



Space Generation Advisory Council
in support of the United Nations Programme on Space Applications

Perspectives on International Civil Space Situational Awareness

Presented by the Space Generation Advisory
Council

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The Space Generation Advisory Council (SGAC):
A non-governmental organisation which aims to represent students and young space-industry professionals to the United Nations, States, and space agencies. SGAC has observer status in the [UN Committee on the Peaceful Uses of Outer Space \(COPUOS\)](#).

The Vision of the Space Generation is to:

*Employ the creativity and vigour of youth
in advancing humanity through the
peaceful uses of outer space*



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The Declaration of SGAC:

"We express the hope and the conviction that our common future ought to proceed *ethically*, with an *understanding* of the long-term consequences of our actions and with *all humanity* walking forward together as one." [12]

Our focus is on pragmatic [space policy](#) advice to policy makers based on the interests of students and young professionals





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2009 brings not only the International Year of Astronomy, a celebration of all the accomplishments that mankind has made in reaching for the stars since Galileo Galilei looked out of the first telescope 400 years ago, but also the 10th anniversary of the foundation of the SGAC.



On this birthday, we celebrate and re-affirm the importance of the voice of the world's youth for ensuring the peaceful and free exploration and development of space. The SGAC is comprised of the future users of the near-Earth space environment. It has a vested interest in the inheritance of a clean near-Earth environment, and thus supports whatever measures can be taken to make current space operations sustainable.



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Our Dependence on Space

Humanity depends more on its space-based infrastructure than ever before for. We need it for:

- navigation,
- communication,
- transportation,
- security,
- meteorology,
- geography,
- geodesy,
- surveying,
- Earth observation,
- scientific research,
- disaster prediction, detection, observation and recovery.



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SGAC supports sustainable operations because with *no further* human space activity, space will become increasingly dangerous because:

1. Much of the current satellite and debris population will orbit for decades or much longer. [11]
2. Without intervention, the amount of debris will steadily increase because it has reached a large enough population to create more debris through collisions of debris fragments. [1]

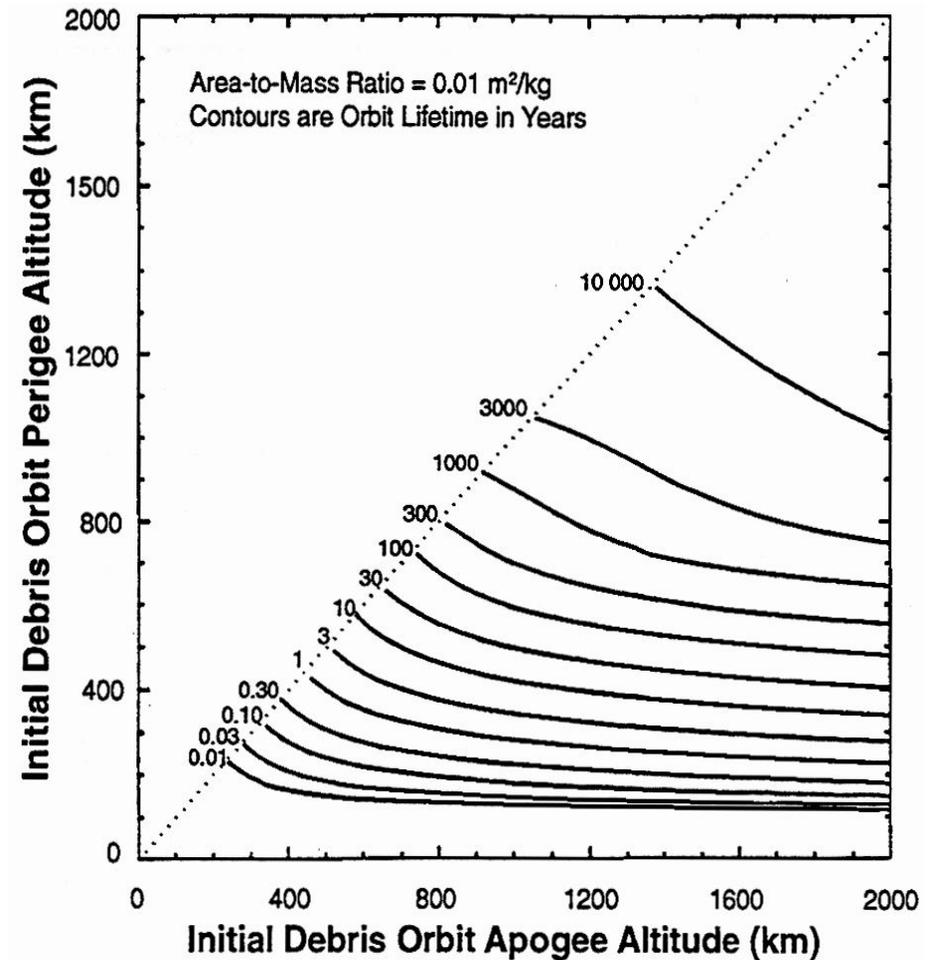
This means that we have already exploited near-Earth space with little regard for the future development of space.



