collaboration, partnerships and networks among relevant stakeholders is critical and finally, the co-existence of indigenous astronomy and contemporary astronomy should be strengthened and encouraged.

12:10 – 12:30 - July 8, 2025

An Almost Forgotten "Star Compass" of the Mfantse Fishermen

Paul Nyarko-Mensah PhD, Jesus Julius K.E. Ellis, Samuel Hayford, Patrick Abaidoo, Nana Ama Browne Klutse PhD
University of Pretoria, South Africa

Abstract:
The study investigated the use of celestial bodies for navigation by the Mfante fishermen of Cape Coast, with the hope of finding out if there are still artisan fishermen who still rely on the celestial bodies to navigate the oceans for fishing expeditions. Also, to explore how to encourage the familiarisation of the celestial bodies among the younger fishing folks and make suggestions. Using purposive sampling nineteen fishermen were interviewed about the use of the celestial bodies for navigation during fishing expeditions. Nine old men and ten young fishermen were interviewed about their knowledge in the usage of the celestial bodies for navigation during fishing expedition.The study found out that the Mfantse fishermen of Ghana use the stars and the moon for navigation in fishing since the 13th century. This made the fishermen acquired knowledge of the celestial objects. However, this knowledge is getting extinct, as it is not documented and also with the advancement of technology, younger fishermen prefer to use Geographical Positioning System (GPS), Telescope, compass and mobile phone for fishing. Further, the results showed that unlike the younger fishermen, older fishermen still use the celestial objects for fishing expeditions. They are able to navigate the ocean for fishing expedition without the aid of modern communication gadgets, in this regard the study recommended documentation of the knowledge of the older fishermen for the use of posterity.

12:30 – 12:50 - July 8, 2025

Counter–Mapping: Building bridges and locating a place in space for /Xam San cosmology

Neil Rusch

University of the Witwatersrand, South Africa

Abstract: The Square Kilometer Array Observatory (SKAO) is being constructed in Australia and South Africa, on land inhabited by Wajarri Yamaji people and former /Xam-speaking San. Both groups posses cosmologies predicated on place-based star lore. For the /Xam, the sky's things have a predominantly earthly origin, particular to their homeland /Xam-ka !au. The Milky Way is created from ash and !hụiń roots, burnt in a fire and tossed into the sky by a girl of the Early Race. As things of the earth, the scented roots are eaten by humans, baboons and also by porcupines. As sky's things, the roots become stars; the red (or old) !hụiń making red stars, the white (or young) !hụiń making white stars. For the /Xam, co-creation and being-in-the-world requires participation in the formation and maintenance of the universe. The antithetical priorities of Western as opposed to /Xam ontology manifest in multiple ways. Western ontology is inflected with the idea that "we" evolved "out" of animality. In contrast, /Xam mythology describes an origin where animals and people share a common humanity. From a non-anthropocentric viewpoint, lacking strong Cartesian divisions, the world is whole. Seeking variety within oneness informs one approach while the other is geared to development, advancing in linear progression towards the future. The functional interrelatedness of indigenous experience challenges classic Western logic and the law of the excluded middle[i] in which binary either/or reasoning predominates and where efforts are directed towards a future that is perceived to be an improvement on the present, and therefore better. As a community, can we move forward and realize humanity's space-based ambitions without recognizing the disparities between Western scientific and indigenous ontologies? Building bridges between cultures was the focus of IAU 278, held in Lima, Peru. Fifteen years later, what are the achievements? My assessment is limited to a set of projects – Shared Sky (exhibition); Karoo Cosmos – /Xam-ka !au and the /Xam (publication); !Aitsa (film) and !Aitsa Outreach (Karoo/Kalahari community engagement). The conclusion I draw is that there are many hidden assumptions about the nature of science and indigenous knowledge, which demand scrutiny and deconstruction before genuine bridge building can take place. From this perspective my presentation looks ahead to the potential I see in the Carnarvon Science Exploratorium (CSE). Commissioned by the South African Radio Astronomy Observatory (SARAO), the facility will celebrate the science and intellectual history of the SKAO. An area of 81 m2 is allocated to /Xam cosmology and sky lore. Meaningful occupation of the space could be achieved by descendant /Xam communities using counter-mapping methods to: 1) challenge dominant narratives; 2) illustrate place-based experiences; and 3) actively apply history, that "looks for transformation in the present on the basis of evidence from the past."[ii]

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Session 7: Indigenous Astronomy in Africa

13:50 – 14:10 - July 8, 2025

Reconstructing the Seven Stars (fkuu) Story in Taiwan Indigenous Cou Culture

Kang–Shian Pan & Ya-Chen Yen

Dabang Elementary School No. 1, Taiwan

Keywords: Taiwan Indigenous Cou, the Seven Stars, Pleiades, Calendar

Abstract:

Over the past two centuries, various regimes have significantly impacted Taiwan's society, driving the Indigenous peoples towards modernization. Not only their homeland and territories but also their languages, folklore, and cultures have rapidly diminished in the sands of time during changing dynasties. Cou, one of the Taiwan Indigenous groups, has preserved the legend of the Seven Stars, so-called fkuu in Cou, though much of its meaning has been lost over time. It has become hard to connect Cou's culture with the legend, posing challenges and mysteries. Thus, we collected the tribal literature, oral histories, and artworks of the tribe's artists. Also, we applied astronomical approaches to fix the coordinates and time. Combining our results with local geographical features and their cultural insights, we restored the story. After reconstructing the story, we identified the Seven Stars as the open cluster, Pleiades (M45). We found the significance in concepts of calendar, methods for determining the exact dates of their ritual festivals, and how moral education is implemented in daily life. Moreover, we promoted the legend with new insights in the tribe's elementary school, guiding the children to understand their culture and wisdom as shared by the tribal elders.

14:10 – 14:30 - July 8, 2025

Activities Related to the constellations of the Indigenous Ainu peoples of Japan

Megumi Yamauchi
Independent Researcher, Japan. info@astro-ninja.com

Abstract:

Currently, the Ainu are the only indigenous people recognized in Japan. The Ainu people have mainly lived in the northern regions of Japan, and today, Hokkaido, the northernmost island of Japan, is the center of their cultural transmission.

Today, Ainu astronomical knowledge has not been passed down, and few people know about it, but it seems that they had their own unique way of looking at the night sky.

The oldest surviving Ainu literature from more than 200 years ago contains the names of the constellations in the Ainu language.

In addition, more than 200 Ainu names of celestial bodies and stars are recorded in his book by Mr. Sueoka Tomio, who has visited Ainu people in various parts of Hokkaido since the 1950s and collected their words and episodes related to astronomy.

I am working to introduce the constellations of the Ainu people of Hokkaido based on the information left by Mr. Sueoka Tomio. My work started in 2011 and continues now.

I have created a constellation quick reference board of the Ainu constellations and have shared the fascinating constellations of the Ainu people through workshops not only in Japan but also in Taiwan, Hong Kong, and Malaysia.

It takes some ingenuity to convey the starry skies of 40-45°N latitude to people living in warm countries and regions.

However, with such ingenuity, it is possible to convey the culture of the Ainu people and the nature of the region through the constellations to people in faraway places.

My presentation is about the connection between the constellations of the Ainu people and the nature of Hokkaido. I will tell how I introduced the Ainu constellations and how I carried out my activities.

11:10 – 11:30 - July 8, 2025

Heaven as an Interactive Arena for humans and nature among the Ainu

Akira Goto
Nanzan University, Japan

Abstract:
On the northernmost island of the Japanese archipelago lived an indigenous hunter-gatherer people, the Hokkaido Ainu (Ainu means 'human'). Their cosmology, myths, oral history and star lore contain many elements comparable to those of the ethnic groups of northern Eurasia and probably North America. In a previous paper, I made some analyses of Ainu housing structure and burial orientation with some reference to the sun (Goto 2018). The Ainu also have a rich planetary and stellar lore for predicting seasonal cycles and knowing orientation.

In particular, the Ainu have a rich star lore concerning the bear, the Big Dipper (Ursa Major), Gemini, and so on. The information is largely taken from Tomio Sueoka's privately published book, The Legend of Stars of Ainu-tari [=humans] (in Japanese), 2009. For example, there is a story about the Big Dipper and a bear in the northern region of Hokkaido: Originally, the bear was a daughter of the chief in Sakhalin who married the chief in Soya Kotan, northern Hokkaido. Even after she turned into a bear, she was very gentle, rescuing children in distress and helping people hunt. One day the chief (=husband) went into the forest. The bear, who missed her husband, ran over him, but the frightened chief tried to kill the bear with a poisoned arrow. At the moment the chief shot the arrow, the celestial god took pity on the bear and lifted him up into the sky. The bear became Ursa Major: the rise is its waist and the handle is its tail (Suoeka 2009: 178-181).

The Ainu also have a legend about the "king of the forest", Siapka (big deer), and the hunters who pursued him, in relation to Orion and Sirius. According to the legend, when Siyapka was leading a herd of deer in the forest, three skilled hunters approached the herd from leeward and tried to shoot arrows. Siyapka sensed danger and stepped in front of the herd to let other deer escape, but an arrow hit him in the stomach. The other deer got away, but Siyapka died. Awl God in the sky saw this scene and felt very sorry for Siyapka. The god let Siyapka ascend to the sky, and three stars of Orion's belt was an arrow that hit Siyapka. Sirius always follows the Orion was the hunters (Suoeka 2009: 545-552). This story belongs to star lore called “cosmic hunt.”

Recently I was able to visit the late Sueoka's wife and had the opportunity to see the manuscripts of his writings and the original star charts he left behind. In this presentation, I will mention the possibility of returning his achievement to the Ainu society. In particular, I would like to talk about the air-dome planetarium project I have been working on for the past 12 years. This coming autumn, I am planning to hold a planetarium projection on Ainu astronomy in Bitarori Village, one of the Ainu cultural transmission centers in cooperation with the Board of Education.

12:10 – 12:30 - July 8, 2025

Ethnoastronomy in the Cordilleras: Exploring the Astronomical Beliefs of the Bontoc

Martine Joy Irog, Joy Fayloga, Khristian Dimacali
Philippine Astronomical Society, Philippines

Abstract:
This study explores the indigenous astronomical knowledge, practices, and beliefs of the Bontoc People in the Mountain Province, Philippines. As a community deeply rooted in agricultural traditions and cultural heritage, the Bontoc People possess a unique perspective on celestial phenomena, which they have integrated into their daily lives for generations. Through ethnographic fieldwork, including interviews with elders, community leaders, and local historians, we aim to document their understanding of celestial events, star patterns, and their application in agriculture, navigation, and cultural rituals. This research also seeks to analyze the symbolic and spiritual meanings ascribed to the stars and planets within their cultural framework. By synthesizing these insights, the study highlights the importance of preserving indigenous astronomical knowledge in the context of modern science and education. Ultimately, this work contributes to a deeper understanding of Philippine indigenous cultures, fostering appreciation for their role in enriching global astronomy discourse and inspiring inclusive approaches to science education.

12:30 – 12:50 - July 8, 2025

Nu Anni i Azza Ta Langi, Azza Gafa Ta Davvun (What is in Heaven, is also on Earth): A Preliminary Exploration of Cagayan Indigenous Astronomy

Joshua Jewel Palolan
Cagayan Museum & Historical Research Center, Philippines
Cagayan Heritage Conservation Society, joshuajewelpalolan@gmail.com

Keywords: Cagayan, astronomy, ethno-astronomy, indigenous knowledge

Abstract:

Nu Anni i Azza Ta Langi, Azza Gafa Ta Davvun (What is in Heaven, is also on Earth): A Preliminary Exploration of Cagayan Indigenous Astronomy emphasizes and enumerates the compilation of recorded indigenous astronomy of the past and present people of Cagayan. This study explored the relationship between astronomy and culture and sought the connection and impact of celestial observation, beliefs, and phenomena on the lives of the diverse ethno-linguistic groups of Cagayan province in the Philippines.

This study adopted a multi-disciplinary approach using historical, anthropological, sociological, and astronomical perspectives to understand how astronomy was conceptualized and has affected Cagayano belief systems, folklores, rituals, and daily practices. Data was gathered from literature on Filipino and Austronesian indigenous astronomy and historical accounts from Spanish sources such as the compilation of indigenous Ibanag words by 17th-century Dominican priest Fr. Jose Bugarin, which was later published in 1854 as Diccionario Ibanag-Español. Additionally, interviews were conducted with Ilokano and Ibatan fisherfolk from the island municipality of Calayan and with the Agta-Atta people of the municipalities of Sanchez Mira and Ballesteros, who rely on the movement of celestial bodies to conduct activities throughout the year, particularly fishing and hunting.

This study also connects Cagayan indigenous astronomy with the wider cultural astronomy of Southeast Asia, highlighting shared beliefs and practices of the region. It also addressed the challenges and opportunities in preserving and revitalizing indigenous knowledge and practices in the face of modernization, globalization, and cultural assimilation.

Session 8: Indigenous Astronomy in the 'Americas'

15:40 – 16:00 - July 8, 2025

In the Footsteps of the Traveler: the astronomy of Northern Dene

Chris Cannon
University of Alaska at Fairbanks, USA

Abstract:
Astronomical knowledge and practices have been regularly overlooked in Northern Dene studies. However, fifteen years of collaborative work (2009 to 2024), learning with and from more than 65 Dene Elders, speakers, and tradition bearers across 34 communities in Alaska and Canada has shown that astronomical knowledge is deeply rooted in both practical and spiritual ways of knowing. At the center of these knowledge systems is the Traveler, a figure who journeyed around the world in Ancient Time before incarnating among the stars. The Traveler constellation is composed of numerous smaller groups of stars named using body part terminology. In some Northern Dene cultures, the Traveler constellation covers the entire visible portion of the sky, providing a single unifying system for mapping the night sky and a practical guide for wayfinding in Subarctic environments. Most importantly, the Traveler constellation is a teacher, a gamekeeper, a guardian, and the spiritual embodiment of the world. The Traveler's footsteps traverse the universe, uniting it as a powerful and holistic model for knowing, being, and relating to all things. Immersion into Northern Dene astronomical knowledge is to walk in the footsteps of the Traveler to actualize the ancient model that it provides in one's own life. In this talk, I will describe the significance of the Traveler throughout the Dene family as informed by my own experiential learning and travels on the land with Northern Dene Elders.

16:00 – 16:20 - July 8, 2025

Traditional Eyes and Scientific Instruments: Indigenous Interpretations of Cultural Astronomy Research in the Greater American Southwest

Mary Motah Weahkee
Society for Cultural Astro. in the American Southwest, USA

Abstract:
My tribal affiliation is Comanche Nation and Santa Clara Pueblo. I am a cultural consultant with the Society for Cultural Astronomy in the American Southwest (SCAAS) and the Project Archaeologist for their Cultural Landscapes Survey Program. My work with them is an education in astronomical events that shape the cosmology of the pueblo sites and people we study. I passed along the information I learned working with SCAAS on astronomical events that occur at the solstice and equinox. The use of star charts and knowing how to interpret events is critical since a lot of information is being forgotten. Covid erased quite a few elders, and no one took the time to record such valuable information. During the last three years working with SCAAS, we took the opportunity to study three ancient Pueblo sites. We documented Escalante Pueblo, Lowry Pueblo and Jackson's Castle in Canyons of the Ancients National Monument near Dolores, Colorado USA - not looking at these sites through traditional eyes but those of scientific instrumental observation. This allows me to make a comparison to oral histories and site locations based on geographic data. The use of drone-based photogrammetric and planetarium data gives a deeper meaning in search of oral history that has been lost or incomplete in translation.
The cosmology of the ancient villages is based on a 90^0 wall that appears in all three sites. The walls point directly at horizon markers such as mountain tops or other geographic features on the landscape. The villages are then built around the 90^0 wall; this gives a clear line of site of astronomical appearances in the sky. These observations are used for timing religious ceremonies and events that are practiced to this day. The Moon, Sun and Venus play a great role in the calendar of events as well as Orion's belt.
The religious significance of seasonal change was observed in two of the sites based on astronomical events. This is important because of the impact of climate change and why the people left to pursue other religious deities. As an archaeologist, I have studied rock art features that have star calendars of events from the past and I know that through SCAAS I will be able to return some of the knowledge I lost by helping record and understand the new technology being taught. Without the valuable knowledge acquired while working with them, I would not be able to share with you such technology and interpretive astronomical events that all Native sites are based on. As a Native American from a Pueblo, I made traditional and comparative astronomical observations based on solstice and equinox alignments still practiced by my village and other remaining villages in the Southwest. The current research achieved by archaeology and cultural astronomy is ongoing and now Native American knowledge has stepped in to help the research take on new perspectives. I want to share these cultural interpretations and indigenous astronomies with you at this conference.

16:20 – 16:40 - July 8, 2025

The Culture of the Sky of the Jaguars of Yurupari

Daniel Pedreros Cifuentes, Santiago Vargas Dominguez, Sandra Bibiana Avila Torres

Secretaría de Educación del Vaupés, Colombia

Keywords: Community, Cultural Identity, Ecology, Cosmogony

Abstract:

The worldview of Indigenous peoples in the Americas is profoundly intertwined with their culture, forming a cornerstone of their identity. This connection is largely sustained through the transmission of historical memories, which shape successive generations. Oral tradition plays a vital role in preserving and conveying knowledge about the creation of the world, humanity's destiny, and the practices required to maintain their society across time and through the seasons (Florescano, 2000).

This work presents an ethnographic study conducted at the Piedra Ñi Departmental School, situated within an Indigenous community in the extensive Vaupés reserve, along the Pira Paraná River in the southwestern Colombian Amazon. This initiative highlights the intersection of cultural identity, education, and Indigenous cosmology.

