



# #Space 4.0 Space Safety...

Jan Wörner  
European Space Agency

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European Space Agency



# Space Safety

2013.02.15 09:10:49



# Asteroid 2017 AG13 slips through Earth's defences

JANUARY 10, 2017 12:17PM



Asteroid 2017 AG13 passed Earth yesterday at roughly half the distance of the Moon. It had been discovered only hours earlier.

ARCTIC  
CAR RENTAL IN ICELAND  
ESTABLISHED 1994

**Mietwagen Island ab €40/T**

Unbegrenzte Km & Vollkasko inkl. Jetzt Online buchen und Sparen

[www.arctic.is/Mietwagen-in-Island](http://www.arctic.is/Mietwagen-in-Island)

Advertisement

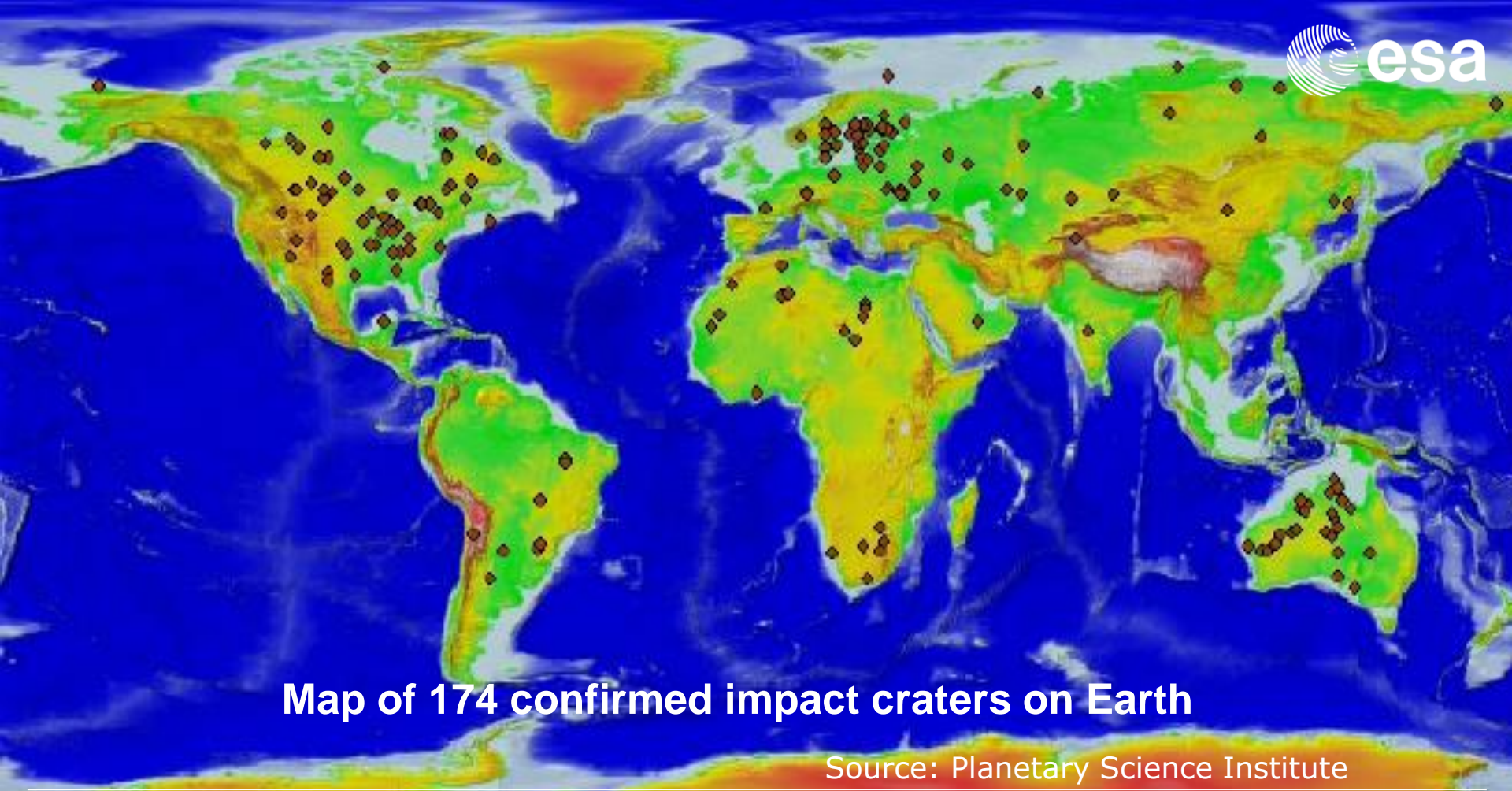
## RIGHT NOW IN TECHNOLOGY

345 READERS [Sydney, Brisbane heatwave: Wait until you see the weather fo...](#)

215 READERS [Wave cloud: Virgin Australia passengers spot unusual 'Mornin...](#)

New crater discovered under the Greenland ice cap  
~ 12000 years ago  
iron meteor about 800 m





