



Knowledge for Tomorrow

Space Science Week

Prof. Dr. Pascale Ehrenfreund

29 March 2016

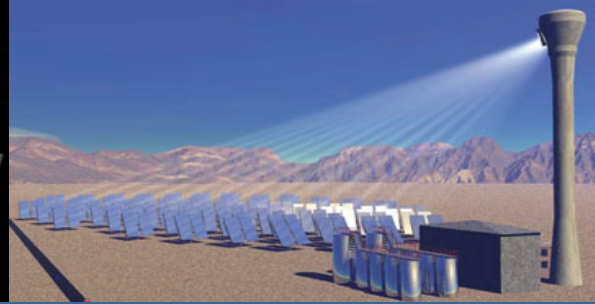
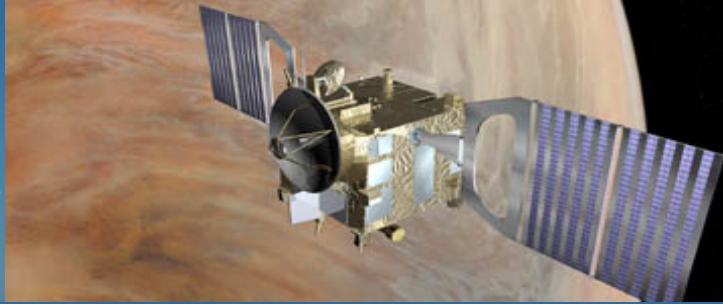


Aeronautics

Space

Energy

Transport



Research Center



Space Administration



Project Management Agency



Missions

Science

Services

Technology

Safety & Security

Outreach

Sites & Facilities

~ 8.000 Employees

33 institutes & facilities spread over
16 sites across Germany

Field stations in O'Higgins
(Antarctica), Inuvik (Canada) &
Almeria (Spain)

Offices in Berlin, Brussels, Paris,
Washington D.C. & Tokyo



Large-Scale Research Infrastructure

In 2015 DLR operated > 150 large-scale infrastructures

Wind Tunnels



Research Aircrafts



Simulators



Research Vehicles & Platforms



Control Stations



Test Facilities



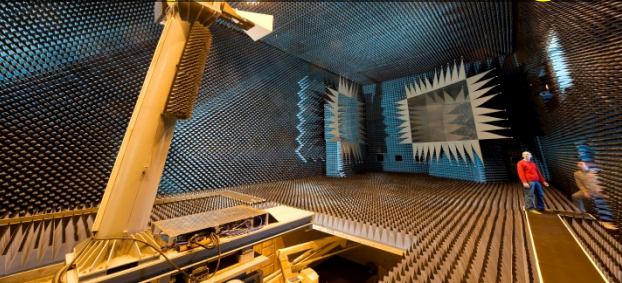
Medical Infrastructures



Research Power Plants



Compact Test Range



Energy Storage Test Facilities



High-Performance Computers



Research Helicopters



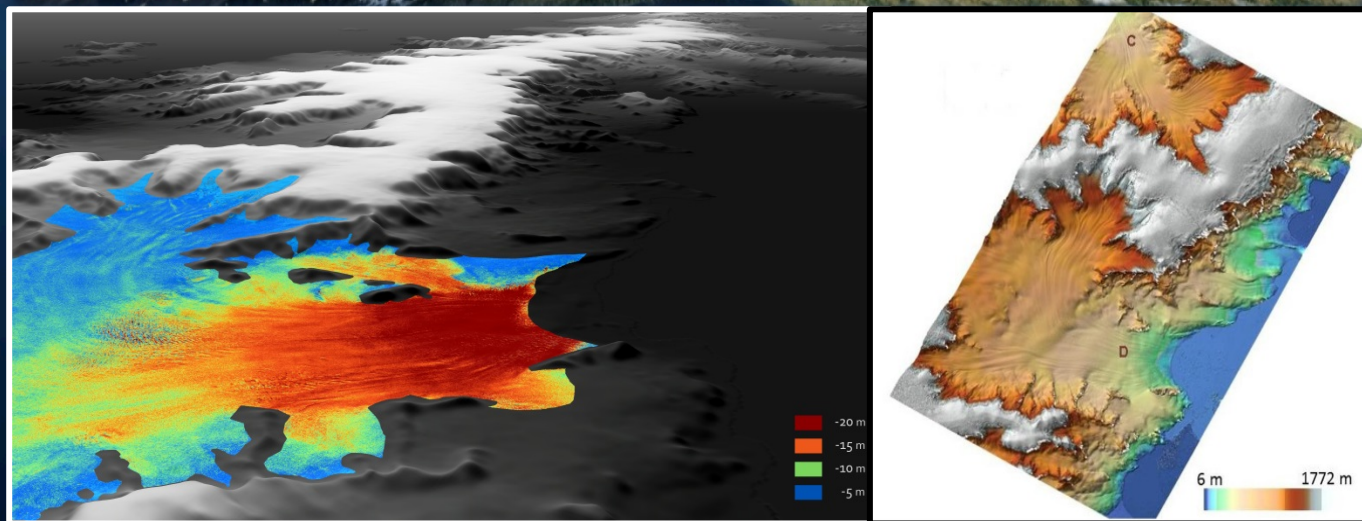
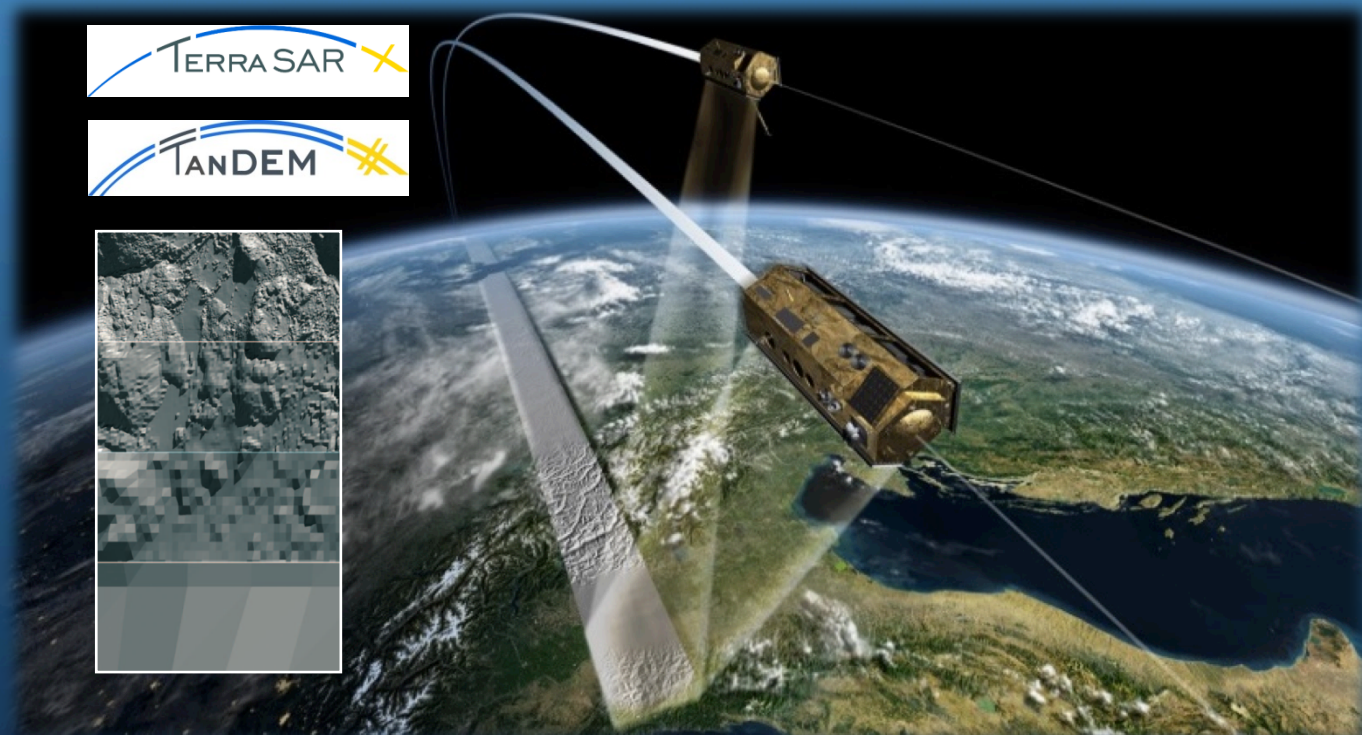
Geo Science – Current Missions

