Proposal for the growth of Singapore's Space Industry and EcoSystem

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Content

Space Technology in Singapore's Context

Strengths of SG	Constraints of SG
1. Open economy that encourages FDIs from MNCs who have been in the Space Industry 2. Strong political will to sustain a space program via the creation of OSTIn and participation in UN COPUOUS and UNOOSA. 3. Strong educational infrastructure in Education System to allow deeper developments in STEM educations (STAR@NUS, SaRC@NTU, SSTL, NUS School of Maths and Science, Active Learning Program - focusing on STEM in mainstream Secondary Schools)	1. Limited land size means the inability to build a localized launch site for rockets and spaceships. It also limits the scale of satellites that we can build. (Size of optics corelates to the resolution of image obtained) 2. Low number of undergraduates pursuing STEM subjects at the University level due to relatively poorer remuneration [1] 3. Low number of STEM local graduates pursuing STEM related careers after graduation [1]

[1]: https://www.nus.edu.sg/newshub/news/2021/2021-06/2021-06-15/STEM-st-15jun-pA14.pdf

Technology and Industry Trends
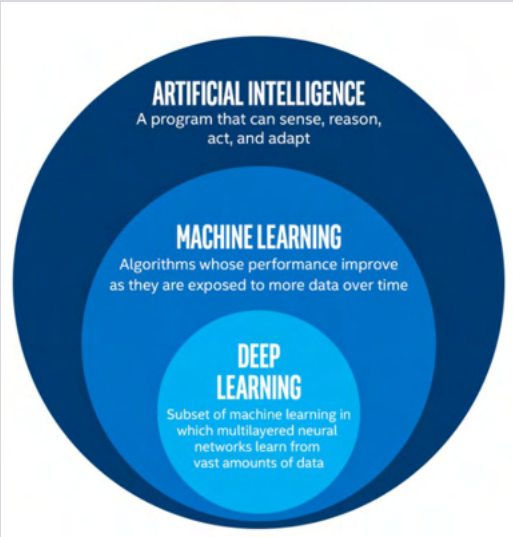
1. **Artificial Intelligence (AI) and Machine Learning(ML) through Data Collection**

   • Using space tech to collect data to disrupt the existing processes and offerings of present industries
   • Using AI and ML to develop software capabilities to predict and pre-empt future actions ←→ Industry Revolution 4.0

2. **Meeting the UN Sustainable Development Goals (UN SDGs) (Some Key Goals)**

   • Goal 2: Zero Hunger - Nature positive food production
   • Goal 11: Sustainable Cities and Communities – Creating sustainable transport systems, reducing adverse effects of natural disasters, reducing impact of cities
   • Goal 13: Climate Action – Collecting data to inform government to integrate climate change measures into policies.

Opportunity 1: Climate Change Monitoring

Space technology provides the affordances for government, NGOs, and researchers to monitor carbon emissions and make accurate predictions to weather and climate changes. Better predictions lead to lives and properties saved.

PROS

1. Data collected raises awareness to the relevant stakeholders about their impacts on the environment.
2. Accurate monitoring of ground temperature helps to preempt and mitigate potential forest fires. Also leads to better deployment of forces on the ground.
3. Being able to collect data and weather patterns to build reliable models for meteorological researchers to reduce adverse impacts on lives and properties.