## Map of 174 confirmed impact craters on Earth

Source: Planetary Science Institute

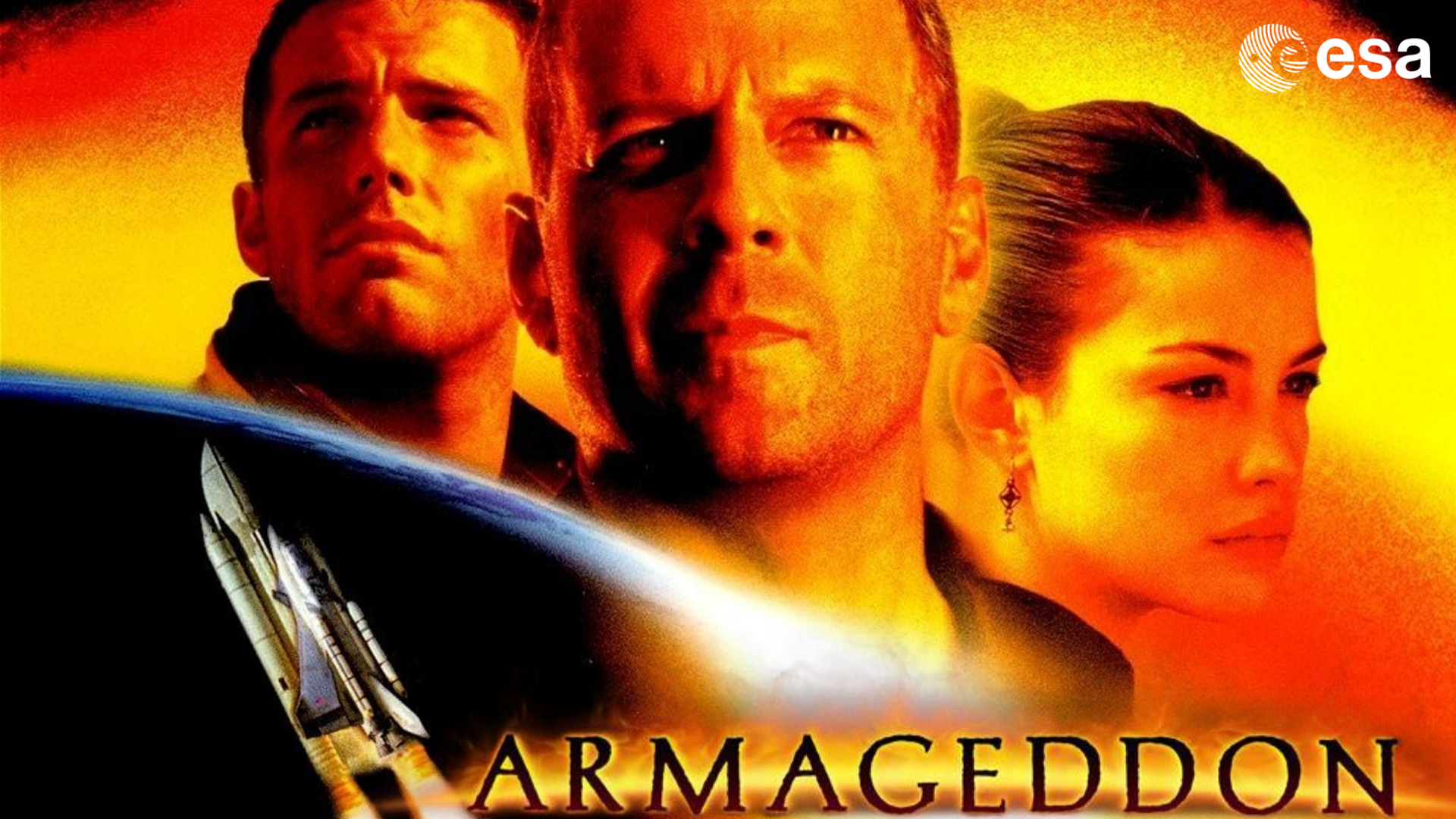


# Asteroids

NEO Diameter	Impact Energy [Megatons TNT] (1g TNT $\equiv$ 4184 J)	Typical Period [years]	Consequences
1 m	0.00008	0.05	fire balls, meteorites may reach Earth surface
3 m	0.002	0.5	fire balls, meteorites reach Earth surface (Sudan event)
10 m	0.08	5	large fire balls, pressure wave, energy 5 times Hiroshima bomb
40 m	5	300	explosion (Tunguska) or crater
140 m	220	10,000	regional destruction or tsunami
500 m	10,000	200,000	continental destruction
1 km	80,000	700,000	millions fatalities, global consequences
10 km	80,000,000	100,000,000	end of human life

