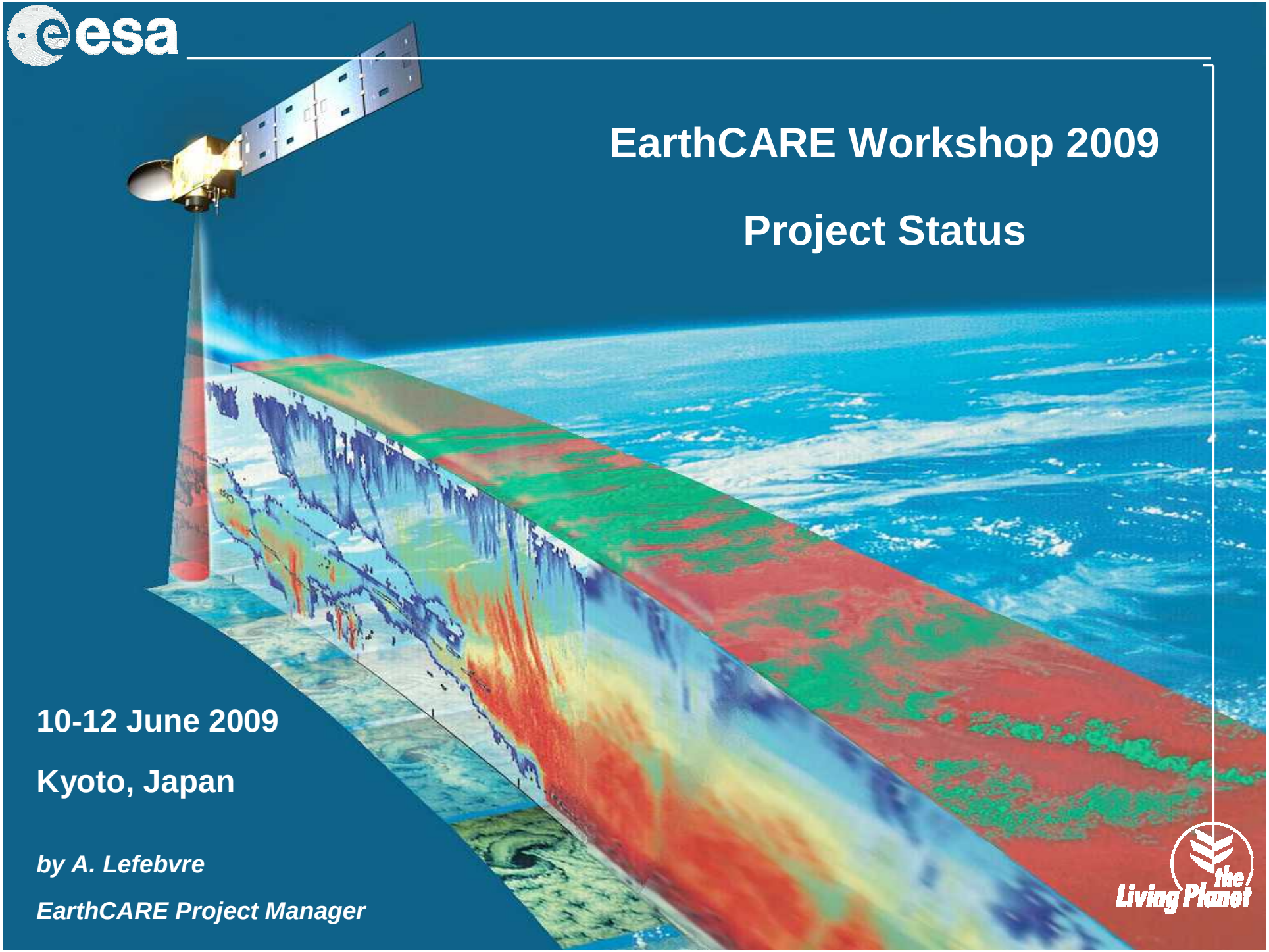


EarthCARE Workshop 2009

Project Status

10-12 June 2009

Kyoto, Japan

by A. Lefebvre

EarthCARE Project Manager

Programmatic Status In Europe - Context

- EarthCARE (Earth Clouds, Aerosols and Radiation Explorer)
  - Part of ESA Living Planet Program (ESA SP-1234)
  - ESA EO 6th Earth Explorer Mission (3rd Core Mission after GOCE and ADM-AEOLUS)
  - Implementation in cooperation with JAXA (Cloud Profiling Radar)
- Key Elements for EarthCARE selection:
  - Addresses fundamental issue of Climate Regulation
  - Need of better understanding of the interactions between clouds, radiative and aerosols processes
  - Synergetic approach using Doppler Cloud-Radar, Lidar, Multi-Spectral Imager and BroadBand Radiometer
- Mission Reference is ESA SP-1279(1) Report for mission selection with its Technical and Programmatic Annex.
- Approved by ESA-PBEO in 2004.