Relevance to Singapore

1. Supporting the national sustainability initiative by 2030, working closely with Min of Sustainability and EOS@NTU
2. 194 states and the EU have pledged support for the Paris Agreement under UN FCCC. By building capabilities in our space technology in the area of climate change, we can attract corporations, NGOs, research facilities around the world to invest in our space tech companies to further and advance their commitment towards climate change.
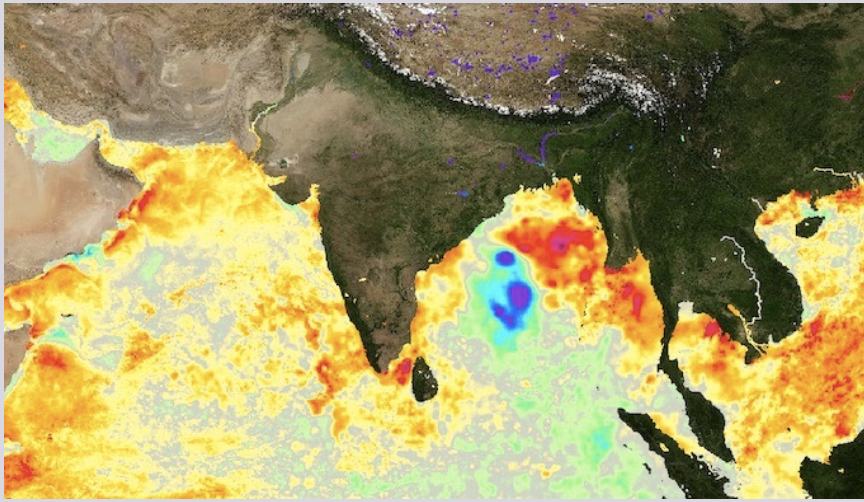
Figure 1 (above): Rising of sea temperatures in the Indian Ocean leading to the rise of cyclone activities
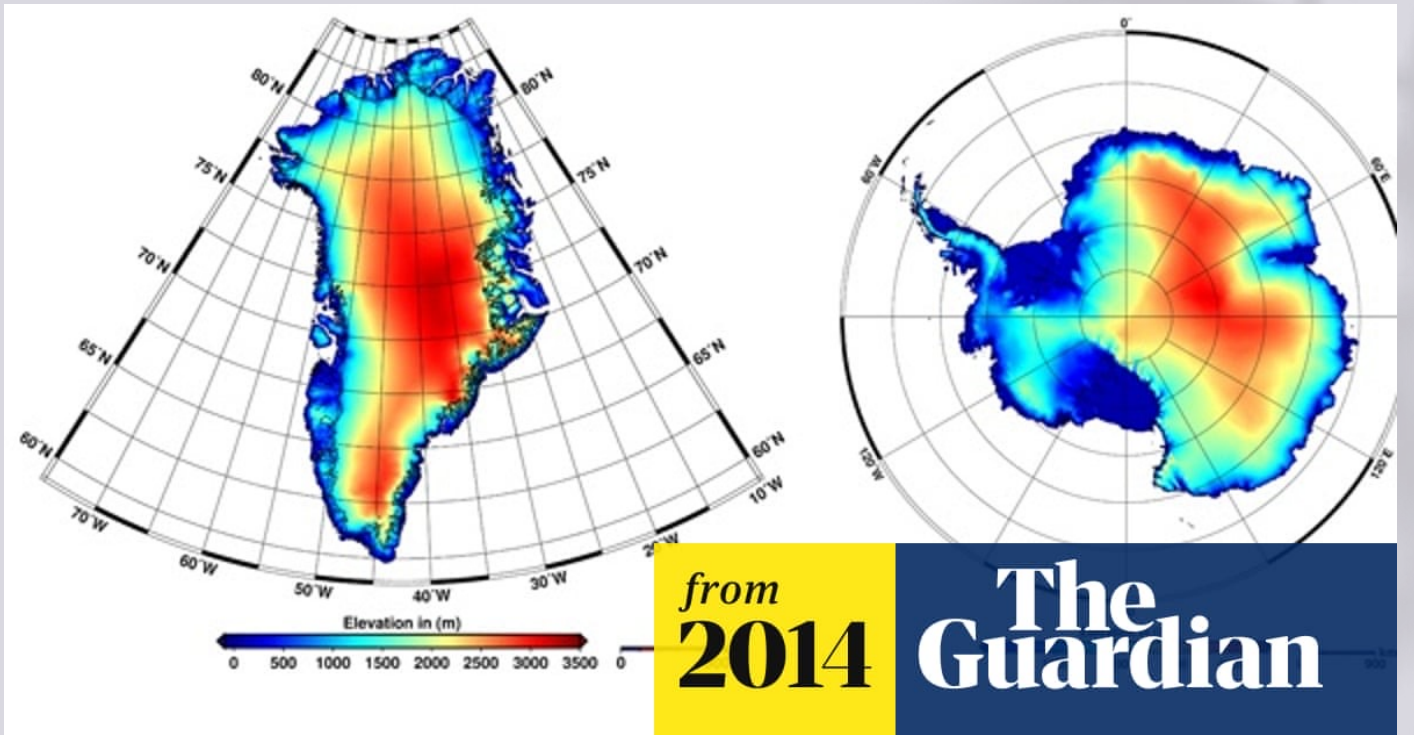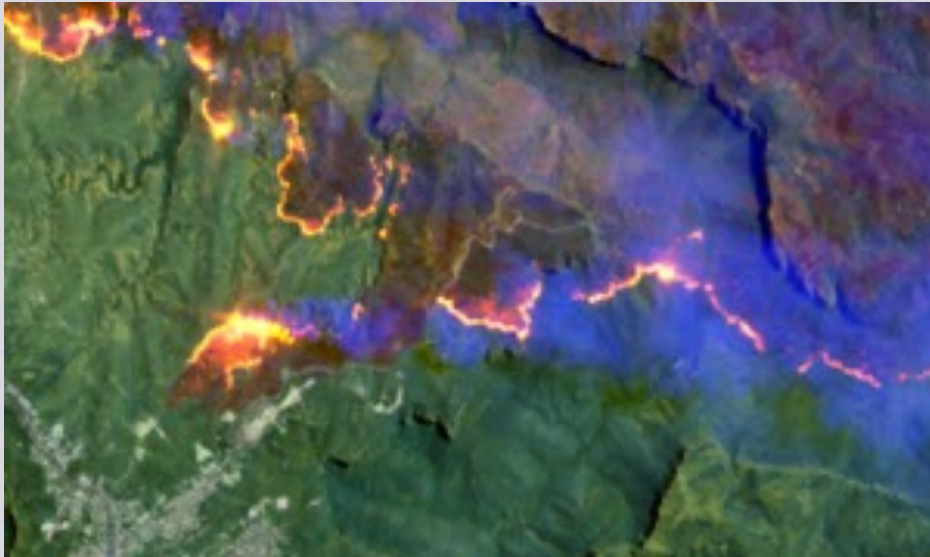© India Climate Dialogue

