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EDUCATION, OUTREACH AND HERITAGE

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Astronomy Education and

Communicating Astronomy

Protection of Existing and Potential Observatory Sites

World Heritage and Astronomy

Development

with the Public

History of Astronomy

DIVISION C COMMISSIONS

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DIVISION C WORKING GROUPS (WG)

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Inter-Commission C1-C2-C3-C4 WG	Astronomy in Culture (WGAC)

TRIENNIAL REPORT 2021-2024

Edited by: Division C Secretary, Mirjana Povic Revised by: Division C Steering Committee

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This triennial report of the International Astronomical Union (IAU) Division C shows an impressive list of activities carried out in the fields of astronomy education, outreach and heritage around the world. We are infinitely grateful to all the commissions, working groups and individual members of the Division C for their commitment to our Society and their continued efforts to make our world a better place through astronomy. Enjoy reading!

1. Division C overview

Division C[†] is one of the nine Divisions of the IAU, covering all aspects of Education, Outreach, and Heritage. Division C members come from other IAU Divisions, Offices, and Working Groups. Division C considers the following definitions:

- Education ranges from primary to tertiary level, including postgraduate studies (master's and PhD), including both formal and informal education, and is informed to society by astronomy education research.

- Outreach communicates astronomy and science to the public through a wide range of media.

- History involves the study of the past, especially in human affairs, such as astronomy and the cultural history of humankind.

- Heritage includes the legacy of astronomical artifacts and structures.

The activities of Division C are coordinated with IAU Offices, including the Office of Astronomy for Development (OAD), Office for Astronomy Outreach (OAO), Office for Astronomy Education (OAE), and the Office for Young Astronomers (OYA) that runs the International School for Young Astronomers (ISYA).

Division C is composed of four commissions, where each commission has different working groups, one inter-division commission, two working groups, one inter-division working group, and one inter-commission working group, as indicated above. Any IAU member from other divisions whose work straddles the boundaries between their scientific interest and Division C may propose working groups within Division C. Enrolling in any of the Division C commissions provides automatic enrollment in Division C. In 2022, the new Division C Working Group on Key Initiatives in Education, Outreach, and **Development** started its operation, by encompassing a number of valuable, consolidated programmes promoted by the IAU in connection with education, outreach, and development. This newly formed working group includes initiatives such as Galileo Teacher Training Program (GTTP), Network for Astronomy School Education (NASE), Pale Blue Dot (Astronomy for Global Citizenship and Environmental Awareness), and Universe Awareness (UNAWE). In 2022, two additional programs were incorporated, Eratosthenes Experiment (Greece), and Project Eratostenes (Argentina-America): la Tierra es Redonda. In January 2024, a request was received to create a **new Commission C5** on Cultural Astronomy. The proposal was reviewed and finally approved by the Steering Committee (after including modifications) and submitted to the IAU Executive Committee for final decision.

Division C has grown over the last three years, as can be seen in Figure 1, with 105 new members in total compared to the March 2023 statistics. Of these, 54 are new junior members. The membership statistics for the last three years are:

† https://www.iau.org/science/scientific_bodies/divisions/C/

- 2021-2022: 2498 active members, with 236 junior members,
- 2022-2023: 2594 active members, with 281 junior members,
- 2023-2024: 2699 active members, with 327 junior members.

Considering a total number of 11182 current active members of the IAU, 24% of them are members of Division C. A full list of members can be found on the Division C website[†].

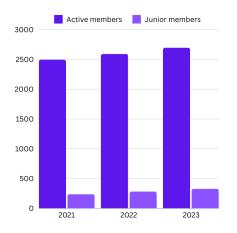


Figure 1. Number of active and junior members of Division C in the period 2021-2024.

