Space Insurance Update

Contents:

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AXA XL Leadership in the Space Insurance Market

→ **Space insurance** is a **critical enabler** of **innovation** and **investment**

→ **The space industry** faces **rapid change**, **increasing failures**, and **new threats**

→ **AXA XL** promotes **actions** and **solutions** that enhance **safe** and **responsible** space activity

→ **AXA XL** is **committed** to **profitability** and **safety** in space

The Changing Space Industry and Environment

→ We've seen…

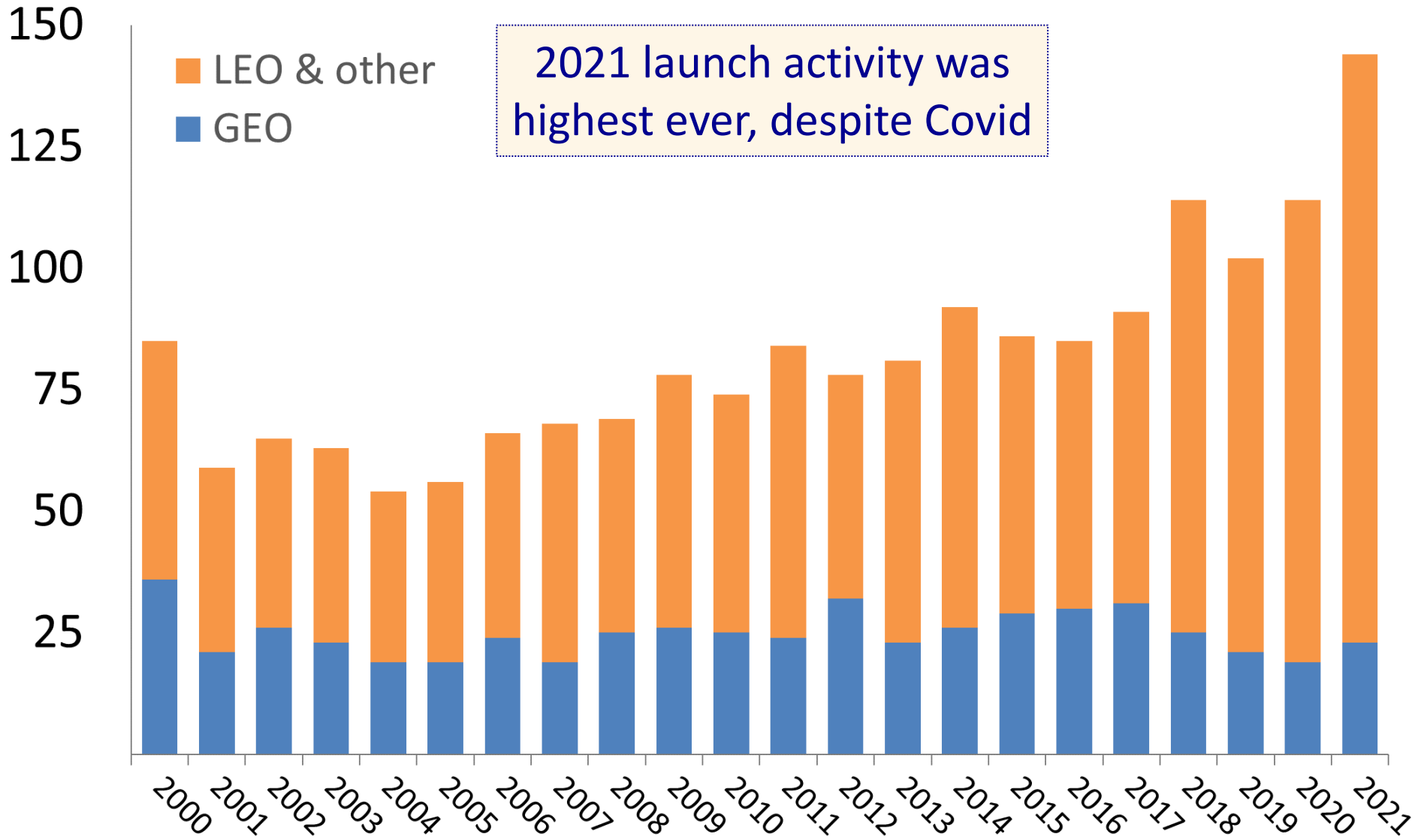
- ✓ New launch vehicles and satellite technologies flown and planned
- ✓ More constellations of small satellites deployed and proposed
- ✓ GEO satellite orders increasing with coverage expansion, replenishments, and C-band clearing
- ✓ Rapidly increasing population of satellites and debris on orbit
- ✓ Improved space situational awareness and space traffic management capabilities

→ …which results in more…

- ✓ Launch failures – new launch vehicles fail more often than mature vehicles
- ✓ Satellite failures – small satellites built with shorter schedules, less testing, less redundancy
- ✓ Supply chain stress – huge demand for electronic parts and globalization of space economy
- ✓ Collision risk – urgent need for accurate and timely object tracking and conjunction warnings

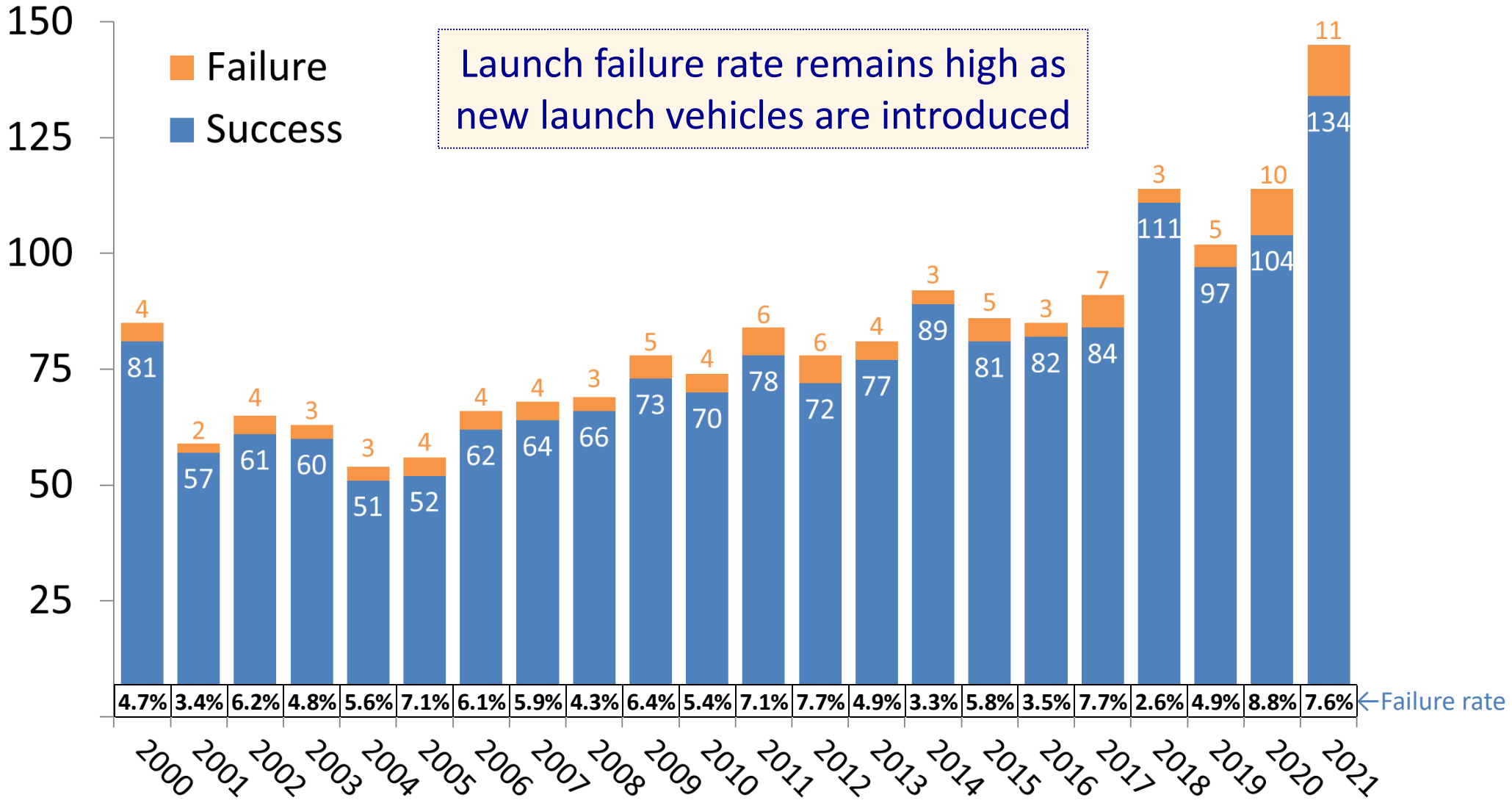
Launches to Orbit

GEO vs. LEO



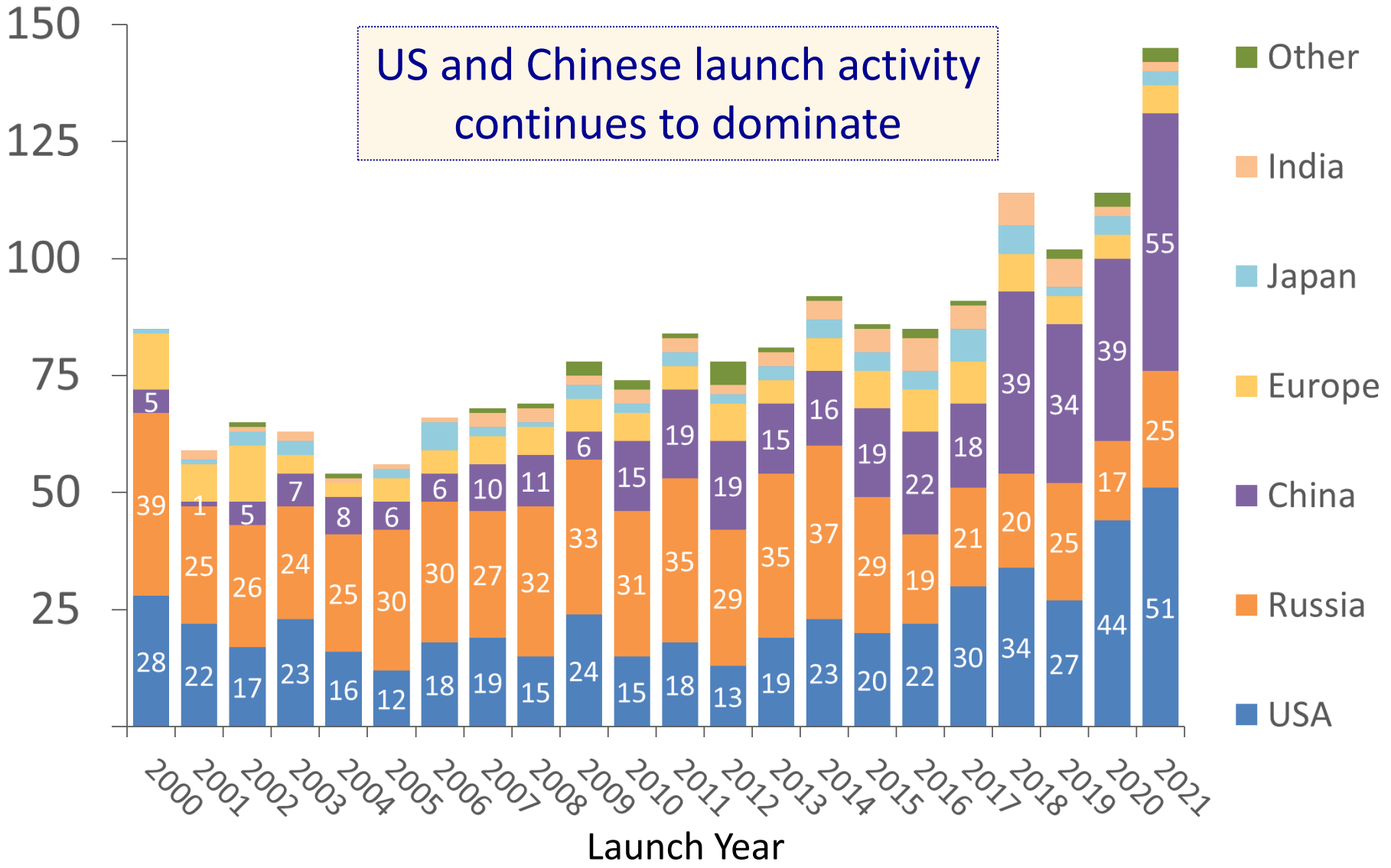
Launches to Orbit

Successes vs. failures



Launches to Orbit

Launch capture by country/region



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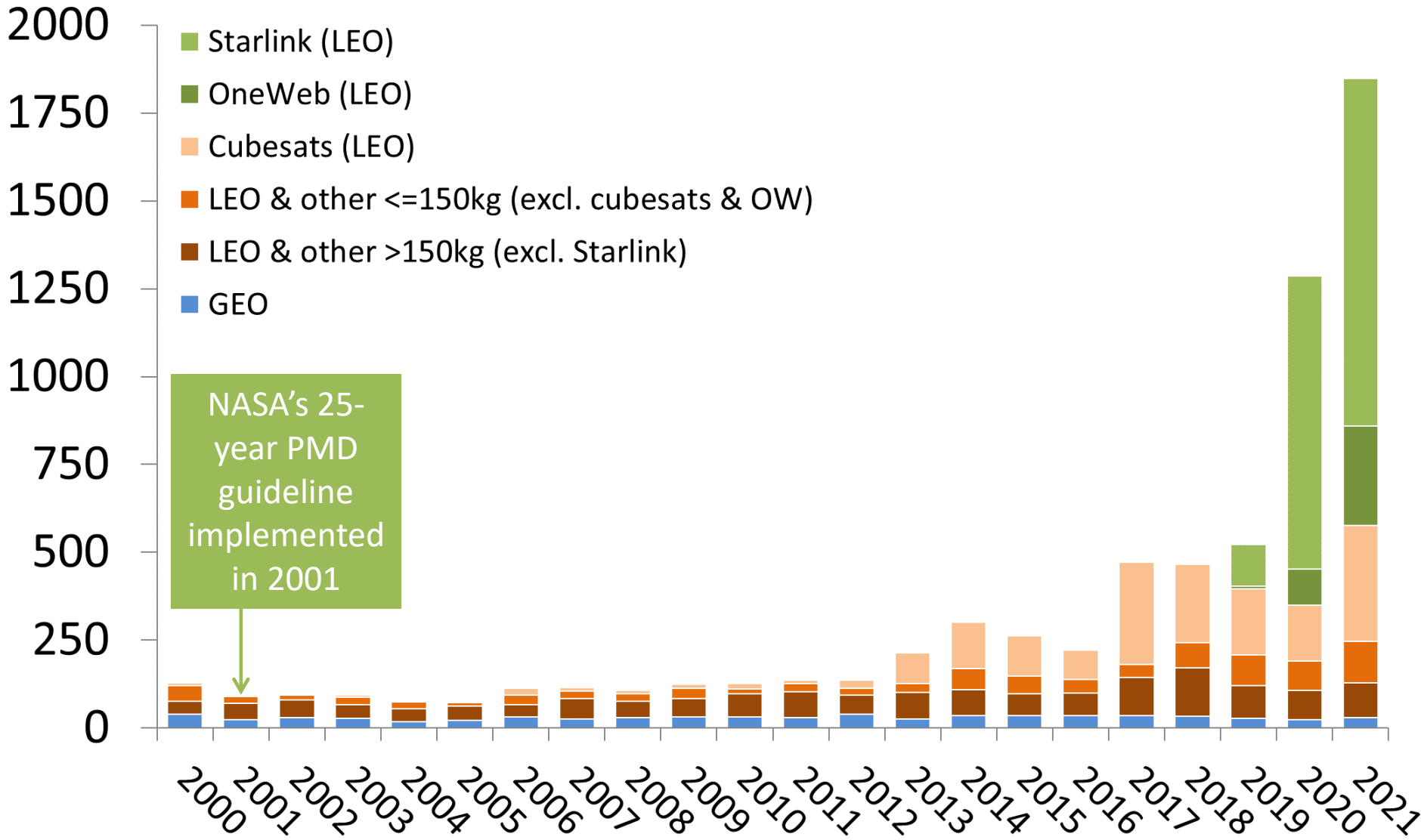
Satellites Launched by Year