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The orbital lifetime of debris increases exponentially with altitude, posing a consistent catastrophic threat to our space infrastructure for centuries.



Caption: Orbit lifetimes for debris released in low altitude, low eccentricity orbits. Radiation pressure effects neglected in orbit lifetime calculations. Image Credit: NASA Safety Standard: Guidelines and Assessment Procedures for Limiting Orbital Debris, 1995



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This simulation by J.C. Liou predicts the amount of debris-objects with mitigation measures.

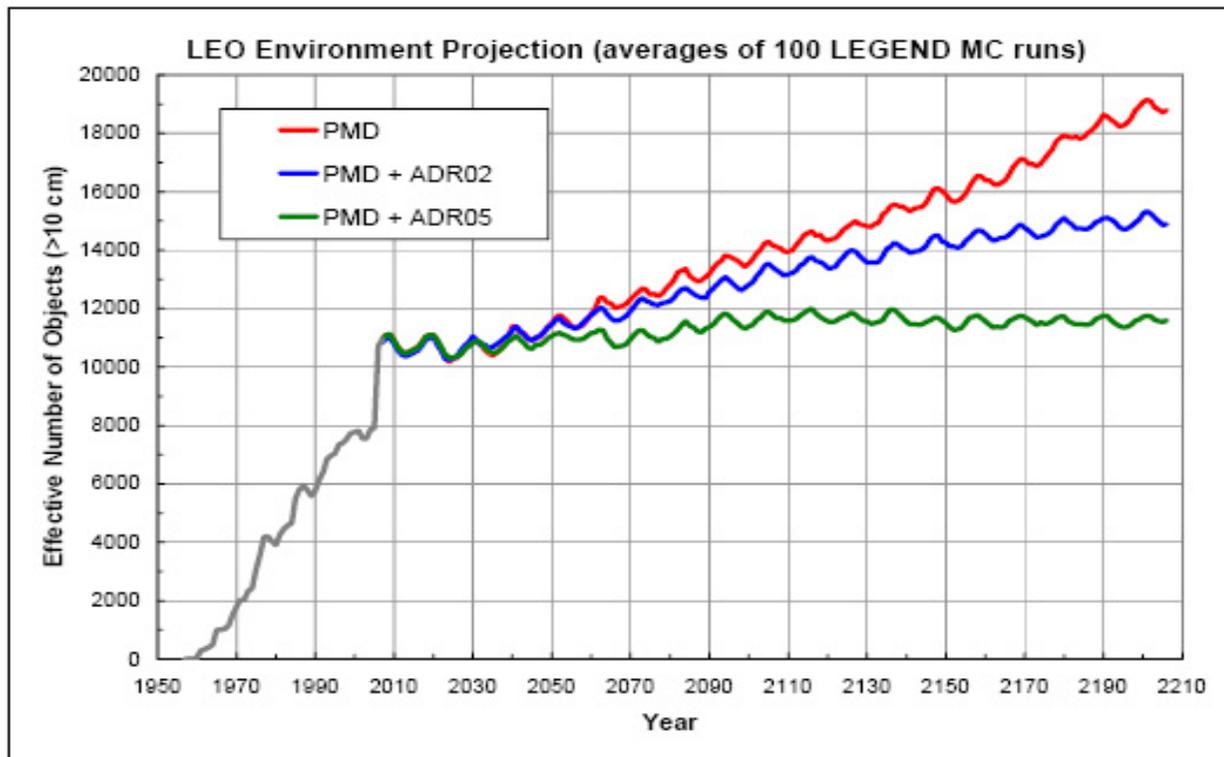


Figure 1. Comparison of three different scenarios. From top to bottom: postmission disposal (PMD) only, PMD and ADR of two objects per year, and PMD and ADR of five objects per year, respectively.

Image credit: J.-C. LIOU, *Stabilizing the Future LEO Debris Environment with Active Debris Removal*, *Orbital Debris Quarterly*, Oct. 2009.