Figure 2 (above): Change in elevation of the polar ice caps (R) and ice caps in Greenland (L) due to rise in global temperature
© The Guardian

Figure 3 (left): Detecting Bushfire Hotspots from Sentinel-2 Imagery
© Sentinel-2

Opportunity 2: Defence and Security

Space technology provides the affordances for governments and militaries to transmit secure infocomms during war and monitor troops and assets on the ground to make on time and accurate decisions

PROS

1. SatCom has always been a means of comms for militaries since the 2000s, slowly edging out the tradition radio communications system.
2. Evolution in Quantum Computing Encryption has further accelerated the growth in Space Tech for military uses to enhance the security of the information uploaded and downloaded.
3. Having the 'eyes' in the sky to provide accurate Situation Reports (SitRep) has helped to prevent loss of lives.
4. Flying of autonomous and unmanned air vehicles over a further range in conjunction with development in AI and Machine Learning inbuild into the air vehicles.

Relevance to Singapore

1. The pursuit of international military co-operation and the openness for intelligence sharing between governments and militaries is prevalent.
2. Partnering with DSO and GovTech in Space Tech helps to further drive the sector and set a benchmark for local space tech entrepreneurs to model after.
3. This is in line with SAF's recent move towards building up stronger C4I (Command, Control, Communications, Computers & Intelligence).

