Space and sustainability

Pontsho Maruping

Managing Director – South African Radio Astronomy Observatory

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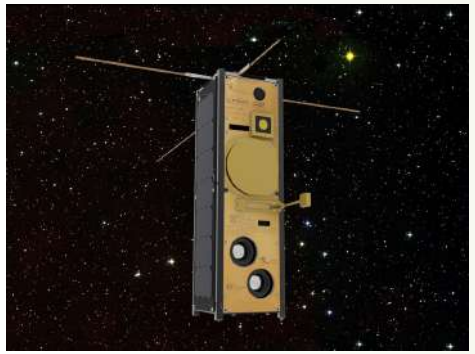
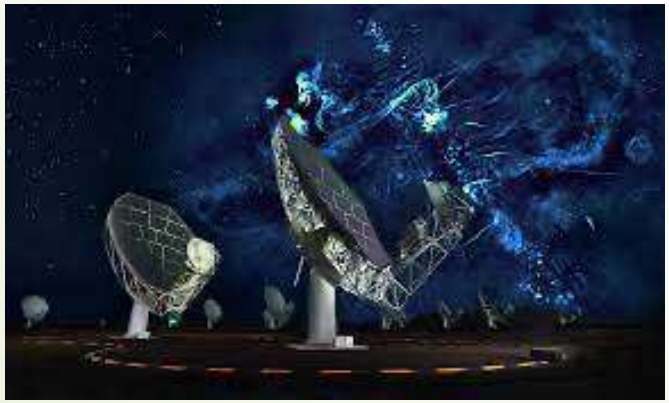
National Space Conference
CSIR ICC

Impact on

- Opportunities for future space exploration and exploitation



- Impact on astronomy

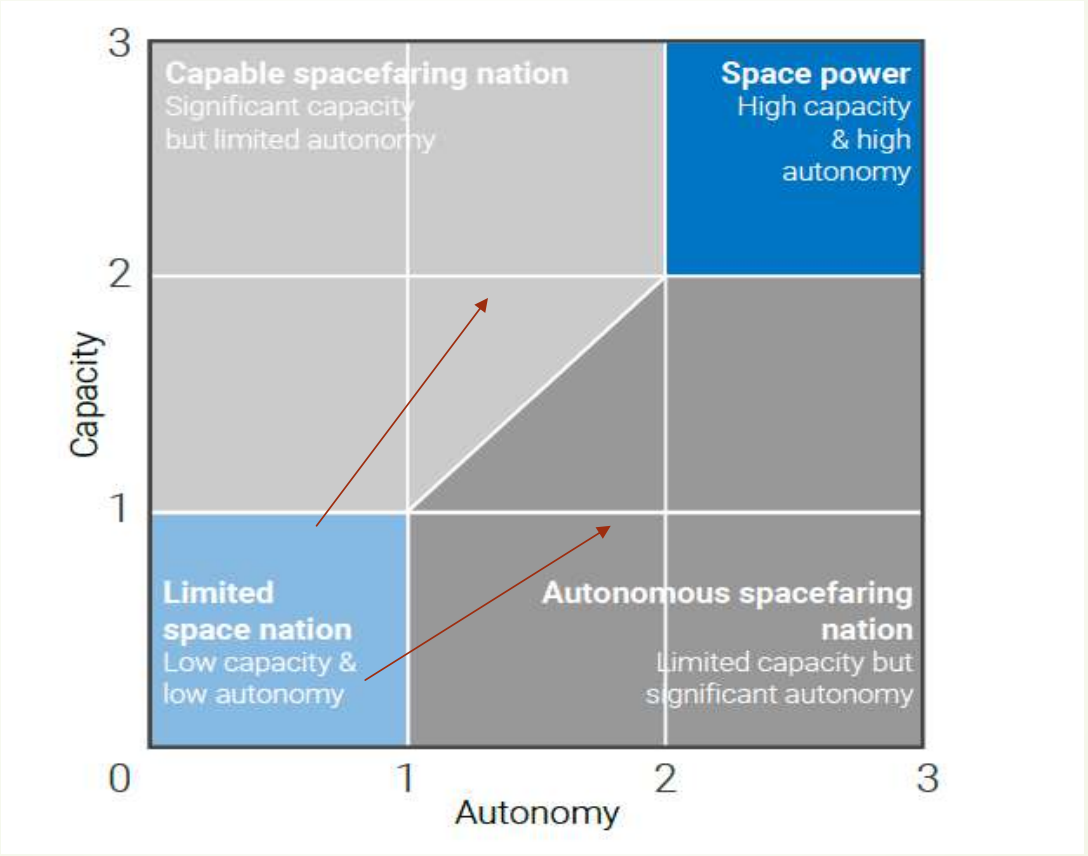


Why is sustainability in space important?