Using an ethnographic approach tailored to educational research (Álvarez & Álvarez, 2001), the study involved immersive fieldwork within the community, primarily through engagement with the Piedra Ñi School. This institution serves students from diverse ethnic groups, including the Macunas, Barasanos, and Tatuyos. It is dedicated to delivering an intercultural education that not only fosters a sense of belonging to their territory and cultural practices but also provides formal primary and secondary education. The project was carried out with students from the Astronomy Group and centered on the community's most significant constellations, as described by the "Knowledge Holder." This esteemed figure is responsible for safeguarding and transmitting the community's cultural legacy to younger generations through oral tradition. According to their cultural sky and ecological calendar (ACAIPI, Knowledge Holders, & Researchers, 2015), four constellations—Pléyades (Yokoaro), Orion (Siortht), Taurus (Wai Kasabo), and Scorpius (Ia Yai)—govern the community's seasonal activities, guiding the transmission of vital knowledge through practical, cyclical rituals.

Collaborative sessions were held in the ancestral Maloca (communal house) between students and the Knowledge Holder, exploring the night sky through the lens of both the Sky Culture of the Jaguars of Yurupari and Western astronomical traditions. The pristine Amazonian night sky, free from light pollution, provided an exceptional observational environment. To complement the traditional teachings, Stellarium software projections were used to illustrate the constellations from a Western perspective.

Linguistic barriers posed challenges as the Knowledge Holder and some students did not speak Spanish. However, the project sparked interest in sciences like physics and chemistry, encouraged Spanish learning, and highlighted the equal value of Indigenous cosmological knowledge alongside external scientific frameworks (ACAIPI, 2010). This initiative represents a meaningful exchange of knowledge, fostering mutual respect and

reinforcing the importance of Indigenous cultural identity in the broader discourse of astronomy and science education.

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16:40 – 17:00 - July 8, 2025
The Amazonian Tikuna/Magüta animate constellations

Priscila Faulhaber
Museum of Astronomy and Related Sciences/CNPq, Brazil

Keywords: Indigenous cosmovision – sky-earth relations – heliacal set

Abstract:
According to the Tikuna/Magüta elders, the images they see in the skies are animals that migrated from Earth to the skies walk along the Tapir Way. They relay the circulation of water from the celestial to the terrestrial and the subterranean domain in the mediation of the upper, the middle and the underworld. The Masters of the Universe sent their sons from this forbidden transgression to the sky, where they had to remain to prevent any further transgressions and disgrace. There, they found the Jaguar's Leg (in the constellation of Orion), the Caiman's Jaw (near Taurus), the Tortoise (Baweta, related to the area of the Pleiades), and witnessed the fight between the Anteater and the Jaguar. Parts of the dead animals' corpses were propelled into the sky after these earthly confrontations, transforming them into constellations whose cycles mark the passage from the dry to the rainy season, as seen on the horizon at dawn. Most of the other animals that represent Tikuna constellations, such as the Anteater and the Jaguar, are active both during the day and the night. The elders also assigned meaning to the passage of chronologically linear time and organized relevant survival activities based on their mostly lunar calendars, which according to their way of thinking are fundamental for the growth of women. These connections are in the center of the significance of the animate constellations this paper aims to analyze. The aim is to exam their understanding of what occurs in the earth-sky dominion, correlating the constellations' celestial movements with the events experienced by the Tikuna/Magüta people in their everyday lives. Constellations are figures envisioned by viewers that include dark sky illustrating a relationship among the stars that differs from the celestial configurations commonly taken for granted among those familiar with the constellations of Western astronomy. The Amazonian cosmos can be simplified as well by correlating three worlds: the earth where the live beings dwell, the upperworld, and the underworld. That model framework makes sense in based on a specific logical correlation to the Magüta people particular cosmovision, although conveyed by the means of cultural astronomy analysis in the realm of middle range theory.

Videos
Ethnoastronomy of Aceh Traditional Guidance in Agriculture

Hannah Maresfin
Himpunan Astronomical Amatir Jakarta, Indonesia

Keywords: Aceh ethnoastronomy, Agriculture Ethnoastronomy, Syeikh Abbas Kuta Karang, Keuneunong

Abstract:
Ethnoastronomy has a major role in Indonesian traditional life guidance, including for people in Aceh, Sumatra. Using their traditional calendar, people in Aceh created guidance for various agricultural and daily life activities, such as the guidance written by Syeikh Abbas Kuta Karang in his books Tajul Muluk and Sirajul Zalam fi Ma'rifati Sa'adi wal Nahas or Keuneunong system used by Kluet tribe in Aceh. This study discusses the system used in various agricultural guidance based on Aceh's traditional calendar and season calculation from an ethnoastronomy perspective and manuscript study. The result of the study shows how in-depth the calculation of the guidance is. Not only calculating the specific season or month to do certain farming activities, but the detail is up to hour, where there is a specific time for planting certain plants or produce, such as on Tuesday the best time to plant produce is between 7 – 10 am. Although this method is no longer been used by most of the farmers in Aceh strictly, they have adopted the important rules and adapted them to meet the changes in current weather and conditions.

Revealing Gylfi's Illusion: A Systematic Analysis and Proposed Astronomical Interpretation of Mythological Elements Found in Gylfaginnin

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Abstract:

Icelanders of the Middle Ages had access to popular astronomical knowledge despite their relative isolation from continental Europe. Icelandic manuscript GKS 1812 4to contains *Arateaic* images, as well as AM 415 4to which depicts an Aristotelian model of the earth-centered universe. Yet, few Norse star names still exist: *Orion's belt* was known as *Frigg's Skirt* or *Fiskikarlar*, and the *Hyades* as the *wolf 's jaw*. Both examples are named after elements of Norse mythology.

The *Prose Edda*, the largest compilation of Norse mythological prose from the medieval period, is widely considered by scholars to be a handbook for poets or *skalds*. But several scholars – Einar Pállson, Björn Jónnson, Gísli Sigurðsson, and Jonni Langer to name a few – have proposed methods of astronomically interpreting the mythological elements therein. Even through the 18th century, Icelandic manuscripts such as SÁM 66 placed eddic prose and poetry alongside cosmological and astronomical charts.

I suggest the stars were a perfect mnemonic device that poets could use to memorize the various names of the gods, their kinship, their locations, and their stories. The poet could use the same constellations every night to tell a different story – they only had to wipe the stage clean and rename the "celestial actors." This can explain why certain related gods share similar feats, such as Odin and his sons Tyr and Vidar who all fight a wolf during Ragnarök. Likewise, it could explain why separate locations sometimes have similar descriptions or bear names which mean the same thing, such as Odin's *Valhöll* (Hall of the slain) and another of his places called *Valaskjálf* (Hall of the slain). I suggest that this is a way a single celestial location is poetically hidden in the prose as two different locations or multiple related gods.

To show this, I used Stellarium to analyze the *Prose Edda's* mythological elements by comparing their poetic descriptions with star knowledge that would have been known before and during the compilation of the *Edda*, namely the Greek Almagest and Arabic al-Sufi star maps. Doing so reveals that the Norse gods, their locations, and their feats could be viewed by using the same constellations, night after night. My interpretations also depict star knowledge left in Norwegian folklore and those found in medieval Icelandic manuscripts. Others correlate to images of gods found in early modern Icelandic manuscripts.

Cultural Astronomy of Ethiopia: Borana Indigenous Astronomical knowledge

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Abstract:

As one of the oldest independent nations, and in the heart of the Horn of Africa, there is plenty of evidence demonstrating the relationship between the early Ethiopian civilization and the cosmos (Tessema, S. B. (2012) ; Kebede, L. W. (2002) & Jackson, J. G. (1939)). They created their own science of sky in order to better comprehend the nature of life on earth by monitoring the movements, the brightness; and size of the sun, moon, and stars as well as celestial phenomena. Ethiopia even has its own unique 13-months lunisolar calendar, and is seven years behind the Gregorian calendar. Ethiopic Books such as the Book of Enoch, Sun, Abu-Shaker, Merha Ewir, and Bahire Hasab are some examples of old manuscripts providing ample data about astronomy, mathematics, and cosmology including alignments with stars associated with each of the thirteen months on the Ethiopian calendar (Black, M. (2023); Bausi, A. (2016) & Charles, R. (1999). Also mythological traditions in Greek, Ethiopians created their own science regarding heavenly objects and gave them names with deeper meanings.

However, there is no conducting enough research in the cultural, historical and indigenous astronomical knowledge of the ancient Ethiopians. Few among (Ruggles, C. (2010); Ayal et.al (2015); Ruggles, C. L. (2015)). This suggests that there is a very large gap and untouched area in the investigations.

The general objective of this research, therefore, is to explore, understand and elucidate the role of such indigenous astronomical knowledge in fostering the advancement of Ethiopia. In this article, we only concentrate on the data that collected from the three regions of the country (North, East and South). Hence, both primary and secondary data collection techniques were used to get relevant data for the study. This includes interviews, focus group discussions, observations and document analysis. For the interview and focus meeting, we used community language to easily engage with respondents and obtain comprehensive information.

Posters

Iconographic evolution of a Lunar myth on the northern coast of Peru

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Keywords: Cultural astronomy, Andean , Peruvian stylistics, Lunar Animal, Moche, Moon, stars, Venus.

Abstract:
There are many studies that have been commissioned to study the iconography of the Lunar animal or dragon from the Recuay culture (200 BC - 600 AD) and later incorporated into the Moche iconography associated with the Moon. Within the framework of the curatorial research of the temporary exhibition "Las señales de los dioses, una mirada al cielo en tiempos prehispánicos" exhibited at the beginning of 2018 at the National Museum of
Archaeology, Anthropology and History of Peru (MNAAHP) we were able to develop an evolutionary line of the same mythological theme relating the elements: Lunar animal, Moon, celestial body (star or Venus), from Moche (2nd century) to eventually Chimú - Inca (15th century) observing not only the transformations that these elements undergo but also the same
support that contains them. A ceramic caught our attention because the scene not only contained the celestial elements studied but also an associated character. Thus, among the extensive literature consulted, we found a myth story "Qalalu Karwancho" collected from oral tradition and translated by Alberdi, A. [2011] that contains elements that coincide with
the characters and motifs present.

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The Terrestrial Emu, Wiradjuri Country: is it an earthly counterpart to the Celestial Emu recognised from Aboriginal skylore? Could it also be part of a larger terrestrial 'Sky Map'?

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Abstract:

Background: Aboriginal peoples see the sky as the home for many ancestral creator beings that came down to make the world, the animals, and the people during a period referred to as the 'Dreaming' or 'Creation Time' (Clarke, 2007/2008; Leaman & Hamacher, 2019). It is a realm which is every bit as real as its counterpart on Earth, complete with rivers and forests inhabited with fish, birds, animals, and ancestral beings (Clarke, 1997, 2007/2008, 2014, 2015a, 2015b). One is reminded of the old adage "As above, so below". In Aboriginal cosmology and cosmogony this can also be inverted: "As below, so above".

The *Terrestrial Emu:*

In Central NSW, between the townships of Narrandera in the south to Lake Cargelligo in the North, is series of ridgelines stretching over 140 km in length, and forming the unmistakeable shape of an emu, complete with head, neck, body and legs (Figure 1). This '*Terrestrial Emu*' is known and recognised widely among the local *Wiradjuri* community as it contains many places of major cultural significance. As Aboriginal peoples see the land, sea and sky as one unified cosmoscape (Clarke, 2007/2008) is this Terrestrial Emu the earthly embodiment of the Celestial Emu from Aboriginal skylore (Fuller, 2014; Leaman & Hamacher, 2019), and vice versa? We look for clues to support this hypothesis.

The Emu and the Kookaburra:

A clue that such a connection may exist is the relationship between the Emu and Kookaburra. In the Wiradjuri skyworld, the constellation of *Gugubarra* the Kookaburra is found just under the belly of *Gugurmin*, the *Celestial Emu*. This seems to be mirrored on the ground with Cocoparra National Park, near the 'belly' of the *Terrestrial Emu*. This National Park is so named because of its connection to a Dreaming relating to the Kookaburra (*Cocoparra* is a Wiradjuri dialectic variation of *Gugubarra*).

Extending the Terrestrial Sky Map:

Starting with an image of the plane of the Milky Way overlaid with the *Celestial Emu* (labelled '*The Emu in The Sky*'), *Wawi* and *Baiami* (alternatively spelt *Byamee* in Figure 2, bottom) we compared this to the landscape surrounding the *Terrestrial Emu*. As a starting reference, we

traced a blue line on the Google Earth image to represent the plane of the Milky Way. Rather than a straight line the landscape of the Terrestrial Emu constrains it into a curve (Figure 2, middle). Interestingly, after continuing through the emu it then traces part of the path of the Murrumbidgee River. In the Wiradjuri skyworld, this part of the Milky Way is the *Wawi*, the

Rainbow Serpent. Is there a correspondence here? Rainbow Serpents are associated with water, specifically rivers and waterholes (Elkin, 1930, 1993; Hargrave, 1983; Piddington, 1930; Radcliffe-Brown, 1926, 1930; Tacon, Wilson, & Chippindale, 1996). Also of note is the location of The Rock (*Kengal*) in relation to the *Terrestrial Emu* (Figure 2, top). *Kengal* is associated with a Dreaming relating to *Baiami*, a Wiradjuri creation ancestor who is seen in the stars of Orion (Leaman, 2024; Leaman & Hamacher, 2019).

Discussion & Conclusion:

Here we present the hypothesis that the *Terrestrial Emu* is but one component of a much larger Terrestrial sky map, mirroring the Wiradjuri skyworld. Although the *Terrestrial Emu* is recognised by the local Wiradjuri community, other elements discussed here remain speculative until further investigation reveals otherwise.

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The Elvina Trail platform as a Milky Way site

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Abstract:
In the vicinity of Sydney, the Ku Ring Gai National Park features many rock platforms displaying rock tessellations, cupules, engravings or a combination of those. From a recent survey of the Elvina Trail rock platform and existing ethnographic records of neighbouring cultural groups, we investigate astronomical interpretations of the site, in particular how the local Indigenous people would have used the site as a representation of the Milky Way in pre-invasion times.

Investigating the Connection between the Waaqeffannaa Religion and Borena Calendar in the Oromoo Culture

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Keywords: Yayyaba Gadaa, Qubeelaa, Waaqeffannaa, Human height, Human Arm span, Borena Calendar, Humanity Physics

Abstract:

This study focuses on the indigenous astronomy of Oromoo people of Ethiopia. The term Waaqeffannaa was derived from two Afaan Oromoo terms waaqa and aanfannaa and it means giving a priority for God by approaching to him. Someone who follows Waaqeffannaa religion (WR) is known as Waaqeffataa/Waaqeffattuu. As Oromoo culture, the universe was created by Waaqa within 27 days whereas the first human being, known as walaabuu, was created on the 27th day. The star, moon, sun, earth and water are the building blocks of the universe. So there are five elements of the Yayyaba Gadaa (Gadaa building blocks) regarding the creation of the universe. Human head, the two human hands (arms) and the two human legs are also the five elements of the Yayyaba Gadaa (YG) regarding the evolution of human being. The total number of human fingers is 20 while a human head has seven major holes as long as it contains two ears, two eyes, nose and mouth. The sum of these 7 holes and 20 fingers gives 27 of the human body parts. Literatures revealed the connection among the 27 days, Borena calendar and the mentioned twenty seven parts of the human body in the YG. Studies confirmed that the indigenous names of the 28th and 29th days in the calendar were derived from the two safuu holes found at lower part of the human body. The connection between safuu symbolism devices (SSDs) and the geometrical process of the Borena variable star system also remains a mystery. Ayyantu teaches the traditional religion by interpreting these devices in addition to calculating the Borena calendar. Even though WR has no written guideline, we know that there are two People in Dambi Dollo who are still following the WR properly. Our group discussions with them revealed that the Oromo people compare the shape of the astronomical objects in the Yayyaba Gadaa universe to the shape of a lemon. The shape of the lemon is interpreted in comparison to the shape of human body jewelry such as bracelets, finger rings, earrings, neck rings and anklets. When a man decides to marry a girl, he throws a lemon at her and promises her love. Then he puts a finger ring known as Qubela on her finger called the Quba qubela. Recent studies also revealed that a moon has a lemon shape. Thus, this culture serves to recognize and respect the divine law system called Safuu. But the Oromo astronomers have not carefully studied the native physical language of this safuu cultural astronomy. Thus, we investigated the knowledge of Oromoo people regarding a circle constant in ancient geometry by measuring a circumference and a diameter of Qubela. The FGD based qualitative data we have collected also directed us to conduct the ape index

experiment as physics experiment of the human body ratio. Having in mind that the lakkofsa Oromoo is important indigenous name of Borena calendar, we developed the lakkofsa Qubela as an indigenous name of a circle constant in the Qubela experiment. The mixed method applied on the human body experiment also generated lakkofsa Ayyantu as an indigenous name of the ape index in the human body experiment. We explored the relationship between the SSDs and the Qubela which is connected to the wedding ring and a moon shape, and consider if the value of π can be extracted from this indigenous knowledge. In general, the findings of this work can be called Oromoo"s indigenous physics of the human body, and we think it can be utilized to ameliorate the present social, economic and political problems in the Oromia region of Ethiopia if we engage positively with young people.

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Ancestral Astronomy in Colombian Ecuador

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Abstract:

The word equator comes from the Latin "aequator" meaning equalizer, which when connected to Greek astronomy defines a maximum circle that divides the spherical earth into equal parts called hemispheres, whose angular distance to the observer's position, to the north or south of the equator, defines the geographic latitude. The Colombian territory is crossed by 617 km of terrestrial equator, crossing the departments of Putumayo, Caquetá, Vaupés and the north of the Amazon.

The objective of this project is to propose the materialization of the equator in Colombia (Latitude 0°), with the design of a cultural and scientific monument designed from the ethnoancestral astronomical knowledge of the communities present in the area; this monument and/or plaza would include: cardinal points, orientation lines, materialization of the equator, sundial and exhibition and workshop areas among others, additionally allowing the integration of teams and personnel from different Colombian and international scientific and academic institutions, related to the areas of astronomy and geospatial data, e.g., Universidad Distrital, IGAC, ICANH, IDEAM, INM, SGC, ISAAC, ISAAC.