By orbit and size, since 2000



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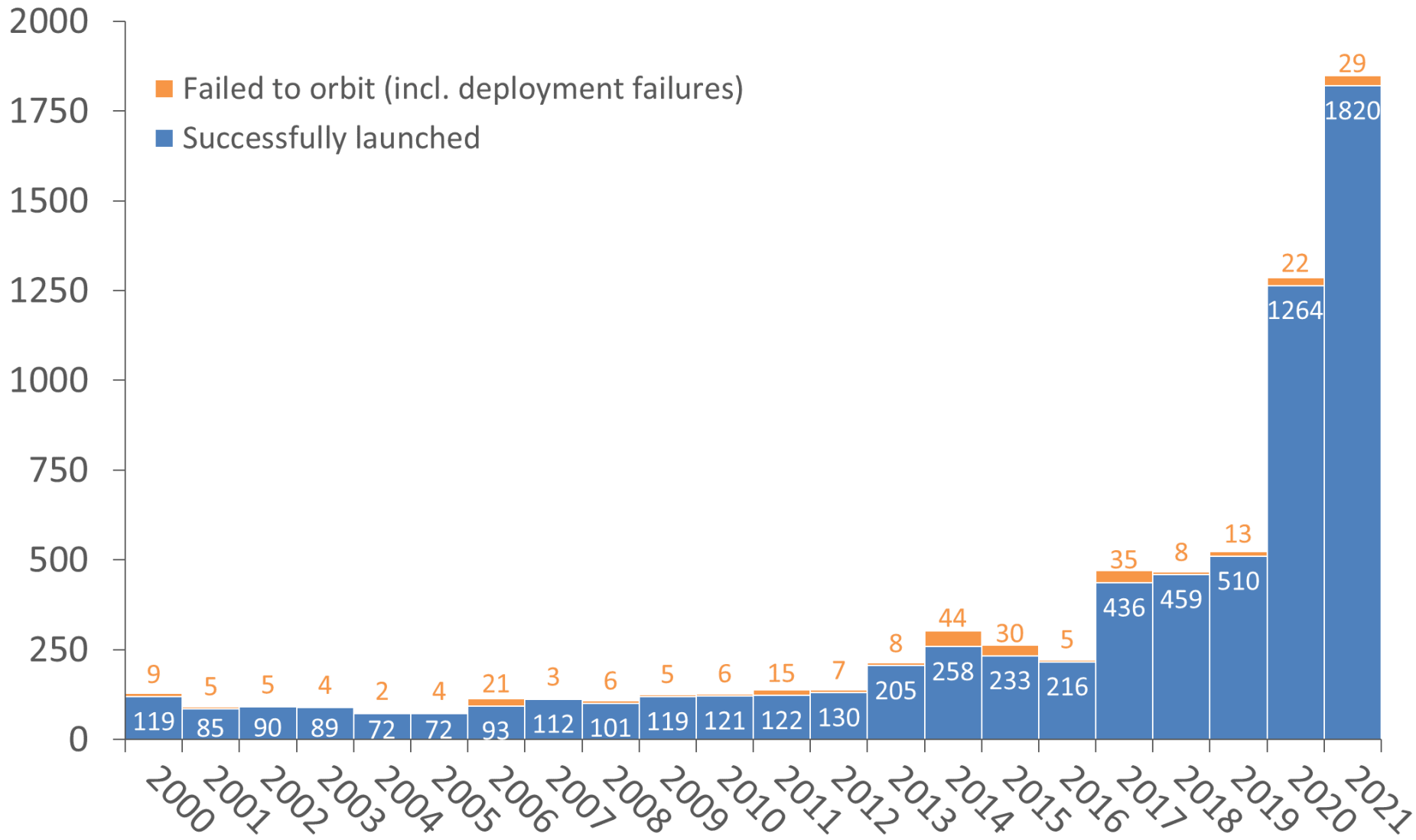
Satellites Launched by Year

Successful vs. failure



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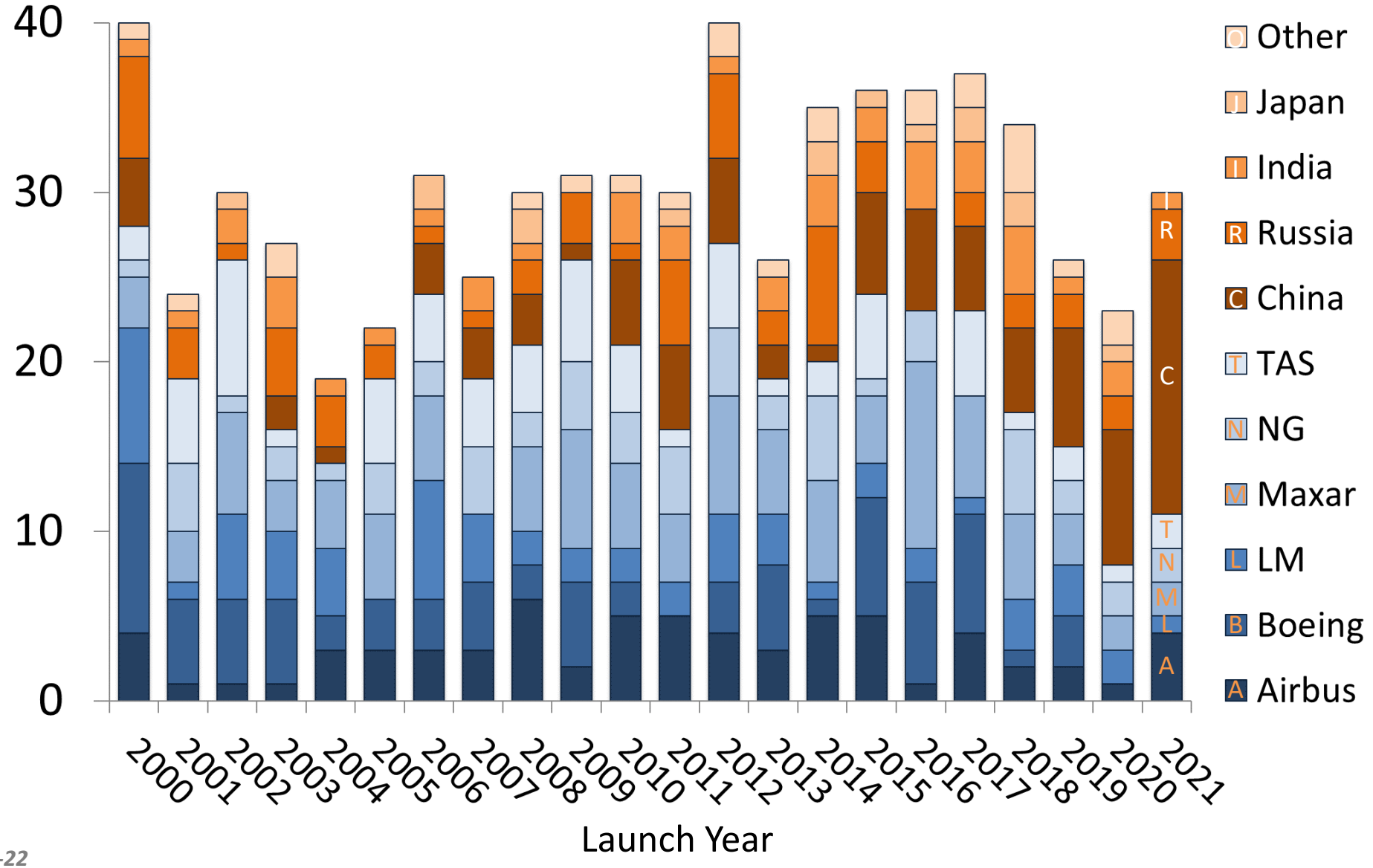
GEO Satellites Launched

Market share, by manufacturer/region



China has driven growth in non-Western GEO satellites

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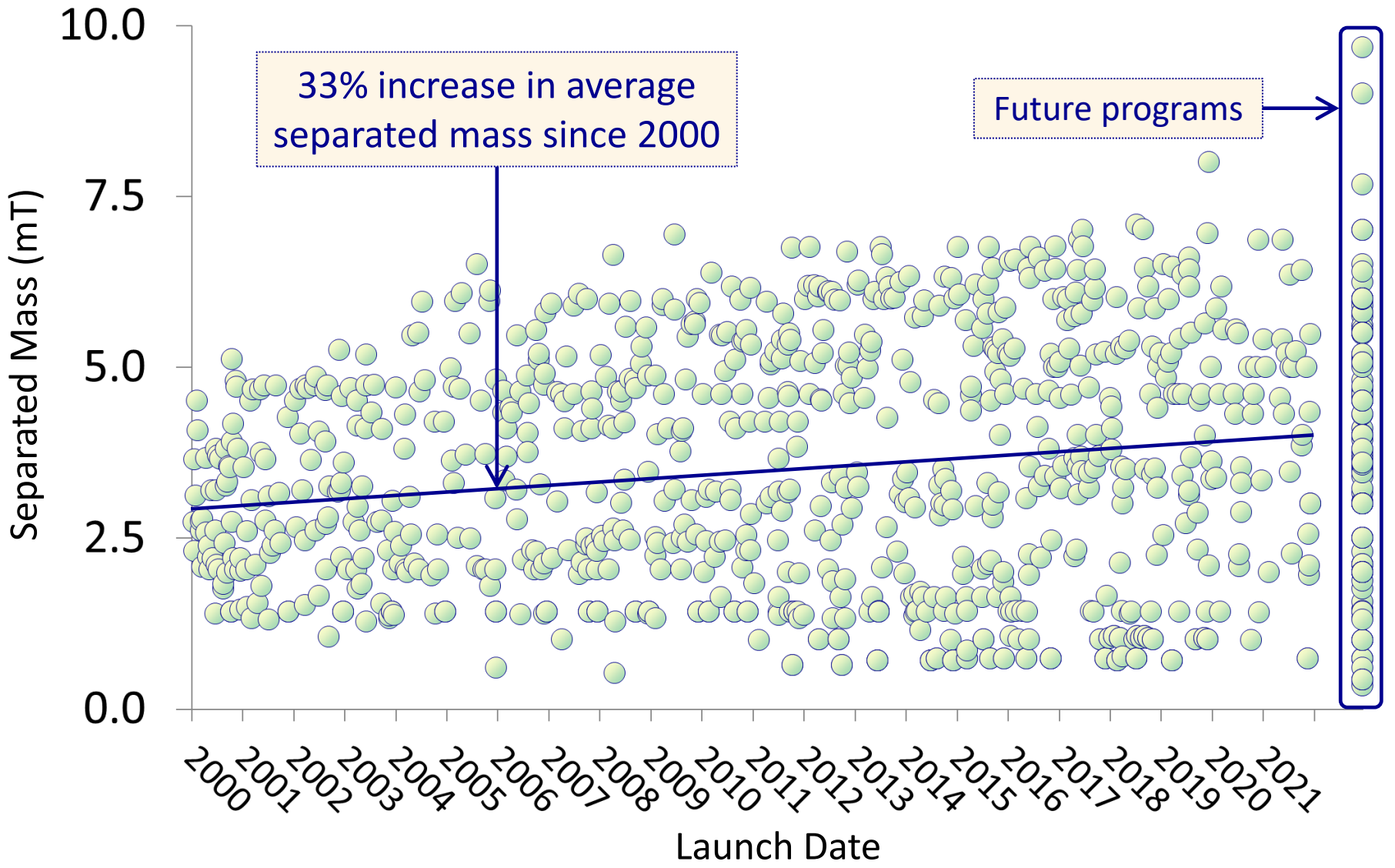
Separated Mass vs. Launch Date