More and more nations have ambitions in space

Capability includes the ability to:

- address the full spectrum of space activities
- Integrate space in national infrastructure, policies & strategies



Autonomy includes ability to:

- access and operate in space without the need of relying on any external source or supply
- Define space policies independently from divergent political interests

Source: ESPI Report 79 – emerging Spacefaring Nations, 2021

Space is important for

Socio-Economic Development

Space Applications is used for evidenced based policy making by decision makers in national government and municipalities, and stimulates the growth of a local space industry

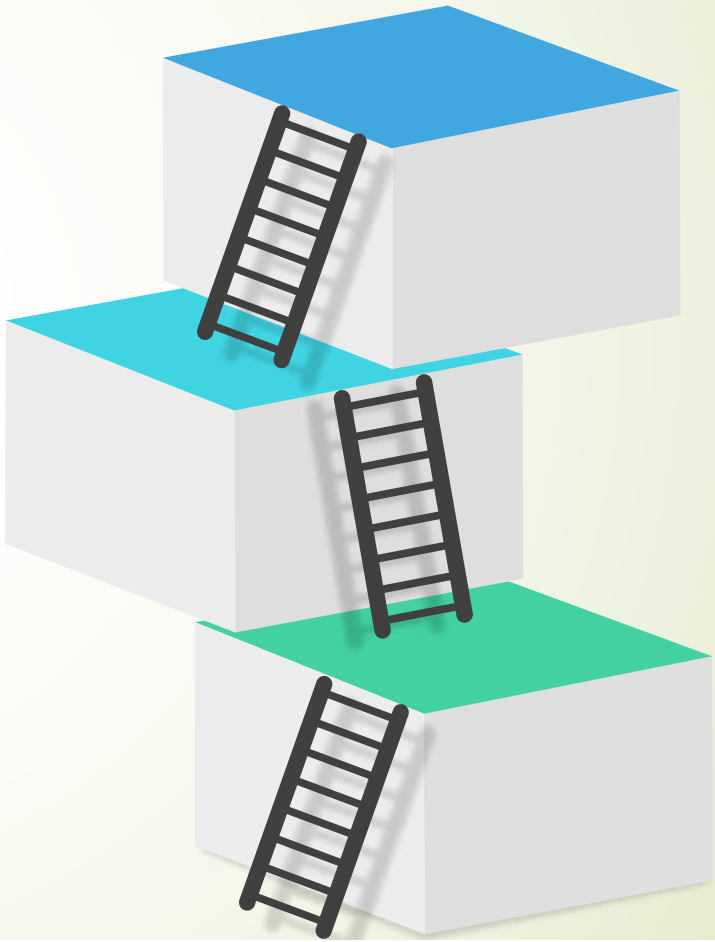
National Security

Space applications is critical to national security as it provides a synoptic view of the earth's surface, accurate location-based services and secure telecommunications

Policy Relevance

Space is identified as one of the key enablers of the Knowledge Economy

Includes interest in astronomy, astronautics and space technology that is involved with the exploration of distant regions of outer space.



