Pseudo-Satellites and Their Use in Near Space

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by
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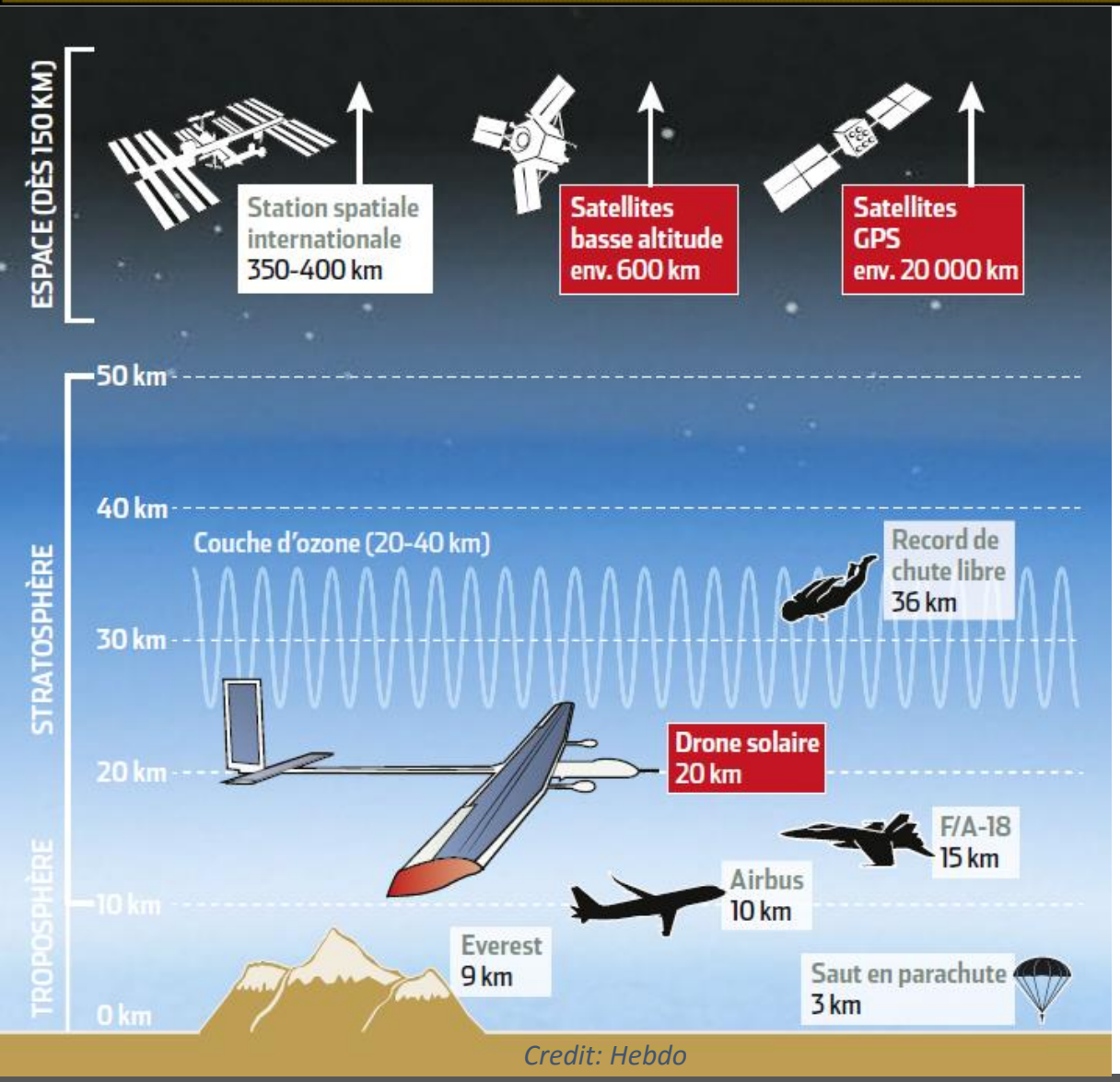
In cooperation with OpenStratosphere, Switzerland



Credit: Hebdo

Definitions:

- Pseudo-Satellite
- Stratosphere
- Perpetual Flight

SOLAR POWER → ZERO FUEL → PERSISTENT MISSION

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).