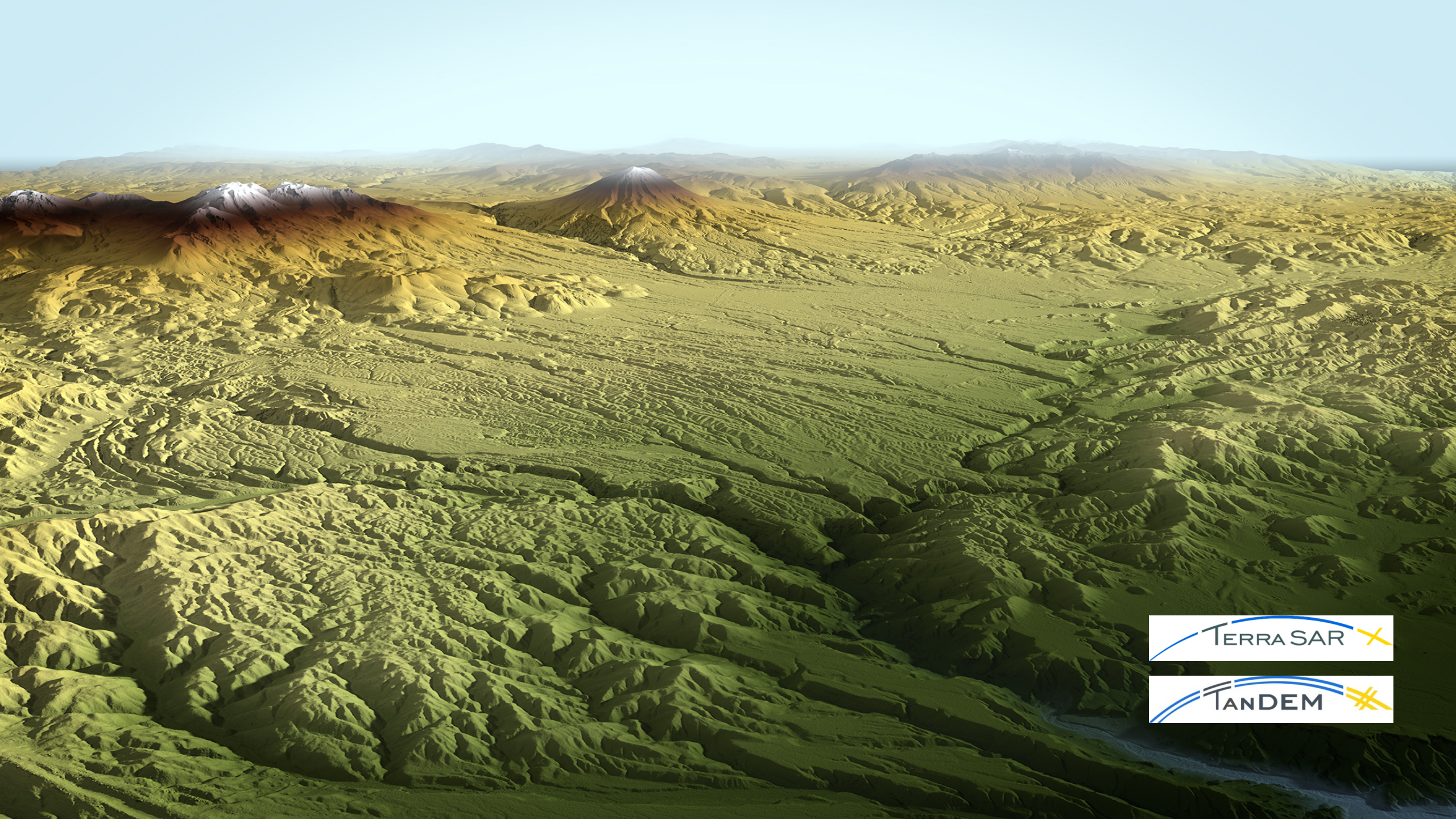
TerraSAR-X and TanDEM-X

- Two high resolution radar-satellites
- Formation flight at short distance (200m)
- 3D images of the Earth's surface
- Digital Elevation Model (DEM)
- Global + high precision

Scientific Impact:

- **New-quality data records:**
- **Ecology, geology, hydrology and oceanography, glaciology**
 - **smallest movements of the Earth's surface (plate tectonics, volcanism, earthquake)**
- **Scientific use coordinated through the DLR TerraSAR-X Science Service System**