South African example

It is getting crowded out there

- GEO 12%
- MEO 3%
- LEO 84%

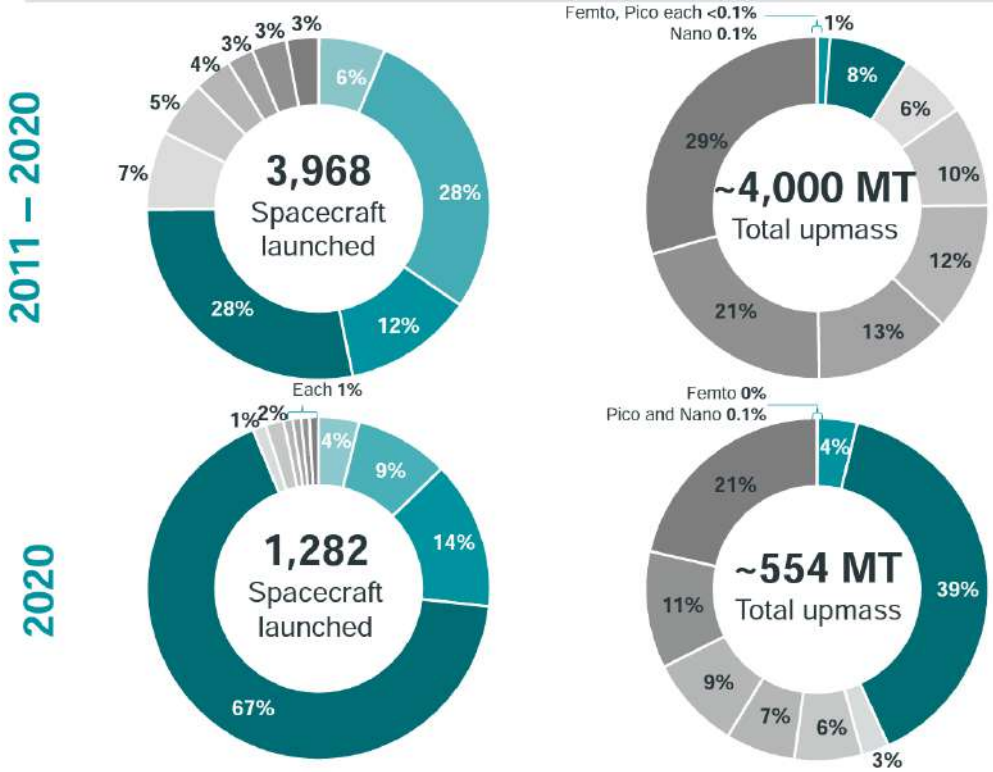
UNCOPUOS, 2021

Why now?

Smallsats Launched and Total Spacecraft Upmass 2011 – 2020

BRYCE TECH

Smallsats in Context and Operator/Mission Type Trends

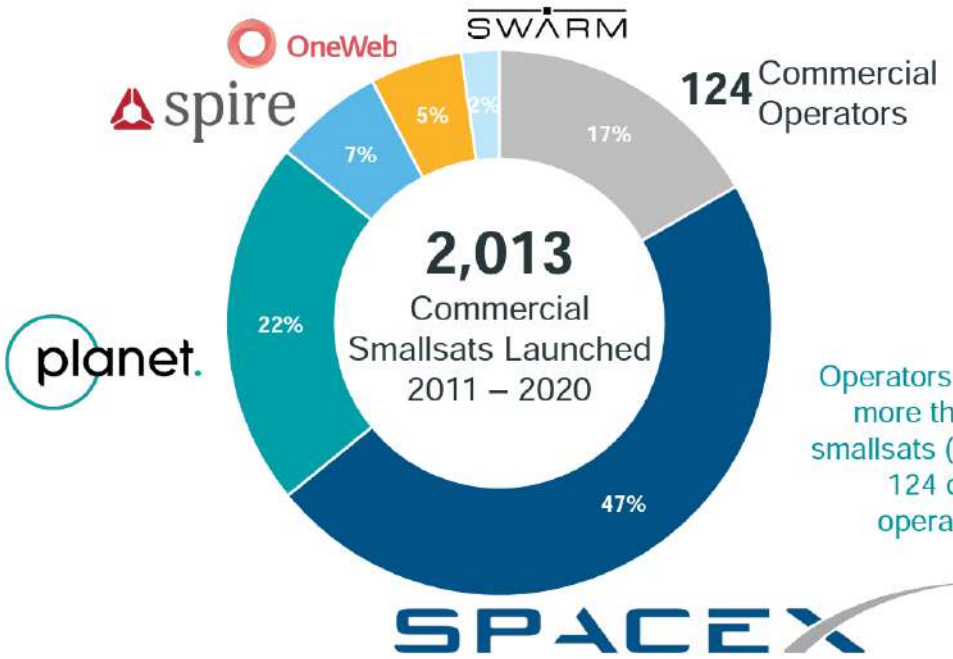


	Mass Class Name	Kilograms (kg)
	Femto	0.01 – 0.09
	Pico	0.1 – 1
	Nano	1.1 – 10
	Micro	11 – 200
	Mini	201 – 600
	Small	601 – 1,200
	Medium	1,201 – 2,500
	Intermediate	2,501 – 4,200
	Large	4,201 – 5,400
	Heavy	5,401 – 7,000
	Extra Heavy	> 7,001

- Smallsats represent 75% of spacecraft launched 2011 – 2020, 9% of total upmass
- Smallsats represent 94% of spacecraft launched in 2020, 43% of total upmass

Why now?