2. Main activities

2.1. Organised meetings

During the last three years, Division C organised a total of 10 meetings in 8 countries, as shown in Figure 2. Division C Days were organised during the IAU General Assemblies (GAs), including:

• Division C Days[‡] during the XXXI IAU GA in Busan, Republic of Korea, on August 5 and 8, 2022. The main topic of the meeting was 'Towards inclusion in astronomy education, outreach, history, and heritage'. The first day was titled 'Beyond the pandemic: a discussion of lessons learned and new opportunities in Astronomy Education and Outreach in the post-Covid era' - reflecting on how education and outreach projects adapted to the COVID-19 pandemic, the negative impacts and the positive solutions. The second day titled 'Respecting astronomy history and heritage: a discussion on the intersection of culture, science, and social movements' focused on culture in the broadest sense, centered in space and time, and how societies have perceived them, accommodating contributions related to the topics developed by Commissions C3 and C4 worldwide and in a diversified set of environments and human cultures. 29 talks have been presented in total, including 5 regular invited talks and 3 invited talks presented by the 2019, 2020, and 2021 IAU Division C PhD Prize winners.

• Division C Days during the coming XXXII IAU GA in Cape Town, South Africa, on August 9 and 12, 2024, the first IAU GA in Africa in more than 100. A total of four topics will be discussed during this historic event, namely: '*Highlights and*

† https://www.iau.org/science/scientific_bodies/divisions/C/members/ ‡ https://www.iau.org/science/scientific_bodies/divisions/C/meeting2022/ Key Achievements of the Commissions' (2 sessions), 'Celebrating Education, Outreach and Heritage of African Astronomy' (2 sessions), and 'Astronomy in Conflict Zones'. More information can be found in the meeting website \P .

In addition, several meetings were organised under the main or partial coordination of Division C. These included the following:

• In 2021, IAUS 366 'The Origin of Outflows in Evolved Stars' (1-5 Nov, virtual meeting, Belgium, https://www.iaus366.be) with Division C as supporting division.

• In 2022, IAUS 368 'Machine Learning in Astronomy: Possibilities and Pitfalls' (2-4 Aug, Republic of Korea, https://sites.astro.caltech.edu/IAUS368/) with Division C as supporting division.

• In 2022, IAUS 374 'Astronomical Hazards for Life on Earth' (9-11 Aug, Republic of Korea, http://multimessengerchakra2022.physics.uoc.gr/) with Division C as supporting division.

• In 2022, IAUS 375 'The Multimessenger Chakra of Blazar Jets' (5-9 Dec, Nepal, http://hazards.astronomia.edu.uy) with Division C as supporting division.

• In 2023, IAUS 386 'Dark sky and astronomical heritage in boosting astro-tourism around the globe' (13-17 Nov, Ethiopia, https://iau386.essti.gov.et/) with Division C as coordinating division.

• In 2023, Astronomy Education Conference (AstroEdu) 'Bridging Research and Practice' (10-12 May, Canada, https://astroeducon.org/2023/) with Division C as coordinating division.

• In 2023, IAUS 384 'Planetary Nebulae: a Universal Toolbox in the Era of Precision Astrophysics' (4-8 Sep, Poland, https://iaus384-pne.ncac.torun.pl/) with Division C as supporting division.

• In 2023, IAUS 385 'Astronomy and Satellite Constellations: Pathways Forward' (2-6 Oct, Canary Islands, Spain, https://research.iac.es/congreso/iaus385/) with Division C as supporting division.



Figure 2. Countries (in red) in which Division C meetings were organised in the period 2021-2024.

¶ https://astronomy2024.org/division-c-education-outreach-and-heritage/

2.2. Evaluation of proposals received for scientific meetings and applications for PhD awards

Each year, the Division C receives a number of proposals that are considered for the organisation of symposia and thematic meetings during the GAs. In total, the Steering Committee received and evaluated 16, 17, and 13 proposals in 2021, 2022, and 2023, respectively.

In addition, each year the Division C also evaluates the nominations received for the IAU PhD awards. In 2021, two nominations were received and the award went to David Barrado Navascués (Spain), for his thesis in the history of astronomy entitled 'Cosmography: the science of the two Orbs'. In 2022, only one nomination for the PhD prize has been received and evaluated, but due to the lack of nominations the Steering Committee decided not to award the PhD prize, and encouraged more nominations next year. In 2023, the Steering Committee received three nominations. The final recipient has been selected and will be announced on the occasion of the next IAU General Assembly in South Africa.