Geo Science – Future Missions I

Environmental satellite - MERLIN

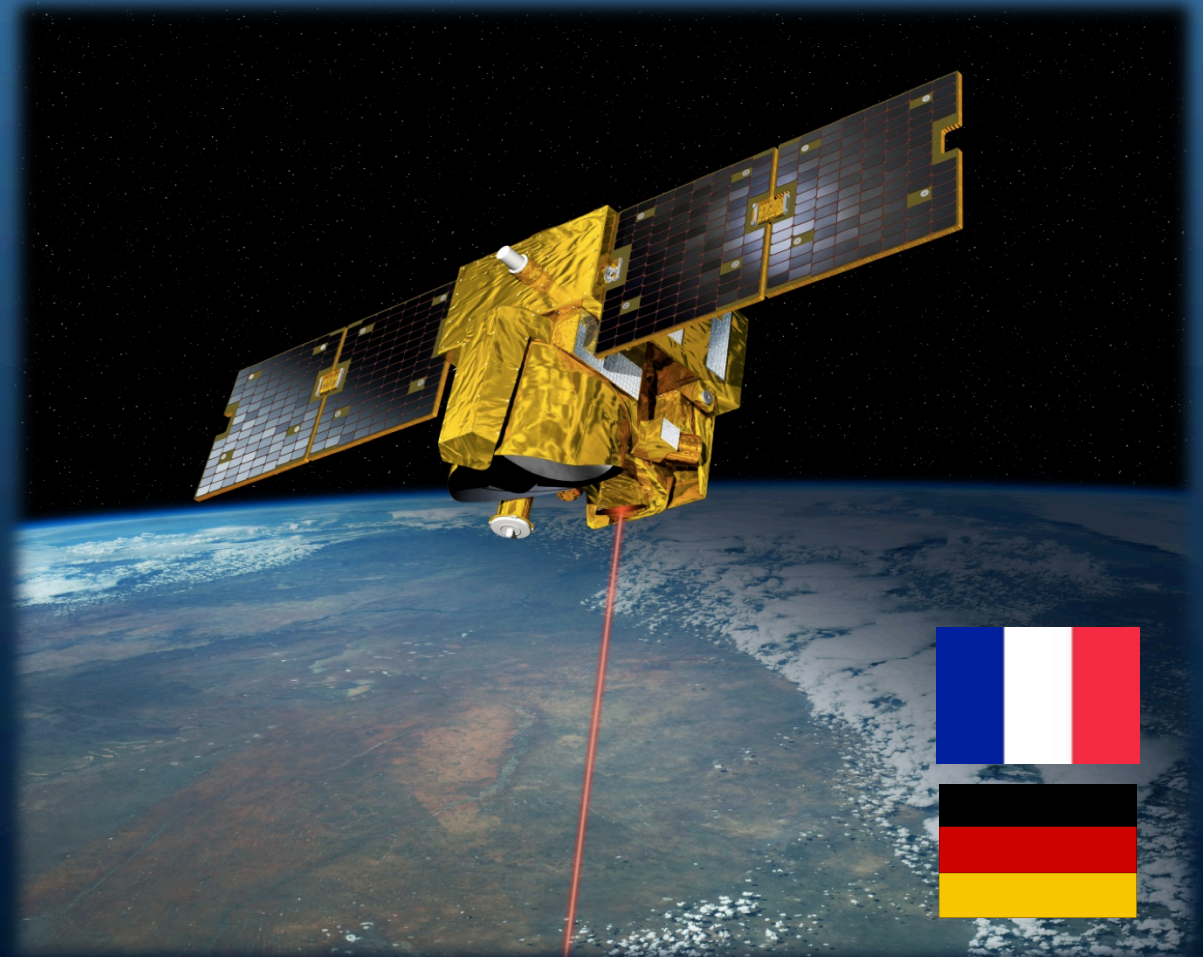
(Methane Remote Sensing Lidar Mission)



- Joint French-German cooperation, performed by the national space agencies, CNES and DLR
- Germany develops the instrument payload - Methane LIDAR
- France develops and operates the satellite
- Launch 2020

Scientific Impact:

- Improved knowledge on contribution to the atmospheric methane amount e.g. from: energy production, wild fires, wetland changes due to climate change such as melting of permafrost soils and ocean sediments (gas hydrates).
- Improved climate change prediction



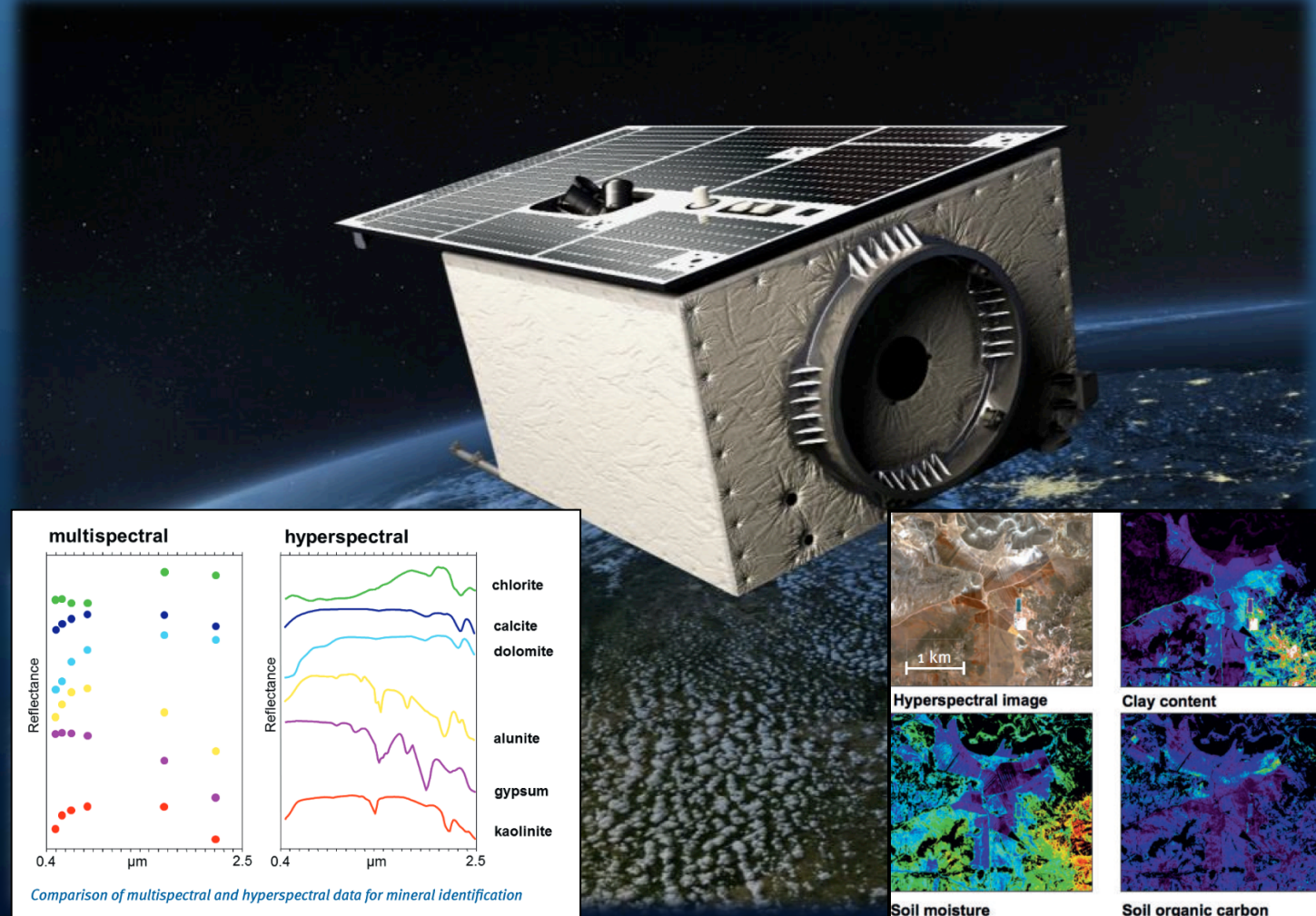
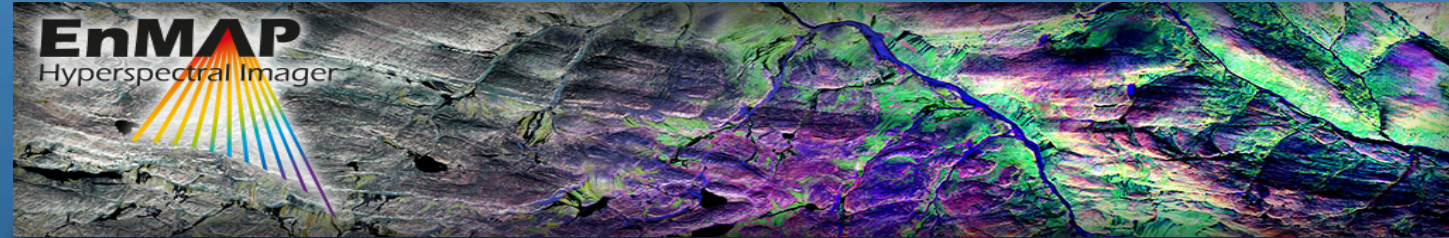
Geo Science – Future Missions II