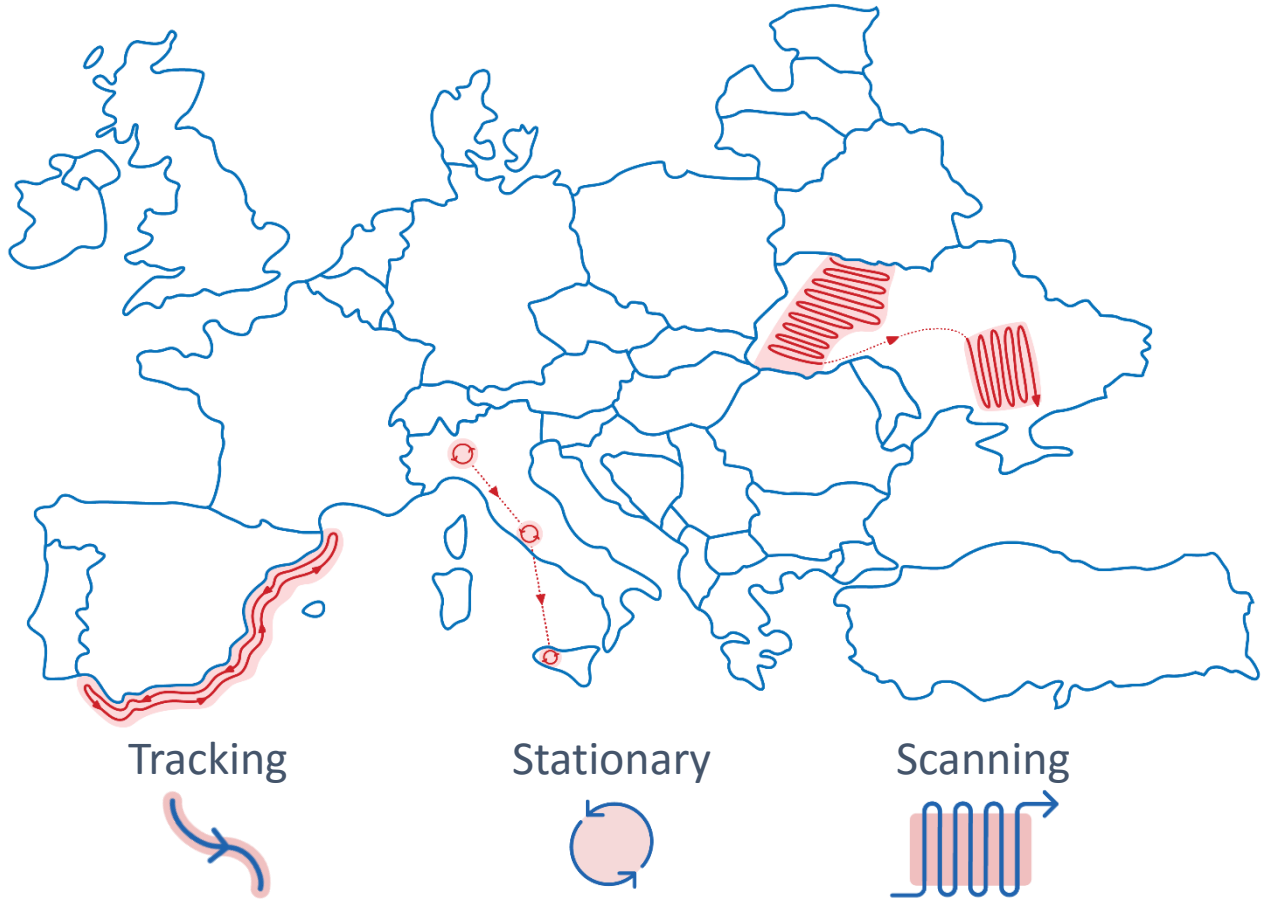
Rockets transit through near-space and may overfly foreign countries enroute. (It is in near-space that rockets gain much of their horizontal speed component to get orbiting). It is in near-space that critical phases of space systems re-entry take place (e.g. fragmentation/explosion during uncontrolled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