GEO satellites launched since 2000



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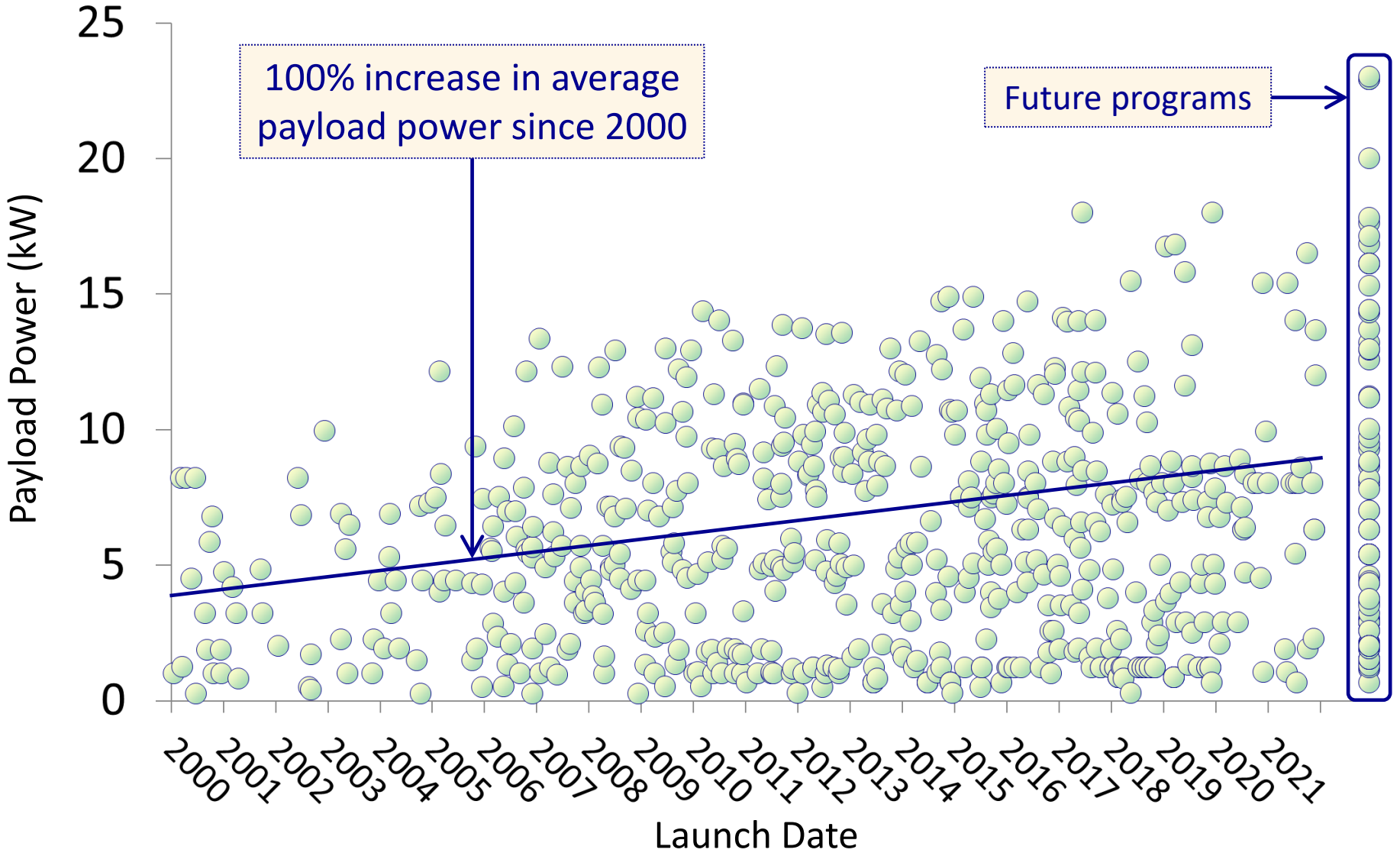
Payload Power vs. Launch Date

GEO satellites launched since 2000



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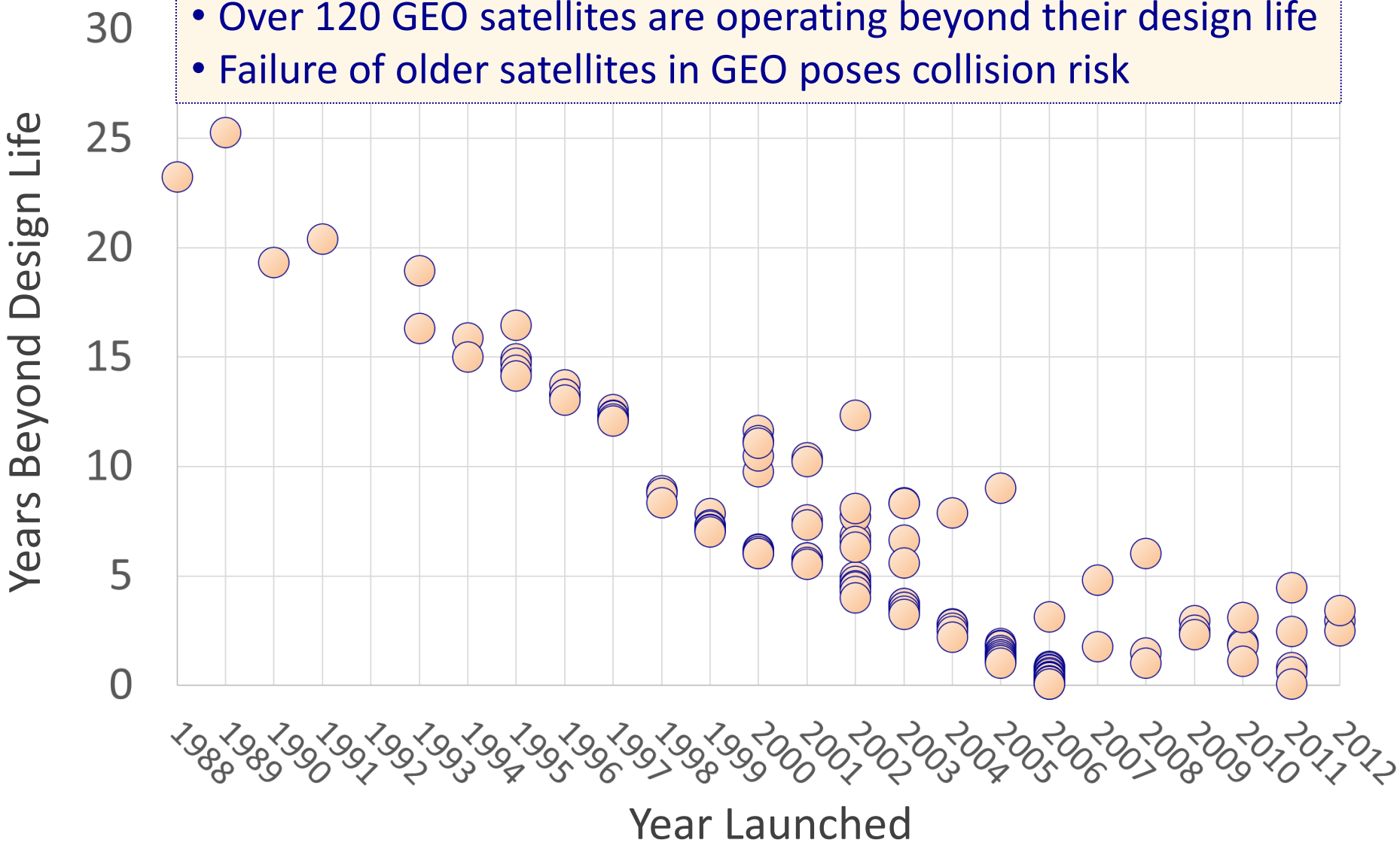
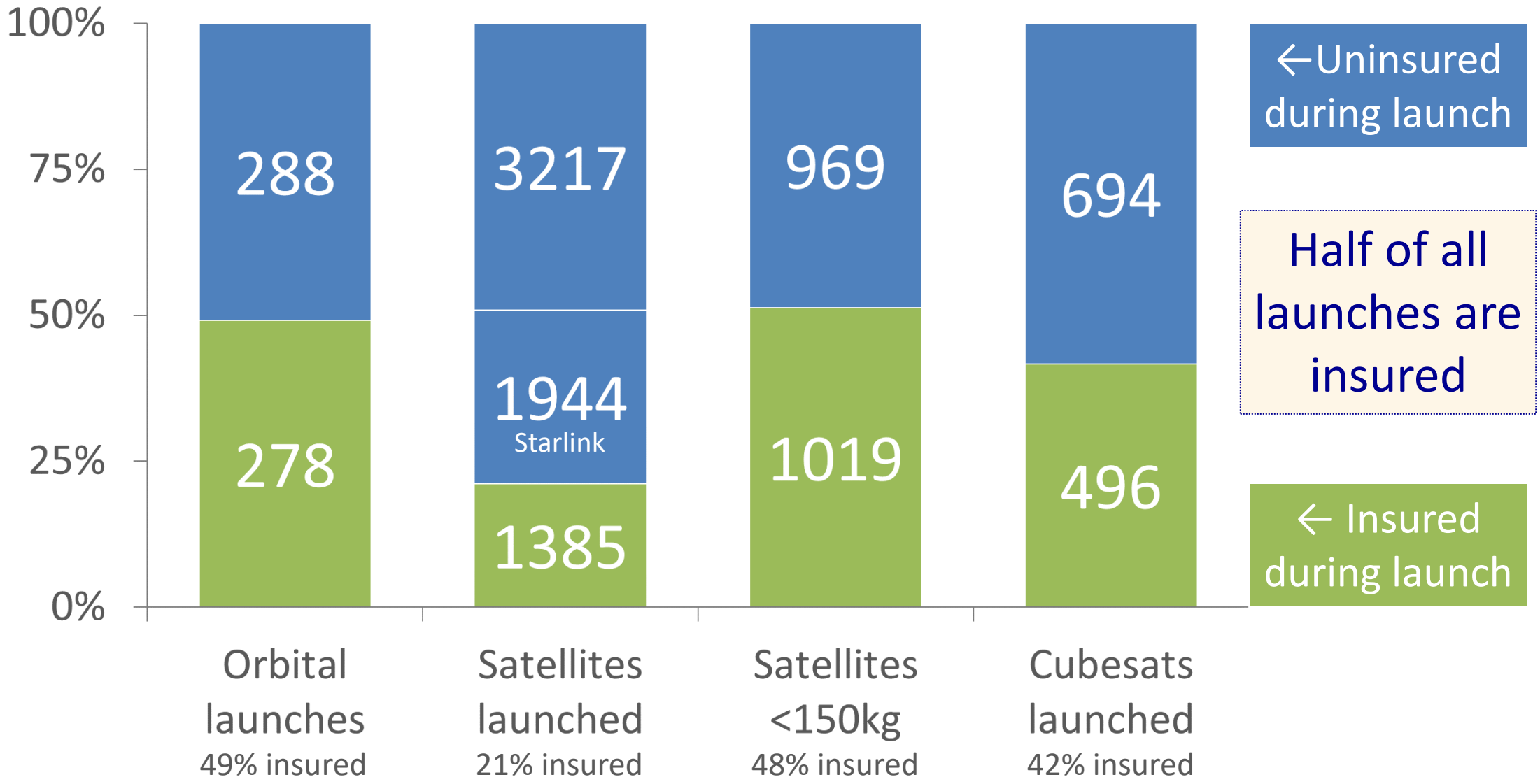
GEO Satellites Operating Beyond Design Life

- Over 120 GEO satellites are operating beyond their design life
- Failure of older satellites in GEO poses collision risk



Launches and Satellites, 2017-2021

Market insured vs. uninsured during launch



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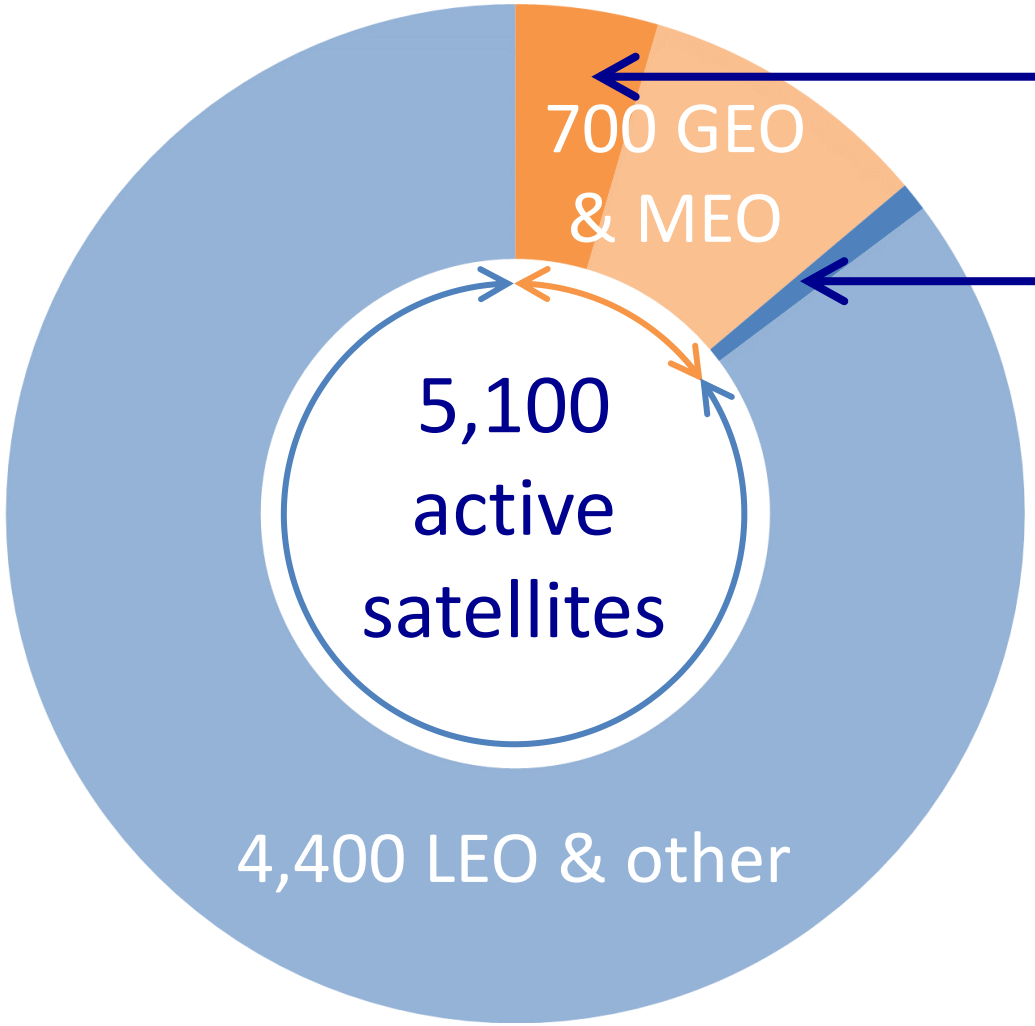
Active Satellites In Orbit