EnMAP (Environmental Mapping and Analysis Program)

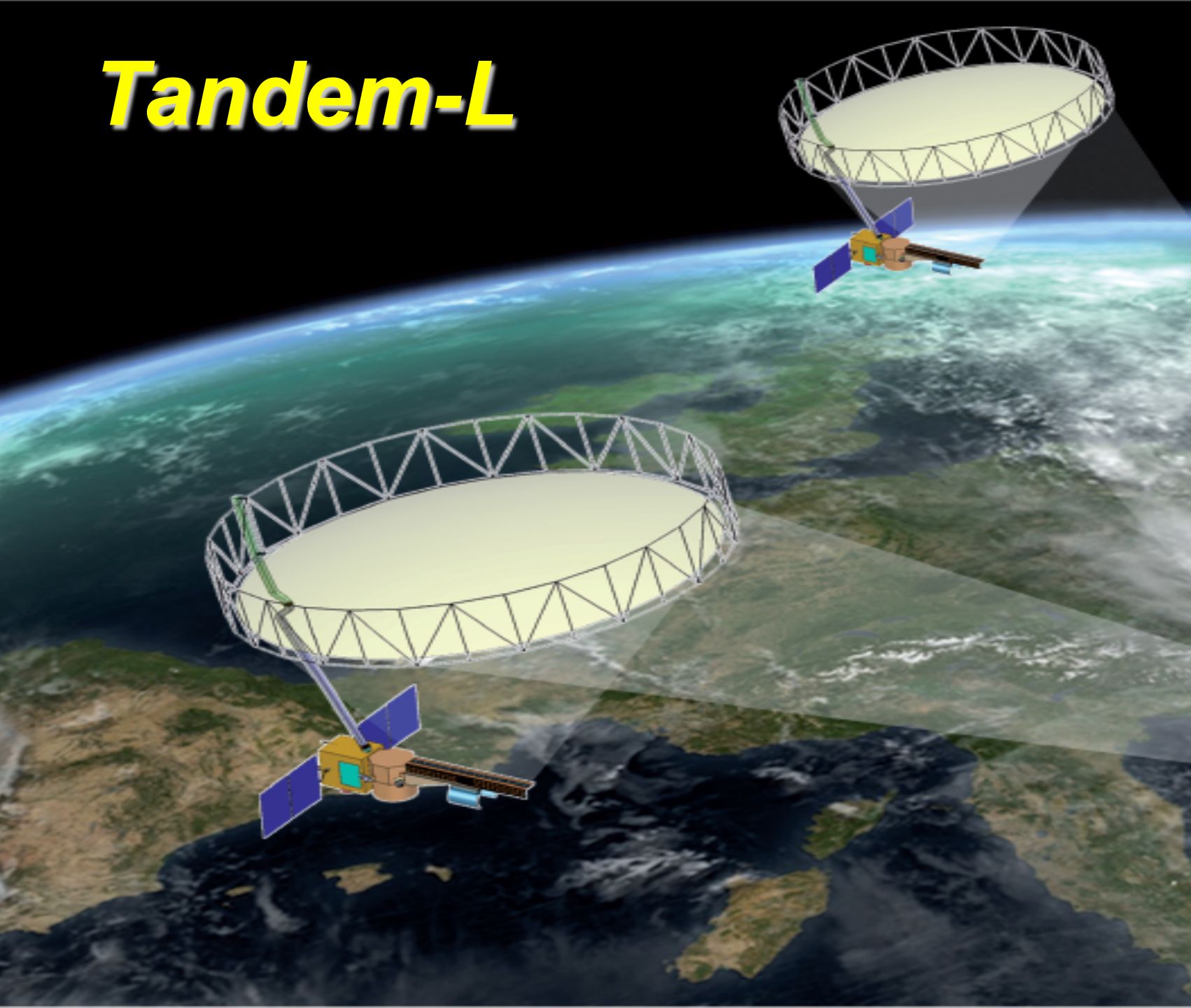
- German hyperspectral satellite mission
- Hyperspectral instrument with over 200 channels
- Launch: 2017

Scientific Impact:

- Key dynamic processes of the Earth's ecosystems by
- extracting geochemical, biochemical and biophysical parameters
- information on the status and evolution of various terrestrial and aquatic ecosystems:
 - agriculture, forestry, soil and geological environments, coastal zones and inland waters



Tandem-L



➔ **Biosphere**



➔ **Geosphere**

➔ **Lithosphere**



➔ **Hydrosphere**

➔ **Cryosphere**



Deforestation, Degradation, Fires* (REDD)

Biosphere

Forest Biomasse Change*

Biodiversity

...

Earthquakes

Volcanic Activities

Land Slides

Geosphere

...

Sea Ice Extent*

Permafrost*

Glacier & Ice Cap Dynamics*

...

Cryosphere

Soil Moisture*

Flooding

Hydrosphere

Ocean Currents*

...