Pseudo-Satellite Features, Advantages & Benefits

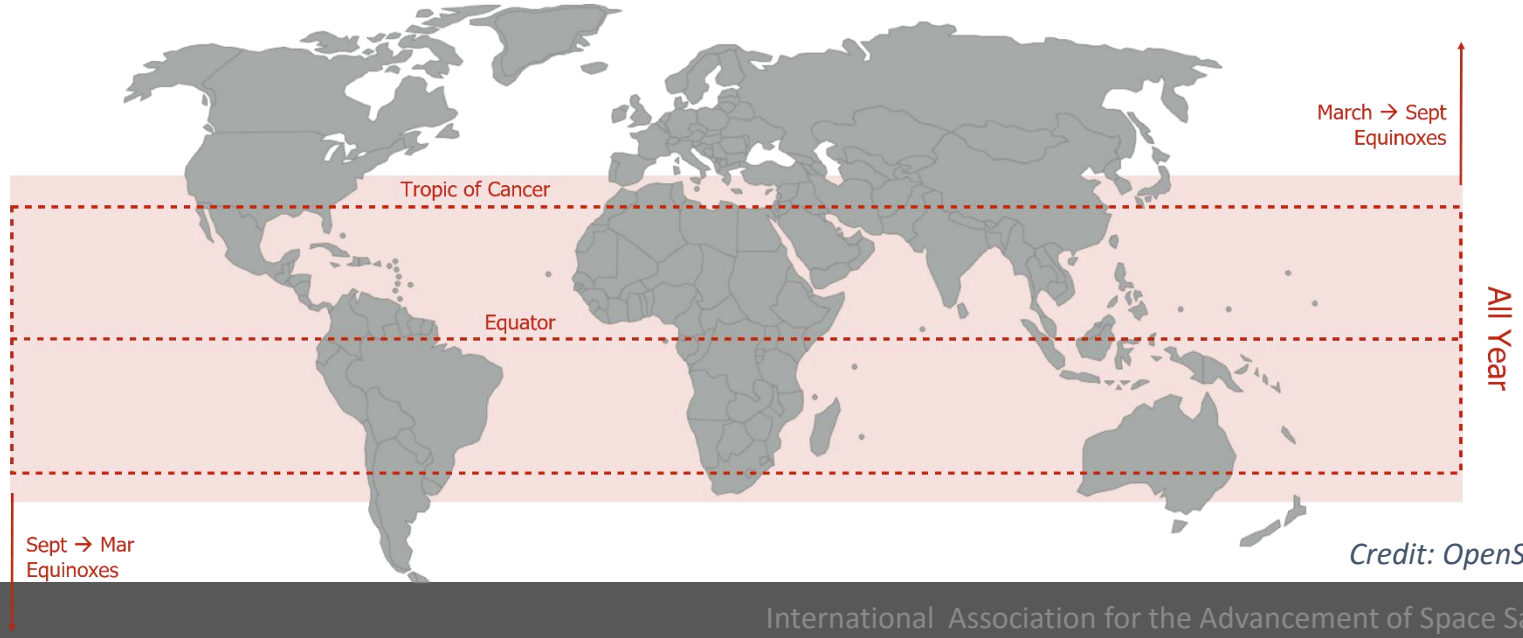
- Rapid (re)deployment in uncongested National Airspace
- Uses existing aviation infrastructure (hangars, runways, com-nav, etc.)
- Much lower and slower than satellites
- No (re)visit time limitations
- Route planning to avoid cloud coverage
- Commercial of-the-shelf payloads (e.g. cameras with <30cm GSD)
- Inexpensive Bill of Materials (BOM) and affordable operations



Credit: OpenStratosphere

Pseudo-Satellite Limitations

- Season & Latitude restrictions
- During night, limited power for payload
- Uncharted airspace
- Availability of new enabling technologies



Credit: OpenStratosphere

Evolution of Operational Window for Perpetual Flight

Aircraft Performance	
k_batt (Wh/kg)	260
Tbatt (h)	6.1
Tpot (h)	1.4
Tn (h)	7.6
Td (h)	16.4

Tnight (h)