2.3. Division C developed documents and reports

Several documents have been produced in the last three years in the framework of the Division C. These include the following:

• The 2021 annual report.

(https://www.iau.org/static/science/scientific_bodies/divisions/c/2022/divc-annual-report-2021-2022.pdf)

• Newsletter on the activities of the Division C.

(https://www.iau.org/static/science/scientific_bodies/divisions/c/2022/divc-newsletter-jan-2022.pdf)

• The 2022 annual report.

(https://www.iau.org/static/science/scientific_bodies/divisions/c/2023/divc-annual-report-2022-2023.pdf)

• This three-year report (2021-2024), which will be published on the Division C website.

(https://www.iau.org/science/scientific_bodies/divisions/C/documents/)

3. Main activities of the Division C commissions and working groups

We briefly summarise here the main activities carried out in the period 2021-2024 in the framework of the Division C's commissions and working groups. The information has been compiled from the triennial reports of the commissions and working groups listed below. For the full information, please refer to the websites listed in this report.

3.1. Commission C1: Astronomy Education and Development https://www.iau.org/science/scientific_bodies/commissions/C1/

Commission C1 continued to promote astronomy education and development through its two working groups, Astronomy Competition for Secondary School Students and Astronomy Education Research and Methods, and its three inter-commission working groups, Astronomy in Culture (WGAC), Education and Training in Astrobiology, and Ethnoastronomy and Intangible Astronomical Heritage. Some of the main activities carried out in the framework of the C1 Commission and its working groups include:

• Organisation of the annual International Olympiad on Astronomy and Astrophysics (IOAA). In the last 3 years, three IOAAs have been successfully organised in Colombia in 2021, in Georgia in 2022 and in Poland in 2023, with the participation of 53 countries. Preparations are currently underway for the organisation of the 2024 IOAA in Brazil.

• The IOAA team conducted a **survey** on the national selection procedure of the participated countries, training in astronomy and astrophysics for students, and funding strategies.

• Organisation of regular activities in the framework of the Astronomy Days at School (ADiS) project, organised four times a year during the equinoxes and solstices in the core countries: Japan, Thailand, Iran, Bulgaria and Romania.

• Running of the Astronomy Education Journal (AEJ, https://astroedjournal.org/)'. Vol.1 and Vol.2 have been published in 2021-2022 and Vol.3 is in preparation in line with the AstroEdu2023.

• Organisation of the **AstroEdu2023** meeting held in 2023 in Canada which hosted more than 140 participants with talks organised in different fields of astronomy education including: research in astronomy education, practice in astronomy education, indigenous perspectives in (astronomy) education and the future of astronomy education.

• Participation in GA 2022 and collaboration with the new IAU working group on Pro-Am relations in Astronomy.

3.2. Commission C2: Communicating Astronomy with the Public https://www.iau.org/science/scientific_bodies/commissions/C2/

The Commission C2 is composed of two working groups, **Communicating Astron**omy with the Public (CAP) Conferences and Communicating Climate Change Through Astronomy, and inter-commission working group, WGAC. Some of the main activities carried out in the framework of the C2 Commission and its working groups include:

• The **CAP Conferences** evolved to a functional working group from this triennium onwards.

• The Communicating Climate Change through Astronomy working group was established in September 2023.

• Close **collaboration** with the **IAU Offices**, in particular with the OAO, including the signing of the Memorandum of Understanding (MoU) took place.

• Close collaboration with the International Planetarium Society (IPS) and revision and renewal of the MoU signed in 2019 took place.

• A survey has been conducted among C2 members to better understand their profile, needs and expectations. The results of this survey will shape the activities of C2 over the

next three years, some of which include: communication support to other commissions, opening a call for mentors, promotion and maintenance of a job list in astronomy communication, improvement of training in astronomy communication, development of a global system to quantify and recognise the activities carried out in astronomy communication and outreach, etc.