Insured vs uninsured



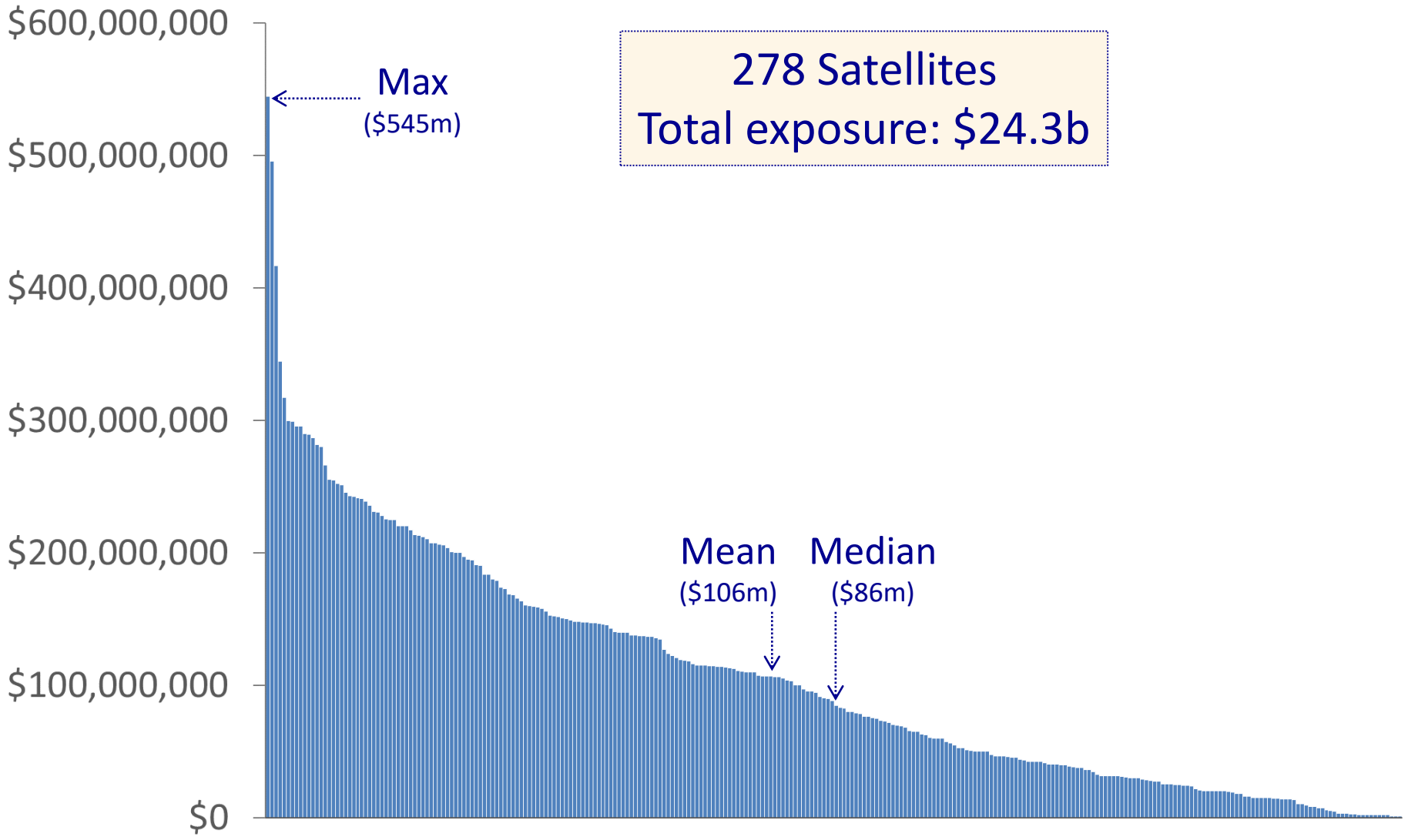
231 insured satellites in GEO & MEO

47 insured satellites in LEO

Total insurance market exposure of 278 satellites in orbit is $24.3b

Market Exposures On Orbit

Satellites in orbit, by individual risk



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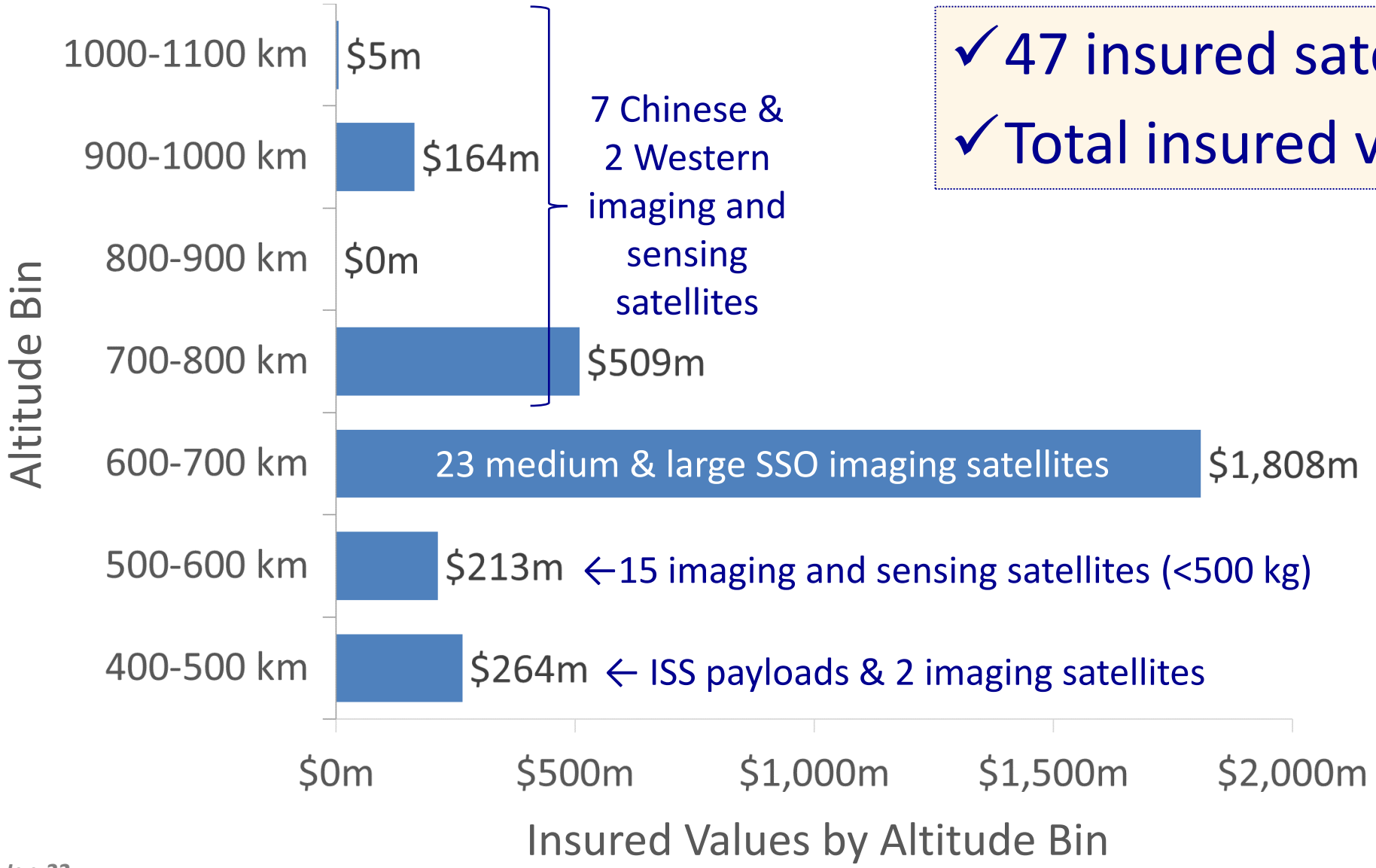
Insured Values In LEO

