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English only

**Committee on the Peaceful
Uses of Outer Space**
Scientific and Technical Subcommittee
Fifty-fourth session
Vienna, 30 January-10 February 2017
Item 5 of the provisional agenda*
**Space technology for sustainable
socioeconomic development**

**The “Dark and quiet skies” proposal as an initiative under
the auspices of the Committee on the Peaceful Uses of Outer
Space for protecting the environmental observing conditions
for large astronomical observatories and world citizens,
submitted by the International Astronomical Union (IAU)**

Summary

The free and unrestricted observation of the sky from the ground and from space is a value both for the scientific research community and — even more importantly — for humankind as a whole.

Artificial illumination degrades the visibility of objects in the night sky and negatively affects the billion-dollar investment currently deployed and planned in scientific observing infrastructures.

This non-paper defines the terms of the problem, describes possible solutions, and proposes actions by the United Nations.

I. Background

1. Astronomy is the most ancient science, present in all world civilizations since the earliest times and still active worldwide both as a specialized scientific research activity and as a cultural heritage at large. Both facets of astronomy, the specialized research aimed at improving our understanding of the universe, and the natural fascination of humankind for the celestial sky need attention.

2. The recent decades have seen an enormous improvement of the research infrastructure of large astronomical institutions. This is true, in particular, for the data collection capabilities, i.e. telescopes (for the UV, optical, and IR wavelengths),

* [A/AC.105/C.1/L.355](#).



antennae (for the radio frequencies), and more recently, detectors for neutrino and gravitational wave events.

3. Ground-based and space-borne assets do not compete, they complement each other. Space telescopes are free from the detrimental influences of the Earth's atmosphere, but they are disadvantaged by the mass and size limitations imposed by the launch vehicle, and by the fact that maintenance and upgrade of these facilities is difficult or impossible. Ground-based telescopes have a much higher light gathering capability, and their flexible instrumentation allows for a quick reaction to upcoming observing requirements.

4. In order to optimize the observing conditions for ground-based assets they are placed in "near space" environments, such as high altitudes or mountain tops. The identification and selection of suitable observing sites is a lengthy and complex process, designed to optimize the combination of climatic, atmospheric, geological, and electromagnetic boundary conditions.

5. A modern observatory represents an investment in the billion-dollar range. This includes the cost of construction, of maintenance and upgrade, and of the science operations.

6. In order to secure the investment and to keep the facilities operating in optimal conditions for several decades it is becoming necessary to protect the environmental observing conditions of the observatories.

7. Ground-based observatories working at the limit of sensitivity are critical for supporting space assets. Many countries are now engaged in research and active observational programmes to track and characterize space debris. In increasingly crowded orbits, these small, faint objects pose threats to working satellites. With adequate warning from ground-based telescopes, station-keeping manoeuvres can be executed to save valuable orbiting assets.

8. Another critical mission for planetary protection is the detection and cataloguing of small rocky asteroids with orbits that take them into potential collision courses with Earth. Depending on size, such near-Earth objects could destroy neighbourhoods or entire large cities should a collision occur. Absolute limiting sensitivity is required to detect them and to determine their size and orbits with accuracy well before their closest approach. A combination of ground-based and space-based assets is likely to be the most effective approach.

9. The extensive illumination of urban areas is extending in size and intensity all over the world. Notwithstanding the need for a proper illumination of our cities, one negative consequence is the deprivation of the vision of the night sky by the citizens. The "light pollution" extends beyond the boundaries of the inhabited areas and makes it increasingly difficult to find accessible areas of the planet Earth that are suitable for scientific purposes and for admiring the beauty of the starry sky.

10. At the XXVIIth International Astronomical Union General Assembly (Rio de Janeiro, 2009), a Resolution in defence of the night sky and the right to starlight was approved (see Appendix). The Resolution reads in part:

- An unpolluted night sky that allows the enjoyment and contemplation of the firmament should be considered a fundamental sociocultural and environmental right, and that the progressive degradation of the night sky should be regarded as a fundamental loss.
- Control of obtrusive and sky glow-enhancing lighting should be a basic element of nature conservation policies since it has adverse impacts on humans and wildlife, habitats, ecosystems, and landscapes.

II. The nature of the problem

11. The detector systems of modern observatories are exceedingly sensitive. They are susceptible to even low-level human-made electromagnetic contamination at distances of up to 100 kilometres.

12. The most obvious problem is the contamination of the night sky due to light sources located in settlements ranging from distant urban centres to local villages, along roads, at industrial production sites, or similar. Particularly damaging are unshielded lights that radiate upwards.

