International Space Governance

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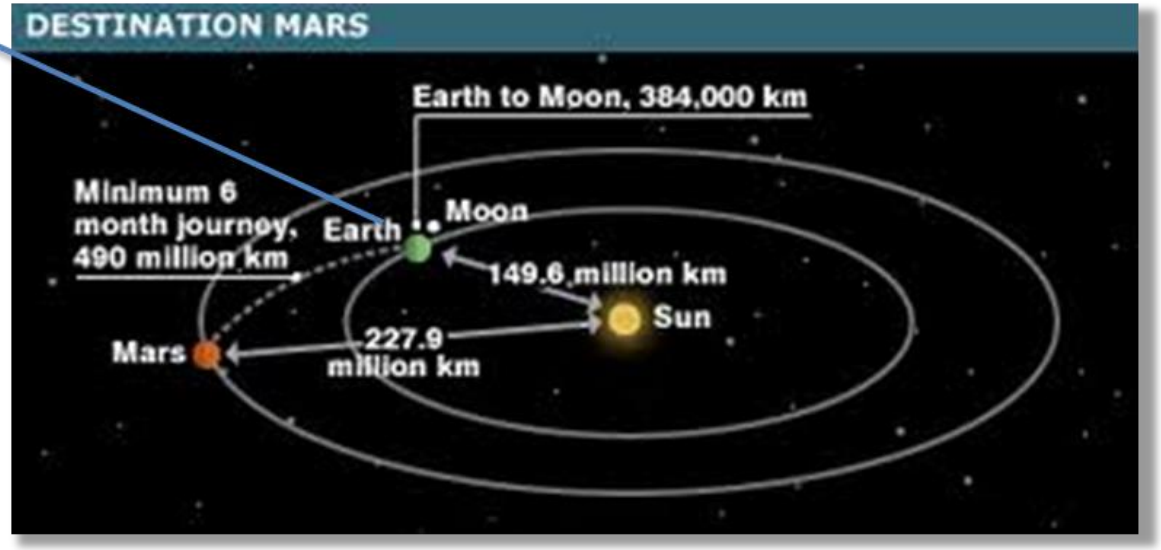
Space Exploration vs. Space Exploitation

Exploitation

Exploration



(Note: according to dictionary '*exploitation*' means making productive use, while '*exploration*' means, traveling over new territory, for adventure, discovery or investigation).

Airspace vs Outerspace: which boundary?

- Several operational boundaries exist between aviation and space:
  - **18 km, upper limit of civil aviation traffic**
  - 50 Km, upper limit of atmospheric buoyancy (balloons);
  - 80 Km, threshold altitude that defines “astronauts” in the US;
  - 100 Km, aircraft aerodynamic controls become ineffective (“Karman Line”);
  - 120 Km, re-entry threshold for space systems;
  - **160 Km, lowest practical operating orbit for satellites.**

Near-Space

- The **Fédération Aéronautique Internationale (**FAI) of Lausanne (CH), the world air sports federation governing aeronautics world records, as well as Australia, have recognized the 100 km separation line proposed by Theodore von Karman between the fields of aeronautics and astronautics, but there **is no internationally legal boundary established in the aeronautical Chicago convention or in space treaties**.

The emerging “Near-Space” (18-160 km)

Because the decompression risk at high altitude cannot be mitigated solely by the use of oxygen masks, commercial airliners are certified to fly no higher than 12-13 km (FL400-430). In the past only military/intelligence aircraft have flown above 18 km (FL 600).

Rockets transit through near-space and may overfly foreign countries enroute. (It is in near-space that rockets gain much of their horizontal speed component to get orbiting). It is in near-space that critical phases of space systems re-entry take place (e.g. fragmentation/explosion during uncontrolled re-entry)

Commercial (and military) interests have begun to develop and operate systems for near-space that are meant to fly from few minutes or hours, to weeks, months or even years: suborbital vehicles, stratospheric balloons, pseudo-satellites and high-altitude drones, air-launches.

Operations in near-space are a potential threat for air traffic beneath and for the public on ground, in case of failures or malfunctions.