83% of smallsats launched 2011 – 2020 are owned by 5 operators



Operators with more than 5 smallsats (from 124 other operators)

*As of the end of 2020

Commercial Operators with more than 5 smallsats*

Operator	# of Smallsats
SpaceX	955
Planet	437
Spire Global	131
OneWeb	110
Swarm Technologies	45
CGSTL	26
Satellogic	20
ORBCOMM	19
Spacety	12
Astro Digital	10
Zuhai Orbita	10
Guodian Gaoke	10
GeoOptics	8
BlackSky	7
Commsat Tech Dev Co.	7
ICEYE	6

Why?

Business Outcomes

Smallsat business ventures of all types continue efforts to prove both their business models and their ability to generate significant revenue. Financial outcomes of today's smallsat companies will impact the long-term smallsat market

Communications Constellations

Smallsat telecommunications operators dominated smallsat activity in 2020 and are continuing deployments in 2021. Launch of these large constellations will influence smallsat activity in the next few years

Smallsat Launch Options

Smallsat operators have an increasing number of launch options including small launch and rideshare. Dozens of new small launch vehicles (many <500kg capacity) are in development to launch smallsats. Launch providers, especially medium – super heavy are increasing rideshare opportunities/initiatives to capture demand from smallsat customers

Government use of Smallsats

Governments are increasingly seeking to leverage smallsats/including in architecture planning to augment existing capabilities

- Space Development Agency deployed first smallsats in 2021, preparing tranches of smallsats in support of National Defense Space Architecture
- DARPA continuing development of Blackjack constellation to demonstrate network of smallsats for military comms, missile warning, and navigation
- NASA supporting smallsat launch through ELaNa, other initiatives
- NOAA exploring use of smallsats for weather forecast modeling
- France launching Composante Optique 3D (CO3D) system for civil and government remote sensing applications
- JAXA RAPIS/RAISE technology demonstration systems
- Several Chinese smallsat systems, various stages development/operation

What is being done about it?

- In June 2019, 87 country members of UNCOPUOS adopted to voluntary guideline to enhance the long-term sustainability of the space domain
- While this was a significant achievement in space diplomacy, it took 8 years to reach this agreement and resulted in a set of non-legally binding measures
- The 21 guidelines include:
  - enhancing the registration of space objects;
  - sharing contact information and space situational awareness data on space objects and events;
  - performing conjunction assessment during launch and on-orbit operations to find potential collisions;
  - designing satellites to increase their trackability;
  - addressing the risks of uncontrolled atmospheric re-entries;
  - strengthening national regulatory and oversight frameworks to implement international treaties;
  - sharing space weather data and forecasts;
  - and promoting awareness of space sustainability.

Implementing requires countries to:

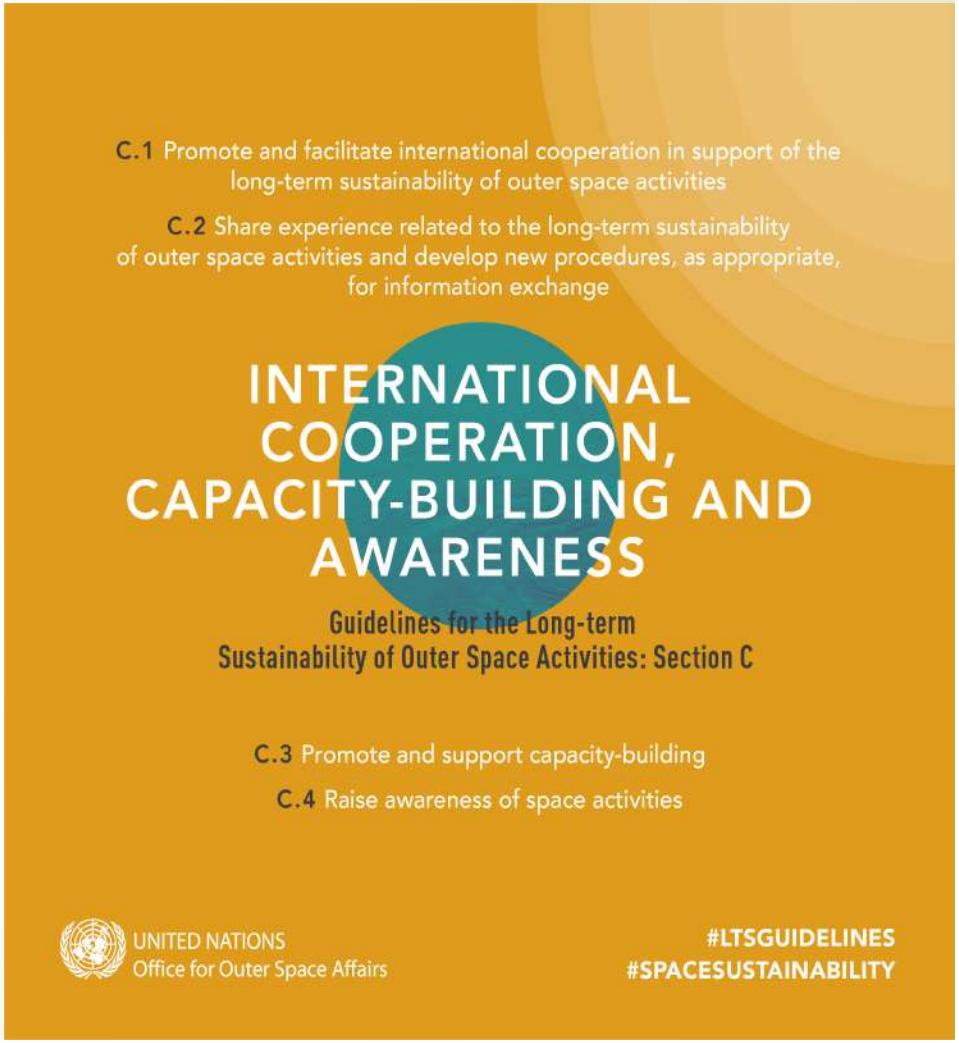
- National legislation
- Regulatory body
- Supervisory capacity
- Limited spectrum allocation