3.3. Commission C3: History of Astronomy https://www.iau.org/science/scientific_bodies/commissions/C3/

The C3 Commission is currently composed of two inter-commission working groups, Archaeoastronomy and Astronomy in Culture and Ethnoastronomy and Intangible Heritage, and two inter-union (URSI), inter-commission working groups, Historical Radio Astronomy and IUHPST Commission for History of Astronomy. Some of the main activities carried out in the framework of the Commission C3 and its working groups include:

• Close collaboration and participation in activities of the Inter-Union Commission for History of Astronomy (ICHA), which is hosted by the International Union of History and Philosophy of Science and Technology (IUHPST).

• Organisation and participation in the Art, image, and astronomical knowledge symposium during the 26th International Congress of History of Science and Technology in 2021 in Prague (virtual).

• Participation in the GA 2022 in Busan, in particular during the Division C Days (see above).

• Support given to a consortium of working groups Ethnoastronomy and Intangible Astronomical Heritage and Archaeoastronomy and Astronomy in Culture to become a new Commission C5 Cultural Astronomy (see above).

• Support provided to the OAO in different **outreach activities**.

• Organisation of the Commission C3 Focus Meeting on the 'History of Astronomy in South Africa: The Late Modern Period' at the GA 2024 in Cape Town.

• Management of the **IUHPST grants for early-career scholars** to attend meetings related to the history of astronomy. This includes ten grants awarded in total, and a number of registration fees for remote participation in GA 2024.

> 3.4. Commission C4: World Heritage of Astronomy https://www.iau.org/science/scientific_bodies/commissions/C4/ https://www3.astronomicalheritage.org/

Commission C4 is composed of two working groups, Astronomical Heritage in Danger and Windows to the Universe: Classical and Modern Observatories, and two inter-commission working groups, WGAC and Ethnoastronomy and Intangible Astronomical Heritage. Some of the main activities carried out in the framework of the Commission C4 and its working groups include:

• Continued inscription in the **UNESCO World Heritage register** of *'properties'* with an astronomical connection. Offered support to UNESCO from C4 with the review of proposals and/or advisory.

• Running of the specific **website on astronomical heritage** (https://www3.astronomicalheritage.org).

• Inclusion of the following astronomical sites on the UNESCO World Heritage List in 2021 and 2023: Chankillo Archaeoastronomical Complex (Peru), The Paseo del Prado and Buen Retiro (Spain), Talayotic Menorca (Spain), Eise Eisinga Planetarium (The Netherlands), Astronomical Observatories of Kazan Federal University (Russian Federation), and Hopewell Ceremonial Earthworks (The USA).

• Adding a considerable number of observatories to the IAU list of 'Outstanding Astronomical Heritage (OAH). Provide support and expertise to the community with potential nominations of future astronomical heritage sites. Operating the OAH portal.

• Work carried out on the **special protection** of the following sites: Hamburg Observatory (Germany), Observatory of La Plata (Argentina), and Armagh, Birr and Dunsink Observatories (Ireland).

• Work on the **collection of data on endangered astronomical sites**. Participation in the IAU-RAS-AAS committee on sensitive astronomical sites.

3.5. Inter-Division B-C Commission: Protection of Existing and Potential Observatory Sites

https://www.iau.org/science/scientific_bodies/commissions/B7/

The Inter-Division B-C Commission Protection of Existing and Potential Observatory Sites currently has two active working groups, **Astronomy from the Moon** and **Site Protection**. Some of the main activities carried out in the framework of this interdivision commission include:

• Organisation of and participation in scientific meetings, including: a special session during the American Astronomical Society conference in 2021, SATCON2 workshop in 2021, the Dark and Quiet Skies II conference in 2021, the IAU CPS/AAS special session in 2022 on the impact of satellite constellations on astronomy, the focus meeting on 'Towards a World Standard for Dark and Quiet Sky' during the 2022 GA, and IAUS 385 in 2023 on Astronomy and Satellite Constellations: Pathways Forward.

• Active participation in the meetings of the Science and Technology Subcommittee (STSC) of the United Nations Committee on the Peaceful Use of Outer Space (COPUOS) in 2021, 2022 and 2023, continuously recommending measures to mitigate the impact of satellite constellations on astronomy.

• In 2021, several briefings were given to the US National Science Foundation, the US Office of Science and Technology Policy, and various committees and institutions on the impact of satellite constellations on astronomy.