With the help of local authorities, two places have been preliminarily identified in the municipality of Puerto Leguizamo, Putumayo department, where the MUROI and SIONAS ethnic groups are located, for which it is proposed to explore and document the traditional astronomical knowledge, from their worldview as native cultures of the Colombian equatorial zone in addition to inquire about their relationship with the geographical positioning; This will be done with interviews to the ancestral sabedores[4] of each ethnic group, in order to know and document their conceptions through writings, pictures and videos, to then create educational material that contributes to the preservation of the knowledge rooted in the native language as well as in Spanish and English, since there is evidence of loss of knowledge due to the fact that the only means of transmission of their stories and knowledge is orality.

Five stages have been considered for the realization of the project:

- *Phase 1*. Dialogues of presentation and support for the project with local authorities to schedule visits to strategic locations, recognition of the equatorial zone of the municipality and identification of the ancestral sabedores of each ethnic group.

- *Phase 2*. Connection with ancestral knowledgeable people of each ethnic group- Preparation of script for the interviews-Preparation of documents for the use of the image and location -Scheduling of date and time of the interviews.

- *Phase 3*. Conduct interviews with the MURUI and SIONA ethnic groups' sabedores - Supporting shots for visual documentation-Treatment of the information collected.

- *Phase 4.* Elaboration of booklets of the ethnoastronomy of each ethnic group - Elaboration of informative and educational videos to help to preserve ethnoastronomical knowledge - Publication of research results in digital media.

- *Phase 5*. Permission for socialization results in educational institutions and in the municipal library-Socialization of the results with the population of Puerto Leguizamo.

The results will be presented to the ethnic communities as well as to the different social and governmental actors in the region, using in-situ meetings as well as academic ICT platforms and the support of the media and the dissemination of cultural, academic and scientific knowledge; it is also expected that this project will generate motivation in the area for the creation of ecotourism, cultural, academic and research programs that contribute to regional development and social restoration in areas that have also been affected by several acts of violence.

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Some Indigenous and other traditional communities' patterns in Rio Grando do Norte´s skies

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Abstract:

Rio Grande do Norte (RN) is a state of Brasil where for many years it was propagated the idea that indigenous and african enslaved descendent people had been completely exterminated and disappeared there. Cavignac (2010) has discussed how this could not be accepted considering historic records of strong resistance of these people in the state. In this same direction, during last decades we see an effort and a movement of self-identification from many people who recognizes and claims themselves as indigenous or quilombolas and at the same time many academic effort has been directed to identify and preserve the knowledge constructed by their ancestors. Artesanal fishermen and fisherwoman are also considered traditional communities whose culture keeps a lot of indigenous influences and interest also concentrate on them. Though many effort is done in accessing the knowledge concerning the knowledge of these people about nature in general – plants in particular, very few has been done about the astronomic knowledge these people keep with them. With this in mind, the team of Planetarium Barca dos Céus ("Boat of Skies"), an outreach project of Federal University of Rio Grande do Norte, have developed interviews with people from local traditional communities in order to access native knowledge about the skies, and to produce planetarium shows that present, preserve and diffuse this knowledge and native experience. By doing this, the project aim to stimulate the connection of local people with nature and their elder identity. In this work I present and discuss about the use and context of some of the skies patterns we have found in some of the interviews, which has been conducted by different people who composed the project. The celestial patterns we will present and discuss about are three: the Boat, the Arapua's Hive, and the "Ways of the Sea" asterisms. The first two of these patterns have shown similarities with indigenous patterns around different places in the words. The Boat, an asterism in the same region of the skies of the Big Dipper, described previously by Jafelice (2014), and pointed by Afonso (2013) as, is known to be similar to tupinamba´s and tembé´s indigenous and African patterns. The Arapua´s Hive, which we learned about from a Mendonça indigenous person, is identified with the Coalsack Nebulae region and is used to preview seasons (FONSECA, 2020). Similarly, Basso (1987) had described that Kapalo indigenous from Mato Grosso sees in that region a hive of Aganagi, dangerous bees, some of them ilustrated by them with the stars of Crux. Finally, the third pattern of stars we found with fisher man from praia da Pipa, who uses three pairs of stars for getting the seas where they fish. These patterns may show a connection with the indigenous history of people in our and other states. Besides, it may inform about strategies of dealing with nature, revealing.

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*some of them

IAU SYMPOSIUM 399

Panel Discussion, GM & Excursion, July 9, 2025

Videos

Catholic Churches in Downtown Rio de Janeiro: Astronomical Alignments and Historical Determinants

Thiago Siqueira; Walmit T. Cardoso; Sixto Benitez
Federal University of Rio de Janeiro, Brasil

Abstract:
In January 1502, just two years after the first Portuguese arrived in the territory later known as Brazil, an expedition led by Gaspar Lemos explored a bay of vast dimensions, mistakenly interpreted as the mouth of a large river, the "Rio de Janeiro." More than six decades later, in 1565, Estácio de Sá founded the city of São Sebastião do Rio de Janeiro, established on the shores of Guanabara Bay to counter the French incursions. The region, rich in resources and contested by European powers, became the site of conflicts and colonial strategies that would shape its landscape. Estácio de Sá led the construction of defensive palisades while the city began to take shape as a crucial point for Portuguese colonization. More than two centuries later, in January 1808, the arrival of the Portuguese Royal Family in Rio de Janeiro marked a turning point in the city's history. Fleeing from Napoleon's troops, the court brought with it the need for urban adaptations that transformed the city into the capital of the Portuguese Empire. This change required new administrative, military, and religious structures. Churches, already present since the city's early days, were reformed and expanded, many following the guidelines established by the Council of Trent, which stated that they should be built facing west, where, according to the church ritual, the priest usually performs the mass at the main altar, facing the people (FRADE, 2016, p. 165). The present study aims to analyze the astronomical alignments of Catholic churches in downtown Rio de Janeiro, built between the 17th and 19th centuries. The measurements conducted revealed significant deviations from the norms established by the Council. Examples such as the former Sé do Carmo, often visited by the Portuguese Royal Family, and the Cathedral of Nossa Senhora da Candelária, show that not all churches adhered to the expected liturgical alignment. These deviations suggest that local, cultural, and political factors influenced the spatial arrangement of these buildings.

Beyond the religious aspect, the study suggests that some churches played a strategic role in the city's defense system. Structures like the Church of São Sebastião on the Morro do Castelo, located in an elevated position with wide visibility, indicate a planning that went beyond liturgy, functioning as territorial landmarks and surveillance points. This configuration reflects not only the urban priorities of the time but also the significance of churches as central elements in the social organization and defense of the colonial core.

Preliminary results support the thesis that the spatial configuration and orientation of the churches were not arbitrary decisions, but rather the result of a plan that integrated religious, political, and military demands. This work offers a new understanding of how these buildings contributed to the formation of Rio de Janeiro, both as symbols of the Catholic faith and as essential components of the city's colonial strategic apparatus.

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Newgrange: a religious temple to the oldest recorded eclipse

Patrick McCafferty
Chemnitz University of Technology, Germany

Abstract:
According to NASA's website, "the oldest recorded eclipse in human history may have been on Nov. 30, 3340 B.C.E. A series of spiral-shaped and circular petroglyphs was found at the Loughcrew Megalithic Monument in County Meath, Ireland."[1]

This interpretation has recently been called into question, with criticisms that the petroglyphs have many possible interpretations, and that it is difficult to calculate the path of an eclipse as far back as five millennia ago. Accordingly, if Loughcrew is to be rejected, this would mean that the[2] earliest recorded eclipse would be from around 1200 BCE, in Anyang, China, where oracle bones record,"The Sun has been eaten." But is it really the case that the great civilisations were the[3] earliest to record eclipses, or is there a way to interpret the archaeological remains of non-literate societies to show that they too were fascinated by eclipses?

Here, I offer support for an early date for an eclipse record in Stone Age Ireland, ca. 3200 BCE. I aim to show that at the Newgrange passage tomb in the Boyne Valley, the architectural layout of the tomb incorporates symbolism of syzygy. Moreover, the petroglyphs at the site contain imagery that is consistent with eclipses.

Newgrange was, however, not just a tomb or an astronomical observatory: it was also a form of temple, incorporating religious symbolism. Building upon the recognition that syzygy and eclipses were important at this site offers us an insight into Neolithic religion. It is found that conjunctions of the heavenly bodies represented profoundly magical moments in their cycles and that a structure such as Newgrange was built to harness that magic, perhaps even with the intention of assisting the reincarnation of the souls of the dead.

Overall, this paper aims to show that keen observation of the skies was practiced not only by the great civilisations but also by non-literate societies. Those astronomical observations were probably motivated by the desire to understand the gods and were linked with ideas of magic and the afterlife. Therefore places such as Newgrange incorporate imagery of eclipses and magic, and represent the origins of both religion and science.

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IAU SYMPOSIUM 399

Dark Skies & Space Futures, July 10, 2025

Session 9: Dark & Quiet Skies I

09:00 – 09:20 - July 9, 2025

Protecting Our Dark Skies: Indigenous Knowledges and the Law

Shea Esterling
University of Canterbury I Te Whare Wānanga o Waitaha, Aotearoa/New Zealand

Abstract:
This presentation focuses on the regulation of dark skies (i.e. how dark skies may be appropriately used for scientific and commercial purposes) and the promotion and protection of indigenous knowledges, especially the knowledges of indigenous women. In particular, it will discuss my research project on the protection of dark skies and indigenous knowledges in Aotearoa New Zealand as funded by the Borrin Foundation.

Given the situation of Aotearoa New Zealand as one of the most important preserves of dark skies, and the importance of ensuring that Māori can exercise tino rangatiratanga (sovereignty) over their taonga (treasure) under the framework of Te Tiriti o Waitangi | the Treaty of Waitangi, it is critical for an appropriate balance to be struck between access and use of dark skies for scientific and commercial purposes and mātauranga Māori (Māori Indigenous knowledge). This means that the law must be able to effectively protect mātauranga Māori and guarantee that iwi, hapū, and whānau retain control over taonga including astronomical knowledges associated with dark skies, while also ensuring that the dark skies of Aotearoa New Zealand may be appropriately accessed and used for different purposes, including scientific research and commercial developments.

Consequently, my project aims to develop governance for the promotion and protection of dark skies and indigenous rights. To achieve this end, I will be travelling to locations certified as International Dark Sky Places (IDSP) in Aotearoa New Zealand and Australia by the non-profit organization DarkSky International for a period of six weeks in total between August and November 2025. These visits will involve conducting interviews with stakeholders (i.e. the individual(s) and/or organization(s) that applied for certification as well as the broader local community) to determine if certification as an IDSP has secured the benefits that DarkSky International articulates. In these interviews, special attention will be paid to the voices and experiences of those who are typically marginalized members of the community including women and Indigenous Peoples and in particular indigenous women who often suffer from double discrimination. Ultimately, the aim of these interviews is to guide the development of governance for dark skies in Aotearoa New Zealand in which partnerships between indigenous and non-indigenous stakeholders is prioritised.

09:20 – 09:40 - July 8, 2025

How dark sky conservation supports the resurgence of cultural/Indigenous astronomy

Nalayini Davies
DarkSky International, Aotearoa/New Zealand, UK

Abstract:
The impact of the 9.6% per annum growth of global light pollution, the exponential growth of satellites, the advent of GPS and the general increase in space-based activities, cannot be denied. In parallel, we are witnessing a resurgence in cultural/Indigenous astronomy across the planet for the certain benefit of future generations. The dark sky movement through its formal certification of dark sky places, a process leading to increased interest in stargazing and astrotourism activities, is protecting the darkness and encouraging the practice of naked-eye night sky viewing which is at the core of cultural/Indigenous astronomy. Protecting the darkness is also critical for celestial navigation which played a vital role in populating the South Pacific including New Zealand and remains culturally important. The interplay between protecting the darkness, the increase in related human created challenges and the growth of cultural/Indigenous astronomy will be illustrated by an examination of the particular experience of New Zealand. An important haven for dark sky conservation with 8 certified dark sky places, this country also has increasingly lit urban areas and a rapidly developing space satellite launch sector (it is one of only 11 spacefaring nations in the world). New Zealand is the country where mātauranga Māori (Māori traditional knowledge) of the night sky is increasingly practiced and perhaps most significantly there is a Māori astronomically determined public holiday which followed the passing of the Te Kāhui o Matariki Public Holiday Act in 2022. The resulting tension between the practice of cultural/Indigenous astronomy and the growth in terrestrial light pollution together with pollution originating from satellites in space, will be closely examined and discussed. In addition, the key relevant findings from a 2023/24 study of more than 200 DarkSky International certified international dark sky places will be presented, illustrating variations across the globe in the level of integration of cultural/Indigenous astronomy in the activities of certified dark sky places. Finally, the talk will address the key topic of how the dark sky movement and Indigenous communities can best collaborate to achieve the desired sustainable growth of dark sky conservation and cultural/Indigenous astronomy.

09:40 – 10:00 - July 8, 2025

Indigenous Ties to Dark Skies: Arabian Astronomy at the Limits of Naked–Eye Visibility

Danielle Adams
Flagstaff Dark Skies Coalition, USA

Abstract:
A camel whose curved neck is comprised of fifth-magnitude stars. A group of camel mothers that surround a young camel represented by a magnitude 5.8 star. A meadow full of sheep and goats, the border of which depends on visibility of the Milky Way. A named "asterism" comprised of no stars at all.

These are but a few examples of age-old traditions of indigenous Arabian astronomy that were built upon the visual splendor of a dark and starlit sky. As our modern world faces a crisis of ever-expanding light pollution that eight years ago had already impacted 80% of the world's population and since then has been brightening our skies by as much as 10% per year (Falchi 2016; Kyba 2023), this paper uses the heritage of indigenous Arabian astronomy to explore what human culture stands to lose if we succumb to the artificial brightening of the nighttime sky. **Drawing from first millennium CE Arabic sources** (Quṭrub 1985; Ibn Qutayba 1956; Ibn Sīda 1898-1903; al-Marzūqī 1914; al-Ṣūfī 1981), **the author examines the cultural import of Arabian asterisms that required visibility of fifth-magnitude or fainter stars (or diffuse celestial objects) for their stories to make sense**. Far from being culturally sidelined, many of these faint stars drove the stories that led to star names we still use today.

A poignant example is the pair of bright stars recognized as Vega and Altair, which were known together by the Arabic name *al-nasrān*, the Two Vultures, a name that was already prominent by the early sixth century CE, as evidenced by the poetry of Muhalhil (d. 531 CE):

> As if the Milky Way of the Two Vultures was a well-trodden path for each group that is spurred on in a caravan. (al-Baṣrī 1999, 80-82, poem 53)

The Two Vultures were known individually as the Alighting Vulture (al-nasr al-wāqiʿ), whose Arabic name survives today as Vega, and the Flying Vulture (al-nasr al-ṭāʾir), known today as Altair. The Alighting Vulture was so named because it formed a V-shape with two nearby faint stars, one of fourth magnitude and one of fifth magnitude. When descending in the western sky, this asterism of three stars bore the appearance of a vulture whose wings were raised up as it alighted onto a surface. We know the bright central star—even using it as the magnitude 0.0 standard candle for stellar brightness— by the name "Vega" today only because of the visibility of the faint stars near it that pristine dark skies made possible and the imaginations of Arabs who dwelled under them. Put more bluntly, there would be no "Vega" today as a star name if that fifth magnitude star were not visible under Arabian skies.

The author's paper will delve into this and other Arabian asterisms, some of whose stars or extended objects lay at the limits of naked-eye visibility but were nevertheless critical to telling the stories from which the asterisms arose. As humanity presses deep into

the space age and fills its skies with artificial light, the lessons we learn from these faint stars can inspire us to reclaim the night wherever we can, so that future generations may still wonder under starlit skies.

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10:00 – 10:20 - July 8, 2025

Spatial Modeling of Artificial Light at Night (ALAN) at the Pusat Astronomi Borneo: Light Pollution Assessment comparison with selected observatory at Malaysia.

Ahmad Hariz Bely[1], Roslan Umar[1], Nor Hazmin Sabri[2], Ahmad Lutfi Afifi Mohamad Nasir[1], Emma Zulaiha Zulkifli[1&3], Amirul Akmal Redzuan[1], Norhayati Ngah[1], Musa Garba Abdullahi[4], Che Ku Ahmad Fuad Che Ku Abdullah[5], Arwin Juli Rakhmadi[6]

[1] East Coast Environmental Research Institute, Universiti Sultan Zainal Abidin, Terengganu, Malaysia, [2] Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Terengganu, Malaysia, [3] Dark Sky Malaysia, Pusat Inkubator Perniagaan, Kota Kinabalu, Sabah, Malaysia, [4] Department of Forestry Technology, Audu Bako College of Agriculture Dambatta, P.M.B 3159 Kano State, Nigeria, [5] Unit Geomatik, Jabatan Kejuruteraan Awam, Politeknik Kuching, Sarawak, Malaysia, [6] Observatorium Ilmu Falak, Universitas Muhammadiyah Sumatera Utara, Sumatera Utara, Indonesia

Keywords: Artificial Light At Night (ALAN), Light Pollution, Geographical Information System (GIS), Sky Quality Meter (SQM), Optical Astronomy.

Abstract:

Sky brightness is crucial for optical astronomical observations that require the dark skies area. The brightness of the skyglow was measured the scattered light from both natural and anthropogenic sources makes up the observed visible brightness. In technical terms, sky brightness is defined as the flux of brightness originating from the night sky per unit area. Magnitude per arcsecond square (mag/arcsec2) and candela per meter square (cd/m2) are common in sky brightness units beside using sky bortle and naked-eyes limit magnitude value (NELM). So, this study aims on multi-brightness analysis of Artificial Light At Night (ALAN) by measuring the light pollution Pusat Astronomi Borneo (PAB) with comparison selected observatory at Malaysia. Data were collected from 31 check point using Sky Quality Meter (SQM) to provide a comprehensive understanding of brightness thought interpolation mapping technique using the Geographical Information System (GIS) to produce spatial model around PAB. The results show Pusat Astronomi Borneo's sky brightness observations have a varied degree of darkness, ranging from 19.84 to 21.52 mag/arcsec2. Higher values suggest good conditions for astronomical observations, while lower values point to light pollution of night sky. The fluctuations show how important it is to continue monitoring in order to enhance sky quality by conducting multi-brightness analysis. The study is important on how urbanization has a significant impact and how light pollution control are needed to maintain the quality of astronomical observations in Malaysia. Therefore, the spatial model from these data will assist optical astronomy researchers in monitoring the level of ALAN in PAB for the purpose of general astronomy observation and the sighting of the new crescent moon.