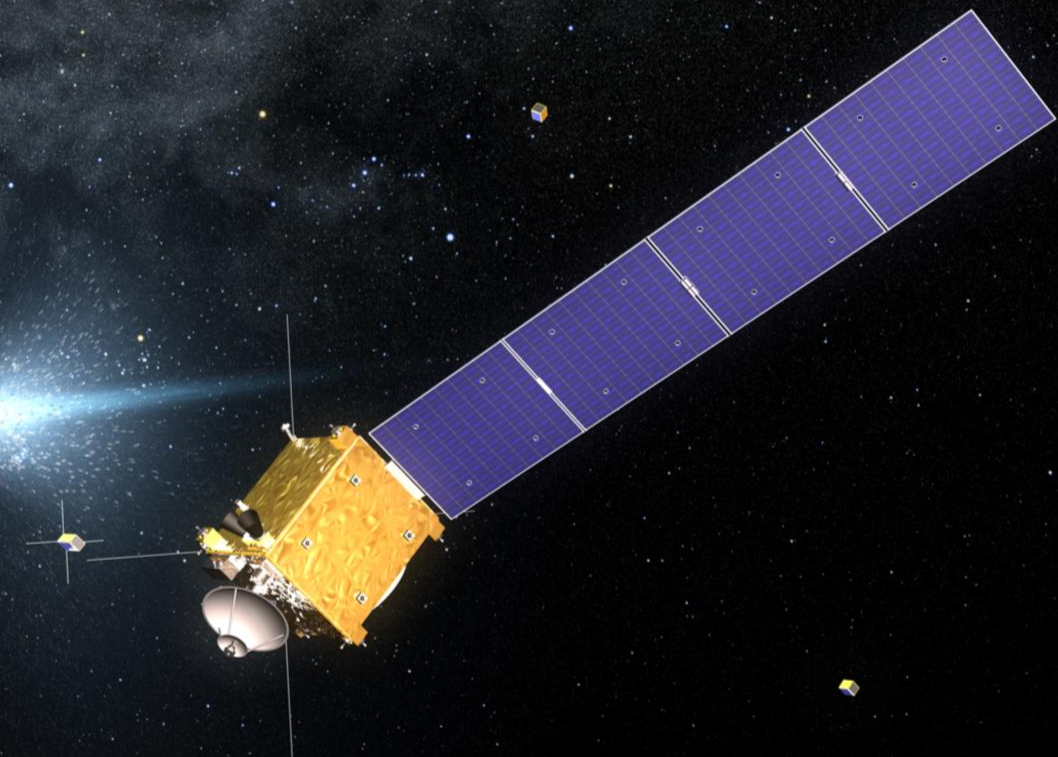
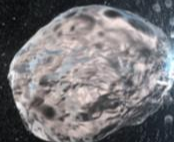
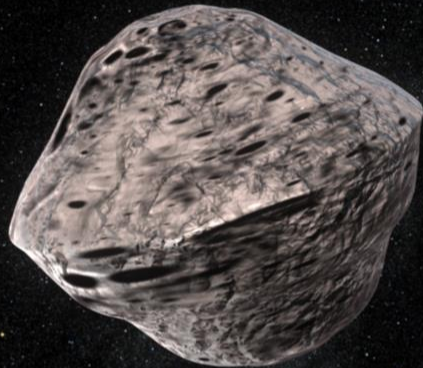