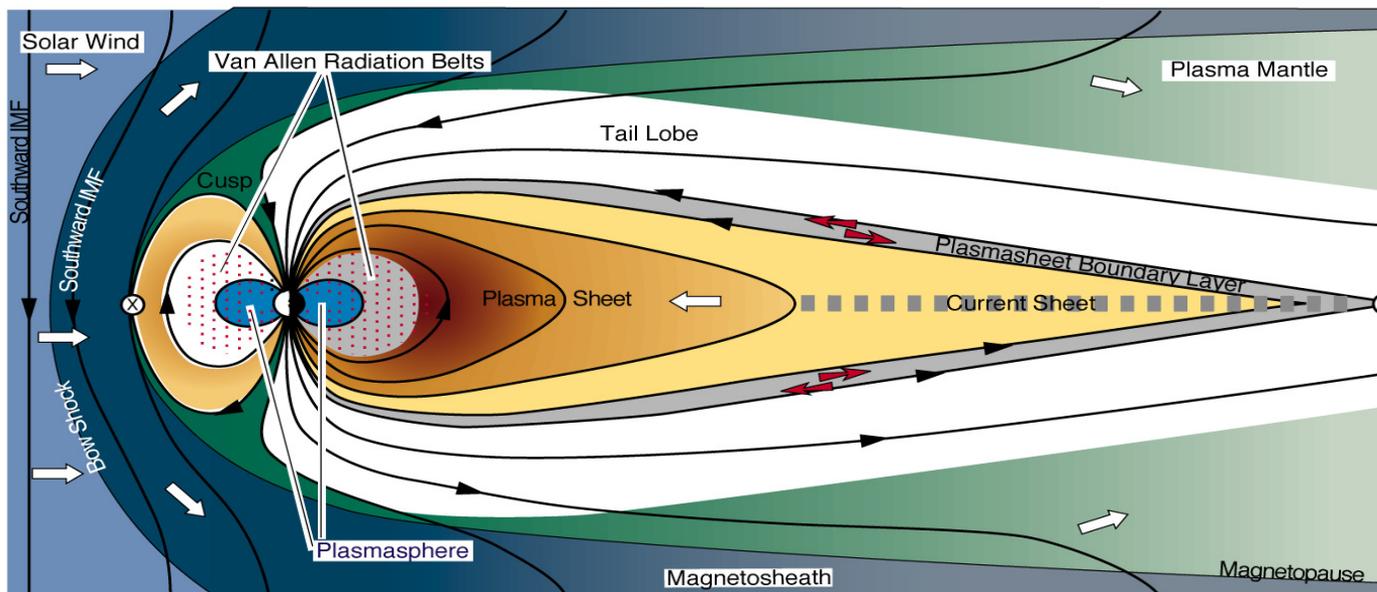
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Space Weather

Space weather also poses a threat to our space infrastructure [4]:

Weather can completely disable spacecraft, preventing them from providing the service for which they were designed, and making them dangerous obstacles in highly-traffic orbits.



Earth's magnetosphere interacting with the solar wind. Image Credit: <http://space.rice.edu/IMAGE/livefrom/sunearth.html>

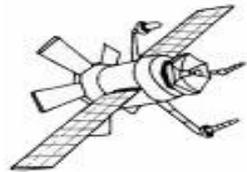


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The Immediate Effects of Space Weather

*Charging and
discharging on
spacecraft
surfaces*



*Electron bombardment by
highly energetic electrons in
the Van Allen Radiation Belt*

22000 miles

*Atmospheric drag,
trapped and solar
particle radiation*

11000 miles

600 miles



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SSA with Regards to Space Weather:

Knowledge of Space Weather is imperative for:

1. The safety of humans in space.
2. The safety of humans on Earth who are reliant on spacecraft. (What latest navigation/meteorological system does *your* airline/train/ship/rescue service/defense force/taxi use?)
3. The protection of our space infrastructure.



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What Can be Done

Sustainable space practices provide a reliable and safe environment in which spacecraft can operate. [15]

With regards to the most technologically feasible and economic methods to minimize threats to space infrastructure, these measures include (with rough definitions):

1. Space Situational Awareness (SSA): observation of space weather, tracking space objects, modeling and predicting the state of the space environment [4,10].
2. Space Traffic Management (STM): the regulated protection of spacecraft using information provided by SSA [9].



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Where we all have can benefit:

National SSA and international civil SSA are complementary.

Elements of National SSA [10]:

1. Space weather surveillance and modeling
2. Metric tracking (position)
3. Characterization
4. Maneuver detection and planning





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We Need Cooperation:

An argument for national cooperation: "In total the overall environmental SSA SoS integrates multiple military and civilian data collection sources. This provides an opportunity for intentional partnership development between the federal enterprise, researchers and university systems. ... The result is best use of taxpayer dollars and more importantly enhanced protection of the nation's space capabilities." [4]

An argument for civil cooperation: "... satellite operators have much better data for their own satellites. When that data is shared among operators, overall space situational awareness can be significantly improved." [14]



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International Cooperation:

The best way to minimize debris is to avoid collisions. Sharing unclassified information is the foundation of international civil SSA. This could include:

1. International catalogue of declassified ephemeris.
2. Sharing data on space weather phenomena will protect the assets of all space-faring nations.





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Our Future Depends on Space Situational Awareness

The goal of international civil SSA will prevent near-Earth space from becoming a physical, man-made barrier. It will make space safer for future exploration and development.

It also provides an opportunity to lay the ground work for increased international cooperation in space exploration and development.

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