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10:20 – 10:40 - July 8, 2025

AI–Powered Solutions for Preserving Indigenous Knowledge and Dark Skies in Urban Spaces

Shafayet Rahman
IAU office for Astronomy Outreach, Bangladesh

Abstract:
Urbanization has resulted in heightened light pollution, reducing night sky vision and jeopardizing Indigenous astronomical knowledge systems. This work presents a novel methodology that incorporates Artificial Intelligence (AI) to mitigate urban light pollution while safeguarding Indigenous astronomy as a cultural and educational legacy. We provide an AI-driven predictive analytics model that:

1. Identifies and delineates urban light pollution hotspots: The algorithm identifies regions with substantial light pollution through the use of satellite imagery and observational data. Research indicates that excessive urban illumination endangers ecosystems and human health. (Zhu, 2023; Jia et al., 2020)

2. Simulates optimum lighting infrastructure solutions: The AI system proposes modifications to metropolitan lighting that mitigate light pollution while maintaining safety. Research has shown that AI can enhance lighting efficiency to reduce energy usage and carbon emissions. (Pachot & Patissier, 2022; Sourav & Wang, 2022; Bachanek et al., 2021)

3. Incorporates Indigenous knowledge systems: By collaborating with Indigenous groups, the model integrates Indigenous astronomical knowledge, ensuring cultural preservation and boosting public education. The Native Skywatchers program has effectively integrated Indigenous astronomical knowledge with contemporary science instruction. (Lee et al., 2020; Venkatesan et al., 2019; Lee, 2020)

This interdisciplinary method addresses the environmental concerns of light pollution while promoting the preservation and spread of Indigenous astronomy traditions. We intend to integrate AI technology with Indigenous knowledge to develop sustainable urban settings that respect cultural heritage and enhance ecological health. (Hamacher et al., 2020; Lee et al., 2020; Artificial Light at Night: State of the Science 2022 Report, 2023)

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Session 10: Dark & Quiet Skies II

11:10 – 11:30 - July 8, 2025

Space age threat to dark and quiet skies

Peter Swanton
Australian National University, Australia

11:30 – 11:50 - July 8, 2025

Protecting dark and quiet skies from interference by satellite mega–constellations

Barbara Horváth
Széchenyi István University, Hungary

Abstract:
Today, space activities play a particularly important role in our lives, with new developments and achievements affecting our daily existence. However, it is less well known that astronomical observations can have just as much impact on our environment. In parallel with the rapid growth of space activities by governments and private actors, opening up new horizons for internet services, communications and telecommunications, one of the oldest scientific activities - astronomy - is under threat. Since ancient times, these observations have brought mankind closer to the unknown, allowing us to study other planets, stars and other celestial bodies, and to better understand our cosmic environment.1 But what are the benefits of astronomy today? Is it still relevant? Although we often don't realise it, we encounter many technologies in our lives that would not have been possible without astronomy, most notably WLAN (Wireless Local Area Network), but other technologies too.[2] In recent years, there has been a strong international dispute over the issue of protecting the dark and quiet skies against light pollution and radio interference from satellite mega-constellations. Space law has a central role to play in this area.[3] However, the question of whether astronomical activities can be considered as space activities and the limits of the principle of free use of outer space as declared in the Outer Space Treaty are still not fully clarified.[4] Therefore, the proposed presentation aims to introduce the economic and social importance of astronomy in modern times, to describe how astronomical activities are assessed under international space law, and to examine the legal issues that may arise from this issue.

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11:50 – 12:10 - July 8, 2025

Cultural Astronomy, Dark Skies, Satellite Constellations and the Space Environment

Jessica Heim

University of Southern Queensland, Australia

Abstract:

Human societies have long been inspired by the starry night sky. The apparent motion of celestial objects in the heavens has been utilized by people around the world as an aid to timekeeping and navigation, and stories told about these objects and their motion through the night and throughout the year play an important role in many cultures' understanding of the cosmos and their place within it. However, increasing artificial light at night has made accessing a dark night sky challenging for a large portion of the world's population. As light pollution increases, the ability to connect firsthand with the universe is lost. Though the pace of this change is accelerating, there is also increasing interest in dark skies and what value they might have for society today. The emerging field of dark sky studies examines this idea using a transdisciplinary approach and seeks to engage multiple fields of academic inquiry in researching, understanding, and finding solutions to light pollution related issues.

While dark sky issues have long been focused on ground-based light pollution, artificial light light now comes from beyond such sources. The advent of satellite "megaconstellations" consisting of hundreds to thousands of satellites in low-Earth orbit is altering the appearance of the starry night sky. Many of these satellites are visible with the naked eye and even more are apparent through binoculars and backyard telescopes. Thus, this is an issue that affects not only professional astronomers, but also, all other sky gazers, including amateur astronomers and those who have cultural and spiritual connections to the night sky.

While discussions between astronomers and the satellite industry have enabled changes that have reduced the brightness of some satellites, the goal of rendering them generally invisible to the unaided eye has yet to be achieved. Furthermore, as the pace of launches quickens, reducing the visual impact of these objects on the night sky becomes increasingly challenging. Given current and expected trends, the ability to view a "pristine" night sky, free from effects of intrusion of light from human-activities may become a thing of the past - something that future generations may never see with their own eyes.

Additionally, the increasing numbers of satellite launches and re-entries, as well as other proposed space activities stand to have effects on the Earth and space environments alike. Thus, the rapidly growing "space sector" is of relevance not only to the fields of cultural astronomy and dark sky studies, but also to an emerging interdisciplinary area of inquiry focused on addressing space environment issues. This paper discusses the areas of connection and overlap between these areas of research and argues for the urgent need for increased interdisciplinary and transdisciplinary collaborative research activities to help address the emerging challenges affecting the night sky, the Earth-space environment, and humanity.

12:10 – 12:30 - July 8, 2025
Protecting dark and quiet skies from Satellite pollution

Samantha Lawler
University of Regina, Canada

Abstract:
Megaconstellations of tens of thousands of commercial satellites are significantly changing the night sky. These changes are affecting stargazers worldwide, regardless of whether they can access services from these new satellites. Satellites in Low Earth Orbit (LEO), where all megaconstellations are planned to operate, reflect sunlight long after sunset, and appear to the naked eye as bright points of light moving across the background of stars. Starlink satellites, which currently comprise more than two thirds of all active satellites, are particularly visible as bright "trains" of satellites for a few days after launch, with effectively zero public education work by Starlink, resulting in countless UFO reports worldwide. The sheer number of planned satellites dramatically increases the risk of a runaway collisional cascade called the Kessler Syndrome, which would limit use of Earth's orbit for decades-to- centuries once initiated, and would result in a hideous snow-globe of flashing, reflective debris visible for the couple of hours before sunrise and after sunset. Even if collisions are avoided, individual satellites in megaconstellations have short planned operational lifetimes, with ablation in the upper atmosphere as the only disposal option. The huge numbers of satellites depositing their metal vapour in the upper atmosphere threatens to change atmospheric opacity, as well as cause ozone depletion and other changes in atmospheric chemistry. Satellites that do not fully ablate in the atmosphere can have potentially lethal pieces reach the ground. All of these serious pollution issues are lessened by enforcing a limit on the number of satellites in LEO. Despite being easily visible to the naked eye worldwide, very few members of the general public (or government officials) know about the dangerous situation in orbit, which makes pushing for regulation very difficult. Similar to education campaigns on climate change, satellite pollution education has a huge challenge in finding a balance between conveying all the dangers to a mostly ignorant public, while not overwhelming those who care deeply about the sky. I will discuss some education campaigns that are being carried out by many groups of astronomers and others around the world. I hope this talk will lead to many discussions and brainstorming sessions with other conference attendees on other ways to push for regulation of commercial satellites in orbit.

Session 11: Indigenizing the Astro-Space Sectors

13:30 – 13:50 - July 8, 2025

Indigenizing the Drake Equation: how Indigenous methods can help us understand life in the Milky Way Galaxy

Hilding Neilson
Memorial University of Newfoundland & Labrador, Canada

Abstract:
The Drake Equation is a thought experiment whose purpose is to understand the ingredients necessary for life and advanced technological civilizations to exist on other worlds in our galaxy. However, beyond reflecting on life on Earth we have no knowledge of many of these ingredients, such as the number of planets that have life, the number with intelligent life, the number with advanced civilizations, and the
lifetimes of these civilizations. In this talk I will review the Drake Equation and the biases that scientists have traditionally had in discussing this equation and how it has led to the current searches of biological and technological signatures. I will discuss how the Drake Equation looks different if we consider it through the lens of Indigenous methods and sciences and how these methods would lead to a dramatically different view of life in our Galaxy.

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Royal Astronomical Society of Canada Toronto Centre Speaker's Night. February 17, 2021, https://www.youtube.com/watch?v=jxmUlRFSPlU

13:50 – 14:10 - July 8, 2025

Echoes of Star Stories: Integrating Indigenous narratives into modern stellar astrophysics

Dionysios Gakis
University of Texas at Austin, USA

Abstract:
Indigenous narratives have long preserved observations of celestial phenomena across generations, providing insights that resonate with modern astrophysical research. These stories, deeply embedded in cultural traditions, encapsulate observations of events such as stellar variability, supernovae, eclipses, and planetary alignments. Indigenous communities have also long used the stars as tools for navigation and for structuring their calendars, highlighting their advanced understanding of celestial patterns and their practical applications in daily life. These narratives not only complement our historical records but also o<er human-centric perspectives on phenomena like stellar life cycles, framing them in ways that mirror modern astrophysical models. By exploring records from diverse Indigenous communities—including the Aboriginal Australians, Pueblo peoples, Inuit, and Polynesians—this presentation will illustrate the profound connections between these narratives and our current understanding, with an emphasis on stellar astrophysics. Integrating these traditions not only acknowledges and respects the knowledge encoded but ensures they remain relevant in the Space Age. Furthermore, fostering collaboration with Indigenous communities safeguards this knowledge while creating opportunities for mutual learning and cross-cultural engagement. Bridging traditional narratives and modern science enriches our collective understanding of the cosmos. Lastly, it will be explored how these narratives can enrich public engagement, education, and even hypothesis generation in research. Using Indigenous narratives in teaching not only honors these traditions but also inspires students to connect cultural heritage with cutting-edge astrophysics.

14:10 – 14:30 - July 8, 2025

No Silver Bullet: the path of co-design in First Nations Led Astrotourism

Jamie Rooney[1], Aunty Kerri Douglas[2]

[1]*University of Melbourne, Australia,* [2]*Dja Dja Wurrung Clans Aboriginal Corporation*

Keywords: Astro-tourism,

Astro-tourism is booming. According to Tourism WA, over 70% of their target markets express an interest in the cosmos and identify stargazing as a meaningful experience they're willing to pay for (TWA, 2021). While this growth benefits the astro-tourism sector broadly, it also opens an unparalleled opportunity for self-determined First Nations operators. Experiences that blend cultural immersion and deep understanding of astronomical knowledge connected to Sky Country is not a new concept for First Nations People, and Djaara are now excited to share this with the world.

Developing these experiences invites a rich layering of First Nations Knowledge systems with Western scientific perspectives. Yet, this blending is rarely straightforward. Building genuine, equitable partnerships requires more than the application of pre-set frameworks or off-the-shelf engagement models. It demands time, respect, trust, shared intent, and deliverable outcomes.

In this presentation, we share the development of an Djaara-led Sky Country tour, co-designed through a long-term partnership between the Dja Dja Wurrung Clans Aboriginal Corporation and a non-Aboriginal cultural astronomer. We'll reflect on the lessons learned, offer insights into the collaborative journey, and showcase what we've built together.

We'll share how we've approached the work and offer practical reflections to help others find pathways that fit their own contexts.

14:30 – 14:50 - July 8, 2025

MeerKAT, the SKA and Indigenous Knowledge

Anton Binneman
SARAO, South Africa

Abstract:
The main purpose of the research for this study was to determine what stories about the stars are still being told in the communities surrounding the SKA site. The methodology used in this section is referred to as ethnoastronomy. The majority of San Descendants living in towns surrounding the SKA site adopted a Western way of life with minimal reference to the ways of the ancient San, and anthropologists have discussed several reasons for this.

The way in which the indigenous San peoples used the stars and the stories they told about the stars were replaced with modern technology and, in some respects, Christianity. The stories documented by Bleak and Loyd and later documented by Socio anthropologists have been forgotten by most, and only traces still exist. In a recent survey, some stories were utterly forgotten, and most of them did not exist at all. Examples would be the use of stars determining direction, which was replaced by modern navigation available on mobile devices, and the story of the young girl who created the Milky Way, replaced with Christian interpretations of the Jewish creation narratives.

The Method used in this study was to Identify the knowledge carriers in the communities and ask for referrals to community members knowledgeable in Indigenous astronomy and stories about the stars. These individuals were then invited to workshops where the stories of Bleak and Lloyd were introduced by showing an image or introducing a concept and then asking the knowledge holders to tell the stories and to explain how communities used this. In total, 52 Elders from 7 communities were involved in the stories that will be depicted and reflected on.

Workshops were run in communal spaces, and where the knowledge holders were too old to travel, house visits were arranged. The stories were documented this way. The communities agreed to share the stories, and they agreed that a publication sharing these stories would be made available to them at no cost, ensuring that the knowledge was made available to the local communities.

The workshops and visits were facilitated over 7 days in October 2023. The stories Identified could be sorted into the following categories:

- Nature Rhythms and Cycles
- Ghosts and the spiritual dimension
- Different versions of the Water Snake
- Objects that move in the sky

For this study, we will focus on Nature, Rhythms and Cycles. The Stories that were told by the communities have explicit traces of the original San stories contained inthem, but most of the stories themselves disappeared. One example would be the story of the Girl who created the Milky Way, which is referred to in the story The Heavenly Road or Afrikaans

"Die Hemel straat", but people don't know the origins of the stories. When enquiring where it comes from, they will say they heard the Elders refer to the Milky Way with this term.

Stories that touch on the original San Stories but that have changed and of which locals do not know are the stories of the Dakryer and became interwoven with the IsiXhosa stories about the Tokoloshe, which can be linked back to Mantis as a troublemaker and someone who likes to tease people and has a great love for small Children. Mantis was a Mythological figure central to a lot of San beliefs. In tradition, Mantis was a trickster figure who was deluded. Mantis had creative powers and a severe propensity for mischief that got him into serious trouble, which he always got out of and emerged as the victor. The San Mantis was a resident of basically everything from the wind to the Moon and the Stars. During the Workshops, the Dakryer was depicted as a character that moves from roof to roof looking for homes with small children that he could tease, and if you managed to harm him in some way, he would be able to get out of it by changing into one of your family members.

The easiest way to make sense of these stories and the use of stories is to explain the context in the time before the arrival of the German settlers and, Later, the British. Wild animals like Puffadders, Scorpions, Cape Cobra, Leopards and Lions were roaming the area. The safest strategy would have been to stay indoors and close to one another at night; a full moon and a dark moon would have had different types of danger that the early San would have had to deal with. To keep children indoors, stories like these would have been told to ensure children did not go where there was no supervision. It could also have been used as entertainment to explain the world that they were living in and make sense of their reality

14:50 – 15:10 - July 8, 2025

Cultural Astronomy for Sustainable Development: A study on Indigenous San Communities in Botswana and Namibia

Tumo Fortunate Kedumele
Botswana Int. Univ. of Science & Tech., Botswana

Keywords: Cultural Astronomy, Sustainable Development, Indigenous San Communities, Indigenous knowledge, Southern Africa, Scientific Astronomy

Abstract:

This study explores the cultural astronomy knowledge of the Basarwa/San and Bangwato communities in the Central District of Botswana, as well as the Ju/'Hoansi San community in North-Eastern Namibia. The research was conducted in collaboration with the Central Botswana San community in Moralane village, the Bangwato ethnic group in Serowe and Paje villages, and the Ju/'Hoansi San community in Namibia. The San communities are widely recognized as the indigenous and native people of Southern Africa, possessing a wealth of raw and untouched knowledge of the history of ancient astronomy within a Southern African context.

The primary objective of this study is to gain insight into how astronomy and the celestial realm influence the culture, history, and daily lives of these communities. Additionally, the study seeks to identify and establish connections and similarities between the Basarwa/San/Bangwato in Botswana and the Ju/'Hoansi San community in Namibia. Furthermore, to also preserve the indigenous language used in these communities, as it plays an important role in interpretation and understanding of the cultural astronomy knowledge according to the perspective and perceptions of these indigenous communities. The intention is to facilitate this through cultural astronomy documentation and advocacy for inclusion of cultural astronomy in primary and secondary schools educational curriculum.

The indigenous knowledge, along with folk stories collected during the first and second phases of this study, were meticulously recorded, interpreted, and subsequently compared and correlated with modern astronomy. The purpose of this knowledge-matching process was to establish a connection between cultural astronomy and scientific astronomy. This will for example contribute to understanding how modern astronomy telescopes affect these indigenous communities, which is important considering the current discussion on whether and how local (indigenous) stakeholders should be included in the development of telescope projects. Several telescope projects around the world (for example in Australia, South Africa, Namibia and Hawaii) are creating initiatives to include indigenous culture and knowledge into their projects. This study aims to contribute to the lessons learned in these projects by looking at the specific examples of the Basarwa/San, Bangwato and Ju/'Hoansi San communities. In that way, it will show how indigenous astronomy can be used to guide scientific astronomy and astrophysics in the space age. Further, the study highlights how both (indigenous and scientific astronomy) can contribute to the socio-economic development of these communities in the new age of space through education development.