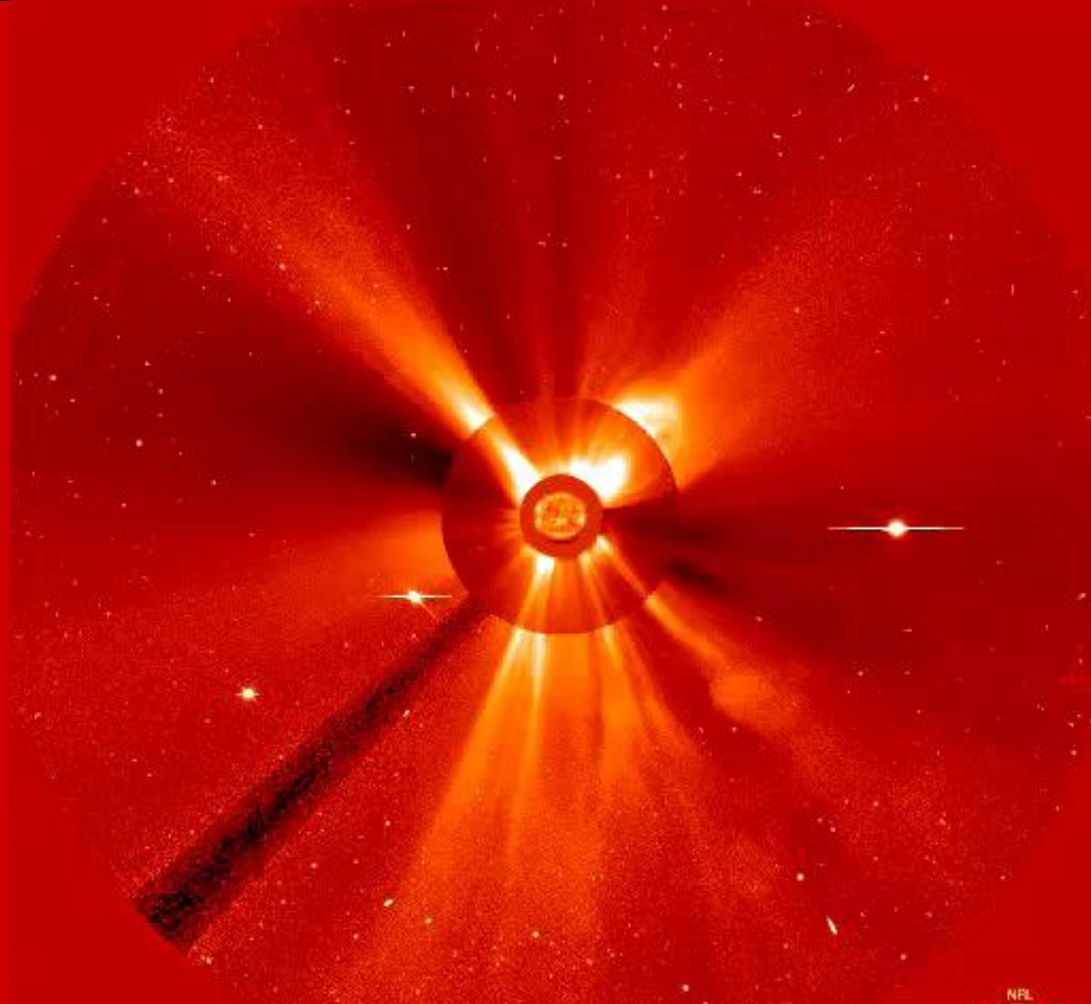


# ARMAGEDDON

# Planetary Defence



# Solar flare





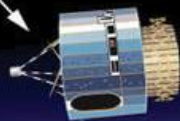
Elmar78



# Solar flare

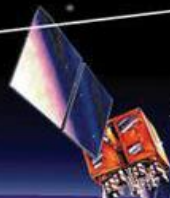


Energetic Electrons



Damage to  
Spacecraft  
Electronics

Solar Flare  
Protons

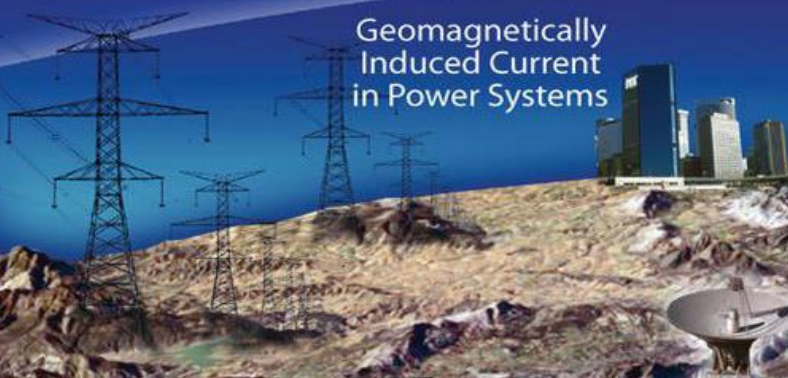


GNSS Signal  