Tandem-L



*) Essential Climate Variables

Days

Weeks

Months

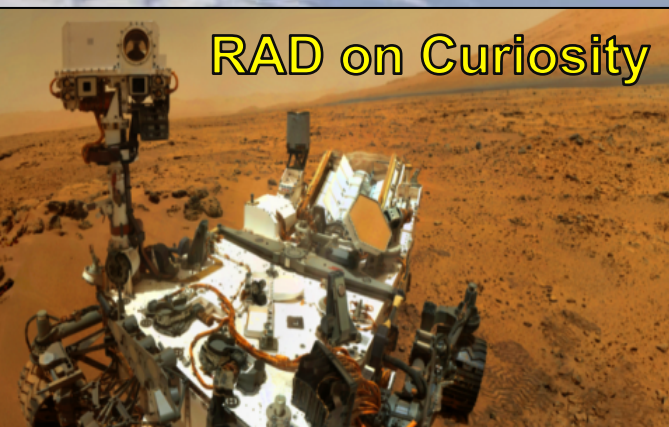
Years

Observation Interval

Examples of US-German Programmes & Projects



SOFIA – Stratosphere observatory for infrared astronomy



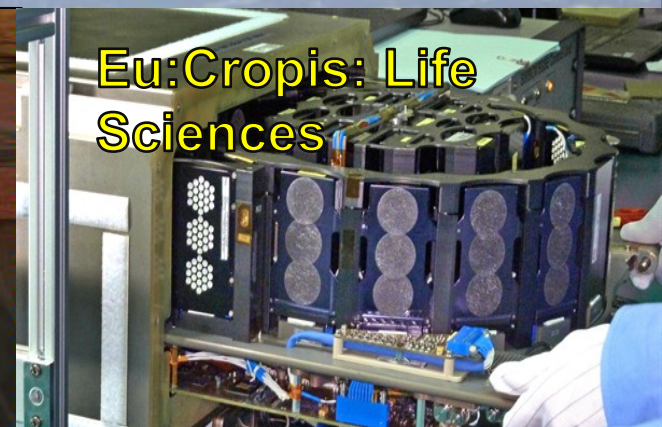
RAD on Curiosity



2 Cameras on DAWN

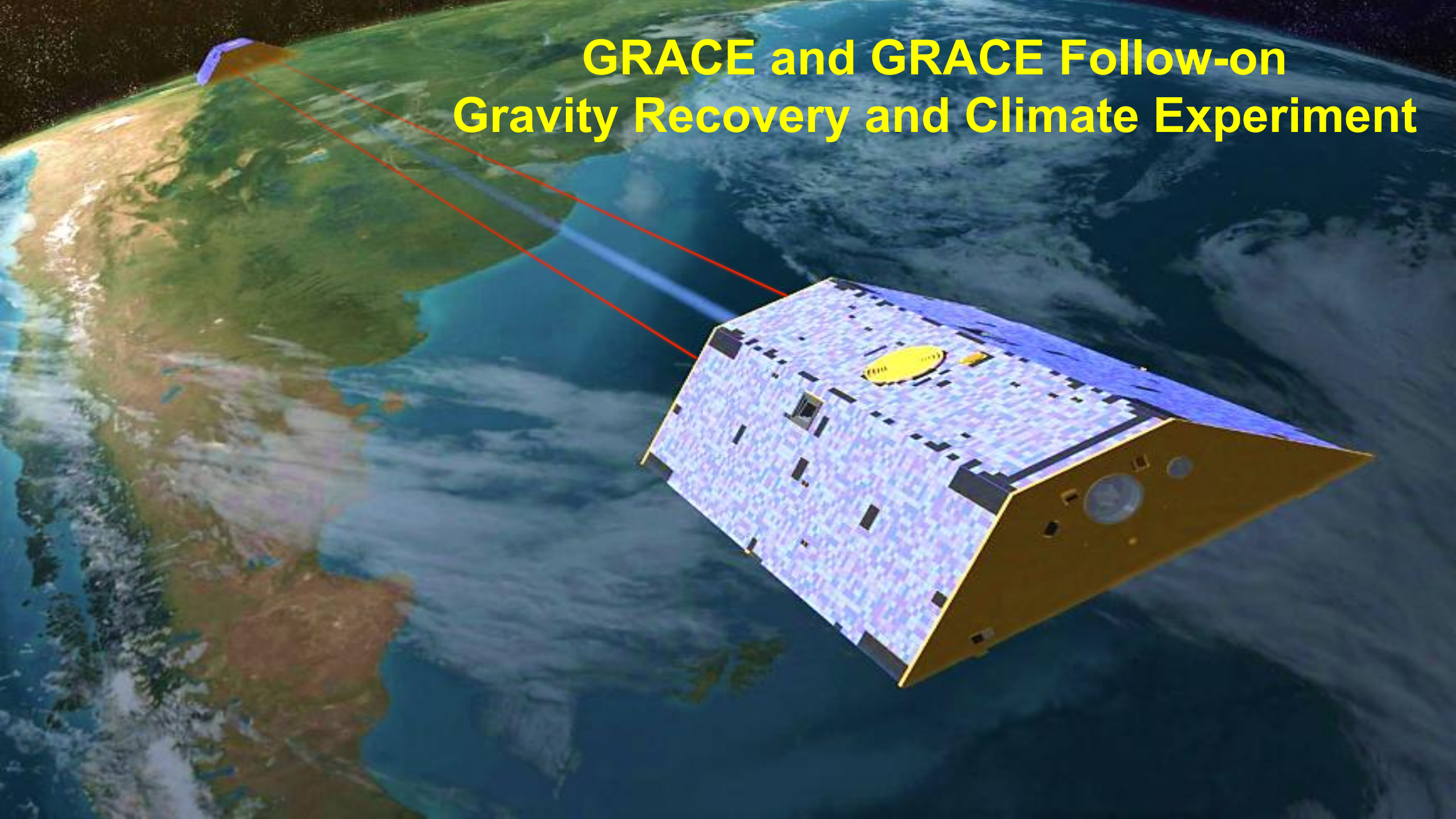


HP3 on NASA InSight