Session 12: Space Futures

15:40 – 16:00 - July 8, 2025

Space: A global commons for all humanity

Morgan Saletta & Kevin Orrman Rossiter
University of Melbourne, Australia

Abstract:
As humanity expands its astronomical knowledge, and that knowledge is expanded in tandem with space exploration, we face an unprecedented opportunity to think about how space and its resources will be managed and shared. Existing legal frameworks, anchored in the Outer Space Treaty, provide a foundational starting point but require significant expansion to address the ethical, economic, and philosophical challenges posed by the proliferation of space faring nations, the expansion of private enterprises into space and eventual space resource exploitation. This paper will draw inspiration from indigenous, non- Western, and Western traditions of collective ownership and stewardship, as well as international treaties governing shared global resources to explore how we might best manage space as a global commons in a way that benefits all of humanity.

This paper also explores practical governance solutions, including new treaty regimes and the creation of a Global Sovereign Wealth Fund with citizen's dividends (Saletta and Orrman-Rossiter, 2018), to address the challenges of managing space as a commons. By integrating diverse cultural and legal perspectives, we can foster a future where space exploration promotes equity, sustainability, and prosperity for all.

Ultimately, this paper seeks to demonstrate that the management of space and its resources as not merely a political, technological or economic question but an ethical imperative. By forging governance systems that prioritize both collective well-being and private innovation, we can ensure that the benefits of space exploration serve all of humanity, creating a legacy of equity and stewardship for future generations.

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Saletta, M. S., & Orrman-Rossiter, K. (2018). Can space mining benefit all of humanity?: The resource fund and citizen's dividend model of Alaska, the 'last frontier'. Space Policy, 43, 1-6.

16:00 – 16:20 - July 8, 2025

Is there a place in the space for refugees? Astronomy of the Western Sahara from the exile

Andrea Rodríguez–Antón
Institute of Heritage Sciences (INCIPIT–CSIC), Spain

Abstract:
According to the UN, the Western Sahara is the only no-self-governing territory in Africa. The Spanish colonialism in this region, started in 1884, affected the territorial organization and land use, altering the traditions of the nomadic groups (Hernández, 2010). This impact was increased by the Moroccan occupation of the territory, which forced the displacement of the population to refugee camps in Algeria. As nomads, Saharawis necessarily developed a profound knowledge
of the sky for organising daily and seasonal activities, establishing spatial references for moving or praying and, furthermore, the cosmos was also a source of inspiration and imagination (Mulero Clemente, 1945).

This wisdom presents notorious influences of ancient Arab astronomy –probably brought into the Western Sahara during the Arab conquests in the early Middle Ages (Norris, 1986)– and was mostly transmitted orally and through its use to the different members of the group. The orality and lack of written treatises on this topic, together with the drastic break with the land and practices, strongly threatens the preservation of this skylore and all these imaginaries and practices around the sky. This work presents the last results of Amanar, a multicultural and multidisciplinary project developed in the Sahrawi refugee camps in Algeria for the study of Sahrawi folk astronomy (Benítez Herrera and Rivero González, 2010), and the strategies that are being carried out for the conservation, diffusion of this knowledge and to raise awareness of this heritage within the Sahrawi society and the international astronomical community. Another fundamental aim of this presentation is to raise questions about the role that the refugees may play in a colonial space race, the benefits (if any) they could obtain, the threats they faced in a context of war and environmental breakdown and, more broadly, to consider how we cultural astronomers can contribute to bringing the voices of the landless into discussions around space.

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16:20 – 16:40 - July 8, 2025

Moon Ritual and Shamanic Outer Space in South Korea

Hae-Seo Kim
University of California at Irvine, USA

Abstract:
South Korea's national space agency, Korean Aerospace Research Institute (KARI), joined NASA in 2021 as an international collaborator in the Artemis mission to send the first human woman to the moon. In their own way, Korean shamans have been in touch with the moon for millennia, calling on the moon's power to heal and bring prosperity to people. Korean shamanism is an indigenous religious practice in Korea that engages outer space through its rituals and worship. However, KARI does not incorporate shamanistic beliefs into its scientific epistemology or its institutional history – in fact, at the exhibitions at the space museum in Goheung, the public-facing part of the space station, it goes to lengths to distance itself from shamanism to establish its scientific authority. Through an ethnographic observation of a shamanic moon ritual of the first full moon of the lunar calendar year that takes place in Goheung, this paper raises the question of what it means to know and engage the moon through a shamanic ritual in a place that is increasingly shaped by space scientific activities. Goheung is a coastal fishing town that has traditionally relied on shamans and shamanic blessings for a good fish harvest. It is also the location of South Korea's first space launch pad and space station.

Through an ethnography of a shamanic ritual taking place in the same location as the national space program, this paper examines the politics of knowledge entailed in engaging outer space and historicizes the power dynamics that structure the relationship among space scientists, shamans, and locals in Goheung, South Korea.

In a moon ritual, ghosts, spirits, and gods of outer space and otherworld come into the body of the shaman and the ritual participants, rather than the shaman traveling to outer space and the spirit world like in North and South American shamanism. Through ritual dance and performance that communicate with the moon spirits, the shaman and the ritual participants' bodies become outer space; a space in which spirits, ghosts, and gods reside. The shamanic ritual creates a bodily relationship with outer space, one in which the cosmos and cosmic bodies are not "outer," but inside the ritual participants' bodies, and "inner" to lived experiences and histories of people on Earth, and directly connected to livelihoods such as fishing and farming.

The focus on embodied performance and bodily enactment of outer space challenges the popular view of outer space as an empty and disembodied space. The idea that outer space is empty, does not belong to anyone (terra nullius), and therefore can be exploited and colonized at will, perpetuates the histories of colonialism and settler colonialism on Earth (Smiles 2020; Shorter and TallBear 2021; Young 1987). Instead, examining outer space through embodied Korean shamanic performance centers the body and its earthly lived experiences of agriculture, colonialism, war, displacement, and migration, as well as joy, kinship, friendship and community (Prasad 2023).

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16:40 – 17:00 - July 8, 2025

Observatory and Sustainable Development Goals: An Exploratory Study of Timau National Observatory, Indonesia

Antonia Wibowo

National Research and Innovation Agency, Indonesia

Abstract:

Indonesia is currently developing a new observatory. It is located at the slope of Mount Timau, in Central Amfoang sub-district, Kupang Regency, East Nusa Tenggara Province. This observatory is called the Timau National Observatory. Like other observatories around the world, Timau National Observatory is located on land owned by an indigenous community. Moreover, the Indonesian Ministry of Environment and Forestry has inaugurated the area around the observatory as a national park called Mutis Timau National Park. Due to its strategic position on land owned by an indigenous community and inside a national park, Timau National Observatory can leverage benefits for professional astronomers, the indigenous community, and the biodiversity in the national park. Regarding the benefits of the Timau National Observatory, this presentation aims to explore four critical issues concerning the Timau National Observatory. They are indigenous and scientific knowledge of astronomy, the observatory's benefit and impact, best practices to foster collaboration, and observatory and sustainable development goals (SDGs). This presentation was prepared after a combination of investigative exploration and exploration for discovery. It was an investigative exploration because the presenter explored four issues that had never been discussed before when discussing the Timau National Observatory. Moreover, it was an exploration for discovery because the presenter revealed the importance of the Timau National Observatory in four different aspects. Since the observatory is still new and underway in its construction, this presentation used concepts and best practices from various countries regarding indigenous knowledge of astronomy, the benefit and impact of the observatory, and the best practices for collaboration to serve as a benchmark for management and research at the Timau National Observatory when it is ready to operate. After exploring those three issues, this presentation also provided an analysis of how the existence of the Timau National Observatory can support SDGs. The exploratory study's results show that Timau National Observatory can support SDGs 4, 8, 9, 10, 11, 15, and 17. To achieve those SDGs, when it is ready to operate, Timau National Observatory has to do three things: create spaces for multidisciplinary studies; create dialogues between professional astronomers and the indigenous community as the owner of indigenous astronomical knowledge; and develop a sustainable astro-tourism program by involving the indigenous community. Furthermore, the Indonesian government and professional astronomers need to create a sustainable training program for the indigenous community, so that they can participate in the astro-tourism program, such as becoming guides and lodging service providers, as well as presenting cultural products to tourists. Equally important is education about modern astronomy science, such as the need to preserve the dark sky, for the sake of the natural ecosystem in the Mutis Timau National Park, the health of the Amfoang people, and the continuity of both indigenous and modern astronomy science.

17:00 – 17:20 - July 8, 2025

‘Unacceptable to our people': diverse cultural beliefs, Indigenous rights, and the future of human activities on the Moon

John Barentine
Dark Sky Consulting, LLC, USA

Abstract:
The human presence in outer space is undergoing a transition from one in which nation states are the dominant actors to an emerging status quo in which states merely supervise the activities of private entities. Such largely commercial ventures include extracting natural materials from the Moon, a celestial body of great cultural and spiritual reverence for some Indigenous societies. However, the existing international legal framework governing activities in space focuses on its "exploration and use", centered in a Western worldview that attaches to a past history of colonialism and exploitation of people and resources. While that framework, articulated in the Outer Space Treaty (OST), claims to guarantee that outer space will remain "the province of all [hu]mankind," only entities with significant political power have to date decided the limits of the acceptable uses of space. This paper examines the historical record for clues about how states, private actors and Indigenous societies might interact in the future on matters of outer space governance to achieve more just ends. It analyzes a key case study: the dispute between the U.S. National Aeronautics and Space Administration (NASA) and the Diné people of the American Southwest over the launches of human cremated remains to the Moon in 1998 and 2024, acts the Diné president called "deeply disturbing and unacceptable to our people and many other tribal nations." In a future in which space becomes increasingly commercialized and entities like NASA transform into mere contract-administering agencies, it is unclear how an impending, exploitative human presence on the Moon can simultaneously honor Indigenous rights and perspectives on lunar issues. The presentation concludes that best practices for future engagement with the Moon must transcend the mere "due regard" and "international consultations" required by the OST in favor of arrangements where participants co-create a human future in outer space.

Videos

Astrotourism: A Tool to Promote Dark and Quiet Skies

Joyful Mdhluli, Samyukta Manikumar
IAU office of Astronomy for Development, South Africa

Abstract:
Astrotourism has rapidly become a popular and innovative form of sustainable tourism, offering a unique blend of stargazing, educational outreach, and luxury experiences rooted in astronomy. Beyond its appeal to travellers, astrotourism is as a powerful catalyst for local economic development while advocating for the protection of dark and quiet skies.

The International Astronomical Union's (IAU) Office of Astronomy for Development (OAD) recognises astrotourism as a flagship initiative that demonstrates astronomy's potential to drive socioeconomic benefits. This presentation will highlight practical resources developed by the OAD to support individuals, businesses, and observatories in integrating nighttime activities into their offerings, fostering economic growth while safeguarding the pristine night sky and its associated heritage.

By encouraging community ownership of and empowerment through indigenous and scientific astronomy, and encouraging collaboration between observatories and surrounding communities, our resources strive to encourage community-owned, bottom-up astrotourism initiatives that incentivise protection of both the night sky and the heritage that surrounds it.

Light pollution and its perception in rural contexts in the central–northern region of Santa Fe province, Argentina

Armando Mudrik
Universidad Nacional de Córdoba. Facultad de Filosofía y Humanidades. Museo de Antropología. Consejo Nacional de Investigaciones Científicas y Técnicas. Instituto de Antropología de Córdoba; Argentina.

Abstract:
From the perspective of ethnoastronomy (Iwaniszewski 1991, López 2015), this talk explores "customs" related to celestial realm present among farmers who are descendants of European immigrants, or "settlers," established in towns and rural areas that originated as agricultural colonies in the central-northern region of the Argentine province of Santa Fe, from the second half of the nineteenth century to the mid-twentieth century. Particularly, through our fieldwork, we are beginning to investigate the relationships between these farmers' perception of the sky and the phenomenon of light pollution. These relationships are strongly intertwined with traditional logics and classificatory schemes of the sky, which are linked to the productive tasks of contemporary farmers and their immigrant ancestors who settled in the region during the aforementioned colonization process. The traditional ways of organizing and structuring their perceptions, experiences, and representations of the celestial realm are characterized by a transversal aspect: the establishment of certain consonances between celestial and terrestrial phenomena.

In fact, from this traditional perspective, the sky is perceived as a space of "signs" that must be interpreted to determine certain phases of various activities, processes, or phenomena considered relevant to the terrestrial domain (Mudrik 2019). As our fieldwork reveals, these farmers interpret certain manifestations of light pollution in the region's skies as frost announcement signs (Mudrik 2024).

Therefore, this ethnoastronomical contribution shows how there is an important continuity in the habitus (Bourdieu 1997) that structures perceptions, representations and practices related to the sky within the framework of the rural productive activities carried out by our interlocutors. This continuity persists even as celestial phenomena or features have changed. Furthermore, this study underscores tensions and conflicts identified by other authors when addressing the notion of UNESCO's heritage (Ruggles 2017). Specifically, it challenges the static and universal valuation of heritage and calls attention to the dynamic and multifaceted nature of cultural conceptions and practices regarding the sky, particularly in the context of light pollution of the sky.

In this sense, the heritage framework of international organizations tends to prioritize static conservation, which implies framing cultural and social changes brought about by historical contingencies—such as new relationships with sky features emerging from light pollution—as a "loss." However, the traditional ways in which this social group perceives certain manifestations of light pollution do not reflect a process of "acculturation." Rather, they represent genuine cultural creations shaped within a specific historical context (Bloor 1991).

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Architectural Heritage in Astronomical Observatories: Adapting Terrestrial Architectural Designs to Space Environments

Fiorella Karla Nava Chuctaya, Luis Mauricio Huaco Zúñiga
Univ. Nacional de San Agustín de Arequipa, Peru

Keywords: Astronomical Observatories; Architectural Heritage; Space Adaptation; Architectural Design; Space Architecture

Abstract:

Currently, we face great challenges in science; significantly, the habitability beyond Earth might be closer than we think. Knowing that astronomical observatories collect data on celestial objects from the vast universe and connect us with the past, a logical idea would be to leverage this knowledge to create conservation sites in current and future space missions. Astronomical observatories are fundamental for maintaining the continuity of research and the connection with Earth's astronomical legacy. In this study, we present an architectural compilation on the preservation of heritage in astronomical observatories. We analyze criteria and strategies, exploring the adaptation and creation of terrestrial architectural designs in space environments, in order to facilitate scientific research from a planetary surface using astronomical observatories. As architects, we organize projects utilizing the infrastructure and resources associated with exploration. Additionally, this research is expected to adapt to new applications in space architecture.

Posters

Outshined and Endangered: the Impact of Artificial Light on Australia's Wildlife

Krystal De Napoli
Monash University, Australia

Keywords: photopollution, light pollution, wildlife, Australia, dark skies, Indigenous knowledge, cultural astronomy

Abstract:

Since time immemorial, Sky Country has provided a dark oasis under which Australia's unique wildlife have evolved. With only the stars and the moon for illumination, many native species have adapted their intrinsic behavioral patterns to these subtle light cues. As the sky doubles in brightness every 8 years, light pollution remains an often overlooked driver of biodiversity decline posing significant risks to Australia's wildlife, many of which are already vulnerable or endangered. By altering nocturnal environments, artificial lighting interferes with critical processes such as foraging, reproduction, migration, and predator-prey dynamics for a wide range of species, including insects, amphibians, birds, and mammals. Restoring dark skies is an ecological imperative which can be achieved by pursuing actionable solutions, such as adopting wildlife-friendly lighting practices, enforcing dark sky policies, and integrating ecological considerations into urban and infrastructure planning. By reducing light pollution, we can provide immediate relief for species already under pressure from habitat loss and climate change. This presentation underscores the urgency of addressing light pollution as a silent but pervasive ecological disaster, offering a pathway to safeguard Australia's biodiversity and sustain millenia-old cultural traditions.

ACKNOWLEDGEMENTS:

I recognise the Boon Wurrung and Wurundjeri people of the Kulin Nations as the traditional owners of the lands on which I live and work. I pay respect to their Elders, past and present, acknowledging their enduring connection to this Land, Sea, and Sky Country.

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Guerillas amongst the soldiers: Indigenization and Decolonization of Science curriculum at Canada's most colonial post–secondary institution

Gregg Wade, Danielle Lussier
Royal Military College of Canada, Canada

Abstract:
The Royal Military College of Canada (RMC) is a university built to educate the soldiers who protect and preserve the Canadian colonial project. Its roughly 1200 undergraduates study to obtain undergraduate university degrees while simultaneously undertaking training leading to them becoming commissioned officers in the Canadian Armed Forces (CAF) upon graduation.

RMC is arguably the Canadian post-secondary institution with the strongest ties to, and greatest investment in, settler colonialism. Its earliest alumni were called to participate in the suppression of the Northwest Resistance, ultimately defeating the Métis at Batoche, Saskatchewan leading to the state-sanctioned murder of Michif leader Louis Riel. Today, its young officers go on to command troops abroad and at home, conducting operations in support of Canadian sovereignty. RMC's wood-festooned hallways are decorated with portraits of its famous (and infamous) graduates and their exploits since the College's founding in 1874, just 7 years after the country's Confederation.

It is in this context that we as academic administrative and teaching professionals have been working to introduce Indigenous content, Ways of Knowing, and Decolonial teaching practice into RMC's undergraduate curriculum. In this presentation we will elaborate two distinct contributions. The first was the development of RMC's first decolonial science course (SCE101: Indigenous Perspectives of Science and Technology), an introductory-level Indigenous Studies course aimed at Settler learners, designed to be co-taught by an Indigenous professor and a Settler professor. SCE101 incorporates circle-based teaching, and significant handwork and land-based learning components. The second is the story of the incorporation of an Indigenous Studies component into RMC's 4th-year Introduction to Astrophysics class, in recognition of the severe educational gaps existing in RMC's Common Core curriculum and in light of a lack of institutional readiness to resolve them.