Scintillation

Radiation Effects  
on Avionics

Ionospheric Currents

Geomagnetically  
Induced Current  
in Power Systems



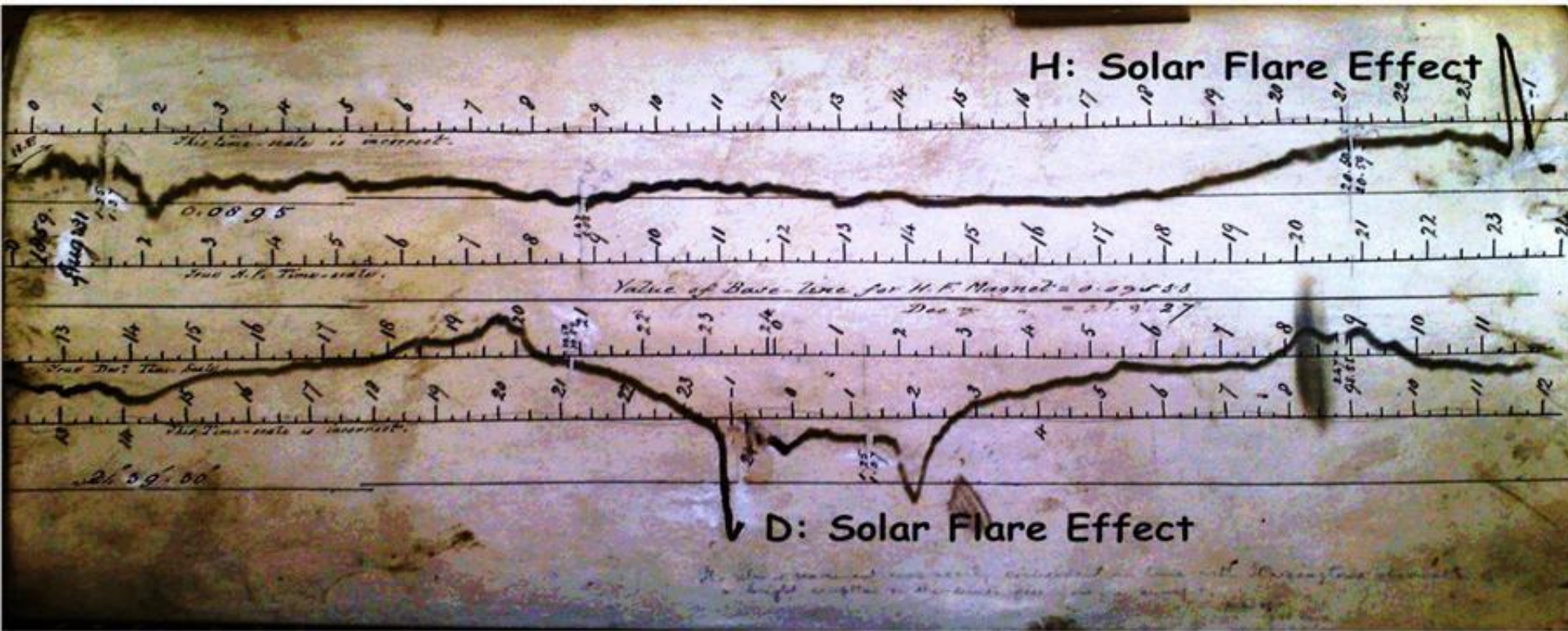
NASA

European Space Agency





# One of 12 magnetograms recorded at Greenwich Observatory during the Great Geomagnetic Storm of 1859

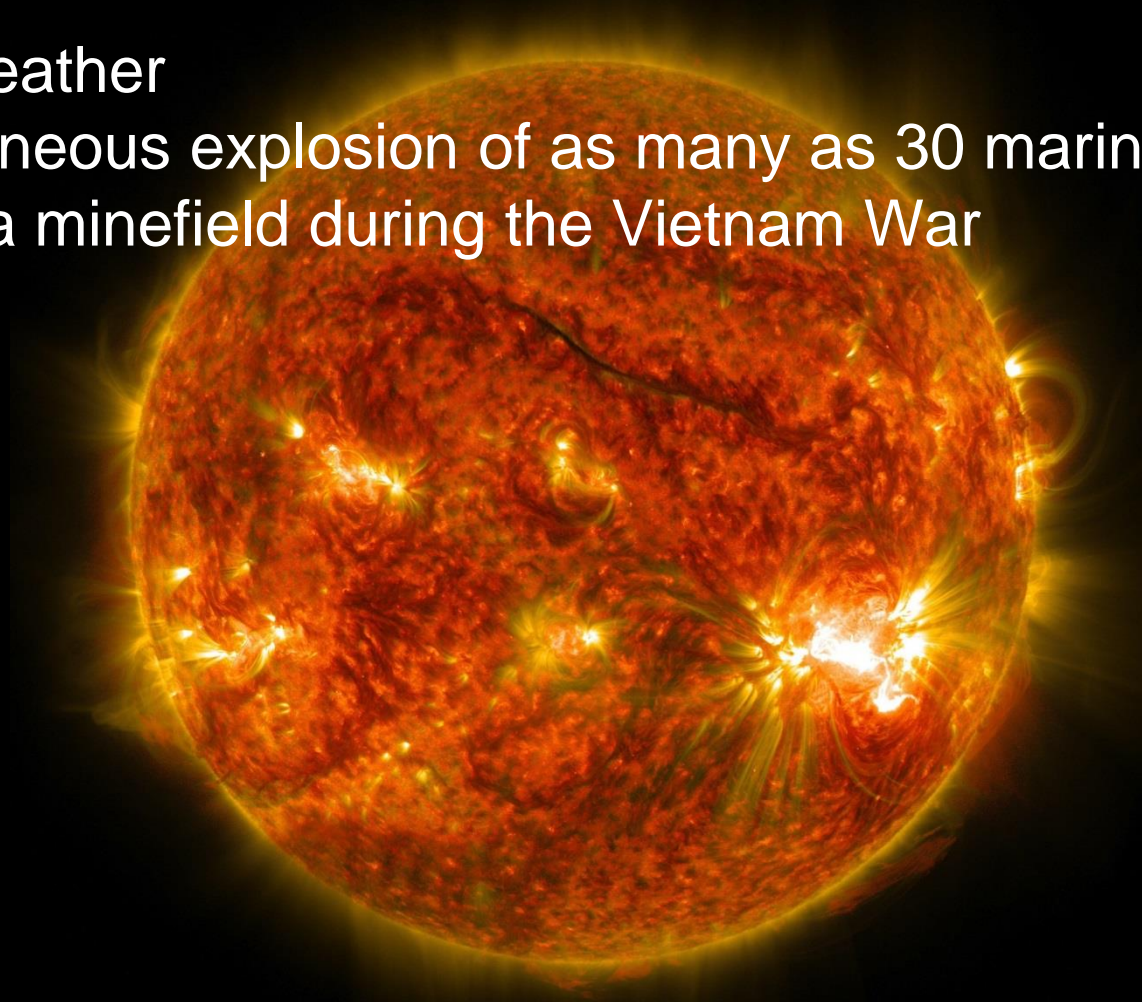