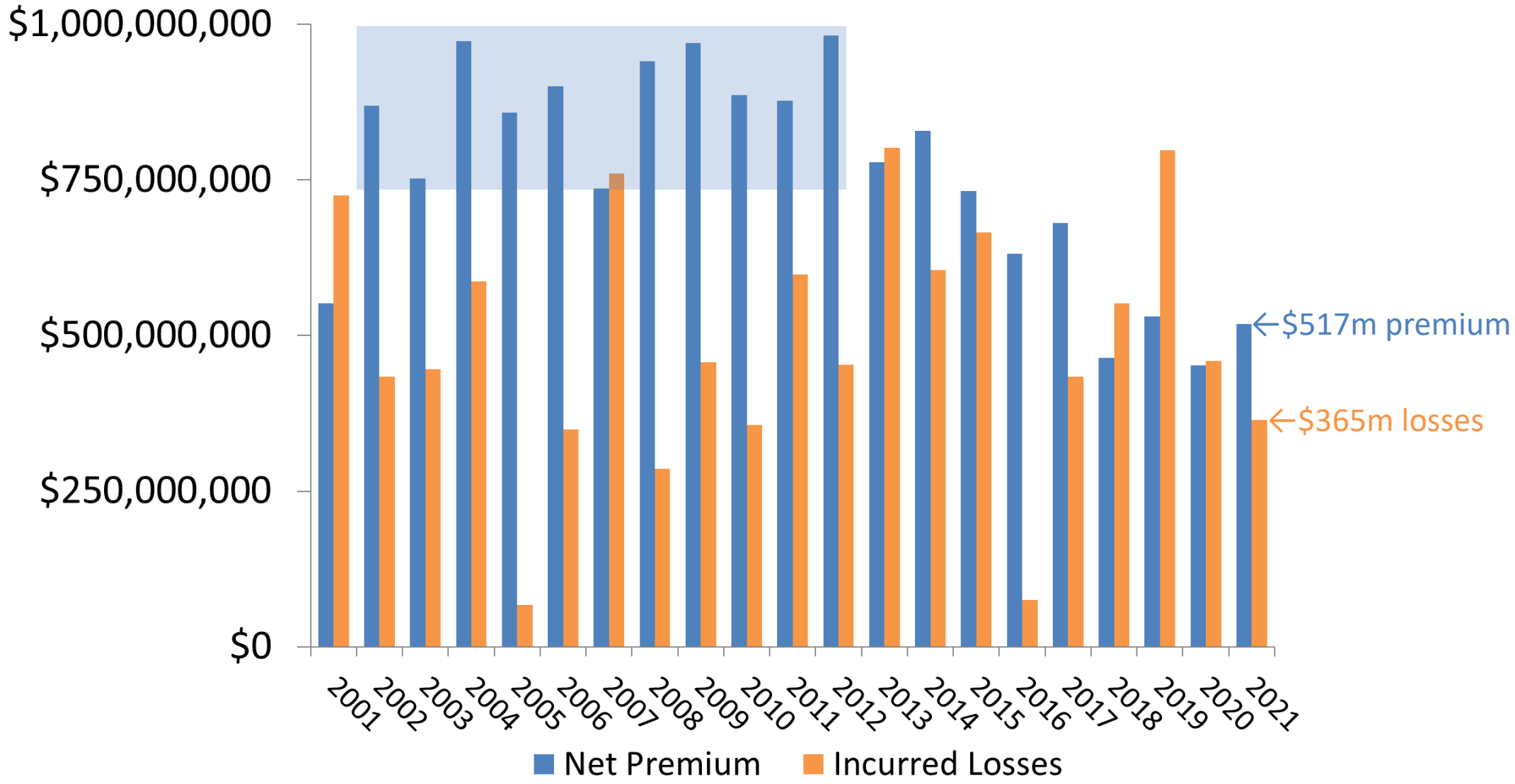
By 100 km altitude bin



- ✓47 insured satellites in LEO
- ✓Total insured value $2.8b

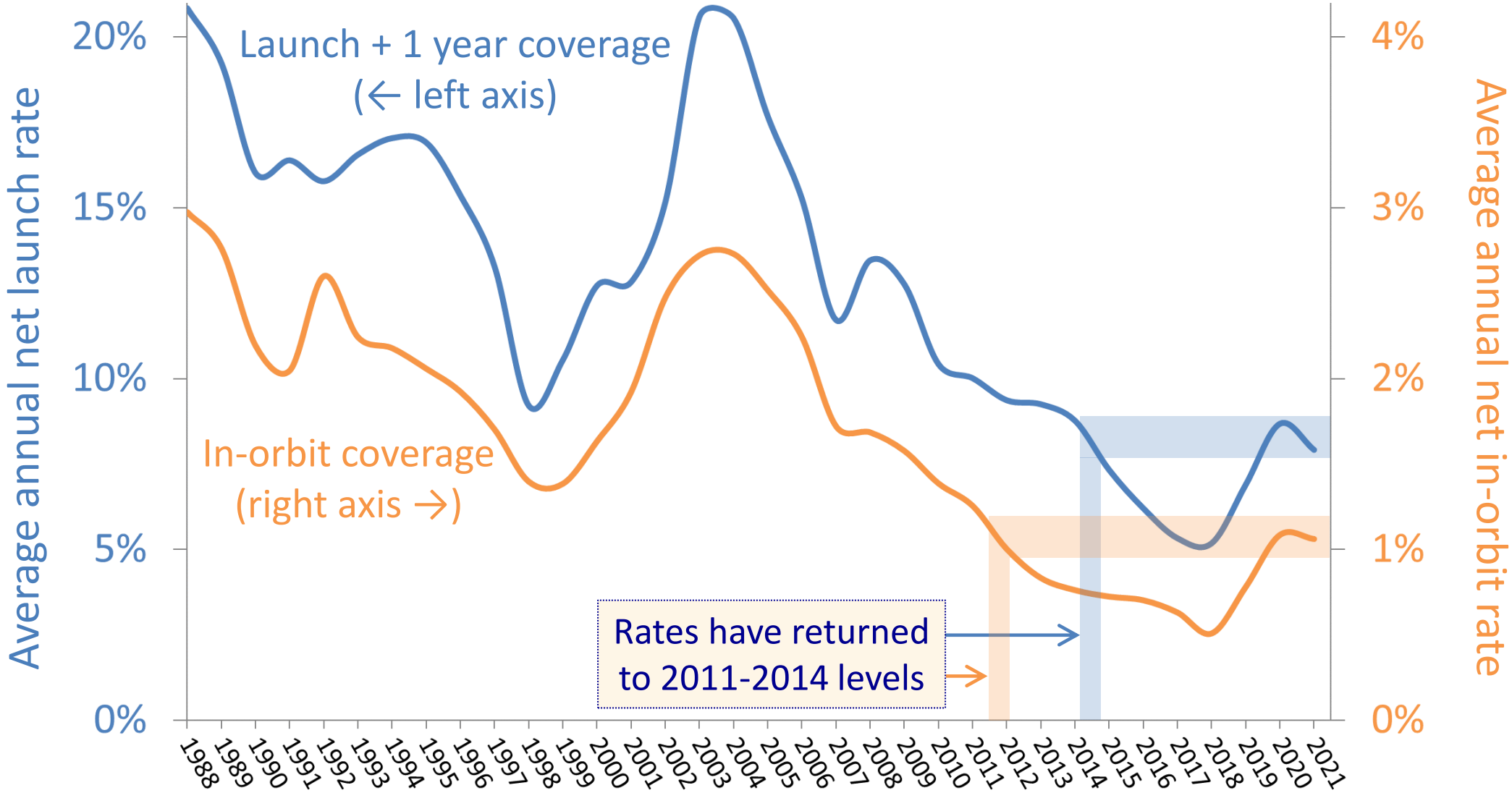
Market Annual Premium and Claims

Net premium on risks attaching, losses at date of loss



Market Rate Development

Annual average net rates by year placed



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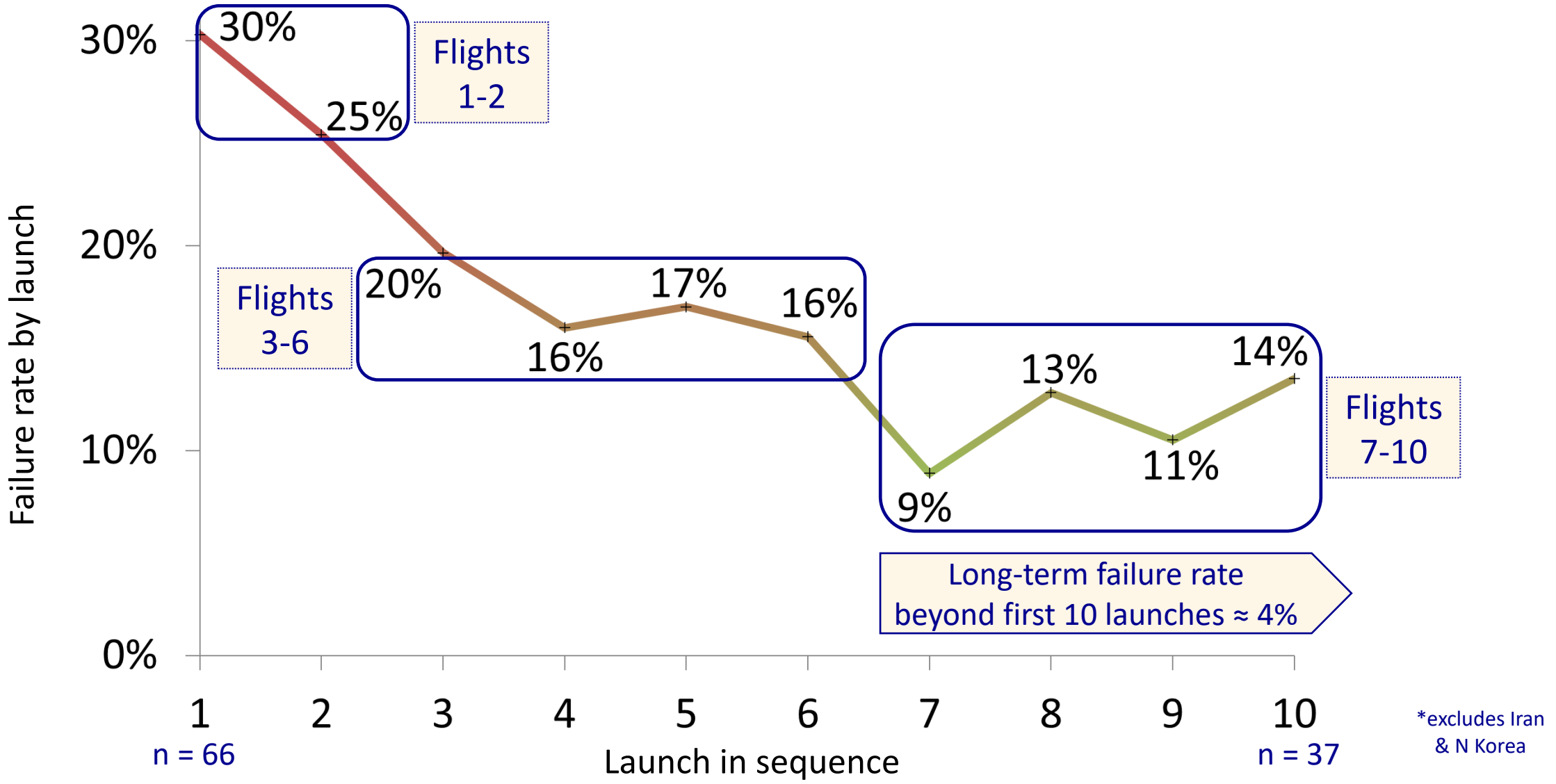
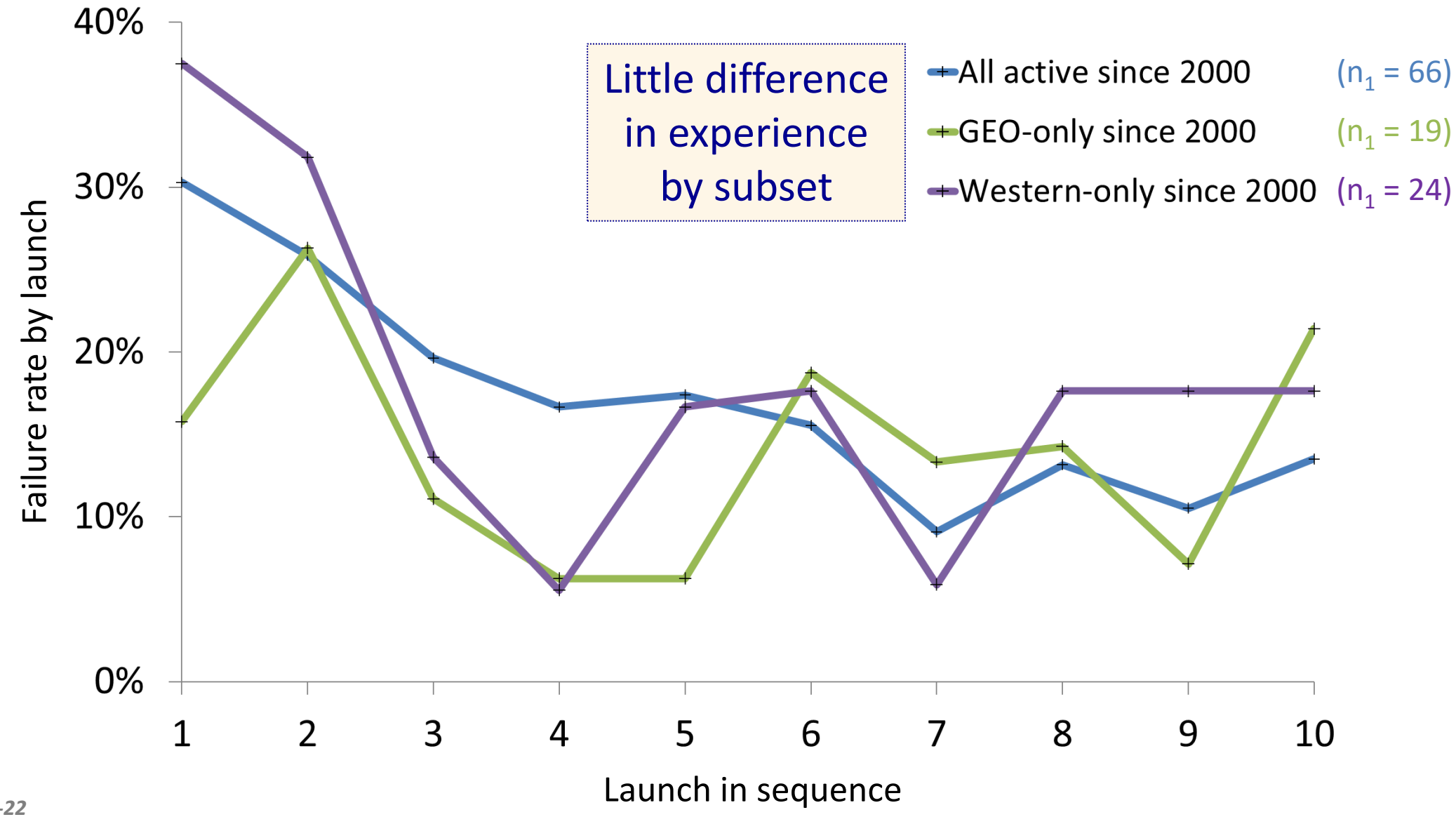
Launch Vehicle Failure Rates

Each launch, first 10 launches, all orbital launch vehicle families active since 2000*



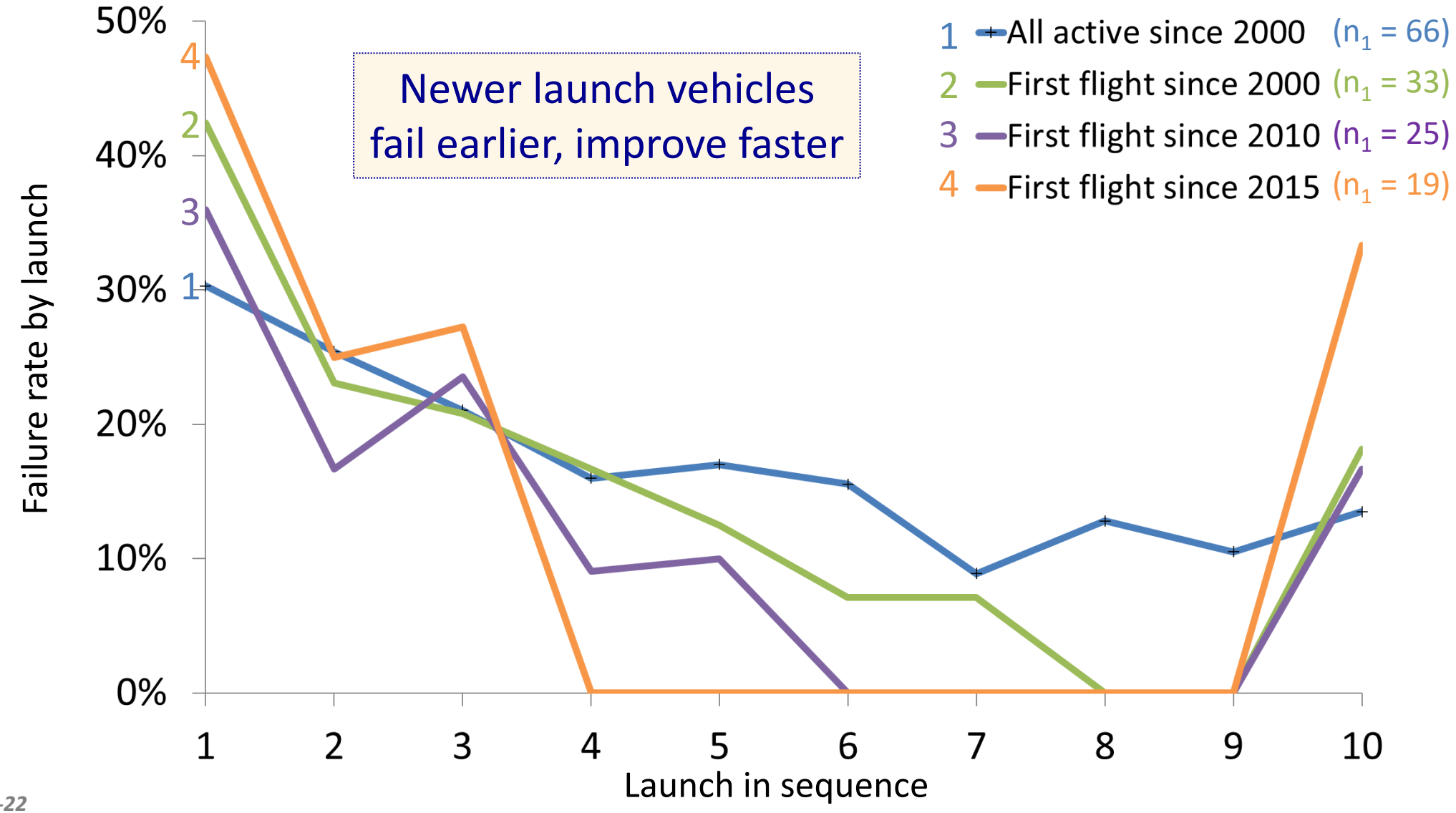
Launch Vehicle Failure Rate Comparison

Each launch, first 10 launches, by region



Launch Vehicle Failure Rate Comparison

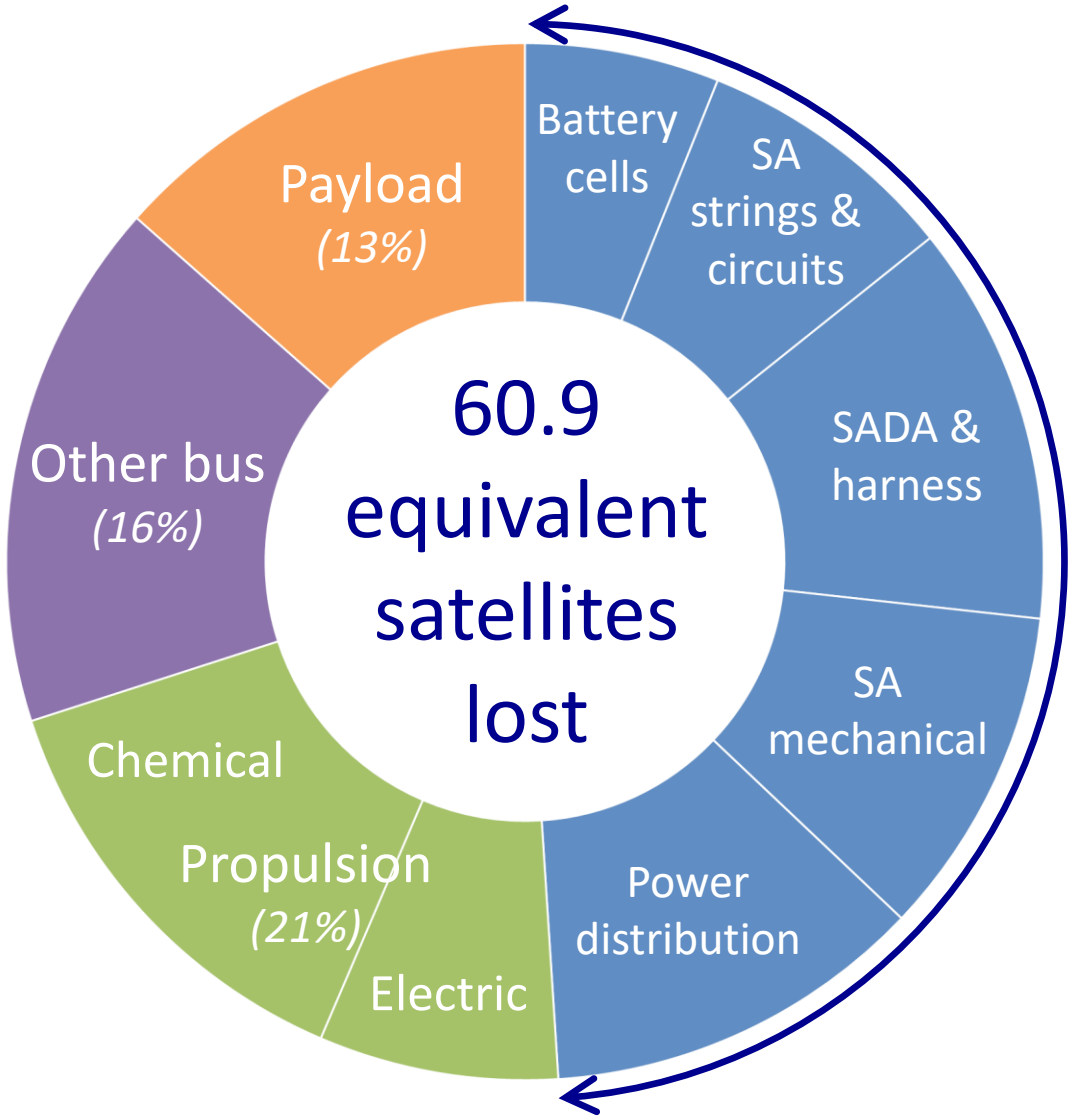
Each launch, first 10 launches, by first flight date