Contesting the Night Sky: A Preliminary Study of Landscape, Scientific Knowledge, and Indigenous Peoples in Hehuan Mountain Dark-Sky Park

Hong-Bing Ong
Department of Geography, National Taiwan University Unit for Indigenous Celestial Phenomena Culture, Astronomy Club Union of Universities in Taiwan

Abstract:
This study investigates the power networks surrounding the Hehuan Mountain Dark-Sky Park, examining how landscapes and the night sky are shaped through the application of scientific knowledge. As Taiwan's first light-pollution-controlled area, the park represents a novel form of spatial governance, encompassing the reconstruction of landscapes and skyscapes, as well as contestations over resource control and power redistribution. Its establishment resulted from a collaborative effort among local governments, astronomy experts, tourism operators, and local universities. By mitigating light pollution and enhancing stargazing opportunities, the park seeks to transform the region into a "starry mountain city", but it neglects the democratic participation of Indigenous peoples in the process. Grounded in Science, Technology and Society (STS) and skyscape theory, this study explores the political dimensions of scientific knowledge and spatial governance, with a focus on stakeholders' interactions and power dynamics. Employing participatory observation and secondary data analysis, it addresses two central research questions: (1) How do the politics of scientific knowledge and spatial governance shape the night sky within the Hehuan Mountain Dark-Sky Park? (2) In what ways are landscapes and skyscapes co-constructed through social activities?

The findings reveal that scientific knowledge plays a pivotal role in facilitating governance and advancing tourism. Astronomy experts not only contribute to preserving the night sky but also translate their expertise into strategies aimed at attracting tourists. Local governments prioritize international visibility and economic development, promoting policies for light pollution control and infrastructure improvements. Meanwhile, tourism operators commodify celestial resources as part of an emerging "starry industry chain," with local universities mediating stakeholder relationships and coordinating planning. However, this process often marginalizes Indigenous cultural rights and spatial agency. The Hehuan Mountain area, situated within the ancestral lands of the Seediq people, has seen its cultural practices and historical narratives increasingly sidelined. Indigenous astronomical knowledge is frequently appropriated to meet tourism demands, such as the transplantation of Bunun myths and the construction of an astronomical museum within traditional territories. This reflects the broader reconfigurations of power at the intersection of science and capitalism, further exacerbating the commodification of cultural landscapes into marketable assets.

The governance of the park provides a striking example of how terrestrial spaces are managed to create skyscapes, particularly by implementing vertical spatial light pollution control. This strategy not only represents technical interventions but also exposes deeply

rooted power dynamics. While the park showcases the potential of scientific collaboration, it also risks perpetuating socio-cultural inequities disguised as ecological and economic advancements. The root of the issue lies not in an inherent conflict between environmental, economic, and cultural priorities. Instead, it stems from the governance framework, which prioritizes capitalism and scientific paradigms over a more inclusive and equitable approach that acknowledges and safeguards the rights and sovereignty of Indigenous peoples. By employing a skyscape perspective, this study provides critical insights into the dark-sky preservation movement, highlighting its socio-political implications and the contested cultural meanings of the night sky. These findings serve as valuable references for crafting more inclusive policies and advancing future research.

IAU SYMPOSIUM 399

Education, De-Colonisation, and the Arts, July 11, 2025

Session 13: Education

09:00 – 09:20 - July 11, 2025

Astronomy and Culture: Using social semiotics to make deeper connections in Astronomy education

Saeed Salimpour, Michael Fitzgerald (LCO)
Deakin University, Australia

Abstract:
Every culture around the world has some connection to the sky whether it is through art, religion, mythology, social practices and much more. This unique characteristic of astronomy offers a rich untapped potential that may offer new insights into teaching and learning, inform innovative pedagogies that are connected, and avenues for bringing astronomy into education.

This talk is based on a recently published study, which uses theoretical perspectives grounded in social semiotics and representation construction, together with experience from the classroom to inform a conceptual framework that taps into the interdisciplinarity of culture using it as a context to bring astronomy education into the classroom.

This framework is made concrete through the use of practical examples from different showing how various events, festivals and calendars can be used to take students on a journey from the familiar socio-cultural context to the astronomical conceptual knowledge.

09:20 – 09:40 - July 11, 2025

Learning of the Outside
Didactics and the altered environment in the universe of the Tikunas culture in the Colombian-Brazilian Amazon.

Jose Balbi & Eduardo Bufalino

Museo del Observatorio de Fisica Cosmica, Argentina & Instituto Superior de Enseñanza Docente, Vicente Lopez, PBA.

Abstract:

Our work studies the sky as seen by the Amazonian indigenous people for centuries. The stars were not always worshipped by all the different cultures and neither were they always used for calendars or predictions. The reality of "A sky in each bend of the river" becomes concrete and encounters a cultural clash when trying to see Astronomy with Western parameters.

Our work in 2024 was that of scientific dissemination. With our eyes on the future, stories and legends were collected before they lost and we tried to capture them in the sky as the indigenous people do to teach such stories to later generations. We are solving the problem of whether we can support this transmission of knowledge in any way and whether our vision is useful for this

This work was carried out by indigenous elders, indigenous students from Amazonian Universities and Western educators and disseminators. As part of the latter, we have tried to understand the knowledge that is transmitted through myths and legends, in order to learn from the culture that was formed by the indigenous people who preceded us on the path of life.

This knowledge is enduring. The elders understand a complete sky culture without new additions, which is why, despite contact with the West, they continued with their design of constellations and celestial phenomena. Even mappings of the so-called "cultural" phenomena were made in modern programs such as Stellarium. How this knowledge was received by future Indigenous Astronomers and how the workshops we held in Amazonas turned out is another of the topics we will address.

We also discuss the challenge posed by the appearance of our group, the intruders, along with our new knowledge, technology and perspectives, and how this contact affected the worldview of a culture whose antiquity in that landscape is impossible to measure. Finally, has our intervention been useful?

09:40 – 10:00 - July 11, 2025

A Sun That Never Sets: Methods of Outreach and Educational Commitments for Astronomy

Cintia Duran
International Astronomical Union, Mexico

Abstract:

A Sun That Never Sets is a research project proposing a linguistic analysis based on the study of various indigenous languages across four regions of the world, aiming to design communication strategies for the teaching of astronomy specifically developed to each community.

It is grounded in the Systemic Functional Grammar linguistic studies, which posits that the structure of language within each society influences roles, behaviors, and forms of learning, thus allowing for an in-depth analysis of the relationship that various indigenous cultures have established with the earth and the cosmos. The ultimate goal is to modify concepts and practices in the dissemination of astronomy to enrich the foundations for teaching at basic education levels.

Highlighting the uniqueness of each community can be a key tool in fostering a new phase in the relationship between astronomy and society, laying the groundwork for multidisciplinary research for the benefit of humanity. This emphasizes the importance of recognizing linguistic and communicative differences in each country; valuing these particularities enables a better understanding of the history, customs, and mindset of each community.

This research proposes to examine the relationship between language, community, and landscape, as seen from various indigenous cultures, working with teams and communities from those regions to establish a linguistic-social analysis. From this analysis, we can derive strategies and methodologies specifically designed for each region, establishing foundational principles to pave the way for a more open and conscious scientific community regarding issues of discrimination, racism, and colonialism. This approach seeks to establish more horizontal practices when engaging with society from academia or scientific language.

10:00 – 10:20 - July 11, 2025
Ale Lau Loa: Indigenous Culture–based learning

Yuko Kakazu
NAOJ & TMTIO, Japan (Video)

Abstract:
Maunakea holds deep cultural and spiritual significance for many Native Hawaiians and belongs to the people of Hawaiʻi. Ultimately, the decision on the Thirty Meter Telescope (TMT) on Maunakea rests with the Hawaiʻi and Native Hawaiian communities. TMT acknowledges that its previous focus on the legal path to construction contributed to division and conflict. With new leadership and a renewed vision, TMT is committed to fostering mutual respect, listening, and collaborating on initiatives that contribute to a brighter future for all, especially Native Hawaiian communities.
We put these values into action by partnering with the host community to co-create programs that address the unique needs and interests of Hawaiian communities. A key initiative is ʻAle Lau Loa, a collaborative indigenous culture-based learning program led by Hawaiʻi County, cultural practitioners, wayfinders, and TMT. Named by a Native Hawaiian cultural practitioner, ʻAle Lau Loa, meaning "long large wave," symbolizes the interconnected histories of indigenous cultures—waves of knowledge passed across generations, land, sea, and sky.

ʻAle Lau Loa offers high school students from Hawaiʻi Island and TMT's partner countries opportunities for cultural exchange, learning from indigenous perspectives. Past exchanges with First Nations in Canada and Okinawans in Okinawa have highlighted the shared values and traditions of indigenous peoples globally.

The program also serves as a vital cultural learning opportunity for TMT staff, who join students in studying Hawaiian culture, language, and philosophy. Through these shared experiences, both students and staff build deeper connections to Hawaiian heritage and values, fostering greater cultural understanding and stewardship.
By embracing these opportunities, ʻAle Lau Loa aims to create lasting cultural connections and support a shared commitment to preserving indigenous knowledge for future generations.

10:20 – 10:40 - **July 11, 2025**

Art & Star Knowledge of the Torres Strait

David Bosun
Mualgal Artist, Torres Strait, Australia

Session 14: Colonialism and Decolonisation in Astronomy
11:10 – 11:30 - July 11, 2025

Colonialism and Eclipses: Native Americans, and Astronomers Contest the Creation of the Astronomical West, 1860–1890

Doug Sam
University of Oregon, USA

Abstract: Eclipses played a major role in establishing the American West as a premier destination for observational astronomy. Between 1860 and 1889, four total solar eclipses were visible in what is now the United States, all in the West. These offered the burgeoning cadre of American astronomers an opportunity to demonstrate their nation's scientific expertise and prowess on an international stage. American scientists hoped to be the first to determine the nature and composition of the sun's corona and find the hypothesized intra-mercurial planet of Vulcan. For personal glory and national pride, American astronomers mounted expeditions during each eclipse, each time penetrating lands that were still either Native-controlled or had only recently been dispossessed from Indigenous hands. In doing so, astronomy and colonialism in the American West had always been intertwined, and astronomical research was only possible because of the ongoing advance of the American Empire to secure these spaces. However, the incomplete closure and conquest of the West meant that the actions of these astronomers were not uncontested. Indeed, I argue that Indigenous peoples were critical to the creation of the Astronomical West, at times resisting and at times facilitating it through their knowledge, labor, and power. Whether they resisted or assisted these settler scientists had real impacts on the development of Western astronomical science and the Astronomical West. Native resistance to colonialism and Euro-Americans' fear of Native power halted expeditions, forcing settler scientists to contend with the limits of American power. This also preserved the West as a space where traditional astronomical knowledge continued to thrive well into the twentieth and even twenty-first centuries. However, Native guides could also use their knowledge to guide settler scientists across unfamiliar lands, kinship networks to unlock new geographies for science, and labor to make these expeditions logistically possible, even paddling canoes loaded with telescopes upriver for days so that settler astronomers could collect their data. Over these nearly 30 years, some of the most consequential in Native American history, the cooperation or resistance of Native people directly impacted Western astronomical science. 'Eclipses also held significant meanings for many Indigenous peoples, who used them to understand their changing world and how to respond to it. It was the 1889 eclipse that inspired the Ghost Dance, one of the most powerful, hopeful, and tragic episodes of Indigenous resistance. Indeed, its violent suppression is often used to mark the breaking of Indigenous power in the West. But, of course, Indigenous people and power survive. Resistance and contestation over the meanings and proper use of places like Mauna Kea or Mount Graham are a continuation of this history that has roots in the nineteenth century and beyond. Studying Native history offers lessons to Western astronomers in understanding the harm and healing that needs to still be done and the need to respect Native people and power as astronomers continue to use Native land to study the stars.

11:30 – 11:50 - July 11, 2025

Perspectives from the United Nations Science Summit on Decolonising Astronomy and Space Exploration

Thilina Heenatigala

Earth-Life Science Institute (ELSI), Japan, Institute of Science Tokyo (ScienceTokyo), United Nations General Assembly Science Summit (SSUNGA)

Abstract:

Over the past several years, the United Nations Science Summit (SSUNGA) has created a venue for decolonising science to address the ethical, cultural, and environmental challenges embedded in global scientific practices, particularly in astronomy and space exploration. This presentation reflects on key insights from the past SSUNGA sessions, which explore the intersections of scientific advancement, Indigenous sovereignty, and the legacies of colonialism.

Decolonising the astronomy and space sectors requires acknowledging and addressing historical inequities, such as the marginalisation of Indigenous communities and the construction of observatories on sacred lands while advocating for sovereignty and equitable participation. It also involves reforming international policies to ensure that space exploration does not replicate colonial practices but instead fosters sustainable, fair, and shared use of outer space resources through updated treaties and global cooperation. Furthermore, integrating Indigenous knowledge systems into scientific frameworks can enrich astronomy and space activities by promoting inclusivity, sustainability, and respect for diverse ways of knowing.

By addressing these critical areas, the United Nations aims to align the astronomy and space sectors with the Sustainable Development Goals (SDGs), including reducing inequalities (SDG 10), fostering peace and justice (SDG 16), and building partnerships for sustainable development (SDG 17). This presentation envisions a decolonised future for astronomy and space exploration, ensuring ethical and inclusive progress for all.

References:

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11:50 – 12:10 - July 11, 2025

Astrophysicists & Discrimination

Jarita Holbrook
Harvard–Smithsonian Center for Astrophysics, USA/UK

Keywords: Decolonizing Astrophysics, STEM Diversity, Discrimination

Abstract:
While considering the role of Indigenous knowledges and Indigenous peoples as we continue towards the space age, we need to understand how astrophysicists create and maintain an unwelcoming and discriminatory environment for diverse scientists, while on the other hand they are actively seeking diverse scientists. Knowing the patterns means that solutions can be discussed and implemented. This presentation focuses on the myths of intellectual superiority, white entitlement, sexism and other forms of discrimination including anti-Black discrimination. Using interview quotes from the HAD AAS oral history project, the ASTROMOVES project and the UCLA EAGER project (co-I Sharon Traweek), patterns of discrimination are presented. Finally, such discussions of discrimination are part of decolonizing astrophysics and other scientific spaces.

12:10 – 12:30 - July 11, 2025

First Nations Astronomy as a Path to Decolonising Australian Museums: Challenges and Opportunities

Valentina Bassich

Imperial College London, UK

Abstract:

Australia is a settler colonial country where the colonisers have never left and is therefore characterised by persistent power imbalances (Moreton-Robinson, 2015). Much research has been done in different fields, such as decolonial and settler colonial studies, on how to decolonise colonial and settler colonial countries. However, an agreement on how to do this has yet to be reached (Veracini, 2007). In this landscape, museums, as historically colonial enterprises that have traditionally shaped and preserved colonial narratives, play a complex role and face similar struggles (Ariese & Wróblewska, 2021). Nevertheless, efforts to decolonise museums are extensive, particularly in Australia. The Indigenous Roadmap Project, which offers a comprehensive set of guidelines for decolonising museums, is a great example of these efforts (Terri Janke and Company, 2018). One of the guidelines suggested by the project is implementing the representation of First Nations knowledge in museums, particularly regarding science.

Five years after the publication of the Indigenous Roadmap Project, this research examines how meaningful representation of First Nations astronomy in Australian museums can aid decolonisation and looks at the challenges museums face in doing so. This field has seen limited research. Despite that, major Australian institutions are starting to integrate First Nations astronomy into their programmes and exhibitions, which suggests the importance of conducting this research to assess and further support these efforts. In this research, I take a philosophical and historiographical approach, analysing museums' efforts through the lens of decolonial and settler colonial theories, which are useful in analysing the epistemological foundations of museums' representation. This research draws from interviews with museum practitioners from two institutions at the forefront of the representation of First Nations astronomy and a Professor of cultural astronomy. The themes that emerged from the interviews were strongly interconnected, which reflects the layered and dynamic nature of museum decolonisation. Despite this interconnectedness, I grouped them into three main categories, which are helpful in identifying the layers through which First Nations astronomy can be considered in decolonising museum practices. These three categories are decolonisation of knowledge, decolonisation of practice and decolonisation of audience engagement.

What emerges from this research is that there is a fundamental tension museums need to deal with between representing First Nations knowledge on its

own terms and the need to use Western frameworks to engage audiences. To address this tension and ensure that the representation of astronomy is meaningful, museums need to engage in conversations regarding how knowledge is produced, categorised and presented to the audiences. These discussions align with some of the recommendations outlined by the Roadmap, and, notably, institutions are having these conversations independently. The decolonisation of museums remains a complex and layered practice; however, from this study, it emerges that representing First Nations astronomy can be a catalyst for other decolonial practices, such as the acknowledgement of colonial histories, engaging the audience in a deeper understanding of First Nations cultures and battling misconceptions, furthering these efforts.

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Session 15: Poetry and Performance in Cultural Astronomy
13:30 – 13:50 - July 11, 2025
The ambivalent resonance of spent energy*: Re–imagining the Space Age through Indigenous/First Nations Poetry By Temiti Lehartel, Charmaine Papertalk Green, Robert Sullivan, Samuel Wagan Watson and Alison Whittaker

Estelle Castro–Koshy
Université de Bretagne Occidentale, France
Abstract:
Literature and performance poetry are mediums of choice to re-imagine how to inhabit the world. They also have a unique capacity to make the invisible and unseen visible, perceptible, and audible. In *Astronomy: Sky Country*, Australian First Nations astronomers and astrophysicists, Krystal de Napoli and Karlie Noon included a creative piece at the end of the book: a letter written from 2044 by "custodians of the planet to the current ones" whose "skies have been almost entirely cleaned of near-Earth pollutants and junk". In her poem "Ô Moana nui" written and performed for the launch of OSPAPIK (Ocean and Space Pollution, Artistic Practices and Indigenous Knowledges: https://ospapik.eu/en/) in French Polynesia in January 2024, Temiti Lehartel, who is of Samoan, Tahitian and European descent, asked about the real price that is paid to have our "celestial space polluted by man-made satellite-stars". This paper contemplates the role of literature in the space age and examines, in particular, how Pacific Indigenous and Australian First Nations poets and writers address space pollution and at the same time provide hope and create a sense of purpose and possibilities. Through a focus on poems by Temiti Lehartel, Charmaine Papertalk Green, Robert Sullivan, Samuel Wagan Watson and Alison Whittaker, it also reflects on the role played by literature in foregrounding the connection between Land/Country, the Ocean/Sea Country and the Sky/Space/Sky Country and in addressing the continuation or new forms of – socioeconomic and epistemic – injustices in the space age.