• Submission of the proposal in 2021 for the NOIRLab and SKAO joint hosting of the **Center for the Protection of Observatory Sites** from satellite constellation interference. The proposal was approved by the IAU and the Centre was officially launched in 2022 (http://cps.iau.org).

• Work through the **SatHub** on developing and aggregating software and coordinating observation campaigns to model, predict, avoid and otherwise mitigate reflections and emissions from commercial low-Earth orbit satellites.

• National and local efforts for the **protection of professional observing sites** have been made in particular in Chile, Spain, South Africa, China and the US, in the framework of activities carried out by the working group on site protection.

• Establishment of the Astronomy on the Moon working group in September 2023 with the primary goals of developing scientific information and policy related to observations unique to the Shielded Zone of the Moon, leading and collaborating in the identification, prioritisation and development of policies to protect sites of extreme scientific value for other astronomy-related observing facilities, inform policy makers and

agencies on astronomy needs and immediate threats, and support the IAU in its efforts at UN COPUOS and other bodies to promote international policy that includes the protection of lunar astronomical sites.

3.6. Division C Working Group: Key Initiatives in Education, Outreach and Development

https://www.iau.org/science/scientific_bodies/working_groups/334/

The main activities carried out in the framework of the Key Initiatives in Education, Outreach and Development are related to the NASE trainings, the Astronomy Education Adventure in the Canary Islands, the GTTP activities, the COSPAR Panel on Education, and the Global Hands-on Universe Conference. The main activities include:

• NASE held more than 100 courses in the last two years, reaching a total of 386 regular courses and 70 courses in cooperation since its establishment in 2009, carried out in more than 70 countries

(http://sac.csic.es/astrosecundaria/en/Presentacion.php).



Figure 3. NASE connections between trainers and countries. Image credits: NASE team.

• NASE organised 3 events under the auspices of **UNESCO** to celebrate the **Inter**national Day of Light. Each year the activities took place online around the March equinox and were called 'Bridges between cultures'. The topics of the last three years were 'Infrared and Music', 'Latitude for Tracking and Navigation' and 'In Search of Micrometeorites'. After the last edition in 2023, the experiments were organised in 178 schools in Africa, America, Asia and Europe. The publications of these events are available on the NASE website.

• NASE organised in-person meeting in October 2023 among NASE countries to discuss and summarise the different activities.

• UNAWE team organised a pilot Carolina-Link PBD-UNAWE event on 13 February 2024 in commemoration of Prof. Carolina Odman-Govender and her legacy (see Figure 4). This online activity included 5 classes in Armenia, Ethiopia, Ireland, Netherlands and Nigeria, and was a very enjoyable experience for the children.

• GTTP organised the 8th and 9th edition of the Astronomy Education Adventure in the Canary Islands (AEACI) in Tenerife (Spain) in 2022 and 2023, respectively. It consisted of a 5-day hybrid course with more than 50 participants in both years. In total, 120 teachers from 19 different countries were trained in these two events.

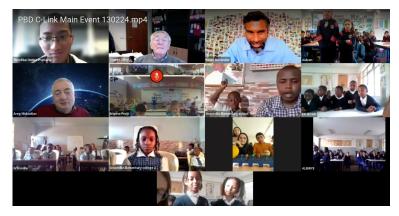


Figure 4. Carolina-Link PBD-UNAWE online activity in February 2023. Image credits: George Miley and the UNAWE team.

GTTP has trained a total of 70,000 teachers in 120 countries since its establishment in 2009.

• The 13th and 14th edition of the ESA/GTTP teacher training took place in 2022 and 2023 (see Figure 5), respectively, under the organisation of CESAR (Cooperation through Education in Science and Astronomy Research).

• The annual Global Hands-on Universe Conference was held in virtual format in 2022 and in hybrid format in 2023 in Japan, with 500 and 200 participants, respectively (https://handsonuniverse.org).

• Eratosthenes America and Greece projects carried out a series of activities in schools in 2022 and 2023.