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
50	15.4	13.4	12.0	10.1	8.6	8.2	8.6	10.1	12.0	13.4	15.4	15.8
40	14.4	13.4	12.0	11.0	9.6	9.1	9.6	10.6	12.0	13.4	14.4	14.9
30	13.4	12.5	12.0	11.0	10.1	10.1	10.1	11.0	12.0	12.5	13.4	13.9
20	13.0	12.5	12.0	11.0	11.0	11.0	11.0	11.5	12.0	12.5	13.0	13.0
10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

k_batt (Wh/kg)	300
Tbatt (h)	7.1
Tpot (h)	1.4
Tn (h)	8.5
Td (h)	15.5

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
50	15.4	13.4	12.0	10.1	8.6	8.2	8.6	10.1	12.0	13.4	15.4	15.8
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10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

k_batt (Wh/kg)	350
Tbatt (h)	8.2
Tpot (h)	1.4
Tn (h)	9.7
Td (h)	14.3

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
50	15.4	13.4	12.0	10.1	8.6	8.2	8.6	10.1	12.0	13.4	15.4	15.8
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20	13.0	12.5	12.0	11.0	11.0	11.0	11.0	11.5	12.0	12.5	13.0	13.0
10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

k_batt (Wh/kg)	400
Tbatt (h)	9.4
Tpot (h)	1.4
Tn (h)	10.8
Td (h)	13.2

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
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10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

k_batt (Wh/kg)	450
Tbatt (h)	10.6
Tpot (h)	1.4
Tn (h)	12.0
Td (h)	12.0

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
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10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

k_batt (Wh/kg)	500
Tbatt (h)	11.8
Tpot (h)	1.4
Tn (h)	13.2
Td (h)	10.8

Latitude	Month 1	2	3	4	5	6	7	8	9	10	11	12
60	17.3	14.4	12.0	9.1	6.7	5.3	6.7	9.1	12.0	14.4	17.3	18.7
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10	12.5	12.5	12.0	12.0	11.5	11.0	11.5	12.0	12.0	12.5	12.5	12.5
0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

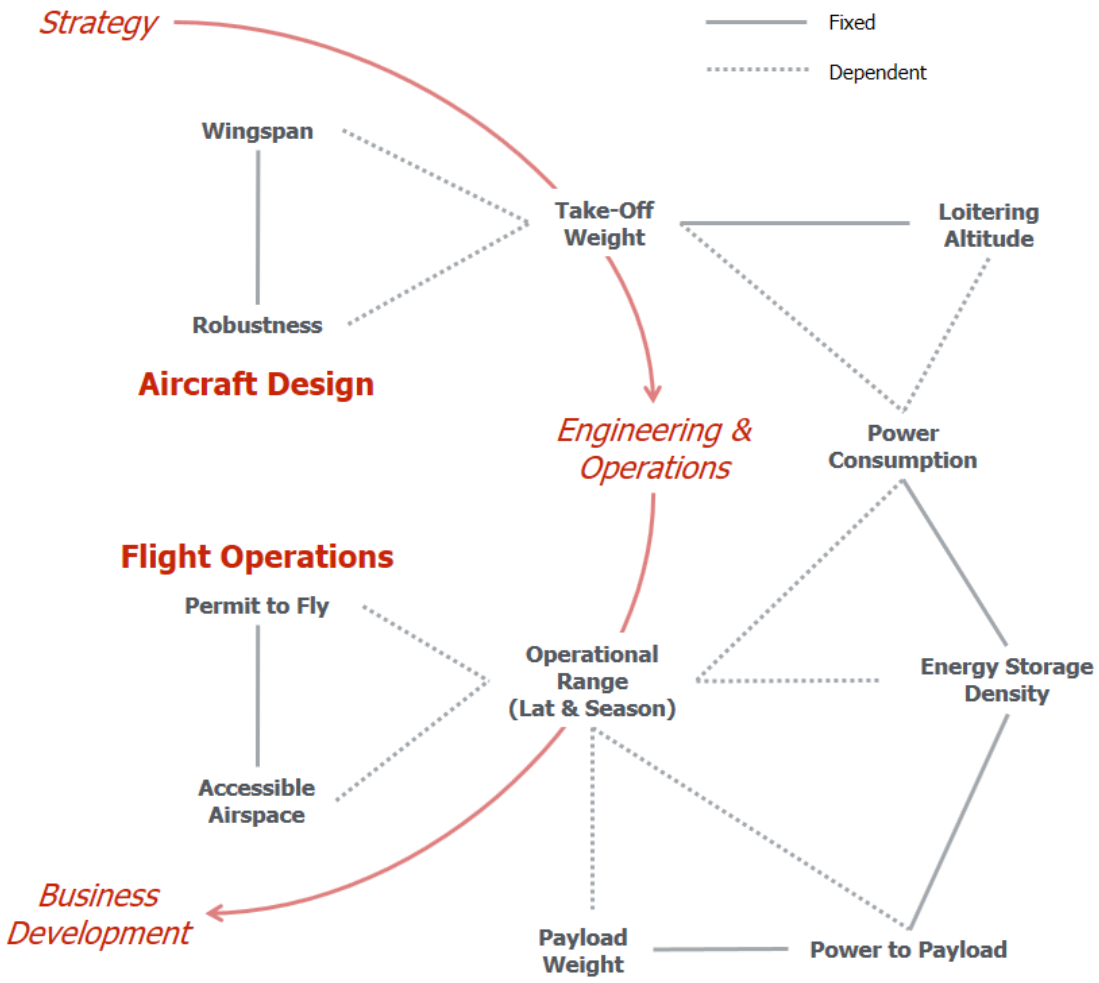
Pseudo-Satellite & Near Space Challenges

