



# Space and sustainability

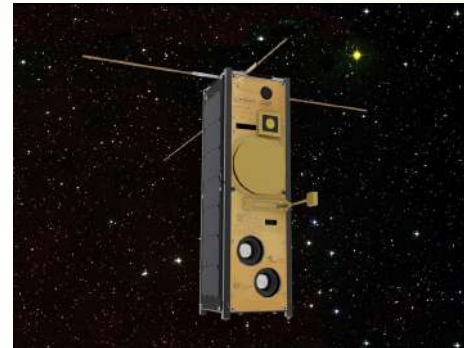
Pontsho Maruping

Managing Director – South African Radio Astronomy Observatory

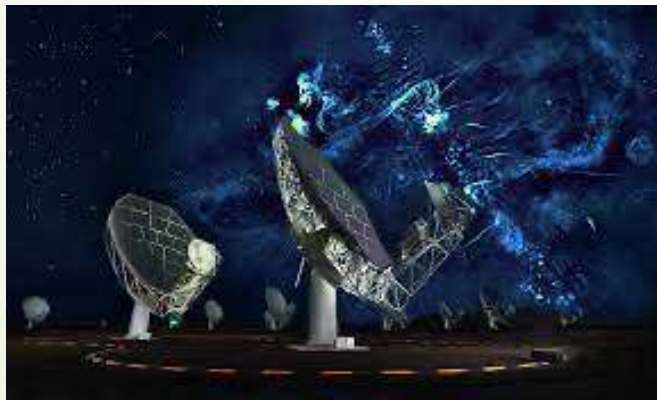
1 September 2023  
National Space Conference  
CSIR ICC