Air-launches: coming of age

Subsonic

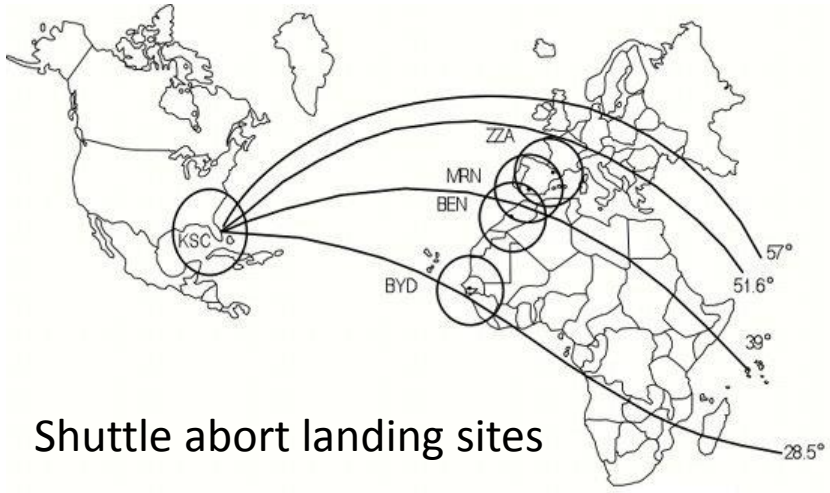
Supersonic

Hypersonic

Next step: air and space traffic integration

Lifting-body space vehicle (e.g. Dream Chaser) operations raise specific safety issues that cannot be addressed by means of use of 'segregated' airspace as for traditional launch operations:

- **abort mode**, when due to failure or malfunction during the ascent phase the vehicle is not able to achieve orbit and has to use an emergency landing site (i.e. an airport)
- **accident during return**, as happened to the Shuttle Columbia, when the vehicle breaks and fragments while overflying the controlled airspace