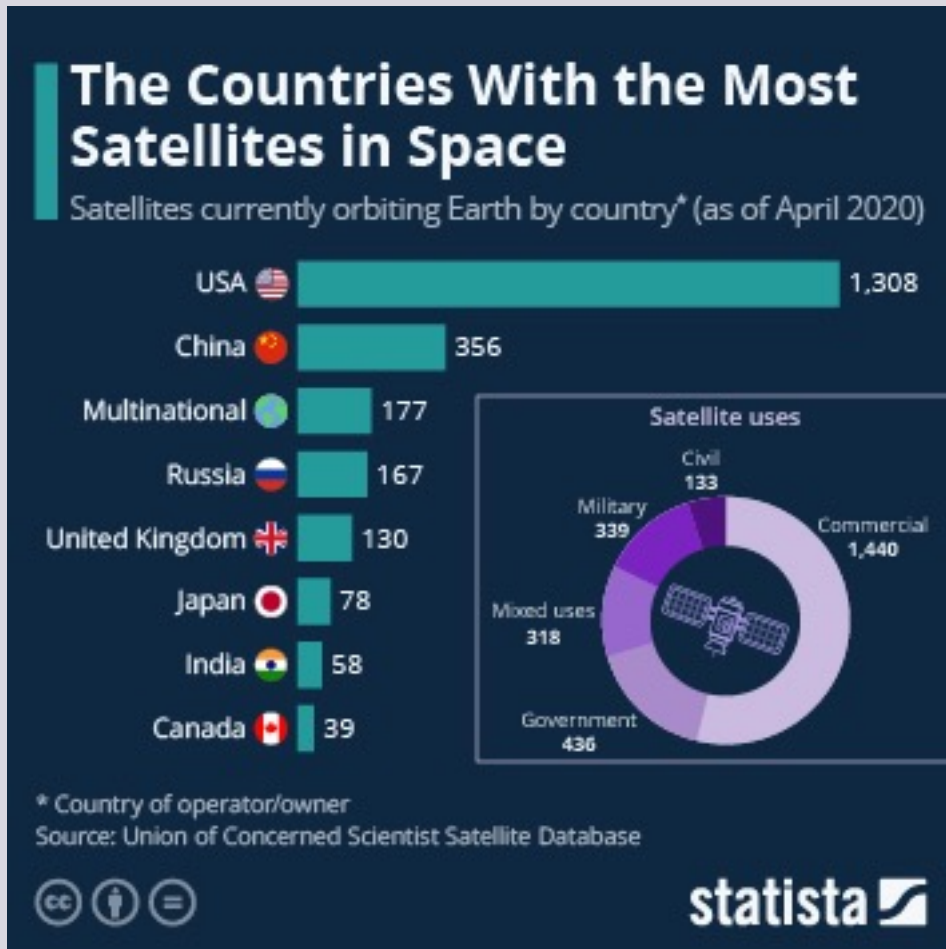Office for Space Technology & Industry, Singapore

Figure 4 (above): Military and Govt satellites makes up 30% of the satellites currently orbiting the Earth
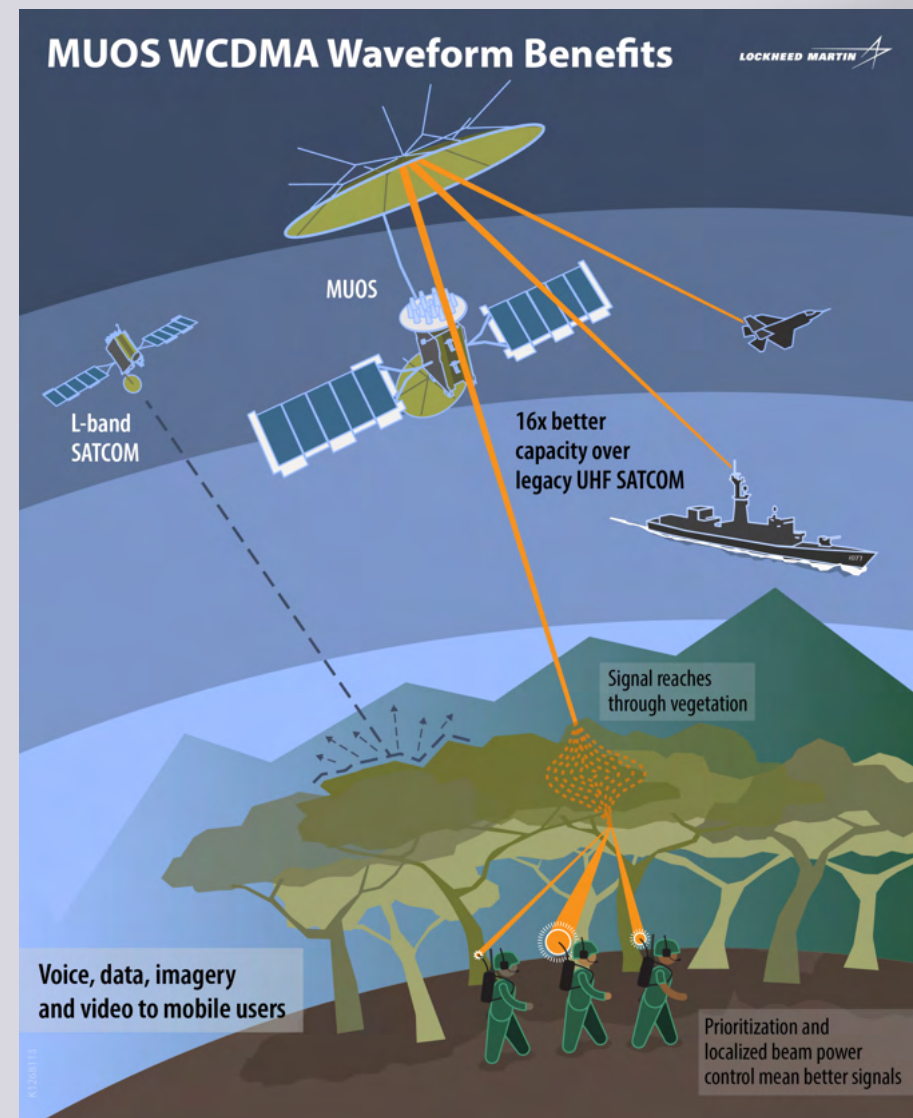© statista