Programmatic Status In Europe - Industrial Team

- EarthCARE Phase B-C/D-E1 industrial contract with Astrium-GmbH signed end-May 2008 at ILA Berlin in the presence of German Chancellor Angela Merkel

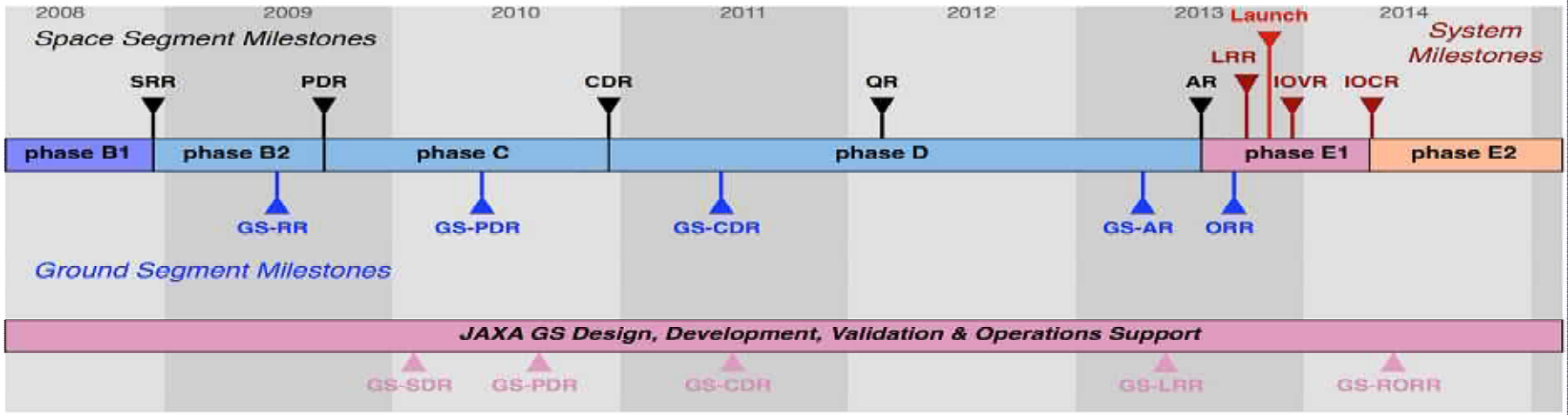
- Industrial Core Team:
  - Spacecraft Prime: Astrium GmbH (D)
  - Base-Platform: Astrium-Ltd (UK)
  - ATLID: Astrium-SAS (F)
  - BBR: SEA/RAL consortium (UK)
  - MSI: SSTL with TNO as sub-contractor (UK/NL)
- Industrial team to be completed during phase B2

Programmatic Status In Europe - Schedule

- EarthCARE Phase B: ~ 16 months
  - EarthCARE Phase B1a was dedicated to initial trade-offs, confirmation of the spacecraft and instruments configuration detailed and considered completed in July 2008.
  - Phase B1b for consolidation of spacecraft and instruments requirements and establishment of configuration baseline with associated documentation and budgets.
  - SRR held from mid-December 2008 to mid-February 2009: Action Items and Recommendations being implemented
  - Phase B2 activities have started: detailed design activities, preparation for equipment procurement, consolidation of plans and schedule.
  - Ground Segment Requirements Review is ongoing
  - PDR scheduled in September-October 2009
- EarthCARE Phase C/D: ~ 45 Months
- Launch Date: Sept/Oct 2013

Programmatic Status In Europe – Timeline

- Overall Satellite & Ground Segment Development Timeline:



Space Segment Milestones:

- **SRR** = System Requirements Review
- **PDR** = Preliminary Design Review
- **CDR** = Critical Design Review
- **QR** = Qualification Review
- **AR** = Acceptance Review
- **FRR** = Flight Readiness Review

Ground Segment Milestones:

- **GS-RR** = GS Requirements Review
- **GS-PDR** = GS Preliminary Design Review
- **GS-CDR** = GS Critical Design Review
- **GS-IR** = GS Implementation Review
- **GS-AR** = GS Acceptance Review
- **ORR** = Operations Readiness Review