Technological Challenges

1) High altitude flying

2) “Dronification”

3) Perpetual Flight



Credit: OpenStratosphere

Regulatory Challenges

- A new type of solar-powered unmanned aircraft
- New concepts of operations (6-month Flight Plans)
- National Permits to Fly (initially)
- Authorisation to fly in Near Space (new Airspace Class?)
- Licenses to operate services from Near Space
- Aircraft systems and operator Certification
- International and national regulatory framework

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of the
Environment, Transport, Energy and Communications DETEC

Federal Office of Civil Aviation FOCA
Safety Division - Aircraft

Application for a Permit to Fly - *FOCA Form 21*
To be used for "Non EASA Aircraft" (Annex II) only

EASA
European Aviation Safety Agency

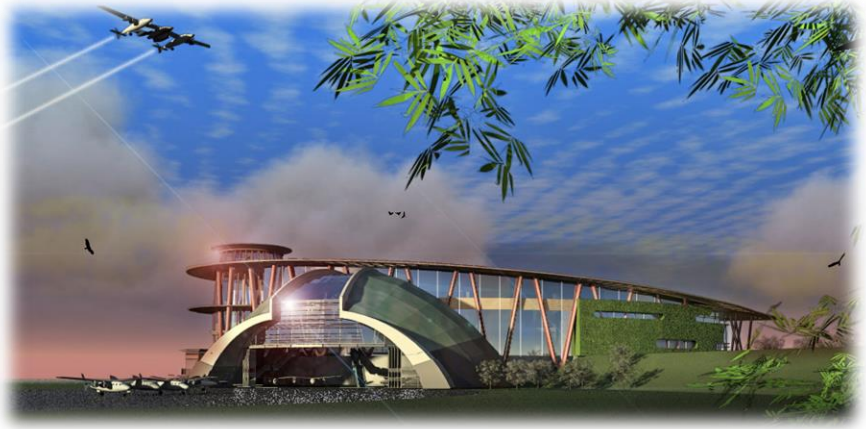
ICAO • OACI • ИКАО
国际民航组织 • منظمة الطيران المدني الدولي

Global UTM Association

JARUS
Joint Authorities for Rulemaking on Unmanned Systems

Market Challenges

- Who needs regional (seasonal) “satellite-like” services?
- Who will develop specific payloads?
- What is the killer application?
- Near Space infrastructure?
- Enabler of new solutions?
- Strategic value?



Credit: Spaceport Malaysia

Credit: Gamaya

What Happens If GPS Fails?

Despite massive reliance on the system's clocks, there's still no longterm backup.