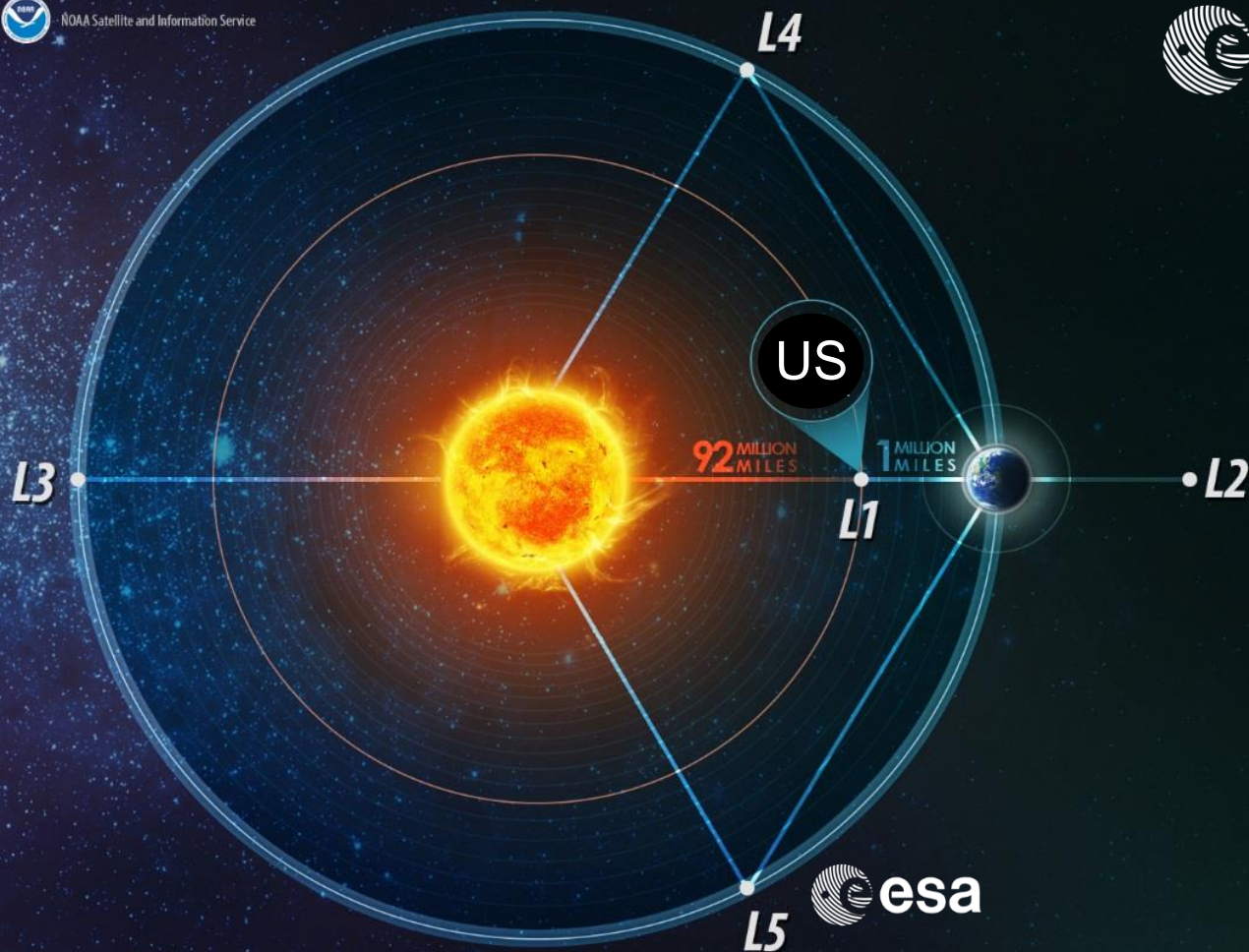
March 1989,  
damage of transformer in the HydroQuebec system  
...cascading grid failure



# Space Weather

→ spontaneous explosion of as many as 30 marine mines in a minefield during the Vietnam War





SWE

US / ESA





## Space Debris

> Ø1cm: > 750000

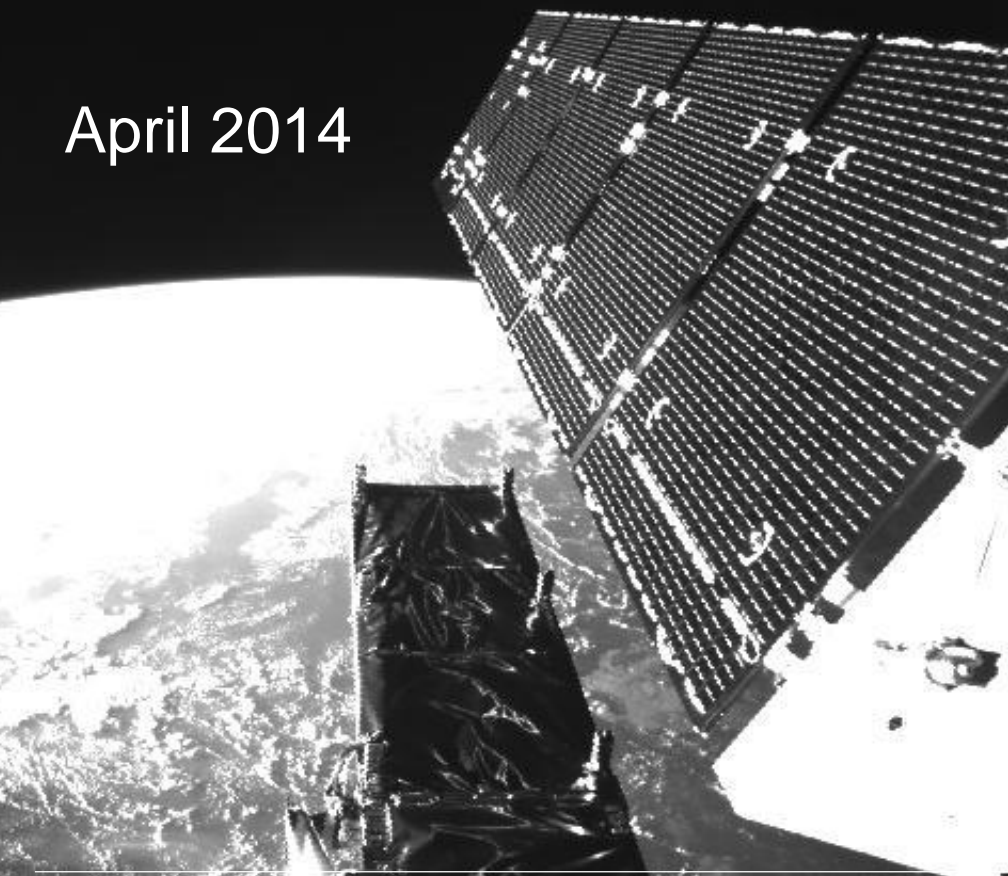
„Vacuum cleaner“?



