

## Earth Observation with the Orbital-Hub Free Flyer

Quantius, D., Kaifler, B., Slijkhuis, S., Storch, T., Romberg, O., Philpot, C., Braukhane, A., Maiwald, V., Seboldt, W., Dittus, H., Baerwalde, S., German Aerospace Center (DLR)

**General Purpose Optical Earth Observation Platform**  
Two telescopes: UV-VIS-NIR-SWIR and MWIR-LWIR (0.2-14.4  $\mu\text{m}$ ; 2° and 20° FoV; 1300 km swath)

**Atmospheric Physics**  
Passive spectrometer UV-VIS-NIR-SWIR; 1x1 km resolution; 400 km swath  
Measurement of trace gases in Mesosphere

**Pointing Platform MUSES Derivatives (Multi-User System for Earth Sensing)**  
Precision pointing and pointing knowledge; data processing

**Cassegrain Telescope Lidar Observatorium**  
Nadir telescope  $\geq 1$  m aperture receiving backscattered laser-light  
Active measurements of atmospheric trace elements

**Spacecraft (Free Flyer):**

- Launch mass: 18.7 t
- Propulsion: chemical; electrical drag compensation
- Diameter: 4.5 m
- Length: 15.4 m
- Power: 20 kW average
- Data: up to 7.2 Gbps  
6-26 Tb per orbit (optical via EDRS)

**Mission:**

- ISS orbit (ca. 450 km altitude, 56° inclination)
- Free in attitude (baseline nadir)
- Rendezvous and docking capability
- Active element for station (re-)assembly
- 10 yrs. mission life time (refuelling capability)
- Benefit for Earth observation as complement to dedicated satellites: Lower orbit altitude, variation in local time, better equatorial coverage, exchange capability of components / instruments

**Science-Elements:**

- Human-Tended Pressurized Lab (including payload airlock) for e.g.:
  - Material Sciences (e.g. MUMS)
  - Replaceable instrument components within easy reach
- External Science Platform (including robotic arm), providing mounting, power, data, cooling for e.g.:
  - Atmospheric physics (active / passive)
  - Earth observation
  - Astrobiology / Astronomy
  - Technology demonstration

A nearly full Moon shines brightly on the Earth's atmosphere on Mar.8, 2015 enticing astronauts aboard the International Space Station to snap this background image as part of the Earth Observation program during ISS expedition 42. It was catalogued by Johnson Space Center of the United States National Aeronautics and Space Administration (NASA) under Photo ID: ISS042-E-307643

In order to perpetuate the achievements of the International Space Station (ISS), DLR has conducted a thorough Post-ISS concept utilizing expert knowledge in a series of Concurrent Engineering studies. The outcome design, referred to as Orbital-Hub, is based on a small crewed LEO platform including a human-tended Free Flyer and is centered on financial feasibility and user needs in the frame of human spaceflight. Besides diverse use cases for the Orbital-Hub, like scientific and commercial  $\mu\text{g}$  application, exploration and technology demonstration, one application area comes from the Earth observation and climate measurement community. The Orbital-Hub's Free Flyer could serve as an observation platform for passive and active atmospheric physics and for optical Earth observation in order to monitor trace gases, aerosols, greenhouse gases, hot spots and analyzing the dynamic of our Earth's atmosphere.