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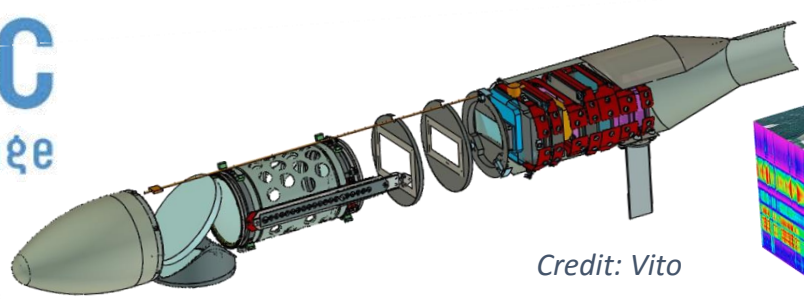
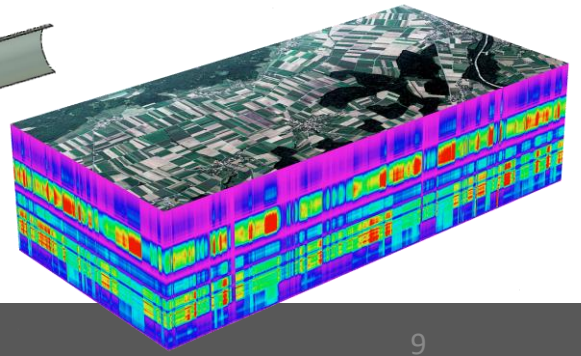
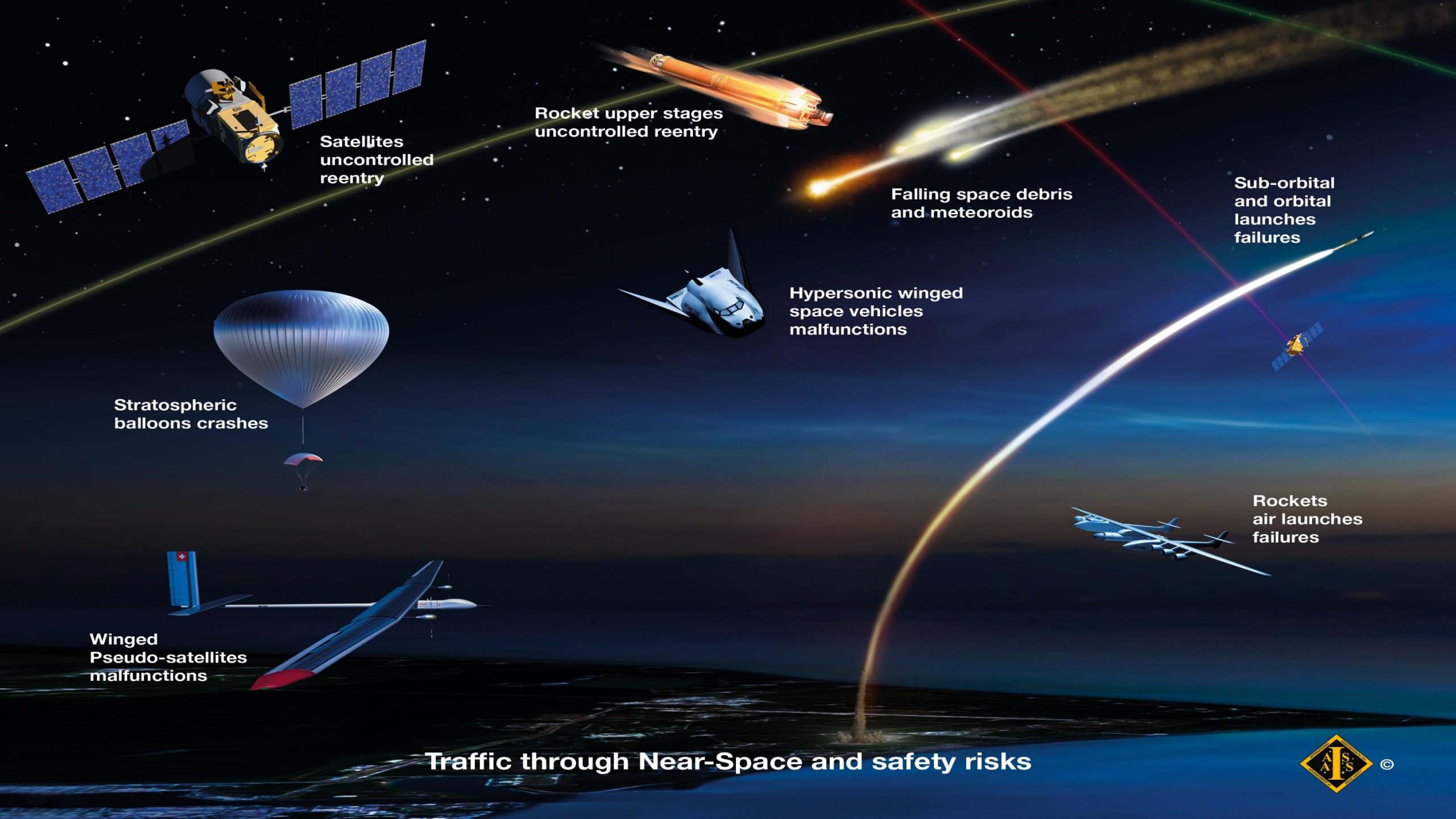
ipcc
climate change