Figure 5 (above): Battlefield Management System for better SitRep for Commander
© Phys.org

Opportunity 3: Food Sustainability and Production

Space technology provides the affordances for food producers to engage in sustainable farming methods and to monitor food supply chains

PROS

1. Satellite imagery of land, soil, farms and crops provide information to food producers on the health of their crops and live stocks. Information that can be obtained include, but not limited to, soil quality, quantity of live stocks (by GPS tracking), area of soil that requires fertilization, soil moisture.
2. Monitoring of sea temperature, wave height and dissolved oxygen provide aqua culture food producers information of the state of their produce
3. GPS tracking of supply chains helps to inform producers and importers to purchase suitable quantities and in the long run reduce food wastage.

Relevance to Singapore

1. Covid-19 has raised concerns over SG's food security. We have a vested interest in ensuring that our global partners food supply remains secure.
2. Uplifting and strengthening neighboring countries food production processes as an importing country builds a win – win situation for both countries.
3. Allowing the trade and industry sector to move towards using space tech to produce food in a sustainable manner is aligned to Industrial Revolution 4.0

Challenges of Space Technology and Mitigation Strategies

Challenge	There is a high barrier to entry, in terms of costs and knowledge.	Environmental Challenges: Carbon emissions from rocket launches and adding on to existing space debris	Disruptive in nature to industries – many may not be able to see the effects of incorporating space tech into their business models immediately
Mitigation Strategies	**Knowledge Barrier** • Partnerships with MOE, Autonomous Universities (AUs) and Science Centre to curate program to develop interest, attract skilled academics into the AUs. • Internship opportunities for local undergrads to local space startups as a part of funding requirements. **Cost Barrier** • Govt Funding and Accelerator programs to attract investors to our local startups. • Licensing out state-owned research to be reinvented by private sector.	• Research and development with companies like Astroscale that seeks to use space tech to overcome the problems. • Building up equivalent capabilities to create sustainability in space. • Looking also at rocket launches and encouraging developments in navigations, engineering and materials to consider how to prepare for rockets to return for reuse and preparing satellites to return safely during end of life.	• Working with local research facilities to build capabilities and integrate them into government organizations. • Host conferences and conventions to share the findings, benefits, challenges and potential on how space tech may have an impact on existing business models • Support partnerships between local companies and MNCs who have already adopted space tech as a part of their business model.

The Way Forward

- Singapore's very own National Space Agency competitive to that of NASA and ESA
- Creation of space tech companies based in Singapore equivalent to that of SpaceX
- Sustainable Space Climate looking into green aerospace fuel and reduction of space debris

Recruiting renowned talents in the industry to mentor and inspire the next generation

Building a vibrant and open local ecosystem with skilled talent pool

Building up local capabilities through education

Supporting startups by connecting them with MNCs and investors

Encouraging mergers and collaborations between startups to capture larger market share

Encouraging spin offs from local research institutions

1 x state owned space office (OSTIn)
1 x private company for space collaboration (SSTA Ltd)
6 x state owned/linked research institutions
(SRC, STAR, CRISP, EOS, DSO, ST Engineering)
Approx 30 private companies
13 x SG satellites launched

Where we are now

Office for Space Technology & Industry, Singapore