Implementing requires countries to:

- Capacity to track and share information
- Technical capability to:
  - Perform conjunction assessments
  - Access to data such as space weather and forecast
  - Address risks associated with uncontrolled re-entry

Implementing requires countries to:

- Establishing meaningful cooperation
- Limited experience in outer space activities and hence no procedures on LTS information exchange
- To support capacity building – relevant institutions need to be established

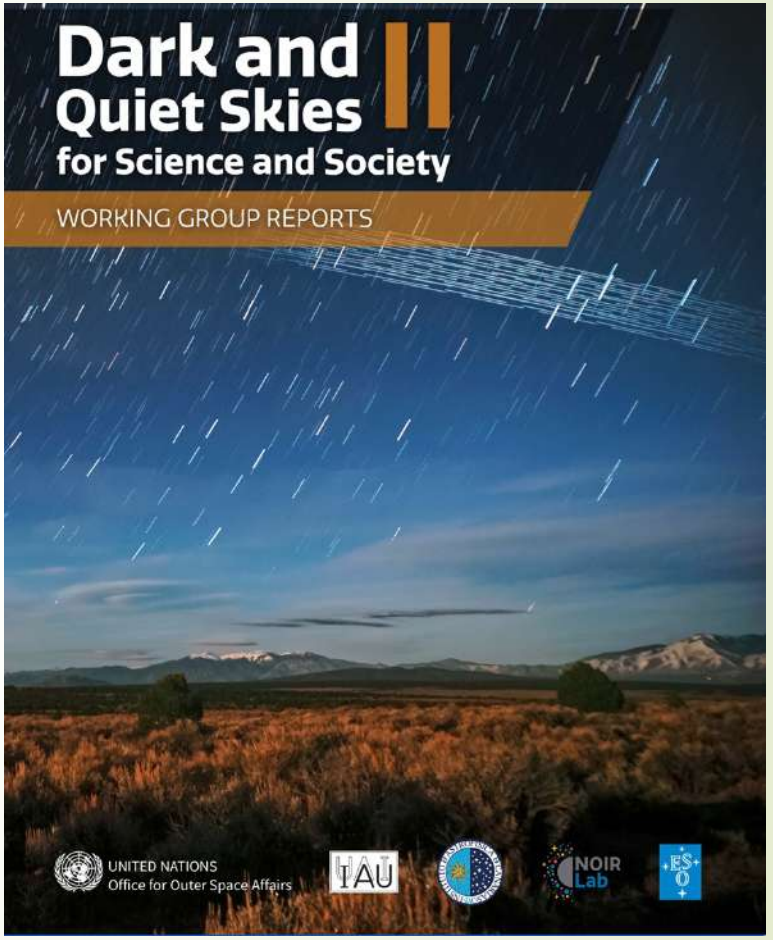


Implementing requires countries to:

- Conduct research
- New measures to manage space debris

Dark and Quiet Skies

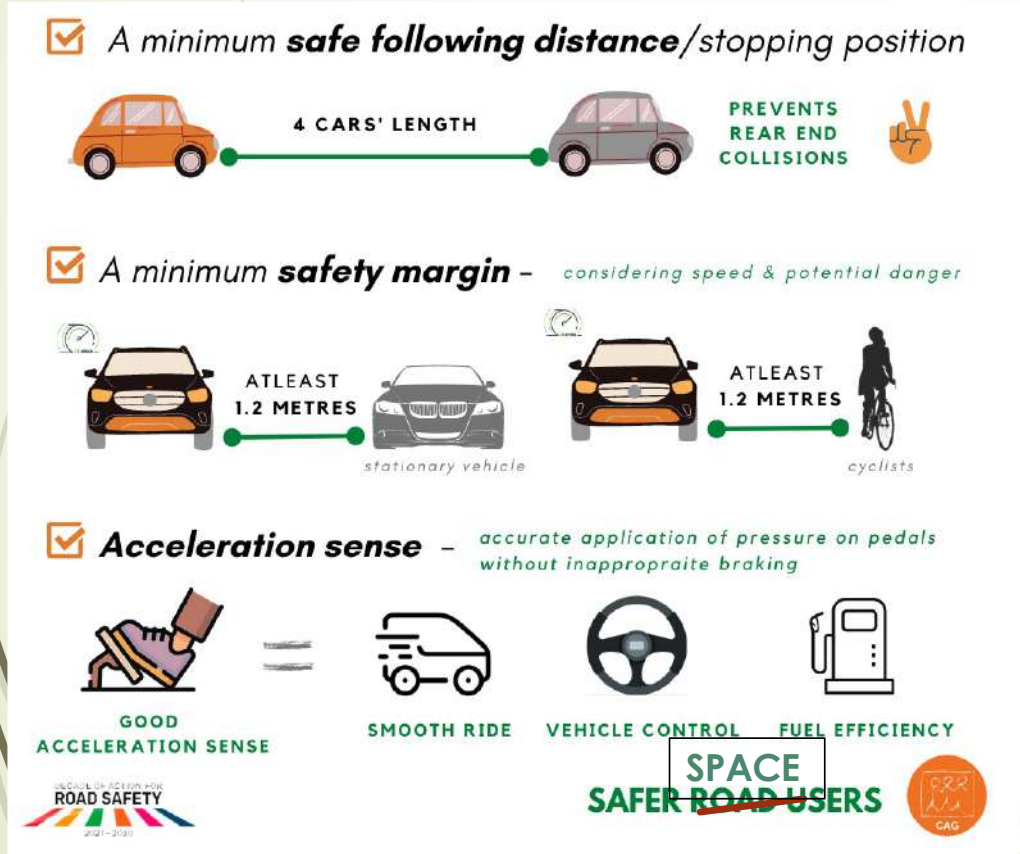
- The International Astronomical Union (IAU) representing 90 countries, has as its mission the promotion and safeguard of the science of astronomy in all its aspects.
- In 2017 the IAU approached the UN Committee for the Peaceful Use of Outer Space (COPUOS), proposing to include the protection of the astronomical sky within its mandate.
- COPUOS asked the UN Office for Outer Space Affairs to co-organize a Conference with the title Dark and Quiet Skies for Science and Society, its aim being to assess the impact of any artificial interferences affecting the visibility of the sky and the detection of cosmic radio signals.
- Following this UNCOPUOS members have been engaging to formalise a working group to address these issues within a multilateral forum.



What is needed long–term?

- proposed actions:
  a) Include astronomical research, from ground and space, as an instrumental part of space activities;
  b) Raise the attention of their respective governmental authorities to the harm created by the uncontrolled expansion of artificial light at night, not only to astronomy but also potentially to other realms;
  c) Support the adoption of the set of voluntary best practices guidelines for low Earth orbit satellite constellations and the astronomical community that are outlined for both radio and optical/infrared astronomy in the reports of the workshop and the Conference;
  d) Include an item on the agenda of the Scientific and Technical Subcommittee entitled "Impact of satellite constellations on astronomical facilities".

LTS will only work if everyone knows the rules and can apply them correctly



Challenges

- Guidelines are non-binding – not enforceable
- Political instability → delayed implementation of UN Working Group activities
- No further development of additional guidelines
- Limited capacity building for developing countries
- Increased private sector activities driven by national ambitions
- Limited multilateral cooperation in resolving the issues

Thank you

A Blue Moon is a rare occurrence that depends on the timings of full moons during the year.
(Image credit: Herken Herken / 500px via Getty Images)