• Organisation of the international citizen science campaign 'Globe at Night' to raise public awareness about the impact of light pollution (see https://globeatnight.org for more information).



Figure 5. Group photo of ESA/GTTP 2023 participants. Image credits: ESA/GTTP team.

3.7. Division C Working Group: Star Names https://www.iau.org/science/scientific_bodies/working_groups/280/

Some of the main activities carried out in the framework of the Star Names working group are:

• Seeking input from the community on documenting indigenous and historical names of stars and asterisms.

• Development of **new strategies and methods** for adding new star names to the international catalogue by reactivating an existing database (http:// ancientskies.org) and by providing a query plugin for Stellarium.

• The team is working towards **expanding its database for the names of stars from different cultures**, and seeking opportunities for adding (unique) proper names for individual stars in the IAU star name catalogue

(https://www.iau.org/public/themes/naming_stars/).

• The **NameExoWorlds** OAO campaign 2022 organised in collaboration with the Star Names has released 20 new pairs of star names for exoplanetary systems of a host star and its planetary companion.

• Organisation and participation in the scientific meeting in Jena (Germany) where the working group team met with the Stellarium team of developers and other researchers in cultural astronomy and discussed how to provide cultural data in formats suitable for educators, software developers, researchers and the general public. In the framework of the same event, the team participated in two social events and gave a public talk at the Jena Planetarium.

3.8. Inter-Division C-E Working Group: Solar Eclipses

https://www.iau.org/science/scientific_bodies/working_groups/93/

Some of the main activities carried out in the framework of the inter-division working group Solar Eclipses are:

• The Moore Foundation has given a grant for the US Libraries to distribute **5 million** sets of partial eclipse safety glasses for the 2023 and 2024 American eclipses.

• Several **public talks** on solar eclipses have been given over the past three years.

• Working group attended and was involved in the organisation of the **Solar Eclipse Conference** in Sigüenza, Spain, on Sep 1-2, 2022 (www.sec2022.com).

• Organised observations of **2023 total solar eclipse in East Timor** (see Figure 6).

• Conducted a **training** with students and amateur astronomers in scientific eclipse observations at the Yunnan Observatories of the Chinese Academy of Sciences.

More information about the activities carried out can be obtained at http://eclipses.info. The working group Chair, Jay Pasachoff, sadly passed away in 2022. A new chair Zhongquan Qu has been appointed.



Figure 6. Preparations for the total solar eclipse observations at East Timor. *Image credits:* Zhongquan Qu.

3.9. Inter-Comission C1-C2-C3-C4 Working Group: Astronomy in Culture (WGAC)

https://www.iau.org/science/scientific_bodies/working_groups/284/

The WGAC continued to be active in advancing all aspects of the growing field of Cultural Astronomy. Some of the main activities carried out in the last three years include:

• Activities carried out by members of the Culturally Sensitive Sites committee with professional astronomers and the general public regarding best practices to be considered for responsible siting when proposing new observatory/facility projects to be built on culturally sacred land. This includes activities carried out in the framework of the EHT project and participation in several meetings, including those of the AAS and IAUS 386.

• WGAC members taught several postgraduate and undergraduate courses in Cultural Astronomy on all continents.

• WGAC members have conducted a series of public talks, interviews and outreach activities.

• Development of Nations and Indigenous Astronomy activities were carried out. This includes activities in Nepal on the exploration of World Heritage sites and their connection to astronomy, mapping and photogrammetry of sensitive rock art (engravings) in the Sydney region (Australia), preparation of the book on Inca astronomy and cosmology by Steven Gullberg, initiation of a multi-site major lunar standstill livestreaming programme, training of local guides in cultural astronomy in Argentina, among others.

• A special effort has been made to strengthen interdisciplinary collaborations with different institutions, organisations, and research centres.

• The WGAC has carried out other activities, such as presentations at conferences and publications (for more information, see the WGAC website).

• Collaboration with journals in cultural astronomy, including: Journal of Astronomy in Culture, Cosmovisiones/Cosmovisoes, Journal of Astronomical History and Heritage, and Journal of Skyscape Archaeology.

Developed in: Addis Ababa, Ethiopia Date: 10 April 2024