# Impact on

- Opportunities for future space exploration and exploitation



- Impact on astronomy

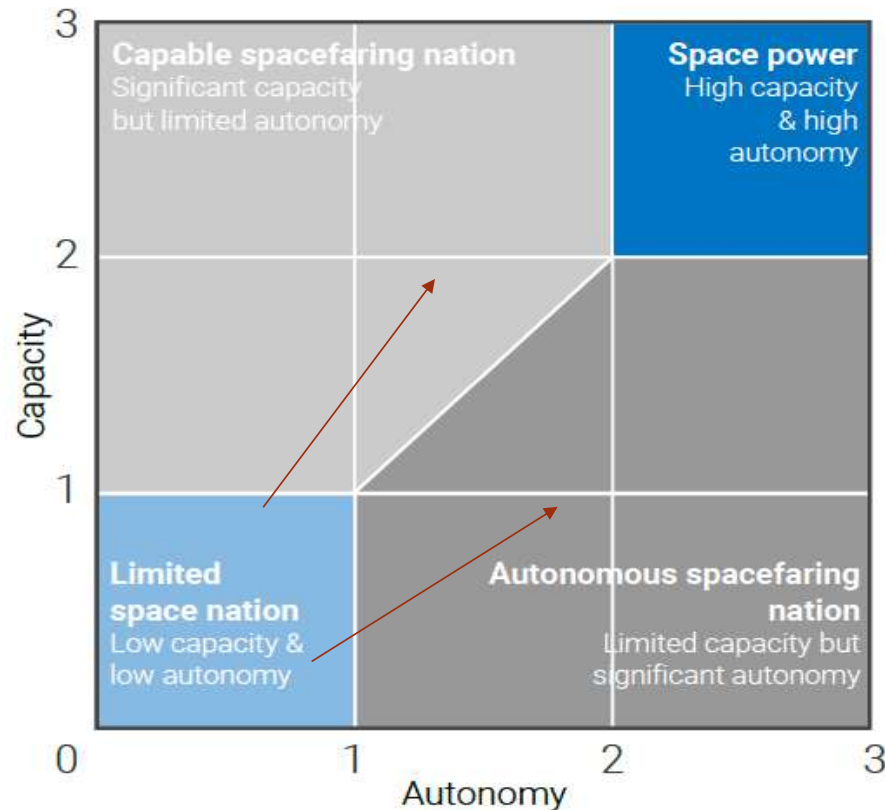


# Why is sustainability in space important?

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

# 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*

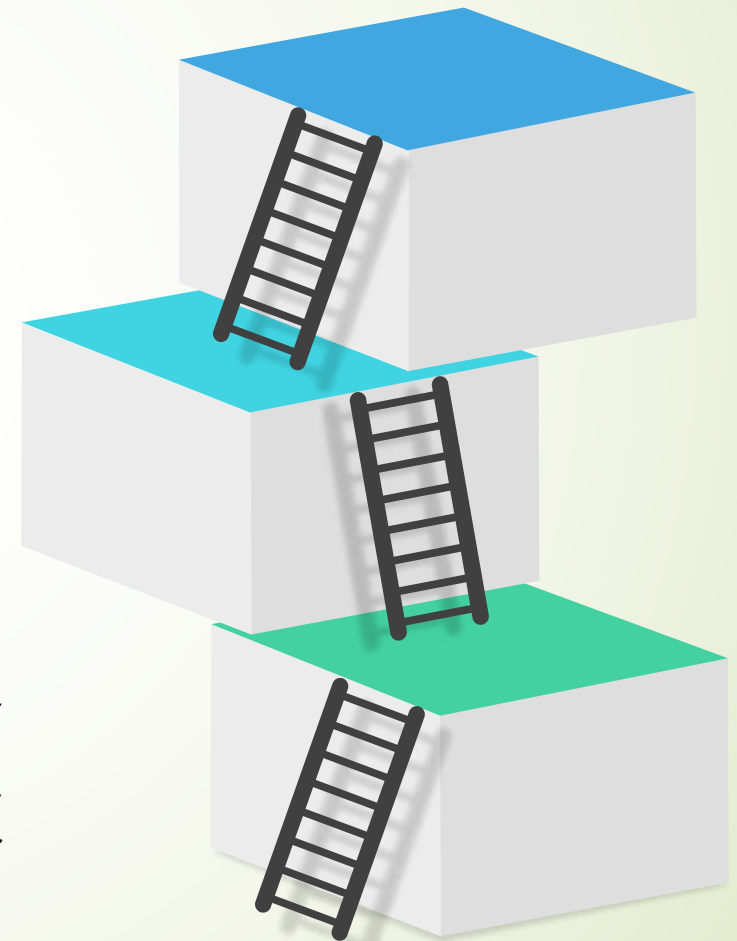
## National Security

*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





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

It is getting crowded out there



UNCOPUOS, 2021

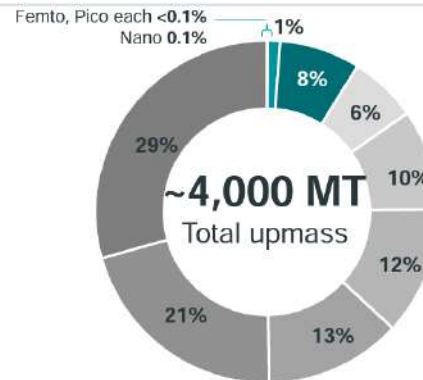
# Why now?

## Smallsats Launched and Total Spacecraft Upmass 2011 – 2020

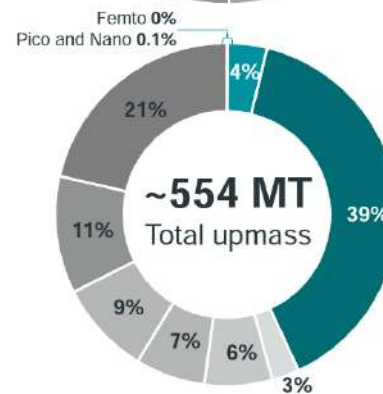
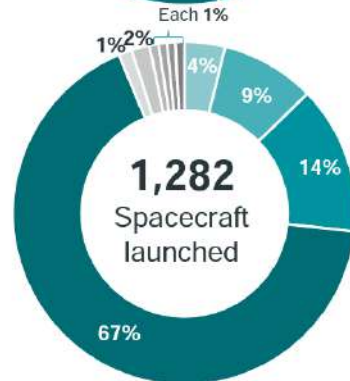
### Smallsats in Context and Operator/Mission Type Trends