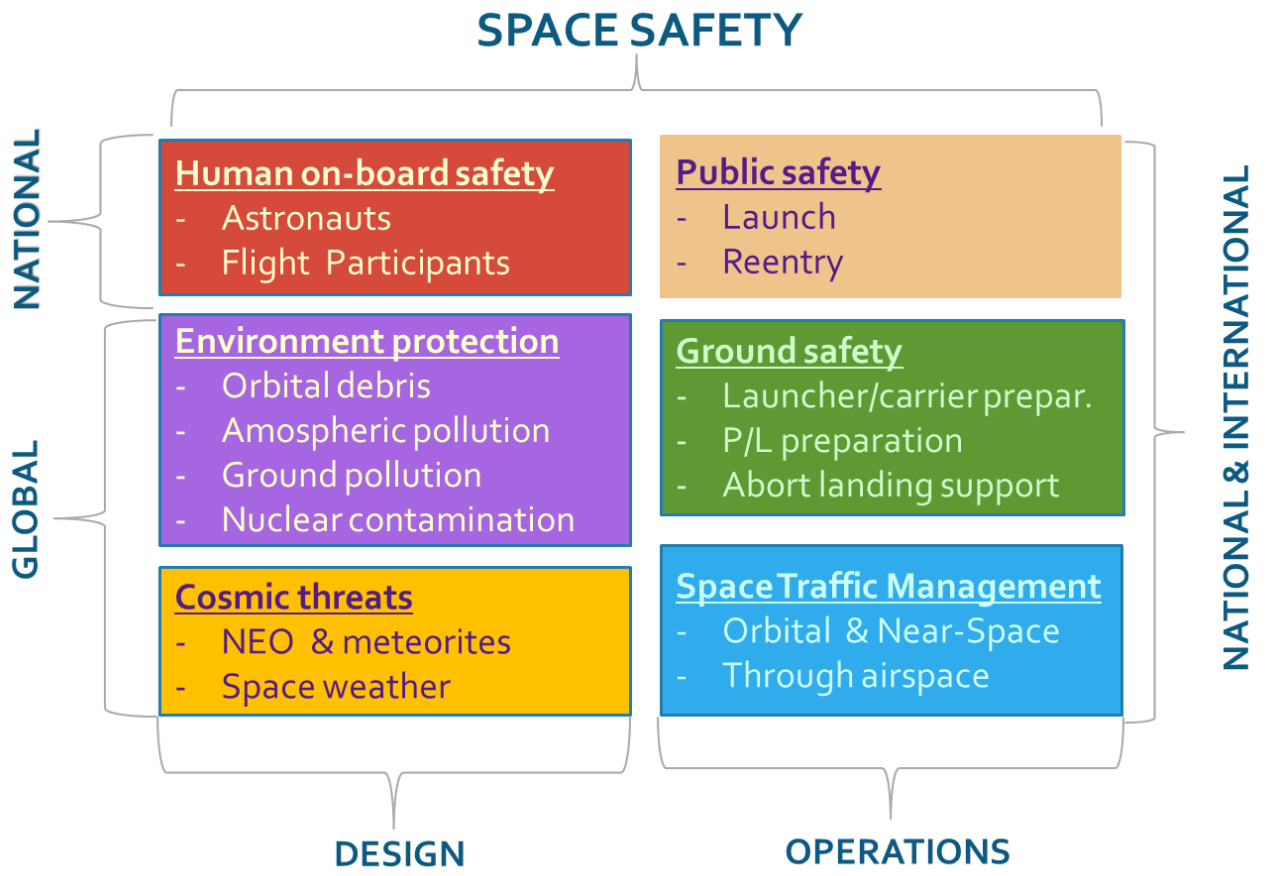
Shuttle abort landing sites

Dream Chaser of Sierra Nevada Corp.*

Congested, competitive and contested

Nowadays space is said to be **“congested”**, **“competitive”**, and **“contested”.** Congested, because of the ever increasing number of space-faring countries, and of countries owing on-orbit assets. Competitive, because commercial operators have become the principal space actors and they drive competition for higher performance and lower costs of space systems. Finally, contested, because over the past two decades, space vulnerabilities have grown dramatically, due to increasing terrestrial dependency on space-based system and development of offensive capabilities in space.

The current situation raises concerns about **safety**, **sustainability** and **security** of space operations. Civil, commercial and military operators all share an overarching concern for the safety of their systems and the sustainability of the space environment. It is around such shared concern that space governance should be built. Security concerns should be dealt with in other appropriate venues.



Space safety is defined as freedom from man-made or natural harmful conditions, which can cause death, injury, illness, damage to or loss of systems, facilities, property, or damage to the environment

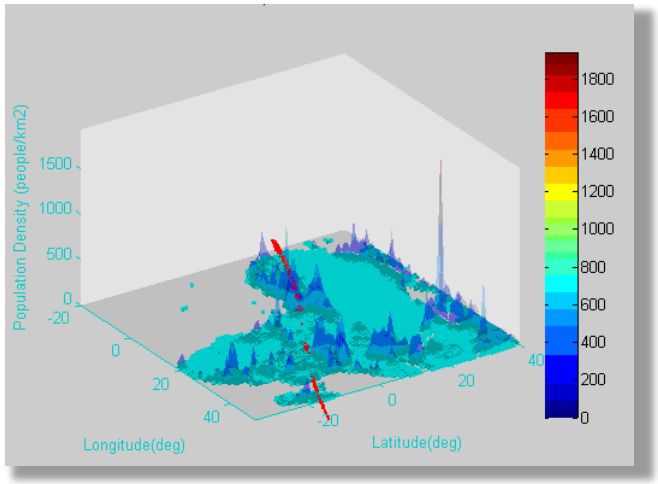
Public safety issues

- Current best practice is to assess risks of launch or re-entry and to approve it when risk levels are acceptable on event-basis. Annual and cumulative risks are not addressed.