# Sentinel 1A



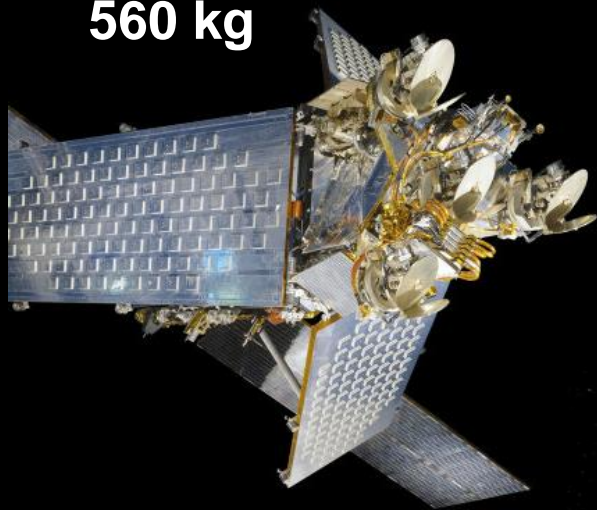
April 2014



August 2016



**Iridium 33**  
**560 kg**



**Kosmos 2251**  
**900 kg**



**Collision**  
**10.2.2009**



**16:05**  
**2009/02/10**



# “ESA’s guide through the galaxy”



Automated Satellite Collision Avoidance  
artificial intelligence



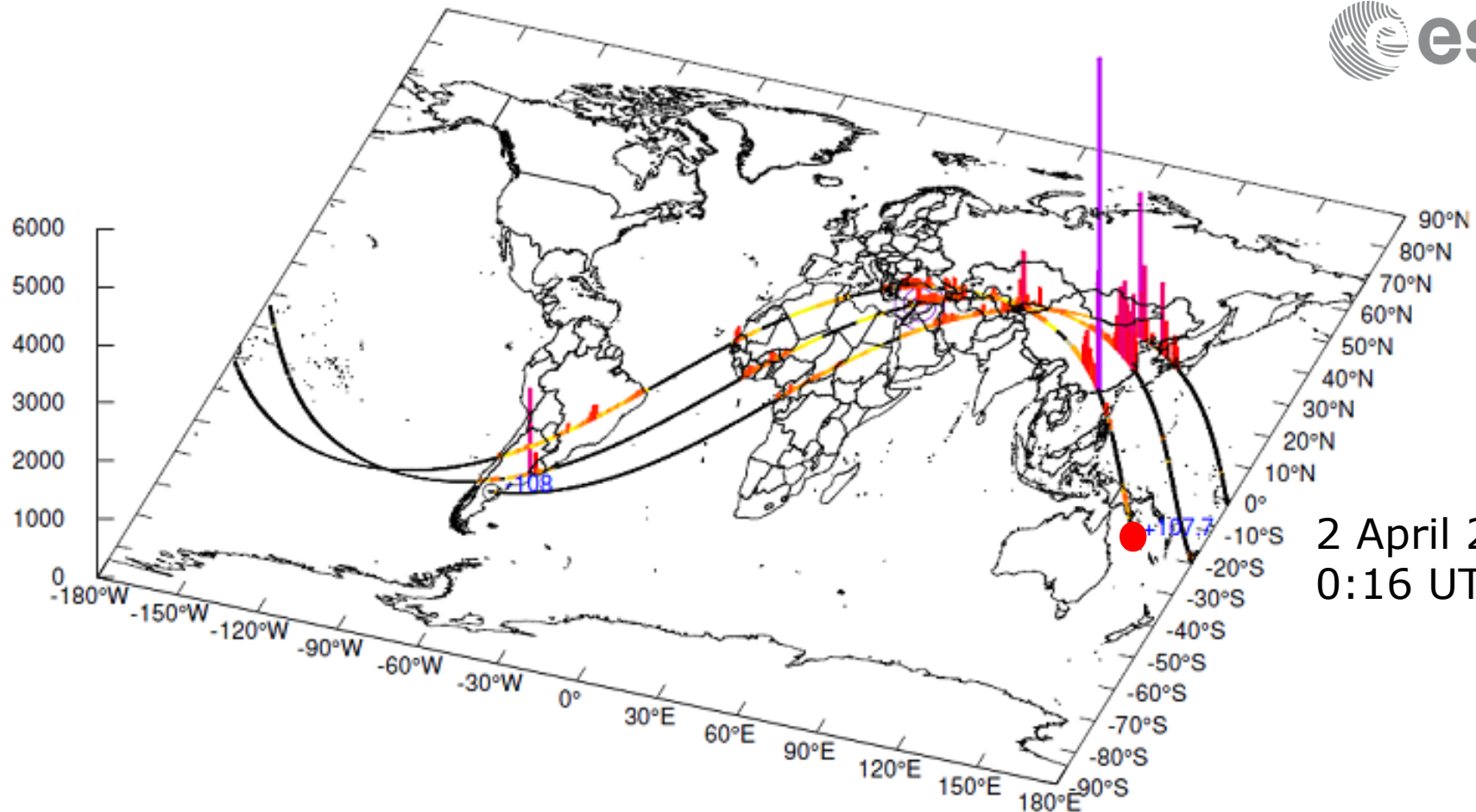




3.12.2013 Chang'e-3



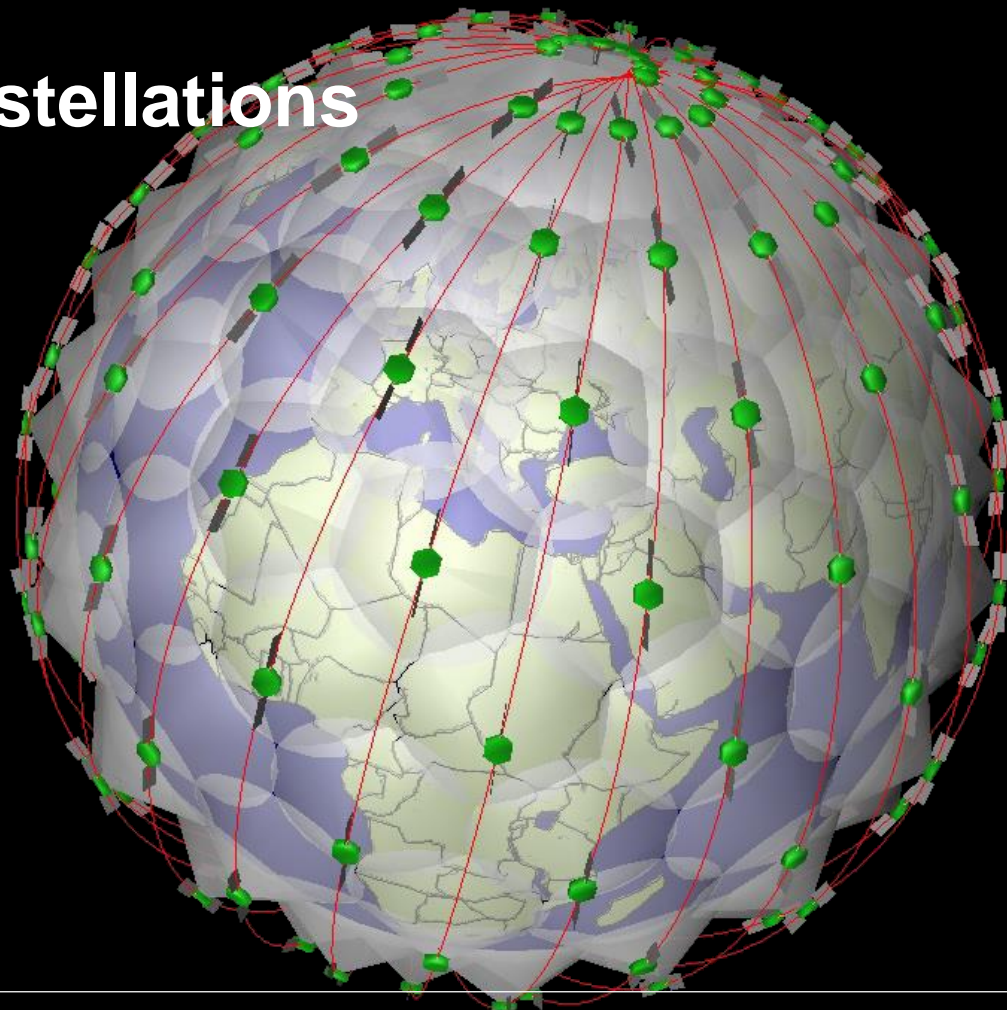




2 April 2018  
0:16 UTC



# Mega Constellations

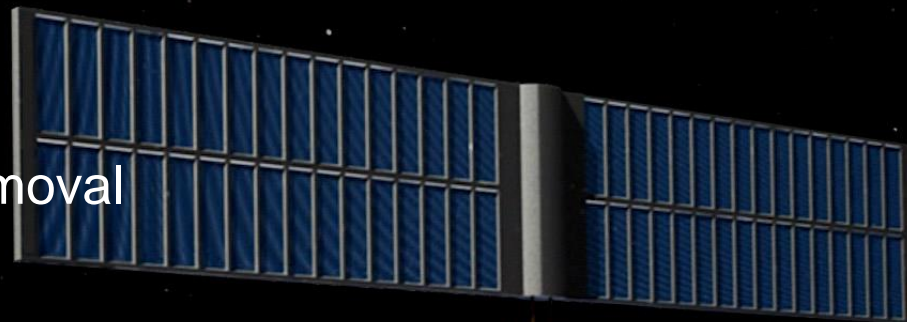


“Stay clean”



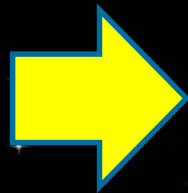
# Vacuum Cleaner

## In Orbit Servicing/Debris Removal





**rule for  
debris avoidance**



- redundant de-orbiting system
- contract with de-orbiting service/provider
- deposit at public entity

A composite image showing Earth from space with various satellites in orbit, a large orange sun on the left, and several asteroids of different sizes floating in the background. The text 'Space Safety' and '→ global responsibility' is overlaid in white.

# Space Safety

→ global responsibility



**THE European Space Agency**