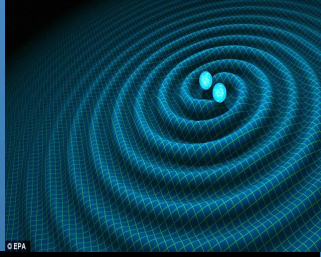
**Eu:Cropis: Life
Sciences**

GRACE and GRACE Follow-on Gravity Recovery and Climate Experiment



LISA-Pathfinder

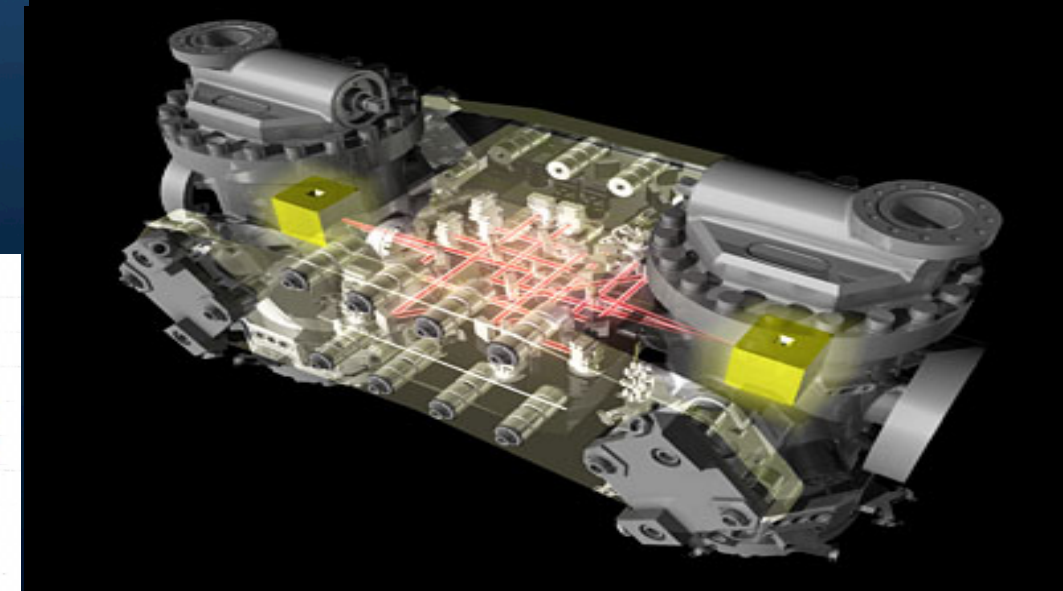
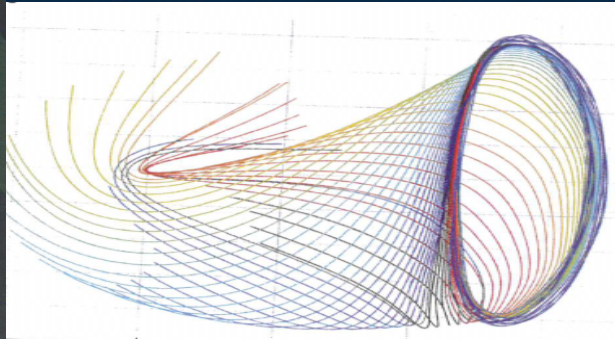
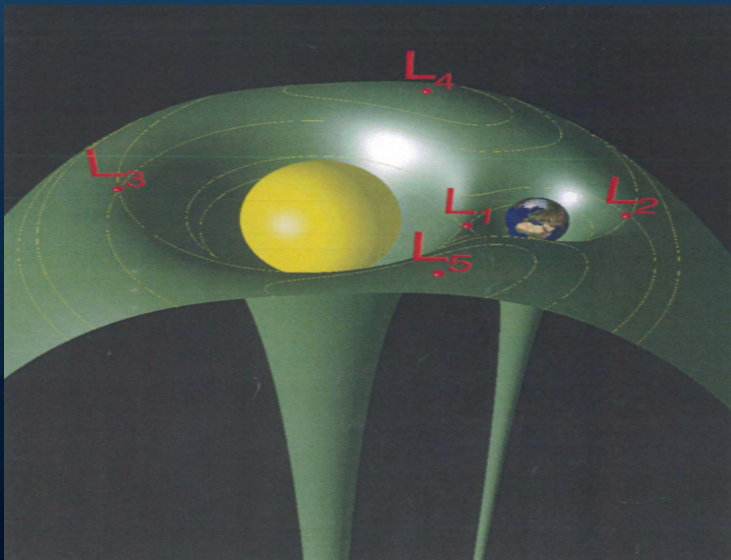
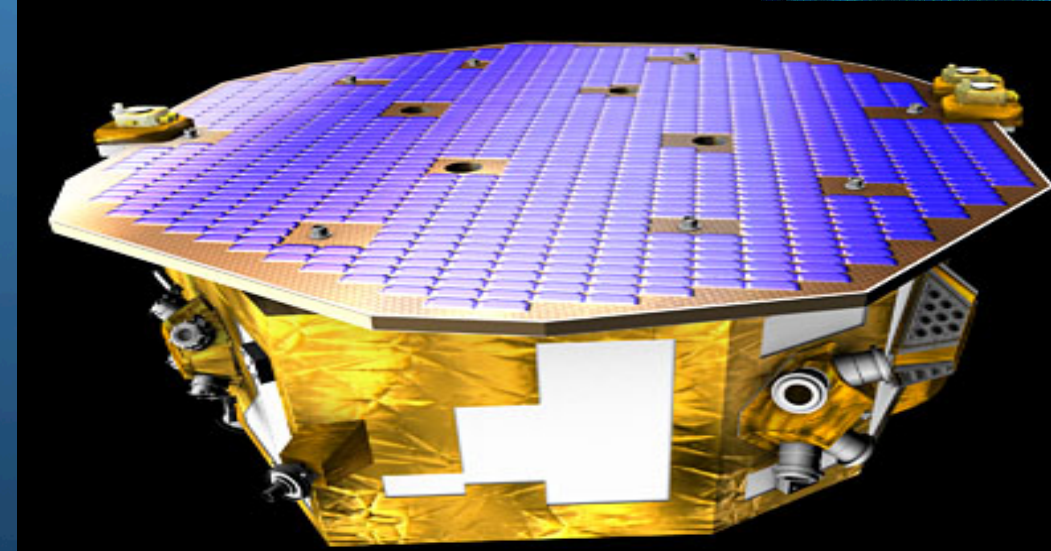
Precursor for gravitational wave observation