Credit: Vito



New Opportunities = New Safety Challenges


Satellites
uncontrolled
reentry
Rocket upper stages
uncontrolled reentry
Falling space debris
and meteoroids
Sub-orbital
and orbital
launches
failures
Hypersonic winged
space vehicles
malfunctions
Stratospheric
balloons crashes
Rockets
air launches
failures
Winged
Pseudo-satellites
malfunctions
Traffic through Near-Space and safety risks
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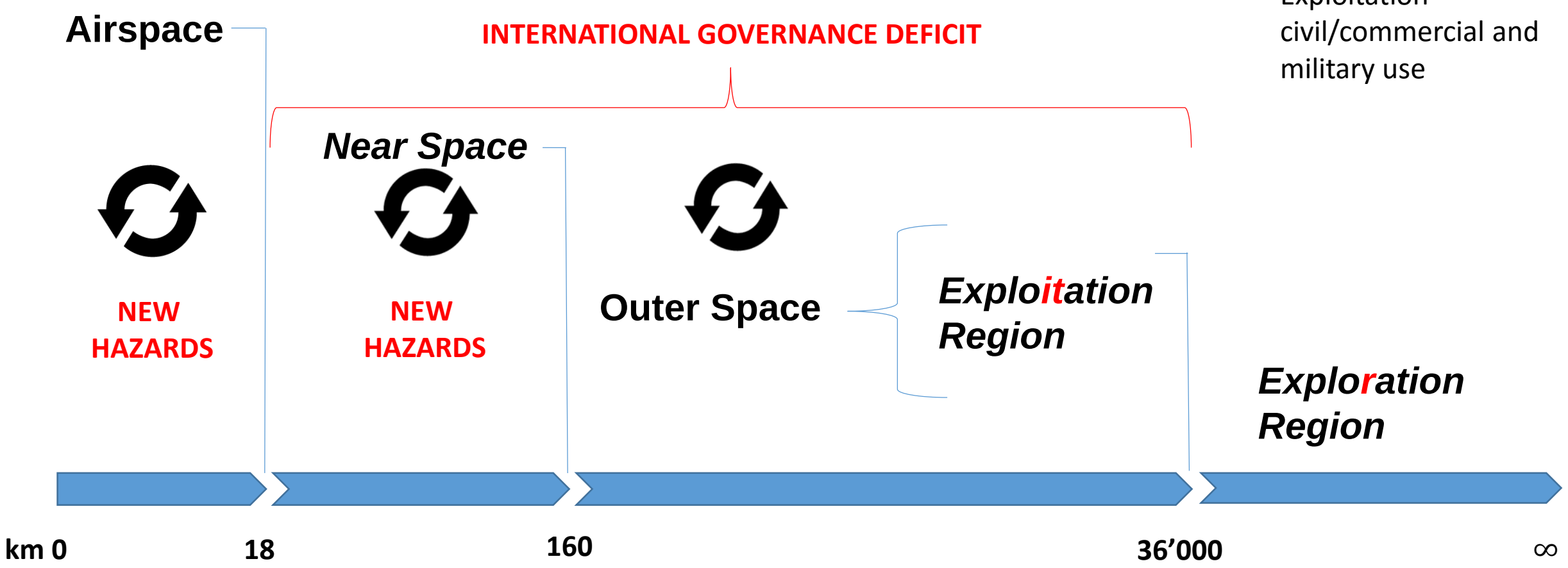
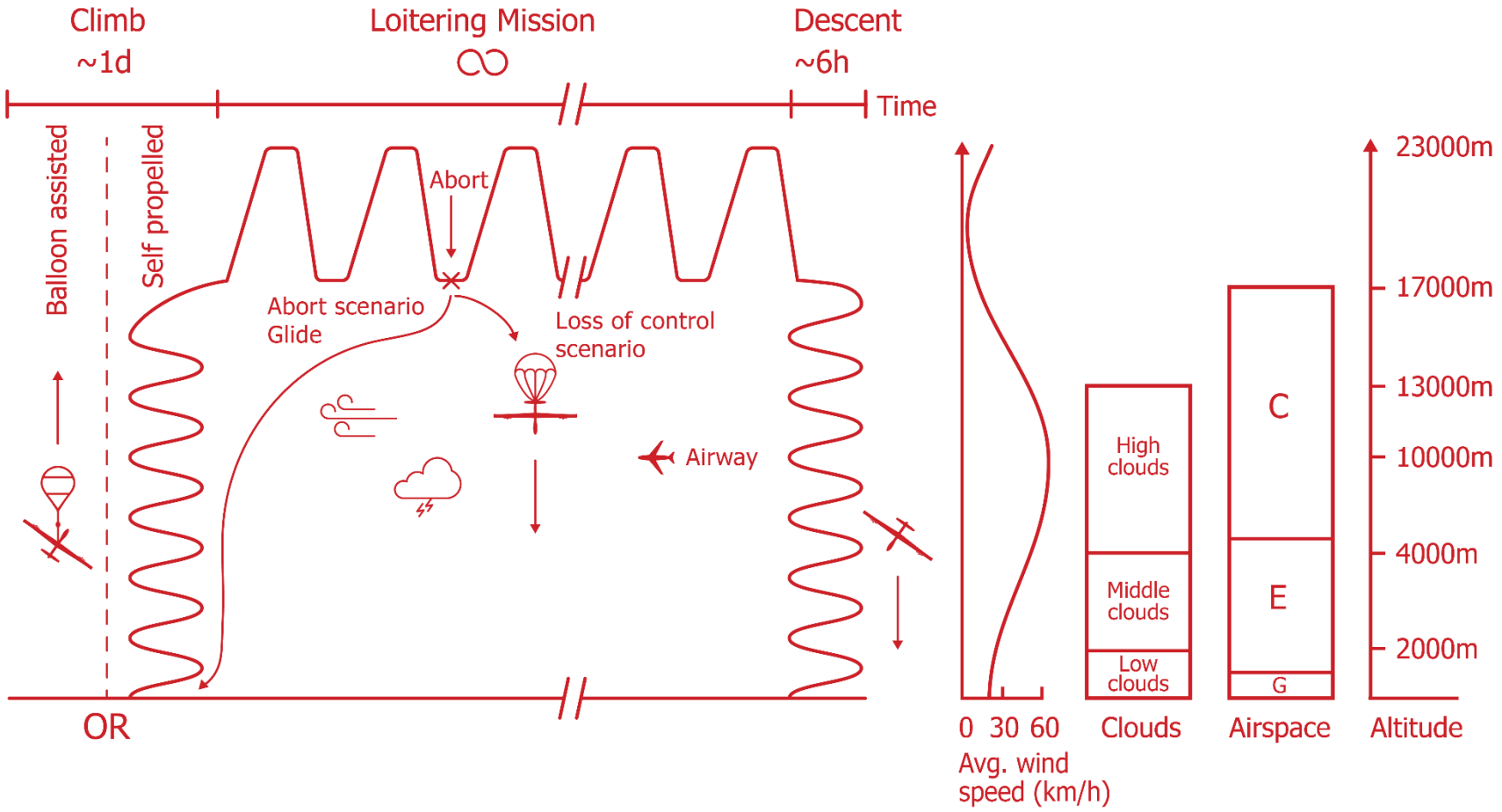
Traffic Above Earth



Pseudo-Satellite Safety Challenges

- Critical transit to/from Near Space
- Missions lasting several months (inspection?)
- Unmanned in uncontrolled airspace



Credit: OpenStratosphere

Conclusions

Why you should care

- ✓ A new disruptive industry ideal for developing countries
- ✓ Will impact all existing aerospace stakeholders
- ✓ Risks need to be understood and mitigated
- ✓ New pure play companies will emerge
- ✓ Most nations will be operating a domestic fleet of Pseudo-Satellites within ten years
- ✓ Creation of local employment and new jobs
- ✓ Driver of economic growth, increased security and environmental benefits

Exploring the Business of Near Space

EUROPEAN NEAR SPACE INDUSTRY DAY

3RD MAY 2017

IATA Conference Center

Geneva Airport, Switzerland

Near Space, above commercial airlines and below satellites, holds many promises but is uncharted airspace!

How, and by whom will this natural resource be used?

How should its access and services be regulated?

What are the new risks that come with disruptive innovation?

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