The first part of the paper reflects, firstly, on imaginaries that are enchanted or disenchanted in the space age, in Robert Sullivan's poem "Waka 46"** for instance, and, secondly, on what is at stake when poems are sent to space – as was the case for a poem by Samuel Wagan Watson that featured on the International Space Station as part of an exclusive commission for the Japanese Aeronautical Exploration Agency. The second part focuses on how Indigenous knowledges, philosophies and epistemologies inform and seed literary productions on critical environmental situations, and provide innovative ways to understand space pollution or to ask important questions. How do we respond, for example, to the "neon dreams" and ambivalent status of space debris in Alison Whittaker's poem "Space Junk"? Whose "neon dreams" are they, what is the role of humour in the poem, and who has the last say on the destiny of space debris? The paper also foregrounds how Indigenous/First Nations literature invites us to "the quiet science of sitting and listening" (Romaine Moreton, *The Right to Dream*).

* This is the last verse of Samuel Wagan Watson's poem included in the "Space Poem Chain", a project by JAXA.

** "Waka 46": https://poetryarchive.org/poem/waka-46/

13:50 – 14:10 - July 11, 2025

OSPAPIK Poetry Performance

Romaine Moreton
RMIT University, Australia

OSPAPIK examines the ways in which artistic expressions allow the artists themselves, scientists, organisers of maritime expedition projects and audiences to better understand how marine ecosystems and Space are affected by the presence of waste and debris. The project focuses on the ocean and space, where pollution can be invisible to the naked eye. The intention to analyse both space and marine pollution is also motivated by the fact that these two spaces share a history of human-exploration and silencing of Indigenous voices. The project aims to study comparatively affective, professional, sensorial, and historical relationships to marine, nuclear, and space debris and waste.

The project intends to answer questions such as:

- How does one speak, communicate, and create arts about spaces that are both distant and immense, and polluted with invisible pollution or minuscule waste and debris?
- How do pollution and waste alter, shift or strengthen people's relationship to the ocean and space?
- What do Indigenous artists transmit to the next generations regarding ancestral presences in the ocean and space through their art on pollution?

14:10 – 14:35 - July 11, 2025

Celestial Harmonies Musical Performance

Daniel Peluso
SETI Institute, USA

Abstract:
Celestial Harmonies, led by astronomer and singer-songwriter *Conner Eko*, aims to blend Western pop with traditional Aboriginal music to share ancient sky knowledge and cosmic perspectives. Inspired by Paul Simon's *Graceland*, which fused Western pop with South African music into an iconic cross-cultural masterpiece, and Carl Sagan's *Cosmos*, which popularized astronomy through compelling storytelling, this project seeks to collaborate with Aboriginal Elders, musicians, and astronomers to create culturally rich and evocative original songs that celebrate celestial themes and interconnected worldviews. Together, we will co-write songs that blend contemporary and traditional musical elements, creating an innovative fusion of music and science that deepens public appreciation for both cultural heritage and the universe's mysteries. Galvanized by how *Cosmos* made complex astronomical ideas accessible through engaging narratives and storytelling, this project will innovate by blending Aboriginal perspectives, scientific insights, and cultural depth into compelling pop music. It seeks to enhance public engagement in the arts, astronomy, and Indigenous culture, fostering appreciation and awareness, just as *Cosmos* did for science. This initiative will not only help promote ancient Indigenous traditions and knowledge for future generations, but also serve as a powerful platform for cross-cultural dialogue, public education, and transformative artistic innovation that redefines the boundaries of modern music and songwriting

14:35 – 15:00 - July 11, 2025

Researching Lightning's Origins with First Nations People in Minnesota, Turtle Island and Australia

Bon Mott & Simon Rose

Second Space Projects, Australia

Abstract: In 2024 and 2025 , artist, curator and educator, Bon Mott is creating installation projects title "Researching Lightning's Origins with First Nations People in Minnesota, Turtle Island and Australia." Bon Mott's research methodology involves reciprocal nurturing through collaboration with communities of non-normative artists to foster meaningful partnerships and is informed by Mott's lived experience of being neurodivergent. The project aims to bridge art and science education by illustrating how cosmic rays may seed lightning in storm clouds. Mott created large chalk drawings on a blackboard in their Saint Paul loft, using chalk gifted by Ho-Chunk Elder Distant Thunder. The research will culminate in a film showcasing these drawings, accompanied by cast bronze ceiling installations. Integral to this project is the mentorship and cultural consultation provided by Simon Rose, a Birriah/Gurreng Gurreng Murri filmmaker and director of The Great Aboriginal People. The artwork created for this project is titled "Lightning in the Middle," inspired by Bon Scott, the late AC/DC singer songwriter. The project integrates astronomy into artistic practices through residencies, sculpture installations, workshops, performances, and artist talks, and it is supported by Creative Australia, the Australian Government's Principal Arts Investment and Advisory Body. The project focuses on the relationship between cosmic rays and lightning. Lightning is theorised to originate from primary cosmic rays, which are high-energy particles (primarily protons) produced by supernovae (also described as heavy metal factories). These cosmic rays can take millions of years to reach Earth. When these rays enter Earth's atmosphere, they initiate a cascade of high-energy particles known as an air shower. Professor Joseph Dwyer studies atmospheric air shower also known as a runaway breakdown. Research indicates that each lightning strike generates approximately 300 million volts of electricity. Professor Olaf Scholten at the University of Groningen specializes in astroparticle physics and lightning research using the LOFAR radio telescope and has mentored the project to ensure scientific accuracy in this project. Engaging with Indigenous people from White Earth, Leech Lake, Bois Fort, and Hereditory Chiefs at Rosebud and Pine Ridge reservations has led to a deeper understanding of Native American cosmologies, which view lightning as connected to Thunder beings. Many Indigenous traditions speak of a connection between people and stars. (Hernandez, 2023). In 2018, a Lakota woman shared her belief that lightning comes from the cosmos, which inspired four years of rigorous research during my doctorate. Native communities appreciate that I view this as real science and provide feedback that my drawings contribute to this insight. The methodology for understanding lightning through collaboration with First Nations peoples emphasizes trust-building and cultural dialogue. Fieldwork conducted in Minnesota and South Dakota in 2018, 2024 and 2025 resulted in Native Americans contributing to the projects ceiling sculptures, which I respectfully integrate these to acknowledge the science embedded in the Thunderbeings that dwell in the clouds during lightning activity. The methodology encourages artists researching here on stolen land to seek mentorship from First Nations peoples, fostering ethical research practices that incorporate Indigenous perspectives from project inception.

Session 16: Indigenous Ecosystem Learning

15:30 – 16:30 - July 11, 2025

Native Skywatchers - Indigenous Ecosystem Learning: STEM Identity at the Intersection of Science, Culture, and Art

Native Skywatchers Team

Native Skywatchers, USA

Abstract:

The Native Skywatchers research and programming initiative has been recording, mapping, and sharing Indigenous sky and earth place-based knowledge for nearly two decades. From NASA to Fond du Lac Tribal College to exoplanet research at the USQ-Centre for Astrophysics … Native Skywatchers is a local and global leader in Indigenous science methodology and research with long-term broad impacts. This presentation will share findings of a three-year Native Skywatchers' project called, "Indigenous Ecosystem Learning", funded by the Heising-Simons Foundation. Four schools: (1) All Nations Program at South High School (Minnesota), (2) Kula ʻAmakihi Program at the Volcano School of Arts & Science (Hawai'i); (3) Little Singer Community School, Navajo Nation (Arizona); and (4) Colegio Montessori de Julia Ambros in Cozumel (Mexico), participated in the project, which included over 120 students and 14 educators. The overarching goal of this work was to positively impact participant's science identity and inspire them to pursue STEM by participating in authentic personal, research and cultural experiences. Engaged underrepresented students participated in STEM through deep dive, hands-on experiences weaving together science, art, and culture while at the same time support them to become media producers and critical thinkers. Reducing inequities and increasing diversity in STEM education and STEM careers is both a social justice issue and scientific progress imperative. Simply put, novel solutions to the complex problems interwoven throughout the Anthropocene requires fresh perspectives from diverse minds across STEM fields. This work is firmly positioned in culturally responsive, place-based, experiential education practices to increase student sense of belonging along with building STEM identity to counter some of the patterns of systematic discrimination and racial inequity in education. Nearly all students (97%) would recommend the experience to other students describing it as fun, hands-on, exciting, as a "chance to be involved", and "…when opportunity knocks, answer the door." Students reported the effects of Native Skywatchers as being able to express themselves through technology, feeling it is important to share science with others, understanding science to do their work, understanding indigenous ways of knowing, and being interested in research. After their experience, students were significantly more likely to identify with people who do science and believe that others saw them as someone interested in science. Facilitators were highly likely to participate in Native Skywatchers programming again with all willing to recommend the program to colleagues. Results show the success of the project is due to an increased sense of belonging and a positive shift in students' STEM identity through authentic participation in science, art, and culture. This work presents a successful model for how astronomical communities might support Indigenous youth and in doing so pave a path for future next generation Indigenous astronomers.

16:30 – 17:00 - July 11, 2025

Exhibit: Soundscapes Across Waterworlds (Sound-Based Moving Image Art, Conceptual Basis & Highlights)

Annette Lee, David Delgado, Kelly Carlton

Native Skywatchers, USA

Abstract:

On Oct. 14, 2024, a NASA-JPL spacecraft left Earth on a nearly two-billion-mile journey to investigate Jupiter's Moon, Europa, an ocean world like ours. What life might exist in the liquid water? The topic presented here is the sound-based intermedia installation, "Ancient Echoes: Soundscapes Across Worlds", part of the 'Blended Worlds: Experiments in Interplanetary Imagination' exhibit (JPL- the Getty PST). Sonic art engages viewers to participate in deep listening and reflection on shaping positive futures built on a foundation of greater connectedness with Earth, all life, and the cosmos. The objectives of this exhibit were two-fold: (1) to create greater empathy through soundscape and (2) to acknowledge the tapestry of life through the story of water. Practically speaking, a human being is made up mostly of water (50-70% depending on fat content). We live on planet Earth with a surface covered by 70% water. Liquid water and the water cycle are critical to life on Earth. And yet, when was the last time we intentionally gave thanks for water? Theoretically humans cannot survive without water. The sonic and moving image artwork " Ancient Echoes: Soundscapes Across Worlds" is an experiment that gives physical form to the artist's Indigenous process of thanking the spirits of nature, a process called "Putting Down Thanks." The power held in this intention is about recognizing the presence of the spiritual world and the gift of water that supports life across the universe. Grounded in the disciplinary framework of Indigenous Contemplative Theories and Practices this work invites viewers to reflect on their relationship with water and 'put down thanks' in alignment with their tradition or practice. The soundscape tapestry in "Ancient Echoes…" blends whale song, human heartbeats, and Europa's sonified magnetic field, connecting Earth's known life with Europa's unknown possibilities. The key question being: to what extent can soundscape inspire greater empathy? Using the Indigenous practice of 'putting down thanks', this work re-centers Indigenous knowledge perspectives and contemplative practices which colonization has targeted and attempted to erase. At a time of increasing detrimental effects of colonization, this sonic and moving image artwork installation aims to counter the wave of destruction forces by offering a simple practice inviting everyone to contemplate roles and responsibilites between human and non-human relations, our terrestrial and celestial ecosystems; specifically recognizing kinship between ocean worlds of Earth and Europa. Soundscapes connect us across time and space.

Videos
Mexican Archaeoastronomy in the Planetariums of the World

Milagros Varguez
Native Skywatchers, Mexico

Abstract:
Archaeoastronomy, an emerging and multidisciplinary field, combines the quantitative approach of Astronomy with various disciplines of the Humanities, such as Archaeology, Anthropology, Linguistics, and Art History, to understand how ancient civilizations perceived and used the sky. This field seeks to comprehend how the observation of the heavens influenced past cultures, especially the pre-Hispanic societies of Mesoamerica, where the relationship with the cosmos had a profound impact on daily life, social organization, and ritual practices. The observational tradition of Mesoamerican peoples, particularly the Maya and Mexicas, is distinguished by its exceptional precision. The Maya developed advanced methods for measuring time and conducting astronomical observations, allowing them to record celestial phenomena and predict key events in their history with remarkable accuracy. Similarly, the Mexicas, with their complex worldview, integrated the sky as an essential element in their ritual calendar, their myths, legends, and in the ceremonies that governed their social and political life.

This paper focuses on the experience of the first fully animated fulldome shows created in Mexico, titled Mayan Archaeoastronomy (2016) and Mexica Archaeoastronomy (2017). These cinematic productions were designed with the goal of bringing the public closer to the scientific legacy of two of Mexico's most prominent cultures, presenting their astronomical advances through an immersive and visually impactful experience. Funded by public resources from the National Council of Science and Technology (CONACYT) of Mexico, these productions not only constitute an effort to preserve and disseminate ancestral knowledge but also serve as an example of multidisciplinary collaboration to bring Archaeoastronomy to new audiences. The talk will address the production process of these shows, the technical and creative challenges encountered, collaborations with international institutions, and the results achieved in terms of audience impact. It will also discuss the value of planetariums and fulldome technology as educational and science outreach tools in the context of Archaeoastronomy. These experiences not only allow for a deeper appreciation of the astronomical knowledge of Mesoamerican civilizations, but also foster a cultural and scientific dialogue between the past and the present, contributing to the global recognition of the intellectual richness of Mexico's indigenous cultures. Participation in these projects highlights the importance of Archaeoastronomy as a bridge between science, history, and culture, enabling current and future generations to discover and appreciate the vast astronomical legacy of indigenous peoples.

Decolonizing the Outer Space Treaty: Integrating Marginalized Perspectives in Space Governance

Giuliana Rotola

IAU Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference (CPS), Italy

Abstract:

International space law, grounded in the Outer Space Treaty (OST) of 1967, has provided a foundational framework for governing the exploration and use of outer space. However, the treaty's predominantly Western-centric development has overlooked the perspectives and needs of marginalized actors, including Indigenous communities, whose holistic and relational understandings of the cosmos challenge the dominant utilitarian and extractive paradigms. These limitations raise critical questions about the inclusivity and equity of current space governance frameworks, especially as humanity's activities in outer space expand and diversify. This research advocates for the decolonization of the OST by reinterpreting its principles through the lens of diverse worldviews, particularly Indigenous perspectives. It explores how values such as reciprocity, stewardship, and interconnectedness can inform a more inclusive and ethical approach to space governance. A central focus of this work is the reinterpretation of key terms such as "use" and "exploration," which have traditionally been defined through Western, state-driven, and commercial priorities. These prevailing interpretations privilege extractive and utilitarian approaches, often excluding non-Western scientific and cultural practices. For instance, Indigenous astronomy, which embodies relational and intergenerational understandings of the cosmos, has been marginalized in both practice and governance. This exclusion is particularly evident in the growing dominance of satellite constellations, which prioritize commercial interests at the expense of preserving dark and quiet skies, which have been adversely affected by the unbalanced emphasis on economic exploitation. The case of satellite proliferation underscores the broader imbalance in space law: while legal frameworks accommodate state and corporate priorities, they neglect the impacts on marginalized actors and traditional forms of sky utilization, exacerbating global inequalities. Using Aotearoa New Zealand's legal recognition of Māori rights and its accession to the Artemis Accords as a case study, the research demonstrates how Indigenous methodologies can serve as models for integrating marginalized perspectives into space governance, moving beyond tokenistic inclusion to create meaningful legal and policy mechanisms that honor cultural diversity and sustainability. This research argues that by centring Indigenous knowledge systems and principles in space governance, it is possible to reimagine legal frameworks that are pluralistic, inclusive, and equitable. Ultimately, this work contributes to the broader discourse on reimagining space law to address global inequalities and promote a more inclusive interpretation of the OST. It offers actionable recommendations to amend existing legal frameworks and establish participatory mechanisms that allow for diverse voices to shape space governance. By critically engaging with terms like "use" and "exploration" and proposing pathways for integrating Indigenous and other marginalized perspectives, this research seeks to foster a governance framework that reflects humanity's cultural and epistemological diversity. Such a framework will ensure that humanity's engagement with the cosmos is not only legally robust but also ethically sound, culturally inclusive, and ecologically conscious.

Colonial Skies: John Herschel, Colonialism, and the History of Astronomy

Stephen Case
Olivet Nazarene University, USA

Abstract:

There is growing awareness of the role colonialism and coloniality plays in the rhetoric and practice of space exploration and exploitation. Organizations such as MIT's Space Enabled[1] and the JustSpace Alliance[2] as well as recent articles in popular media[3] and academic journals[4] highlight the continued effects of coloniality in this arena. Yet astronomy has been a major aspect of projecting and maintaining colonial power since at least the seventeenth century. Astronomy was central to defining the geospatial concept of territory itself; likewise, the navigational and time-keeping applications of astronomy were essential to the colonial project, which in turn gave rise to astronomical observatories around the world.[5] Understanding how colonialism shaped astronomy, and vice versa, is necessary to understand how coloniality continues to shape the methods and practices of modern astronomy. To fully address these enduring issues, we must understand the historical relationship of astronomy and colonialism. This talk examines this entangled history through the life and work of an especially influential astronomer and natural philosopher of the nineteenth century: Sir John Herschel (1792–1871).[6] Through Herschel's extensive surveys of the southern sky, his four years at the British colony of South Africa, his influence on nomenclature of constellations and planetary objects, and his popular writings, Herschel embodied the coloniality of European astronomy even as he resisted what he saw as its negative effects. Indeed, his experience in South Africa had a profound effect on his own rhetoric regarding science itself.[7] Herschel's work thus illustrates the multiple valences of coloniality and colonialism in astronomy: from straightforward projection of imperial power to assumptions of the nature of science. Herschel can thus help us better understand and address contemporary barriers to engaging indigenous astronomies.