Technology demonstrator for LISA

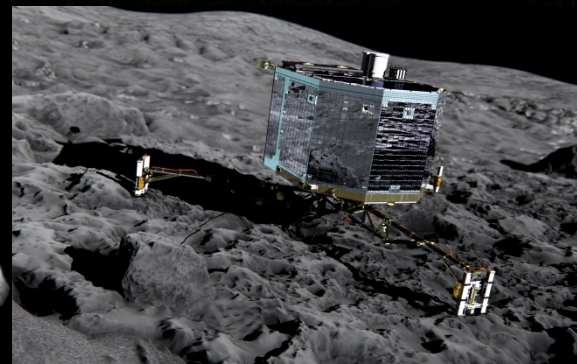
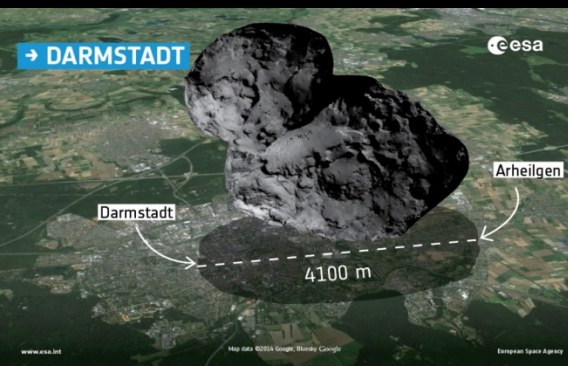
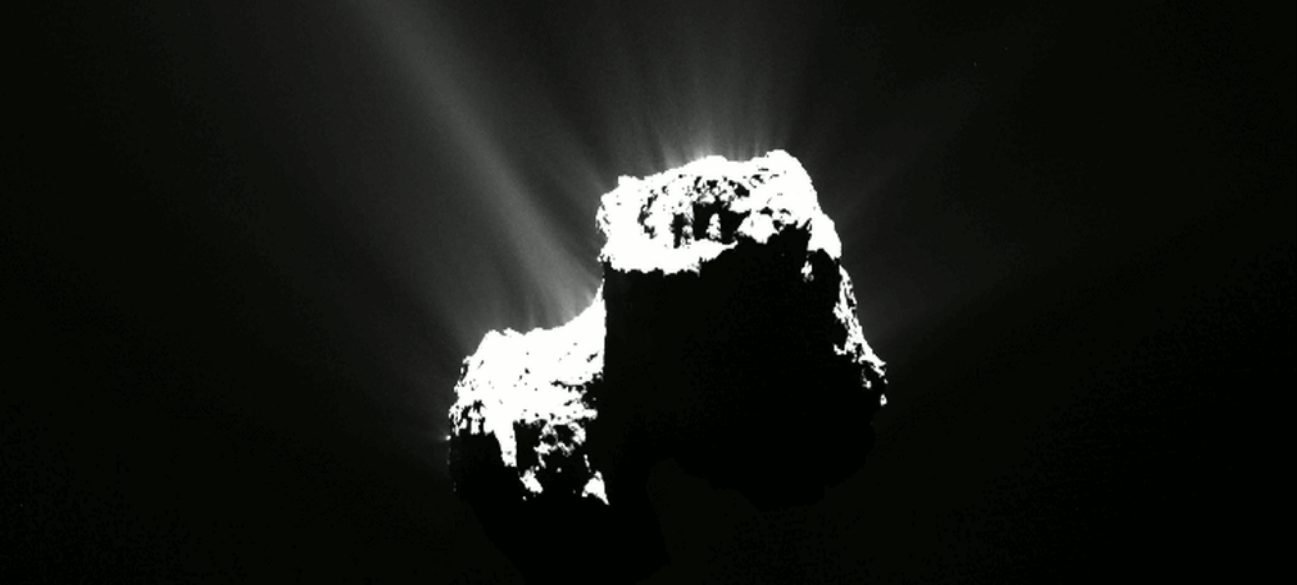
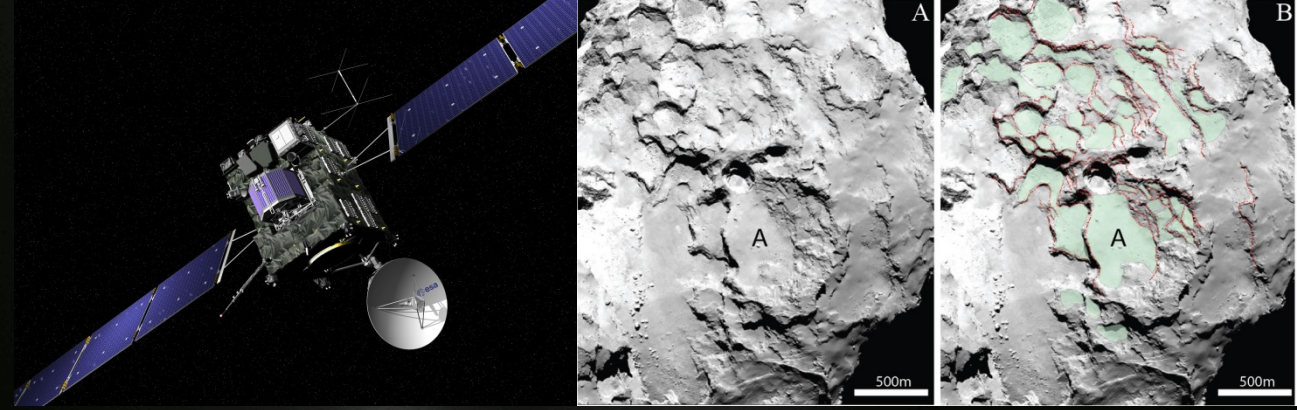
- Drag free orbit and attitude control of $10^{-14} \text{ m}/(\text{s}^2 \cdot \text{Hz}^{0.5})$ with cold gas thrusters
- 2 test masses as inertial sensors on board
- Satellite mass: 1 900 kg
- L1 –Lissajous (Lagrange-Orbit)
- Highly stabilised laser systems

DLR: The LISA Pathfinder Technology Package (LTP)

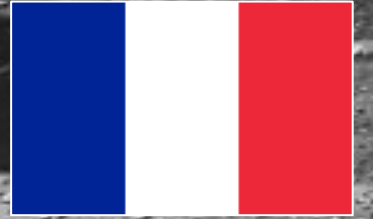
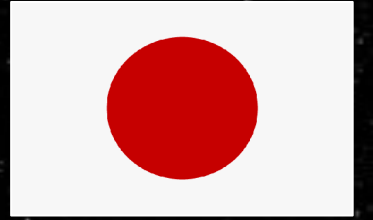


Ongoing Success Story Rosetta

- Rosetta ESA cornerstone mission to Churyumov Gerasimenko 67/P
- Rosetta/Philae instruments from DLR or with DLR participation; **Philae Lander**
- Philae landing - 12. Nov. 2014 first successful **landing(s)** on a comet



Mission Hayabusa-2



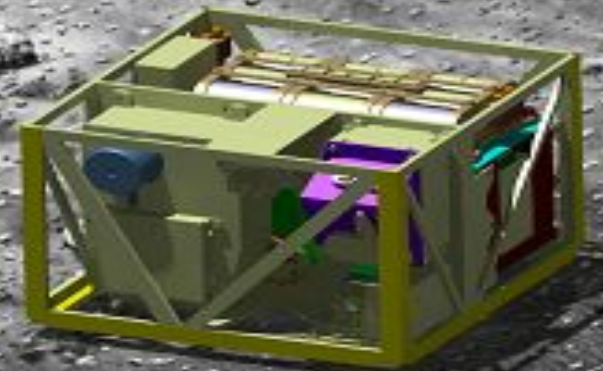
Launch: December 3, 2014

JAXA mission

DLR with CNES: MASCOT-Lander (2019)

Soil samples of asteroid 1993 JU3

Origin of life on Earth?