13. As the wavelength range covered by modern instrumentation is not limited to the optical band, the above is also true for heat sources, such as power plants, and for sources of radio emission, such as radar installations and microwave transmitters, with a particular growing threat from electronic automobile safety devices and automatic driving systems.

14. Another potentially serious threat to the observing conditions is the pollution of the atmosphere by dust or aerosols, caused by mining operations, agricultural burning or by production facilities such as refineries or chemical plants.

III. Possible solutions

15. It is evident that not all observatories require the same strict protection. A list of qualified observatories, along with their observing requirements, should be produced.

16. Often, a voluntary national regulatory frameworks can be established with the strictest required level of protection close to the site, and relaxing it as the distance from the site increases. Proposals to achieve this should be developed by the astronomical community for consideration by the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space. The proposed Conference (see point 18 below) could offer the appropriate platform for discussion.

17. New illumination techniques can drastically mitigate the light pollution induced by urban lighting without compromising safety and security issues. The adoption of new illumination techniques can also represent a substantial energy saving.

IV. Proposed actions by the United Nations

18. The Committee could encourage representatives of the astronomical community by inviting them, through the United Nations Office for Outer Space Affairs and the International Astronomical Union (IAU), to organize a conference on the subject, with the purpose of fully summarizing the issues and making recommendations to preserve “dark” skies. In addition, the United Nations Educational, Scientific and Cultural Organization (UNESCO) could be invited to co-sponsor the conference, in particular for those aspects related to World Heritage values.

19. A conference report, alongside with the proposed suitable guidelines, reference material, and technical experts, could be presented for consideration to the Scientific and Technical Subcommittee of the Committee at its session in 2019.

20. On the basis of the report of the conference, the Scientific and Technical Subcommittee may consider recommending actions that could be implemented at the national level on a voluntary basis for “smart illumination” of urban areas that while fulfilling safety and security requirements, minimize the environmental light and microwave pollution.

21. The Committee could begin encouraging in its reports its member States to define and protect “Dark sky areas” in their countries, that provide optimal scientific observing conditions and offer to their citizens the possibility of enjoying the observation of the starred sky. Further, the Committee could invite the General Assembly to highlight the matter in its resolution on international cooperation in the peaceful uses of outer space.

Appendix

IAU 2009 Resolution B5

IAU 2009 Resolution B5 in Defense of the Night Sky and the Right to Starlight

The International Astronomical Union XXVII General Assembly,

Recalling

1. The IAU/UNESCO International Year of Astronomy 2009 goal 8: facilitate the preservation and protection of the world's cultural and natural heritage of dark skies in places such as urban oases, national parks and astronomical sites.
2. The Declaration approved during the International Conference in Defense of the Quality of the Night Sky and the Right to Observe Stars (La Palma, Canary Islands, 2007).

Recognizing that

1. The night sky has been and continues to be an inspiration of humankind, and that its contemplation represents an essential element in the development of scientific thought in all civilizations.
2. The dissemination of astronomy and associated scientific and cultural values should be considered as basic content to be included in educational activities.
3. The view of the night sky over most of the populated areas of the Earth is already compromised by light pollution, and is under further threat in this respect.
4. The intelligent use of unobtrusive artificial lighting that minimizes sky glow involves a more efficient use of energy, thus meeting the wider commitments made on climate change, and for the protection of the environment, tourism, among other players, can become a major instrument for a new alliance in defence of the quality of the nocturnal skyscape.

Considering

1. The role of the IAU Division XII Commission 50 and its WG Controlling Light Pollution.
2. The role of the IYA2009 Cornerstone Project Dark Skies Awareness.

Resolves that

1. An unpolluted night sky that allows the enjoyment and contemplation of the firmament should be considered a fundamental sociocultural and environmental right, and that the progressive degradation of the night sky should be regarded as a fundamental loss.
2. Control of obtrusive and sky glow-enhancing lighting should be a basic element of nature conservation policies since it has adverse impacts on humans and wildlife, habitats, ecosystems, and landscapes.
3. Responsible tourism, in its many forms, should be encouraged to take on board the night sky as a resource to protect and value in all destinations.
4. IAU members be encouraged to take all necessary measures to involve the parties related to skyscape protection in raising public awareness — be it at local, regional, national, or international level — about the contents and objectives of the International Conference in Defence of the Quality of the Night Sky and the Right to

Observe Stars [<http://www.starlight2007.net/>], in particular the educational, scientific, cultural, health and recreational importance of preserving access to an unpolluted night sky for all humankind.

Further resolves that

1. Protection of the astronomical quality of areas suitable for scientific observation of the Universe should be taken into account when developing and evaluating national and international scientific and environmental policies, with due regard to local cultural and natural values.
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