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1 https://www.media.mit.edu/groups/space-enabled/overview/

2 https://justspacealliance.org

3 https://aeon.co/essays/we-need-a-more-egalitarian-approach-to-space-exploration

4 Alina Utrata, "Engineering Territory: Space and Colonies in Silicon Valley," American Political Science Review (2003): 1–13. https://www.cambridge.org/core/journals/american-political-science-review/article/engineering-territory-space-and-colonies-in-silicon-valley/5D6EA4D306E8F3E0465F4A05C89454D6

5 See for instance, the papers that arose from the conference "Where Science & Empire Met: Observatories in Asia in the Late 19th to Mid-20th Centuries," held in Manila in February 2020 and published in a special issue of Journal for Astronomical History and Heritage 26:1 (2023). Also R. C. Kapoor and Wayne Orchiston, "Colonial Astronomy as an Element of Empire in British India," in this same issue, pp. 113–158.

6 For my recent work on John Herschel see Stephen Case, Making Stars Physical: the Astronomy of Sir John Herschel (University of Pittsburgh Press, 2018), Stephen Case and Lukas Verburgt, eds., The Cambridge Companion to John Herschel (Cambridge University Press, 2024), and Stephen Case, Creatures of Reason: John Herschel and the Invention of Science (University of Pittsburgh Press, 2024).

7 Elizabeth Green Musselman, "Swords into Ploughshares: John Herschel's Progressive View of Astronomical and Imperial Governance," The British Journal for the History of Science 31:4 (1998): 419–35

Posters

Creating an Archeoastronomy Course as part of an Astronomy Minor Track for Non–Science Students

Nilakshi Veerabathina, PhD & Fajer Jaafari, PhD
Department of Physics, University of Texas at Arlington, USA

Abstract:
We are faculty members in the Physics Department at a large American public university, which serves around 50,000 students across various disciplines. In this poster, we will present how we are creating an interdisciplinary Archeoastronomy course for non-science students. Introducing archeoastronomy into the Astronomy track presents challenges, as science and non-scientific interpretations often intersect. This innovative course explores how ancient civilizations understood and utilized celestial phenomena, integrating perspectives from astronomy, physics, archaeology, anthropology, and history—while maintaining scientific integrity. The course aims to enhance students' cultural awareness, critical thinking, and research skills, all while promoting community engagement. As science instructors, we address the challenge of distinguishing between subjective interpretations and scientific evidence. To navigate this, we will discuss teaching methodologies and tools that encourage critical thinking and objectivity, even when dealing with historical sites where experimental and observational data are limited. This approach ensures a comprehensive and impactful learning experience for our students.

Common constellations across cultures

Bridget Kelly, Prof Simon Cropper
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Abstract:
Astrophysicists, anthropologists, and cultural astronomers have identified an intriguing phenomenon; across the world and throughout history many diverse cultures identify similar constellations in the night sky (Hamacher, 2012; Hamacher, 2020; Norris, 2016). The commonalities documented include the selection of stars, the similarity of shapes made, and the common components of the narratives for s constellations across cultures (Gulberg, Hamacher, López, Mejuto, Munro, & Orchiston, 2019; Hamacher & Norris, 2011; Ruggles, 2005). Documented explanation for these commonalities relied on the anthropological; the transference of night sky knowledge between humans throughout history (Ruggles, 2005). However, the commonalities between the Kamilaroi (Australia), Ancient Greeks and Tupi (Brazil) challenge this explanation. Cross-cultural transference would require surmounting significant barriers of geography, culture, language, divergent migration, technology, and time periods of tens of thousands of years (Malaspinas, 2016). We suggest instead that this phenomenon might be better understood through considering the innate human visual perceptual cognition processes we all share. Recent research has identified which visual principles predict the building blocks of common constellations across 27 distinct culture groups (Kemp, Hamacher, Little, & Cropper, 2022), star groupings and the common identification of shapes (Bocur, 2023) and that individuals create common constellations without prior learning, from novel night sky scenes (Kelly, Kemp, Little, Hamacher and Cropper, 2024). These findings lend evidence to the theory that commonality of constellations across cultures not a result of shared human history but rather stems from shared human nature. It invites us to look up past the pages of history to consider the ways in which we are united in experience of gazing upon the night sky and what that can teach us about how we create meaning from the world and with each other.

Introduce Practical Astronomy with Taiwan Indigenous Cou Culture to School Curricula: Cultivating Pride and Tradition in Modern Learning

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Keywords: Taiwan Indigenous Cou, Practical Astronomy, Integrated Education

Abstract:

Located in Taiwan's Alishan mountains, our school serves predominantly Taiwanese Indigenous Cou tribal children and offers a distinctive educational model that integrates compulsory academic learning with local cultural heritage. To develop students' critical thinking and problem-solving abilities regarding their living environments, we design a sequence of curricula based on astronomy and traditional knowledge related to their culture. This also helps them gain observational skills and basic scientific knowledge at the same time. These curricula are centered on the themes of astronomy, culture, ecology, and sustainability to equip the tribal children with competence in both science and social studies and, most importantly, to help them preserve their culture. The long-term perspective is to cultivate students as proactive, interactive, and community-oriented individuals. Ideally, they will commit to lifelong learning and adopt sustenance from their cultural heritage.

Indigenous Astronomy Education and Outreach at Arizona State University

Karen Knierman, Patrick Young, Ric Alling
Arizona State University, USA

Abstract:

We describe projects to center indigenous astronomical knowledge in formal course and outreach contexts in the School of Earth and Space Exploration at Arizona State University, USA. The course SES 394 Cultural Astronomy: Substance of Stars was conceived as a partnership between ASU and the Heard Museum in Phoenix, Arizona, USA. Two departments, the School of Earth and Space Exploration and the Herberger Institute for Design and the Arts, developed the course with the Heard Museum. This online course examines human perception of time and space, how people gain and maintain cultural values derived from their understanding of natural cycles, and how they embed astronomical knowledge in material and oral culture. In conjunction with the Heard Museum exhibition Substance of Stars, we focus on four cultures from across the United States: Akimel O'Odham, Diné, Haudenosaunee and Yup'ik. New cultures, not limited to the continental United States, will be featured in the exhibition and class on a few year cadence. Historical and contemporary artifacts from the show are contextualized with recorded guest lectures and writings by artists and scholars of each culture. The instructors act as facilitators; content is centered on and provided by indigenous artists and experts. Coursework includes asynchronous interactive lectures, sky observations, weekly online discussions and a semester-long project. An opportunity to visit the exhibition is offered to students. The course was piloted in Spring 2023 with 20 students. Currently, the course is being revised to include new videos by the artists and knowledge keepers that have been reviewed and approved by their tribal councils. Over the past 15 years, we have partnered with many tribal, rural, and inner-city schools to bring them astronomy content using the Starlab portable planetarium.

Our teacher trainings have allowed more than 500 teachers to present Earth and Space Science material to 34,000 students across Arizona since 2004. Classic Starlab has a set of cultural astronomy cylinders that teachers can borrow including Navajo Skies, Maya Skies, Chinese Seasons, Chinese Legends, African Mythology, and Hindu Mythology, but some of these are dated and mostly from a colonial perspective. In 2022, ASU Women in Philanthropy funded a new Starlab digital portable planetarium. We are creating a course for SESE students to create Starlab modules for K-12 classrooms. In this course, students will learn outreach methods, develop a module using digital Starlab, and present the module during a school visit. Along with the provided Starlab Digital software content, we can work with tribes to create new content to display in Starlab. Arizona has 22 federally recognized tribes, only one of which was represented in Classic Starlab materials. Teachers in tribal schools report that their students are interested in learning about their own cultural astronomy. Since new content for the Digital Starlab can be created through dome format movies, we partner with ASU's Film School and indigenous knowledge keepers to create dynamicmultimedia content. The new interdisciplinary course will bring together astronomy and film students to create multimedia cultural astronomy modules for Starlab.

Investigating the significance of cultural astronomy research for forming Space Science Club

Emiru Diriba Hirpa
Dambi Dollo University, Ethiopia

Keywords: ESSSDDBA, Odaa, Space Science Club, Young generation, Oromoo Cultural Astronomy, Collaboration

Abstract:

Investigating the significance of cultural astronomy research for forming Space Science Club at Dambi Dollo Town.

Indigenous astronomy allows astronomers to introduce Indigenous group to astronomy and space science. This study reveals the unique importance of integrating Odaa, the sacred tree in the Oromoo Culture, with the Oromoo cultural astronomy research and forming a new Space science club at Dambi Dollo town. The Dambi Dollo is the capital city of the Qellem Wallaga Zone in the Oromia Regional state in Ethiopia. The Ethiopian Space Science Society (ESSS) was established in 2004 and it has been forming space science Associations and clubs in the country. The ESSS Dambi Dollo Branch was established in 2020. There are lots of astronomical events that stimulated the physics department of Dambi Dollo University to establish the branch Association. We reviewed the establishment proposal of ESSSDDBA and uncovered that the International Astronomical Union Symposium 356 and the 2020 solar eclipse astronomical event observed on June 21, 2020 are parts the major factors that empowered the 12 founders the ESSSDDBA to establish the branch. As explained in the establishment proposal of the Branch Association, the African Astronomical Heritage and Diplomacy research division is one of the three main research division proposed as a long term plan of the branch Association. Based on this long term plan, we are investigating the connection between Odaa (the sacred tree) in the Oromoo Culture and the Oromoo Calendar in the Oromoo Cultural astronomy since 2023. We are doing this research project of the Oromoo cultural and practical astronomy by coming together with people from history, Afaan Oromoo and Physics departments in the Dambi Dollo University. The begining of this research in the Dambi Dollo community, focused on the young generation in particular, had the goal to encourage them to do space science. Thus, we established Odaa Space Science Club (OSSC) under the umbrella of the Ethiopian Space Science Society Dambi Dollo Branch Association (ESSSDDBA) by taking in to account the interests of the participants of the research (they were selected using purposive sampling method). Consequently, the target of this abstract is to communicate the achievements of the Oromoo Cultural Astronomy Research (OCAR) for initiating indigenous people to astronomy and space science work and in forming the new Space Science Club at Dambi Dollo town. We have also identified that coining the name using an indigenous term like Odaa that we used in forming the Odaa Space Science Club, attracts indigenous people to the modern astronomy and space science. This was revealed by the interview conducted by the present researchers.

The Wiradjuri Murriyang Project: creating constellation artworks for Stellarium and related educational content

Tina L Leaman[1], Scott "Sauce" Towney[2], Trevor M Leaman[3]

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3. School of Humanities and Languages, University of New South Wales, Sydney, NSW, 2052

Abstract:

Background: The Wiradjuri (var: Wiradyuri) people of central NSW, Australia represent the largest Aboriginal language group in the state, and second largest in Australia. Astronomical knowledge is deeply embedded within Wiradjuri culture (Hamacher, 2014; Leaman and Hamacher, 2019a). However, as is the case throughout Aboriginal Australia, invasion, colonisation and forced displacement caused a significant fragmentation of Wiradjuri traditional knowledge (e.g. see MacDonald, 1998; Read, 1983; 1984), hampering efforts to recover and determine the full extent of this knowledge.

Aim: The Wiradjuri Murriyang Project is a collaboration between Wiradjuri artist Scott "Sauce" Towney and cultural astronomers Trevor & Tina Leaman to create constellation artworks for a Stellarium add-in package based on ethnohistorical records and contemporary ethnographic studies of the Wiradjuri night sky. The same artworks are planned be used for illustrating future educational content for primary and secondary schools on Wiradjuri country (initially) and further afield. The artworks have already assisted with illustrating aspects of Wiradjuri cultural astronomical knowledge in recent publications, such as the paper depicting a Dreaming associated with the Ancestral Creator Baiami (Leaman & Hamacher, 2019b), a magazine article and book chapter featuring astronomically-related seasonal resource calendars (Leaman, 2019a; 2019b), and incorporation into a series of 'Totem' sculptures along the banks of the Lachlan River in Forbes, New South Wales (Forbes Advocate, 2018).

Methodology: Ethnohistorical records referencing Wiradjuri astronomical knowledge pertaining to the constellations of the Wiradjuri night sky ("Wiradjuri Murriyang") was initially sourced from a database of published papers and journals from JSTOR, Trove, Google Books, Google Scholar, UNSW Library, and internet databases. An ethnographic study was also undertaken with Elders and senior knowledge custodians to ensure the accuracy of the ethnohistorical records. From this we were able to identify 13 constellations, two associated with the dark bands of the Milky Way, and eleven associated with important bright stars and/or asterisms. Several other potential constellations are still being investigated by the authors and yet to be confirmed by knowledge custodians and illustrated by the artist.

Constellation artworks were initially rendered in black ink on white A3 archive paper using the characteristic lozenge-style patterning traditionally used in Wiradjuri ceremonial carved trees (Etheridge, 1918, Figure 1, left). These artworks were then scanned at high

resolution, scaled to the recommended size for Stellarium (600x600 pixels for smaller constellations, 1200x1200 pixels for larger), and inverted, creating a white constellation on black background.

Results: A beautifully-rendered illustration of the constellation of Gugaa the Tree Goanna (in the stars of Scorpius) is highlighted in Figure 1 (right). The current collection of 13 Wiradjuri constellation artworks and their cultural interpretations is also given in the accompanying poster. The Wiradjuri Skylore add-in for Stellarium includes a description of each constellation and its cultural meaning, the names of each constellation in English and Wiradjuri, along with the names of some prominent stars, planets, the Sun and Moon in both languages. This package is still in development and not currently publically available. However, we hope to release it as soon as the remaining constellations are added and the Elders have given final permission to release it.

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How we loved and lost the stars: the fate and stakes of the night sky as narrative nonfiction

Joshua Sokol
Freelance Science Journalist, USA

Abstract:
How we loved and lost the stars: the fate and stakes of the night sky as narrative nonfiction Globally, ground-based light pollution is increasing 10% per year and the population of active satellites has quintupled since 2019, producing visible changes everywhere. Yet to date, vanishingly few regulations or even cultural norms protect human access to the nocturnal universe. In my forthcoming book for Random House, meant for popular audiences in the US and abroad, I marry a cultural and environmental history of how the stars have shaped humanity with arguments from astronomy, ecology, dark-sky environmentalism, and Indigenous knowledge systems to make a case for treating the night sky as an imperiled environment worth saving. As a work of contemporary science journalism built on interviews, reporting, elements of memoir, and both secondary and primary texts, this approach still necessitated making several decisions with academic dimensions. I didn't want to retell the traditional, triumphalist history of Western night sky ideas but rather to expand past that. I didn't want to idealize the night sky as pristine nature or "wilderness" but rather as a human environment, an interface between us, society, and the rest of the living world. I also wanted to amplify, but not appropriate, Indigenous voices and thought.

My talk will discuss how, with these guidelines in mind, I chose my structure. Beginning with the evolution of complex vision and studies from sensory ecology on how animals use the stars, my book discusses early but ambiguous archeological evidence of human astronomy. Moving into the ethnographic record, I give examples of the diversity – in form and purpose – of oral astronomies, and the resilience that has preserved and revived many of these traditions in the present, while then recounting how the Greek oral system was incorporated into the work of Hipparchus and Ptolemy. In a pair of chapters I then trace the night sky's role in defining worldwide conceptions of time and space, with a narrative that switches between the Maya world, the more familiar progression from Mesopotamia into Europe, and astronomical encounters between the Jesuits and China in the 1600s and between Europeans and Polynesia in the 1700s. Returning to the West, I trace the advent of artificial light and discuss historical ambivalence about scientific modernity in poetry and the work philosophers like Koyre and Weber. Another pair of chapters explores the light-polluted world's impact on ecology, on human beings, and then another chapter explores the environmental history and risks of satellite megaconstellations. In the book's final chapter, I cover the dark sky movement's successes and the revitalization of Matariki by Maori astronomers as representing alternate ways forward, toward starrier skies.

The Seven Sisters story as a tracer of human migration

Ray Norris
CSIRO / University of Western Sydney, Australia

Abstract:
Many cultures around the world tell very similar stories about Orion and the Pleiades, including how the Orion man/men chase the Seven Sisters, and how the youngest sister is caught or is in hiding, which is why we only see six of the seven stars in the sky. In particular, we see very similar stories in Greek mythology and in Australian Indigenous cultures. This is surprising because, until the British occupation of Australian 240 years ago, there was virtually no cultural contact between Australian Aboriginal people and Europeans since all humankind migrated out of Africa in about 100,000 BCE. And yet there is good evidence that the Australian stories are thousands of years old. So how come the Australian and Greek stories are so similar?

One possibility is that humans brought the story from Africa with them as they migrated around the world to form the current populations in Australia, Europe, and elsewhere. Support for this hypothesis comes from the fact that, because of proper motion of the stars in the Pleiades, 100,000 years ago the stars looked more like seven stars. So it is likely that the stories that came out of Africa were about seven stars, hence the "Seven Sisters'. However, over the millennia the stars moved until they looked like the six that we see today, leading to the stories in many cultures explaining why we can no longer see the seventh. Further supporting evidence for this comes from phylogenetic analysis of the stories around the world, which also point to an origin in Africa 100,000 years ago. Can we extend that phylogenetic analysis to trace the paths followed by those early humans, even to the fine details of how ancient Aboriginal Australians migrated across Australia?

List of Authors