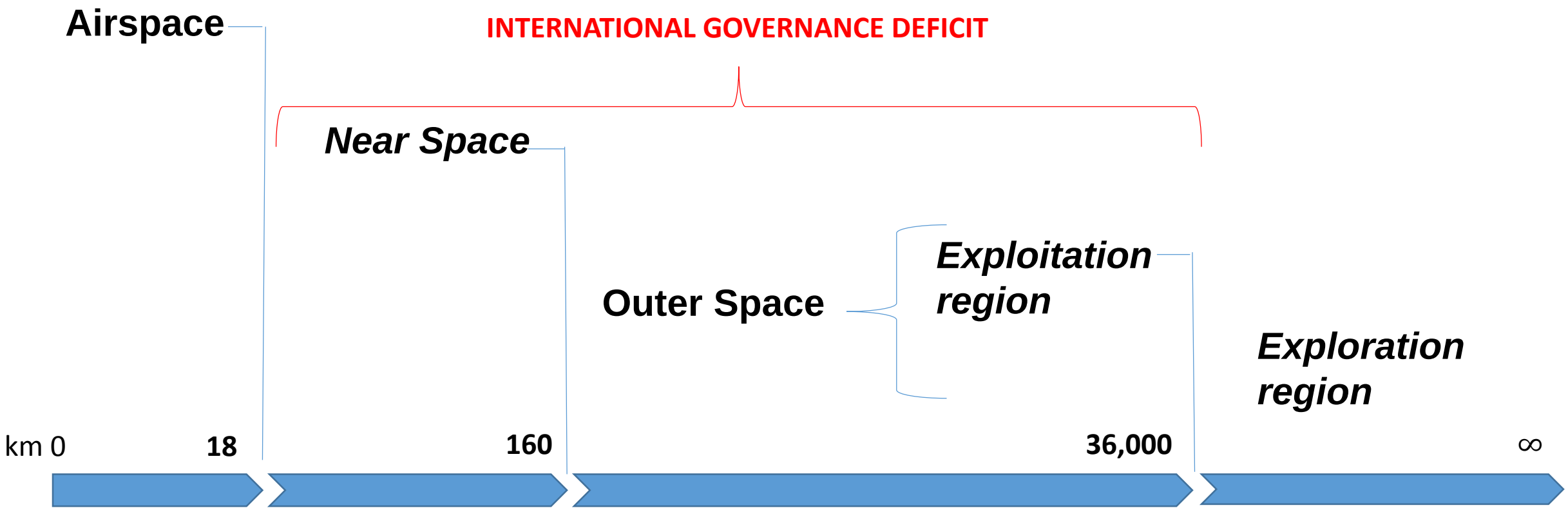
- There is no agency, national or international, that monitors and controls risk imparted to over flown (foreign) populations on a cumulative basis. A city may be placed at risk by launches from multiple spaceports without the launching countries performing any coordinated calculations to assure the levels are tolerable.

- Launch and reentry acceptable risk thresholds are published only by some countries. Methods for their computation are not standardized that leads to wide variances.

- The increase of number of satellites on orbit (e,g, space-based internet) will exacerbate the problem of re-entry safety.



Governing the space above Earth



Governance

"Establishment of policies and rules, and continuous monitoring of their proper implementation, by the members of a governing body. It includes the mechanisms required to balance the powers of the members with associated accountability".

There are several governance models that can be considered for space. For example, the ICAO (International Civil Aviation Organization) , and the IMO (International Maritime Organization)

INTERNATIONAL MARITIME ORGANIZATION

ICAO • OACI • ИКАО

Governance for the FUTURE SPACE

General principles of international space governance

I. *Ensure that citizens of all nations are equally protected from the risk of overflying and re-entering rockets, and spacecraft;*

II. *Ensure that any space system is developed, built and operated according to minimum safety standards which reflect status of knowledge and accumulated experience;*

III. *Minimize the risk of collision or interference, including during transit in the airspace;*

IV. *Ensure protection of ground, air and on-orbit environment from chemical, radioactive and debris contamination.*

V. *Cooperate on the protection from space hazards*

Sharing of roles and responsibilities

There is no appetite for creating a new international organization. Governance could be achieved by expanding roles and responsibilities of existing UN organizations. For example:

- ICAO (International Civil Aviation Organization) could perform safety oversight of commercial space launch and reentry operations, and for all operations in Near-Space.
- COPUOS could establish an international space operations governance framework for space traffic management and space environment protection;

Announcement