Exo-Mars 2016



Schiaparelli enters atmosphere

Time: 0 sec
Altitude: 121 km
Speed: 21 000 km/h

Heatshield protection during atmospheric deceleration

Time of maximum heating: 1 min 12 sec
Altitude: 45 km
Speed: 19 000 km/h

Parachute deploys

Time: 3 min 21 sec
Altitude: 11 km
Speed: 1700 km/h

Front shield separates, radar turns on

Time: 4 min 1 sec
Altitude: 7 km
Speed: 320 km/h

Parachute jettisoned with rear cover

Time: 5 min 22 sec
Altitude: 1.2 km
Speed: 240 km/h

Thruster ignition

Time: 5 min 23 sec
Altitude: 1.1 km
Speed: 250 km/h

Thrusters off; freefall

Time: 5 min 52 sec
Altitude: 2 m
Speed: 4 km/h

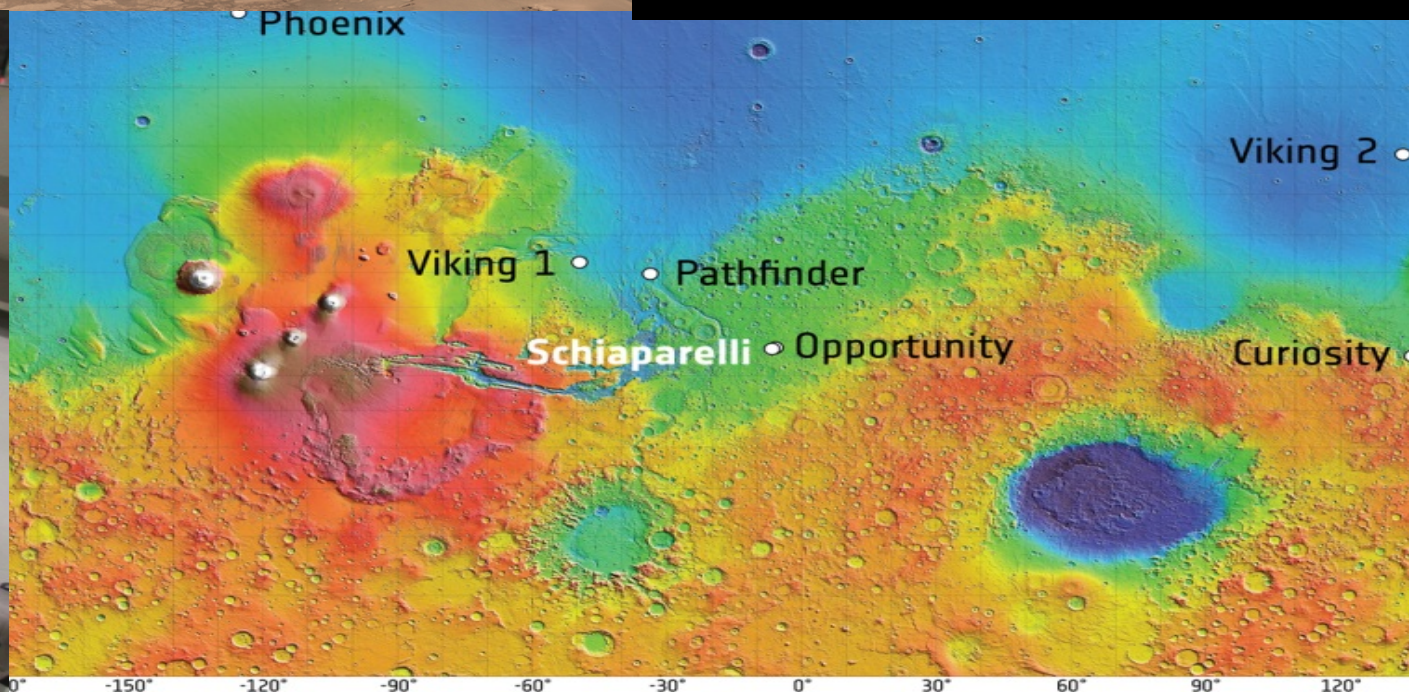
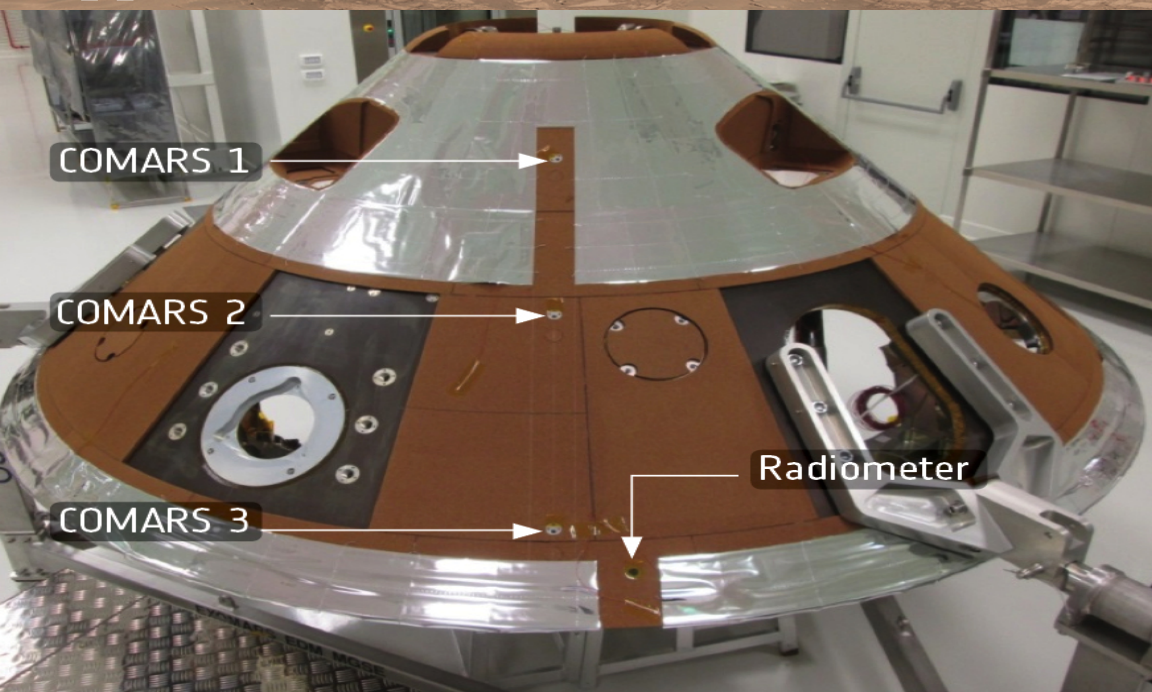
Touchdown

Time: 5 min 53 sec
Altitude: 0 m
Speed: 10 km/h

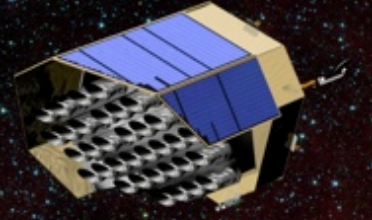
Credits: ESA/ATG medialab

European Space Agency

Launch: March 2016
Arrival on Mars: Oct. 2016
Approx. end: Dec. 2022



Space telescope PLATO 2.0 to search for a 'second Earth'



Blue Dot – Shaping Our Future

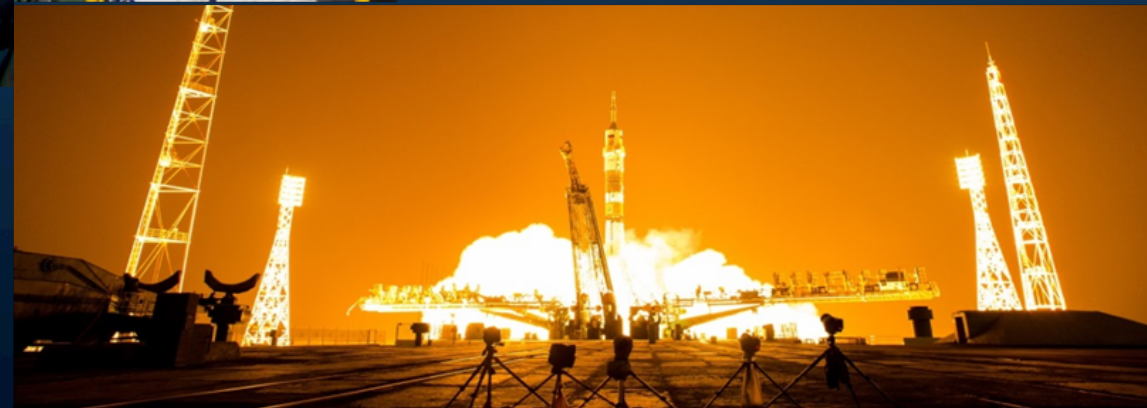


Alexander Gerst:

- ❖ Launch 28 May 2014
- ❖ Landing 10 November 2014



- Human Physiology Research
- Material Science
- Education & Earth awareness



Electromagnetic Levitator (EML)

- Innovative high-tech tool for application-oriented materials research
- Furnace for container free tests on metallic alloys
- Cooperatively developed by DLR and ESA
- In operation onboard the ISS since 2014

Scientific Impact:

- **Primary objective: Detailed understanding and optimization of metallurgical production processes on Earth**