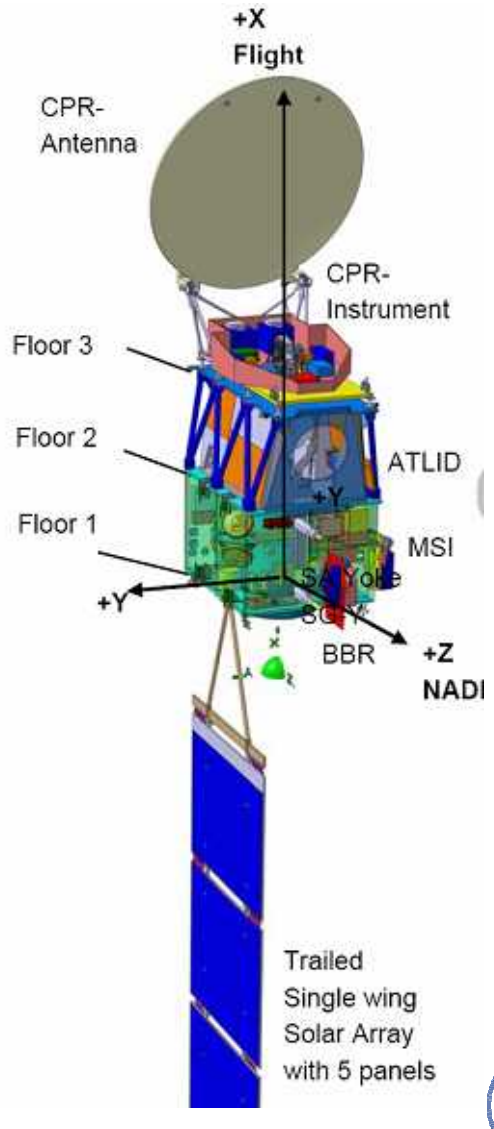
System Milestones:

- **LRR** = Launch Readiness Review
- **IOVR** = In-Orbit Verification Review
- **IOCR** = In-Orbit Commissioning Review

Technical Status – Satellite Configuration

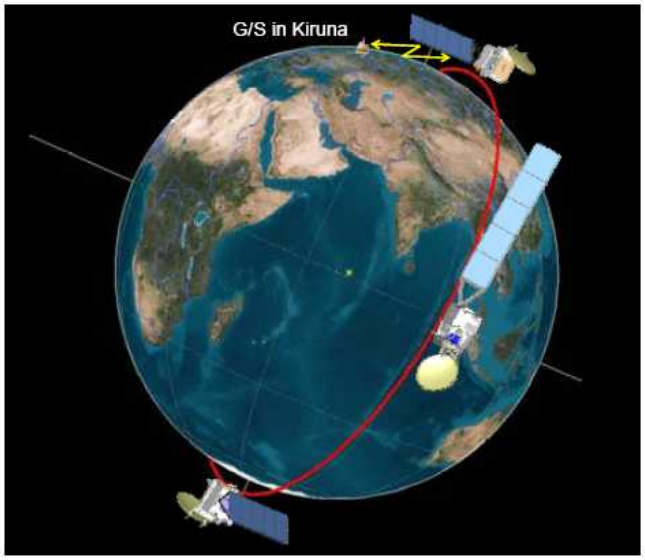
Main technical achievements made since May-08:

- Satellite Design Trade-offs
- Mission analysis
- Launcher & Satellite Accommodation
- Instrument Accommodation
- System Budget Consolidation
- Satellite specification & breakdown in instrument/subsystem/units specification



Technical Status – Mission Key-data

- **Reference Orbits & Design Cases:**
  - MLST: 13:45 - **14:00** (LTDN)
  - Cal/Val orbit @ 394.4 km / 9 days repeat cycle
  - Ops orbit @ 393.1 km / 25 days