2011 – 2020



2020

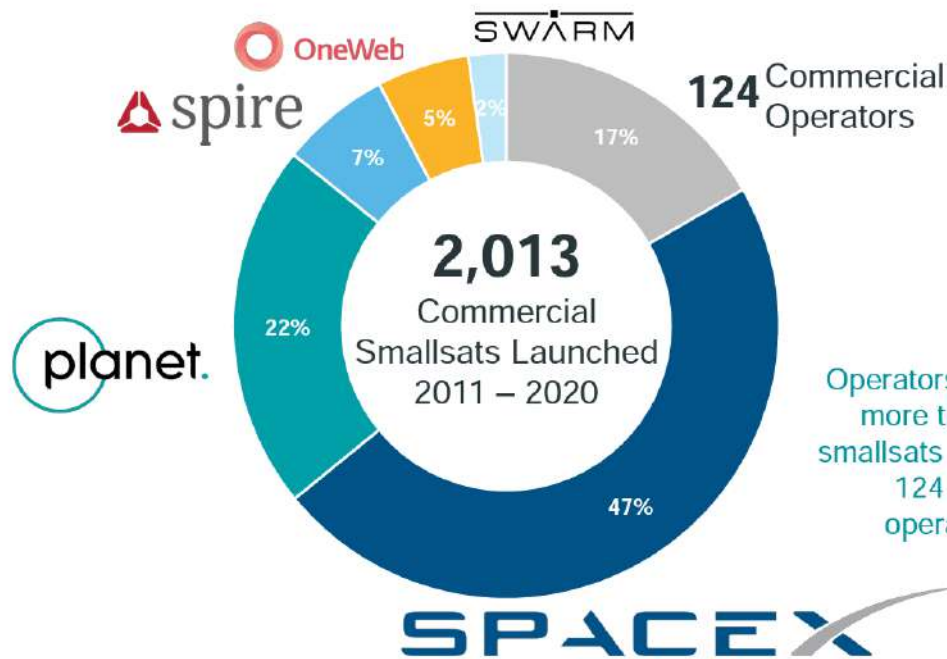


Mass Class Name	Kilograms (kg)
Femto	0.01 – 0.09
Pico	0.1 – 1
Nano	1.1 – 10
Micro	11 – 200
Mini	201 – 600
Small	601 – 1,200
Medium	1,201 – 2,500
Intermediate	2,501 – 4,200
Large	4,201 – 5,400
Heavy	5,401 – 7,000
Extra Heavy	> 7,001

- ✓ 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)

Commercial Operators with more than 5 smallsats\*

Operator	# of Smallsats
SpaceX	955
Planet	437
Spire Global	131
OneWeb	110
Swarm Technologies	45
CGSTL	26
Satelogic	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

\*As of the end of 2020



# 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

- A.1 Adopt, revise and amend, as necessary, national regulatory frameworks for outer space activities
- A.2 Consider a number of elements when developing, revising or amending, as necessary, national regulatory frameworks for outer space activities

## POLICY AND REGULATORY FRAMEWORK FOR SPACE ACTIVITIES

Guidelines for the Long-term Sustainability of Outer Space Activities: Section A

- A.3 Supervise national space activities
- A.4 Ensure the equitable, rational and efficient use of the radio frequency spectrum and the various orbital regions used by satellites
- A.5 Enhance the practice of registering space objects



# 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

- B.1 Provide updated contact information and share information on space objects and orbital events
- B.2 Improve accuracy of orbital data on space objects and enhance the practice and utility of sharing orbital information on space objects
- B.3 Promote the collection, sharing and dissemination of space debris monitoring information
- B.4 Perform conjunction assessments during all orbital phases of controlled flight
- B.5 Develop practical approaches for pre-launch conjunction assessments
- B.6 Share operational space weather data and forecasts



## SAFETY OF SPACE OPERATIONS

Guidelines for the Long-term Sustainability of Outer Space Activities: Section B

- B.7 Develop space weather models and tools, and collect established practices on the mitigation of space weather effects
- B.8 Design and operation of space objects regardless of their physical and operational characteristics
- B.9 Take measures to address risks associated with the uncontrolled re-entry of space objects
- B.10 Observe measures of precaution when using sources of laser beams passing through outer space



# 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

C.1 Promote and facilitate international cooperation in support of the long-term sustainability of outer space activities

C.2 Share experience related to the long-term sustainability of outer space activities and develop new procedures, as appropriate, for information exchange

## INTERNATIONAL COOPERATION, CAPACITY-BUILDING AND AWARENESS

Guidelines for the Long-term  
Sustainability of Outer Space Activities: Section C

C.3 Promote and support capacity-building

C.4 Raise awareness of space activities

# Implementing requires countries to:

- ▶ Conduct research
- ▶ New measures to manage space debris



The image shows the cover of a document titled "SCIENTIFIC AND TECHNICAL RESEARCH AND DEVELOPMENT". The cover has a red background with a central graphic of a globe. The text on the cover includes the title, the subtitle "Guidelines for the Long-term Sustainability of Outer Space Activities: Section D", and two key points: "D.1 Promote and support research into and the development of ways to support sustainable exploration and use of outer space" and "D.2 Investigate and consider new measures to manage the space debris population in the long term". At the bottom, it features the United Nations logo and the text "UNITED NATIONS Office for Outer Space Affairs" on the left, and the hashtags "#LTSGUIDELINES" and "#SPACESUSTAINABILITY" on the right.