Causes of Losses by Subsystem

GEO satellites launched since 2000

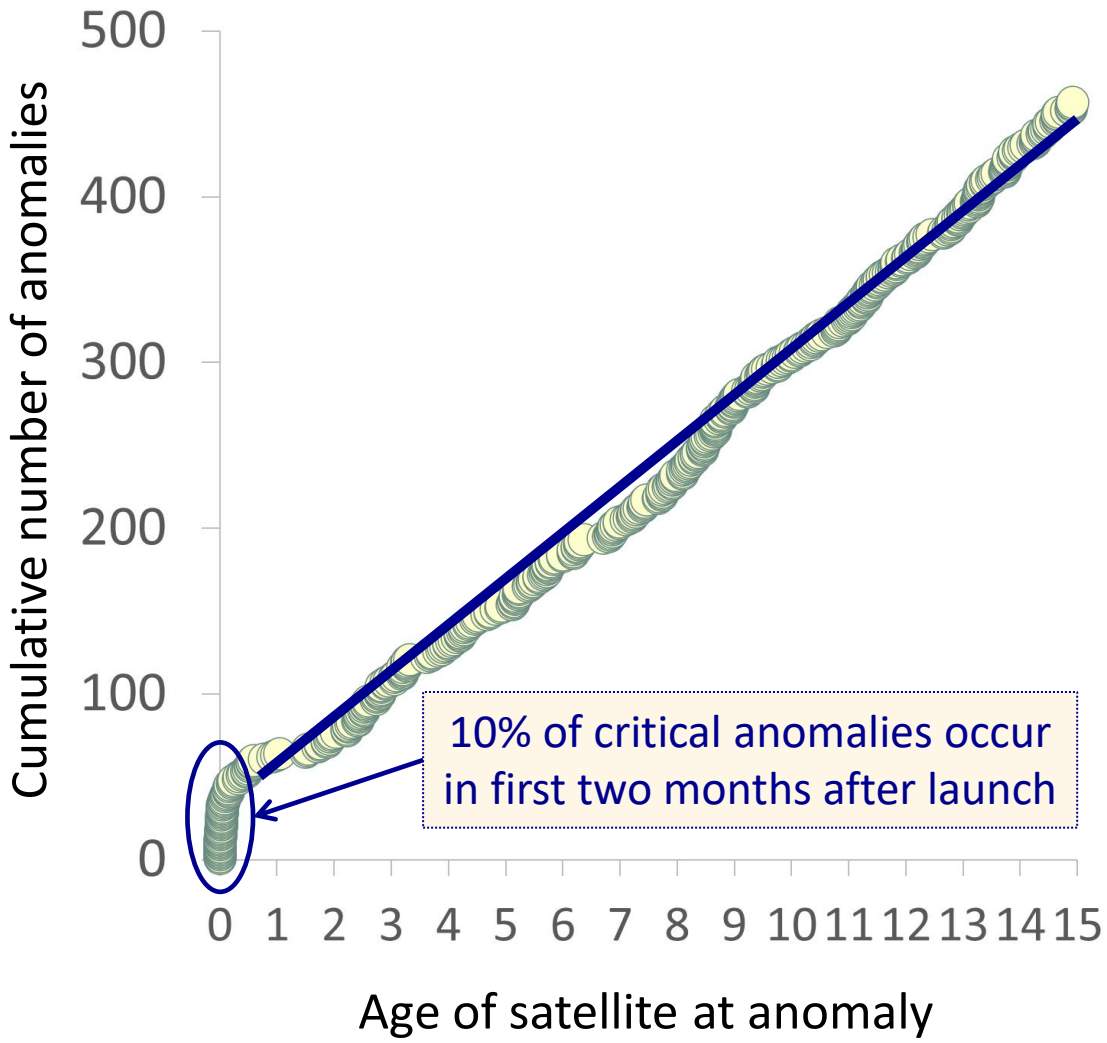
- 660+ satellites launched
- 3,100+ satellite-years of health data on 480+ satellites
- 5,300+ anomalies on 390+ satellites
- 480+ “critical anomalies” on 140+ satellites
- 1,200+ anomalies resulting in loss of redundancy

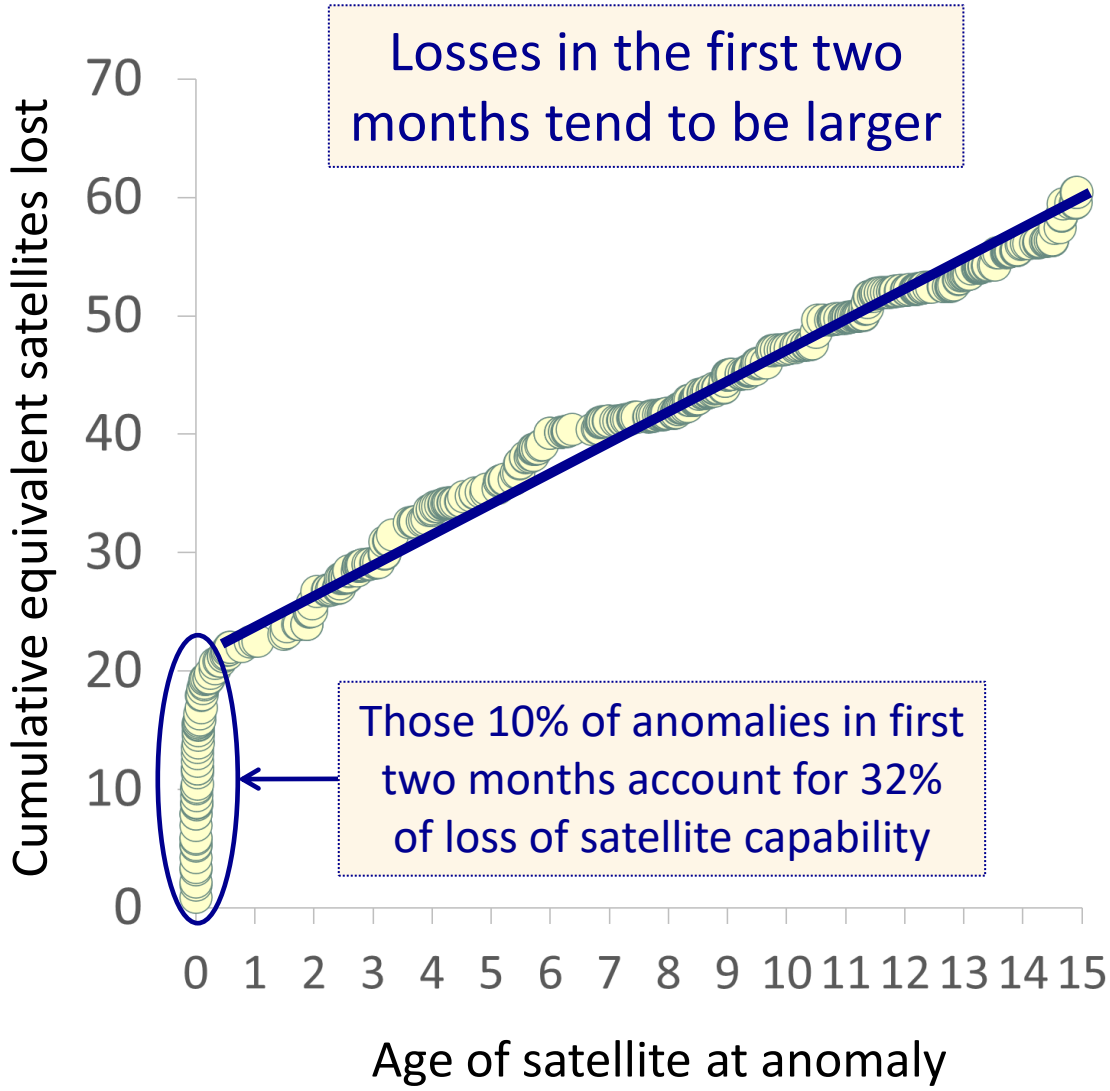


Electrical power subsystem anomalies account for ~50% of loss of capability

Satellite Anomalies and Losses vs. Age

GEO satellites launched since 2000





On-Orbit Servicing Opportunities

GEO satellites launched since 2000

80 GEO satellites launched since 2000 have suffered major anomalies that could have benefitted from on-orbit servicing		
Type of Servicing	Opportunities since 2000	Annualized opportunities
Re-orbit / De-orbit	29	1.3
Inspection / Repair	63	2.9
Life Extension	41	1.9

- ✓ 33 of these 80 (41%) had their major anomalies in the first two months after launch
- ✓ Some of these satellites would have benefitted from more than one type of servicing
- ✓ Many other satellites could have benefitted from life extension or end-of-life disposal

Collision Risk

→ Collision risk in LEO threatens at least $35b of assets

- ✓ Though this figure is likely well under-valued
- ✓ Only 8% of this value is insured
- ✓ Excludes ISS value and economic benefits of LEO activity

→ AXA XL continues to support kinetic space safety and monitoring and tracking of space objects

Space Safety and Responsible Space Activity

1. Space insurers are **concerned**
- Failures ↑, premium ↓ = market volatility
- New launch vehicles = higher risk of failure
- More small satellites = higher risk of failure
- Debris risk? No…*Collision Risk!*
- Some insurers have withdrawn from LEO

2. Insurers in general are **concerned**
- Pandemics and infectious diseases
- Climate change and extreme weather
- Cybersecurity
- Geopolitical instability

The **same rules** that apply in your **house** apply in **space**:
- *"Tell people where you are!"* … **prevent**
- *"Don't make a mess!"* … **mitigate**
- *"Clean up after yourself!"* … **remediate**

3. Adopt **best practices** for **space safety**
   - **Characterize** the **space environment**
   - **Tracking** devices for **SSA**
   - **Propulsion** for **collision avoidance**
   - **Post-mission disposal** within **1** to **5** years
   - **On-orbit servicing** for **inspection** and **ADR**

4. A significant **insurance loss** due to a **collision** in orbit will have an **immediate** and **chilling effect** on the **space insurance** market, and thus on the whole **space industry**

Responsible behavior is the baseline, not the aspiration

Thank you!

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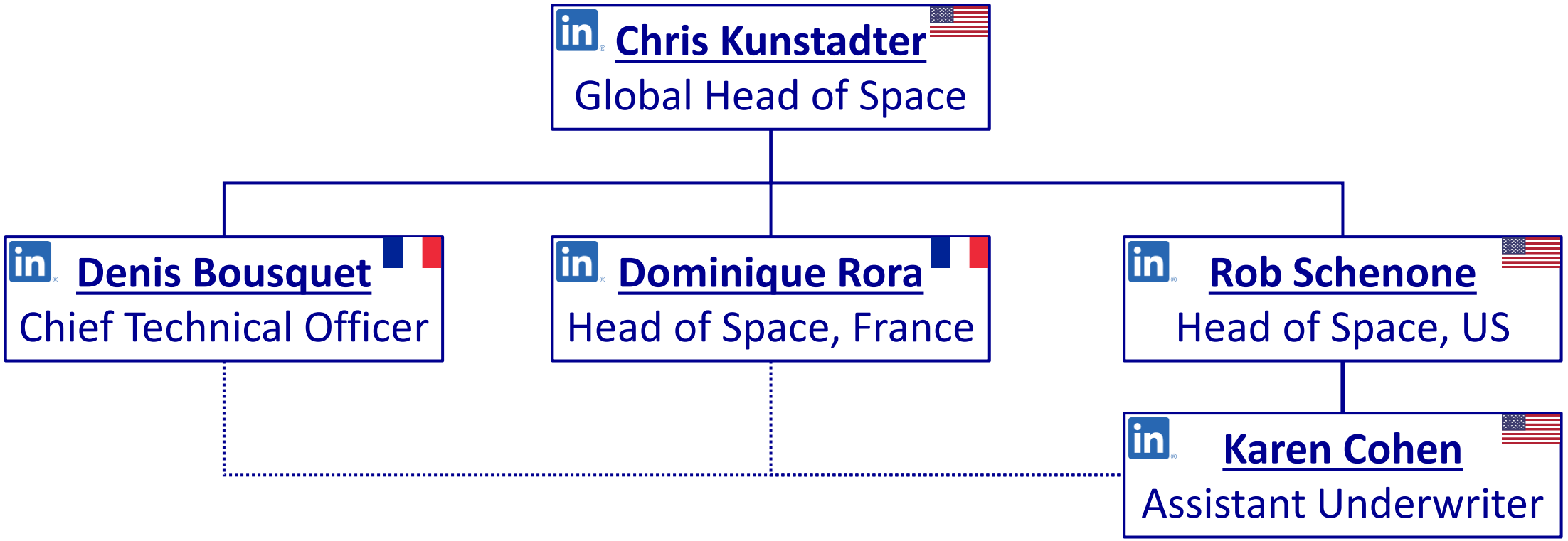
Backup Charts