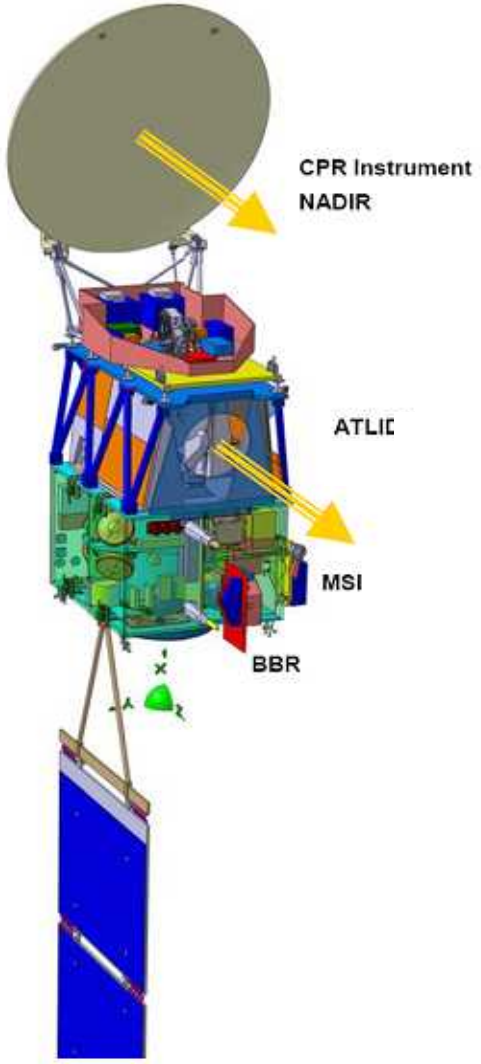


Parameter	Mean Kepler
Semi-major axis	a = 6772.57 km
Eccentricity	e = 0.001283
Inclination (sun-synchronous)	i = 97.055°
Argument of perigee	ω = 90°
Mean Local Solar Time, Descending Node	MLST = 13:45-14:00
Repeat cycle / cycle length	9 days, 140 orbits
Orbital duration	5554.3 s
Mean Spherical Altitude	394.43 km
Minimum Geodetic Altitude	399.6 km
Maximum Geodetic Altitude	427.3 km
Average Geodetic Altitude	409.7 km

Parameter	Mean Kepler
Semi-major axis	a = 6771.28 km
Eccentricity	e = 0.001283
Inclination (sun-synchronous)	i = 97.050°
Argument of perigee	ω = 90°
Mean Local Solar Time, Descending Node	MLST = 13:45-14:00
Repeat cycle / cycle length	25 days, 389 orbits
Orbital duration	5552.7 s
Mean Spherical Altitude	393.14 km
Minimum Geodetic Altitude	398.4 km
Maximum Geodetic Altitude	426.0 km
Average Geodetic Altitude	408.3 km

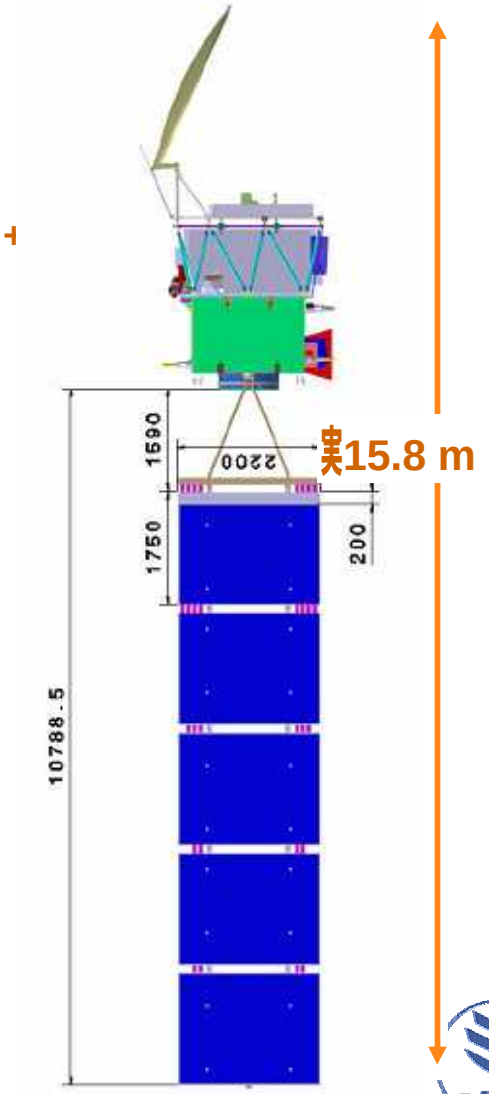
Technical Status – EarthCARE Satellite (1)

- **EarthCARE satellite developed under Astrium GmBh/D Prime**
- **3 Payloads provided by ESA :**
  - **Atmospheric Backscatter Lidar (ATLID,** led by **Astrium-SAS/F):** provides vertical profiles of aerosols and thin clouds operating in the near UV (355 nm), high-spectral resolution and depolarisation channels.
  - **Multi-Spectral Imager (MSI, led by SSTL/UK):** provides horizontal structure of clouds and aerosols - 7 channels (from Visible to Thermal IR), 150 km swath, 500 m pixel
  - **Broadband Radiometer (BBR, led by SEA/UK):** provides top of Atmosphere Broad Band radiances - 2 channels (Short WL/Total WL), 3 views (nadir, fore and aft)
- **1 Payload provided by JAXA /NICT:**
  - **Cloud Profiling Radar (CPR):** provides vertical profile of liquid and ice water clouds - operating at 94 Ghz with a 2.5 m aperture, sensitivity -36 dBZ, 400 m vertical resolution, 1 m/s Doppler capability.
- **Base Platform (led by Astrium Ltd/UK)**
  - CFRP structure & Thermal PF
  - Propulsion Subsystem & Power Generation & Harness
- **Platform Avionics (by Astrium-GmBh/D)**
  - Data Handling & SW & Communications
  - AOCS
  - Power Distribution & Storage