D.1 Promote and support research into and the development of ways to support sustainable exploration and use of outer space

**SCIENTIFIC AND TECHNICAL RESEARCH AND DEVELOPMENT**

Guidelines for the Long-term Sustainability of Outer Space Activities: Section D

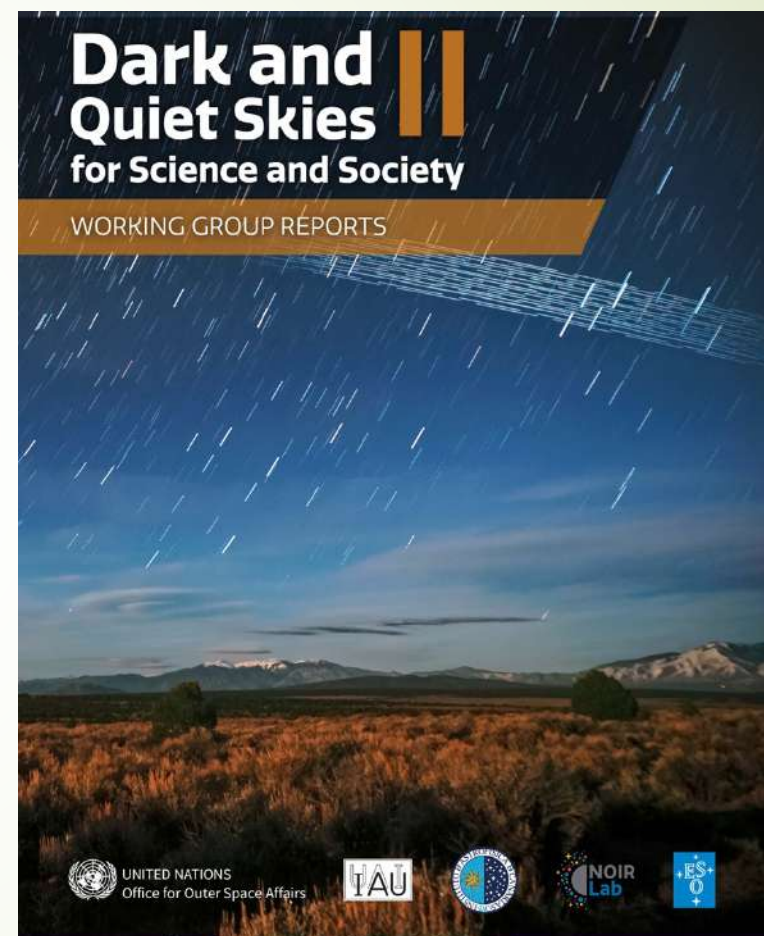
D.2 Investigate and consider new measures to manage the space debris population in the long term

 UNITED NATIONS  
Office for Outer Space Affairs

#LTSGUIDELINES  
#SPACESUSTAINABILITY

# 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

✓ A minimum **safe following distance**/stopping position



✓ A minimum **safety margin** - *considering speed & potential danger*



✓ **Acceleration sense** - *accurate application of pressure on pedals without inappropriate braking*



✓ Keep alert and observe the road for potential dangers



AVOID BLINDSPOTS OF OTHER VEHICLES



WATCHOUT FOR PEDESTRIANS AND CHILDREN



LOOK BEFORE YOU OPEN YOUR DOOR



CHECK YOUR MIRRORS REGULARLY




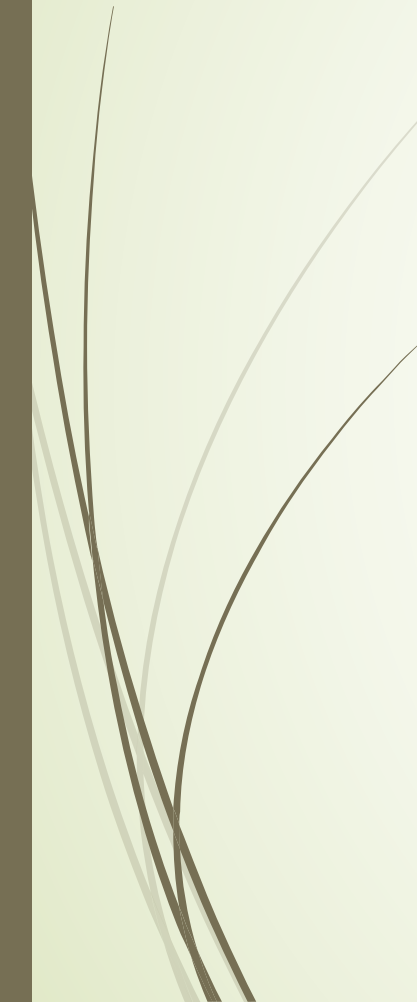
CHECK FOR CROSS TRAFFIC



IDENTIFY ROAD HAZARDS (POTHOLES, BARRICADES, ETC.)



# 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)