Who We Are

→ At AXA XL…

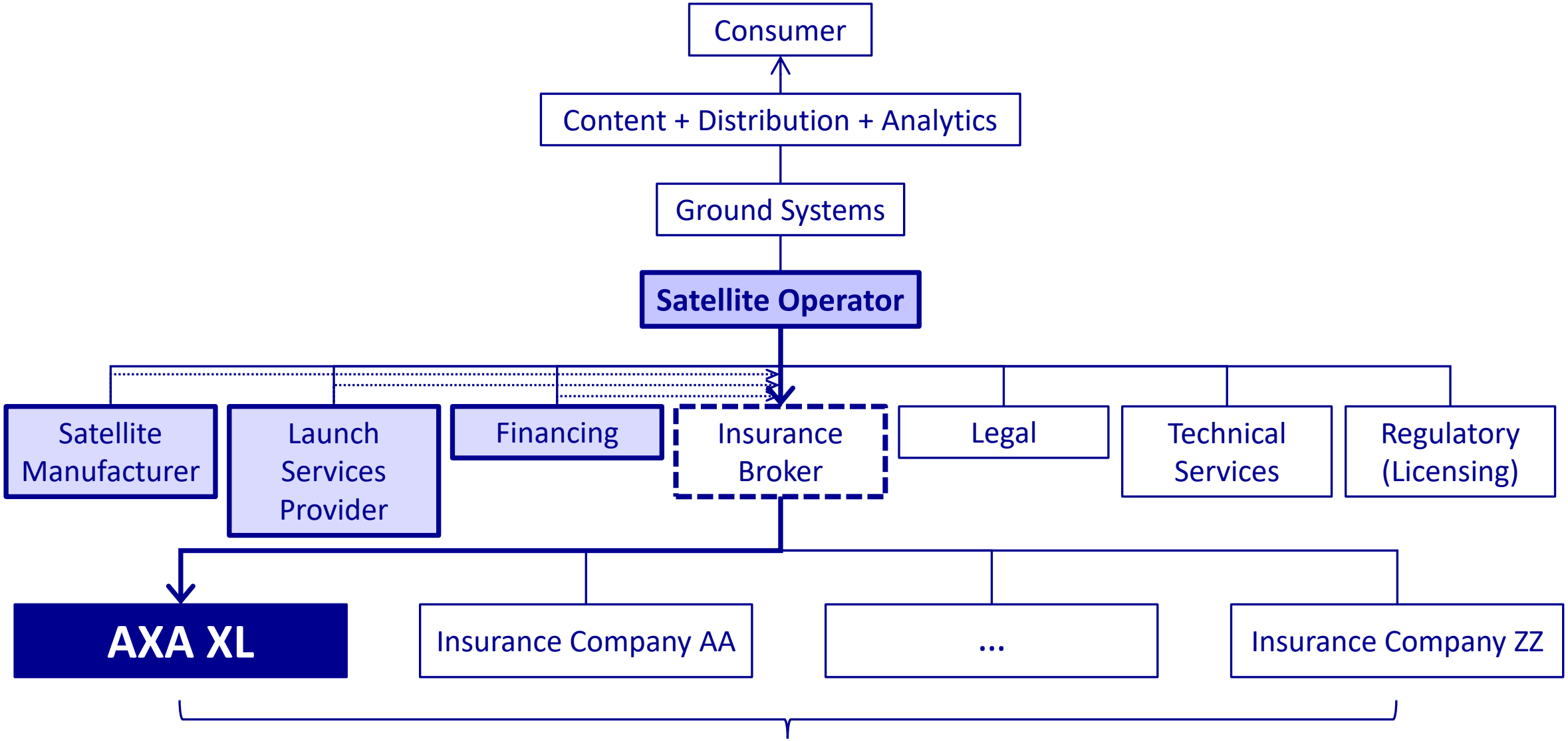
- ✓ We embrace risk
- ✓ We innovate to adapt to the changing space market
- ✓ We encourage responsible behavior in space
- ✓ We are the market leader in insurance solutions for entrepreneurial space
- ✓ We have the market's most respected and relied-upon databases, models, tools, and information access
- ✓ We are recognized for our expertise in policy wordings

AXA XL Space Team



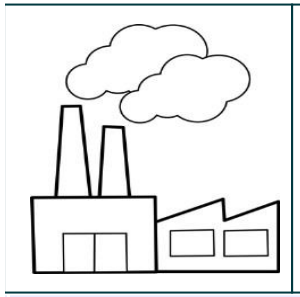
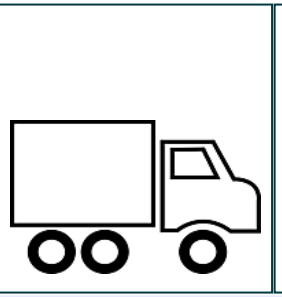
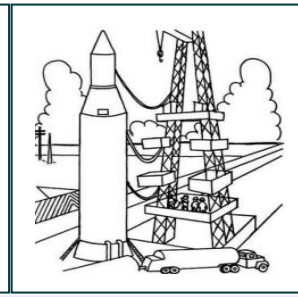
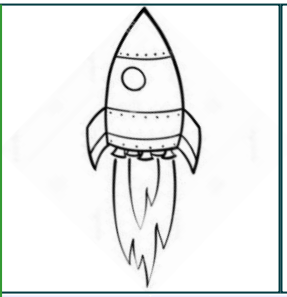
Click name to email
Click in for LinkedIn profiles

Satellite Value Chain



~30-35 direct space insurance companies worldwide

Space Insurance Coverages Offered by AXA XL

Legend:									
Asset									
Liability									
Phase →	**Pre-Launch**					**Launch and In-Orbit**			
Insured ↓	**Integration & Test**		**Transit to Launch Site**		**Launch Site Processing**	**Launch Vehicle Flight**	**Initial Operations**	**In-Orbit Operations**	**Re-Entry**
Satellite Owner / Operator	**Contingent Business Interruption**					**Launch + 1 year**		**In-Orbit**	**Re-Entry / Recovery**
						Launch Vehicle Flight Only	**Post-Separation**	**In-Orbit Liability**	**Re-Entry Liability**
Satellite User	**Business Interruption**					**Business Interruption**		**Business Interruption**	
Satellite Manufacturer	**Marine Cargo (Transit & Pre-Launch) and/or Property**					**Performance Incentives / Warranty Payback**			
Launch Service Provider	**Marine Cargo (Transit & Pre-Launch) and/or Property**					**Launch Risk Guarantee**			
					Pre-Launch Liability	**Launch Liability**			**Re-Entry Liability**
			AXA XL Seamless (Pre-Launch and Launch)						
Other Coverages:	**Engine tests, on-orbit servicing, human spaceflight, etc.**								

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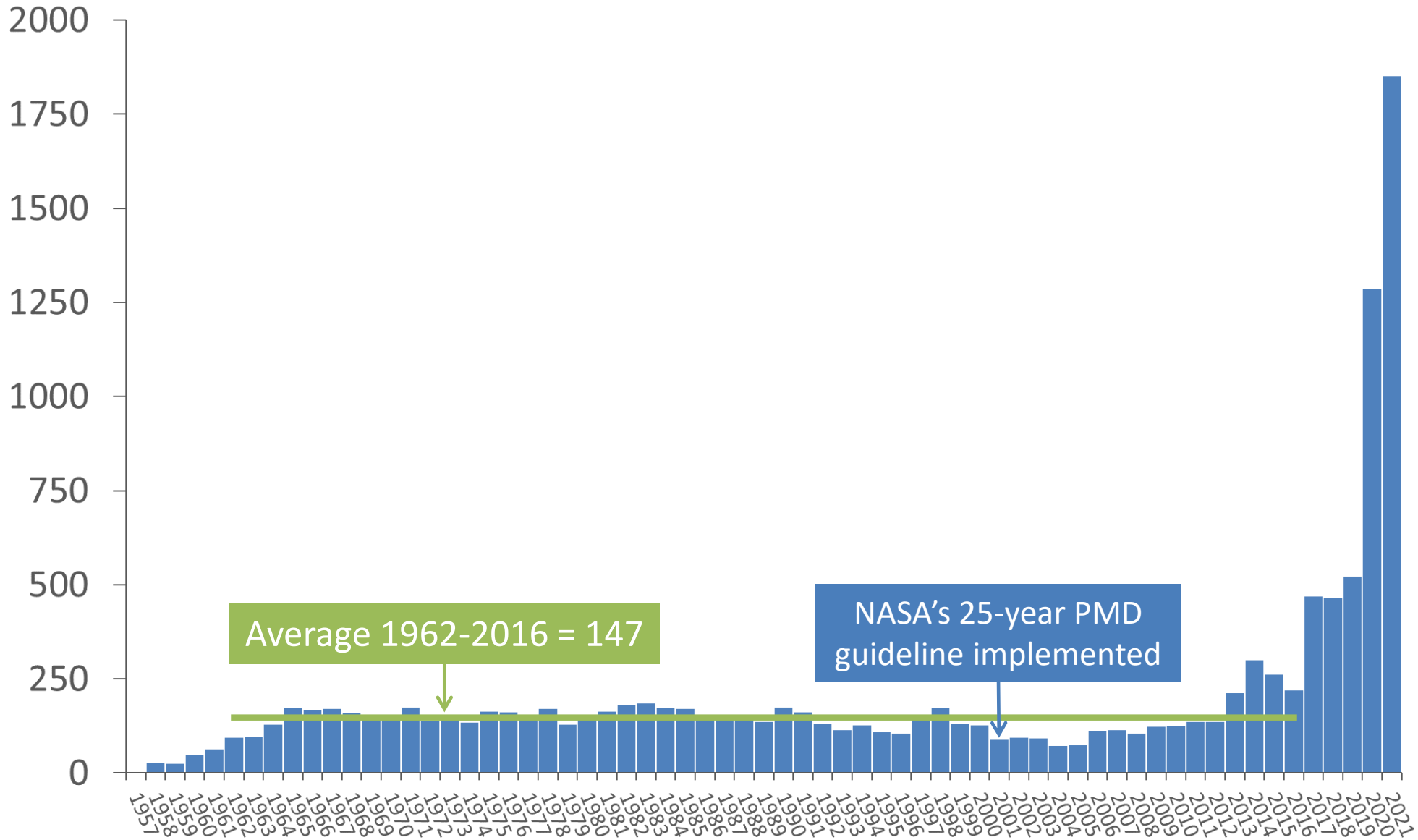
Satellites Launched by Year



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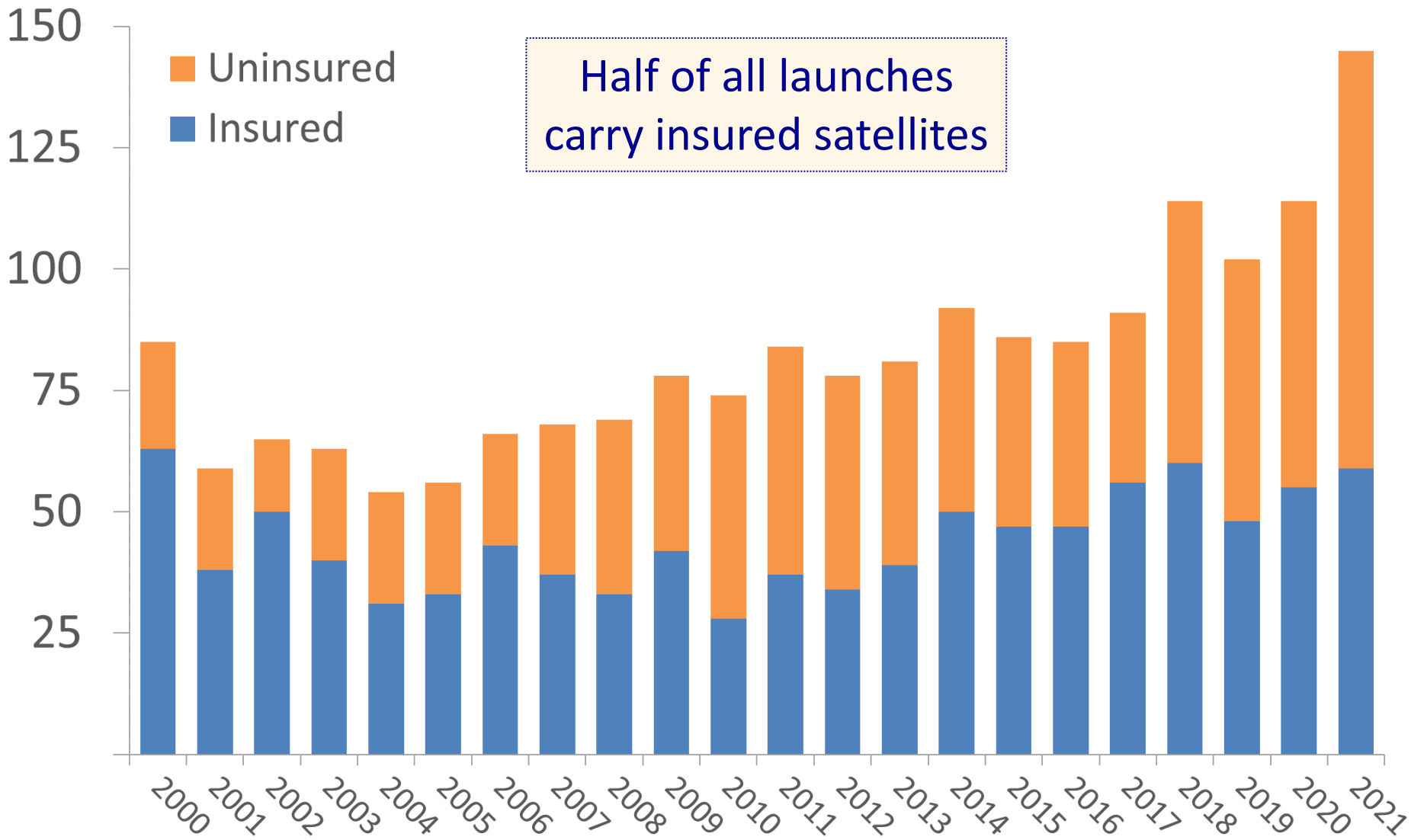
Space Insurance In Perspective

- ✓ **Risk is the intentional interaction with uncertainty**
  - Risk management process: *Identification* → *Assessment* → *Treatment*
  - Treatment options: *Avoidance, Reduction, Retention, Transfer* (insurance)
  - Principles of insurance: *Pooling, Fortuity, Indemnification*
- ✓ **Space insurance covers virtually all technical risk, with few exclusions, from launch onwards**
  - ***Challenges:***
    - ➢ Technical: rapidly-evolving technologies, small satellites, new launch vehicles, constellations, custom-built satellites, generic anomalies, space environment
    - ➢ Actuarial: low frequency + high severity = volatility, small population = large variance of results, large range of values = unbalanced portfolio
    - ➢ Market: short tail, high cash flow, uncorrelated risks, low cost of entry, soft insurance market

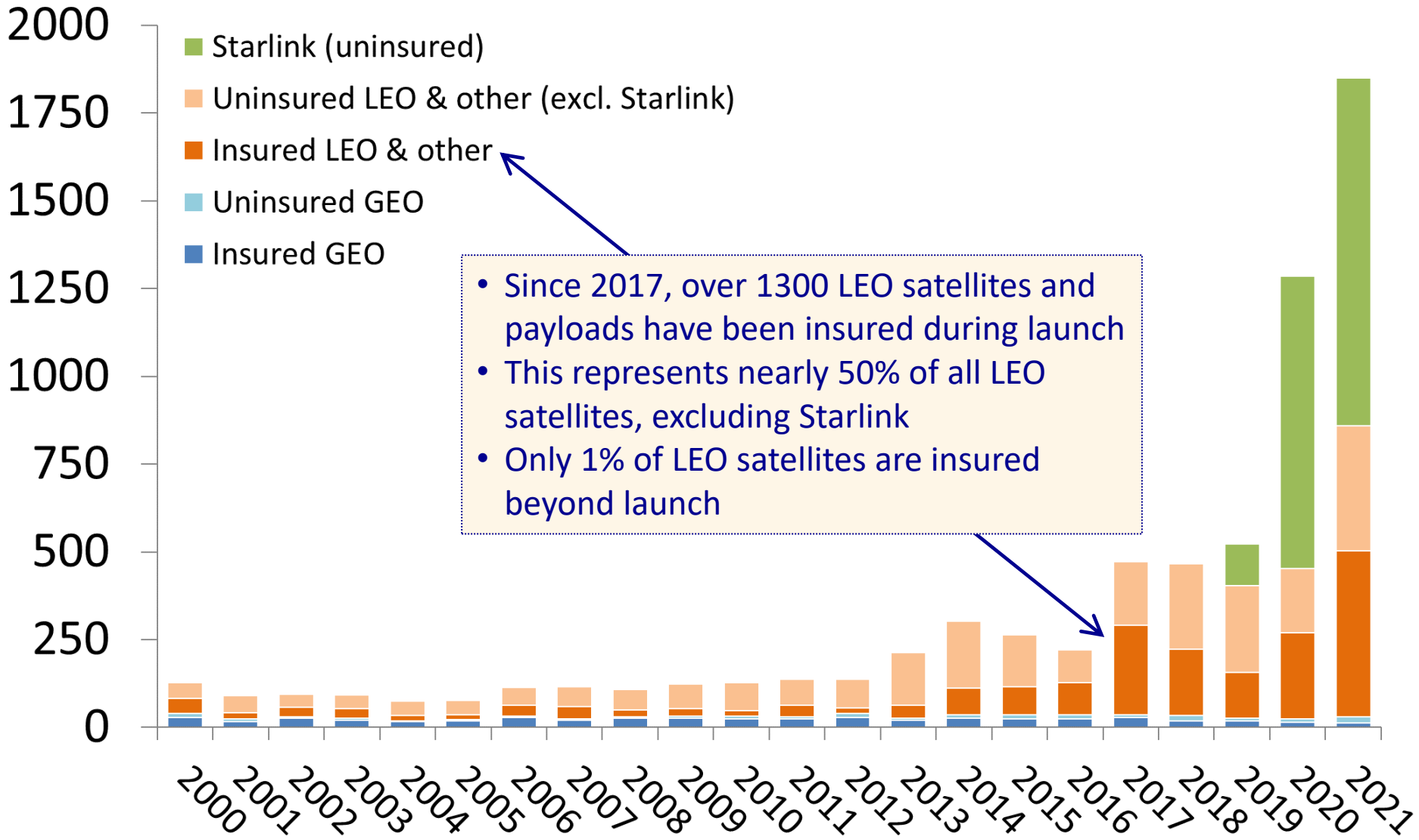
Launches to Orbit

Market insured vs. uninsured



Satellites Launched

By orbit and size, since 2000



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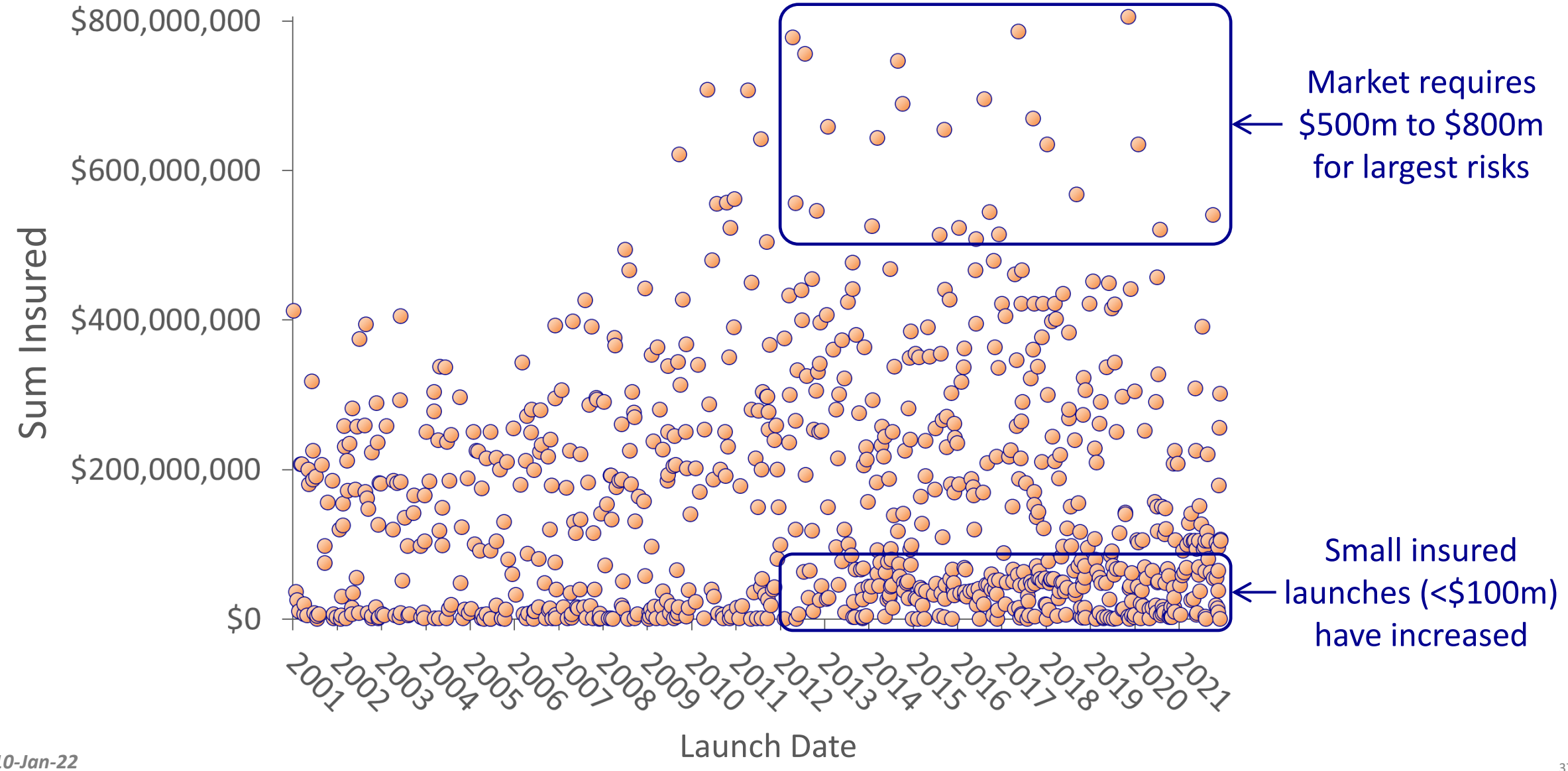
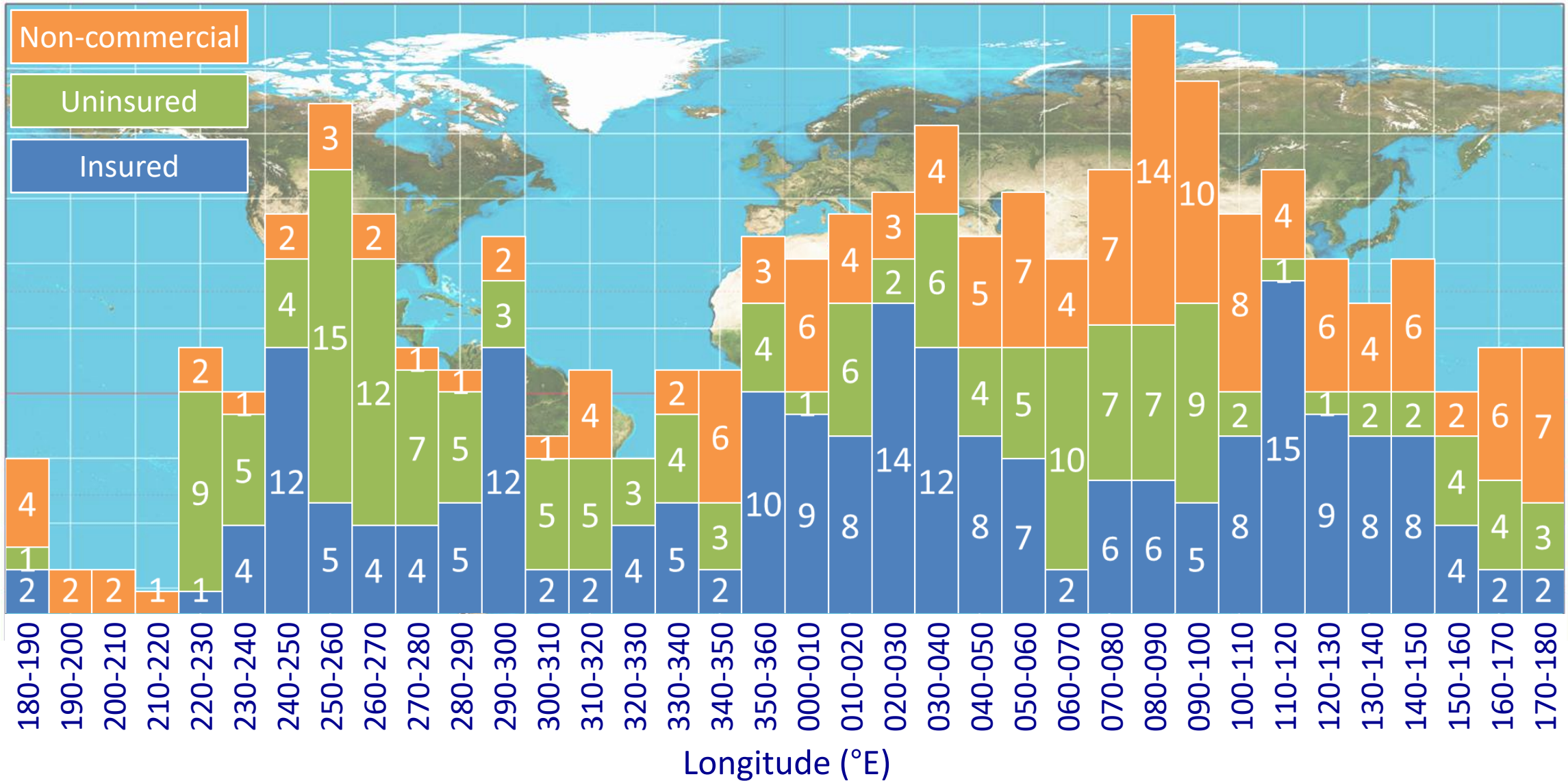
Market Insured Values

During launch vehicle flight



GEO Satellites by Longitude

Insured + uninsured + non-commercial



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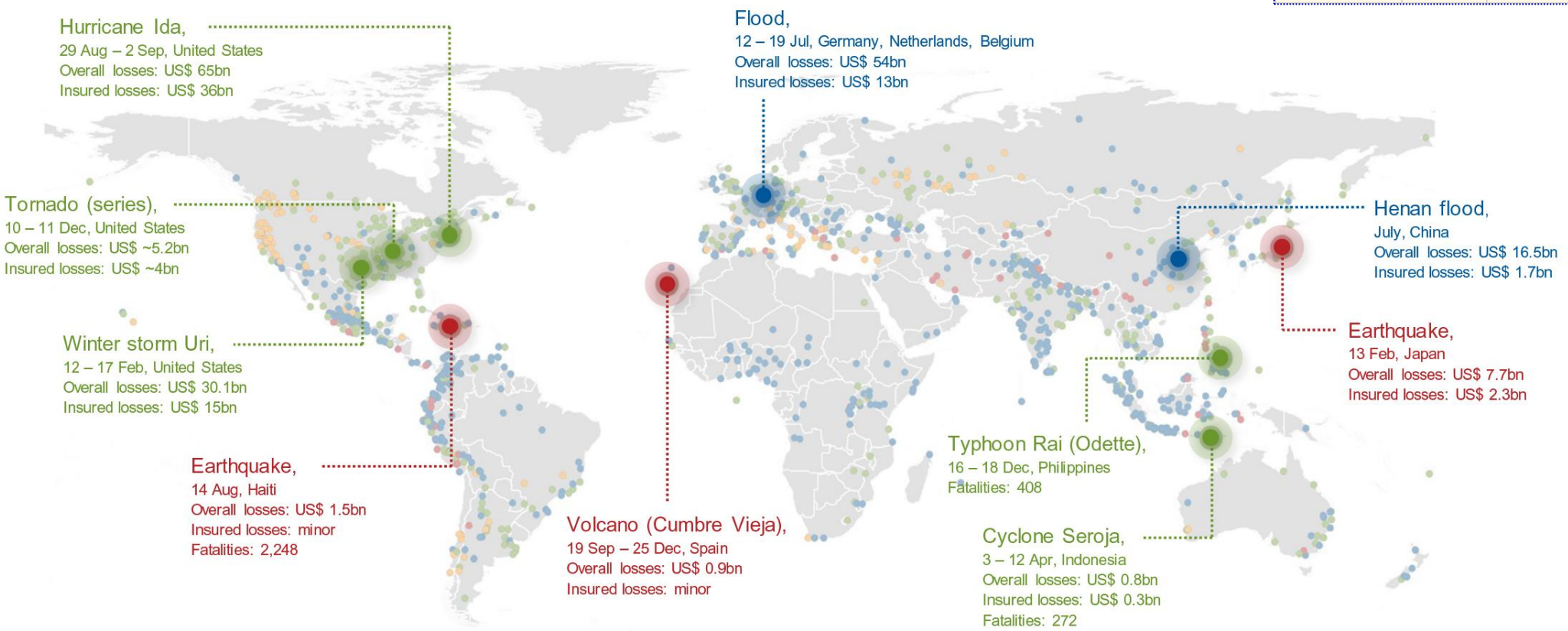
Relevant natural catastrophe loss events worldwide 2021

Natural disasters caused overall losses of US$ 280bn

Year	2021	2020	2019
Economic losses	$280b	$210b	$166b
Insured losses	$120b	$82b	$57b



Geophysical events
Earthquake, tsunami, volcanic activity

Meteorological events
Tropical storm, extratropical storm, convective storm, local storm

Hydrological events
Flood, mass movement

Climatological events
Extreme temperature, drought, wildfire

Significant catastrophes
Small, medium and large loss events

Source: Munich Re, NatCatSERVICE, 2022

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