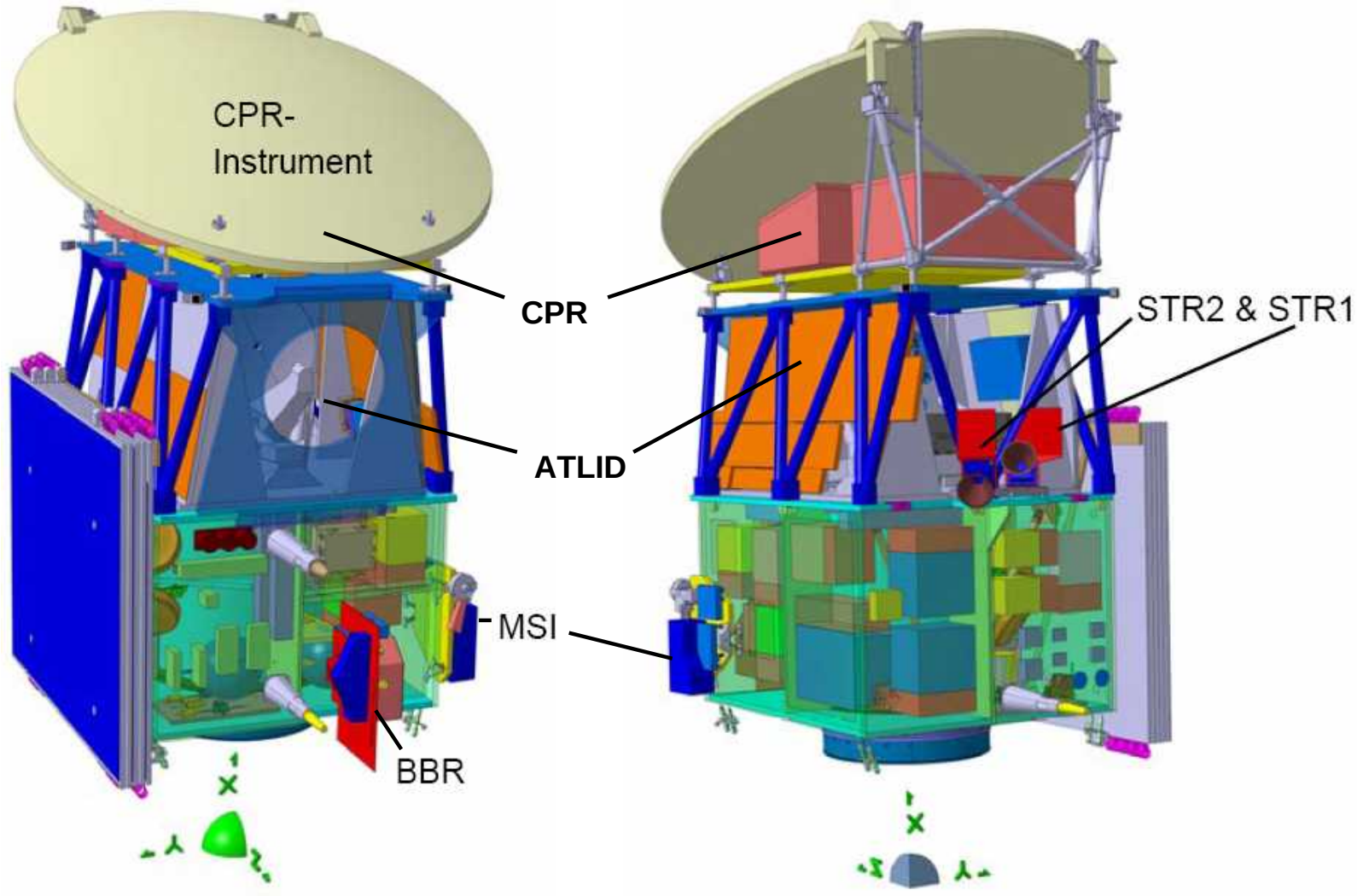


Technical Status – EarthCARE Satellite (2)

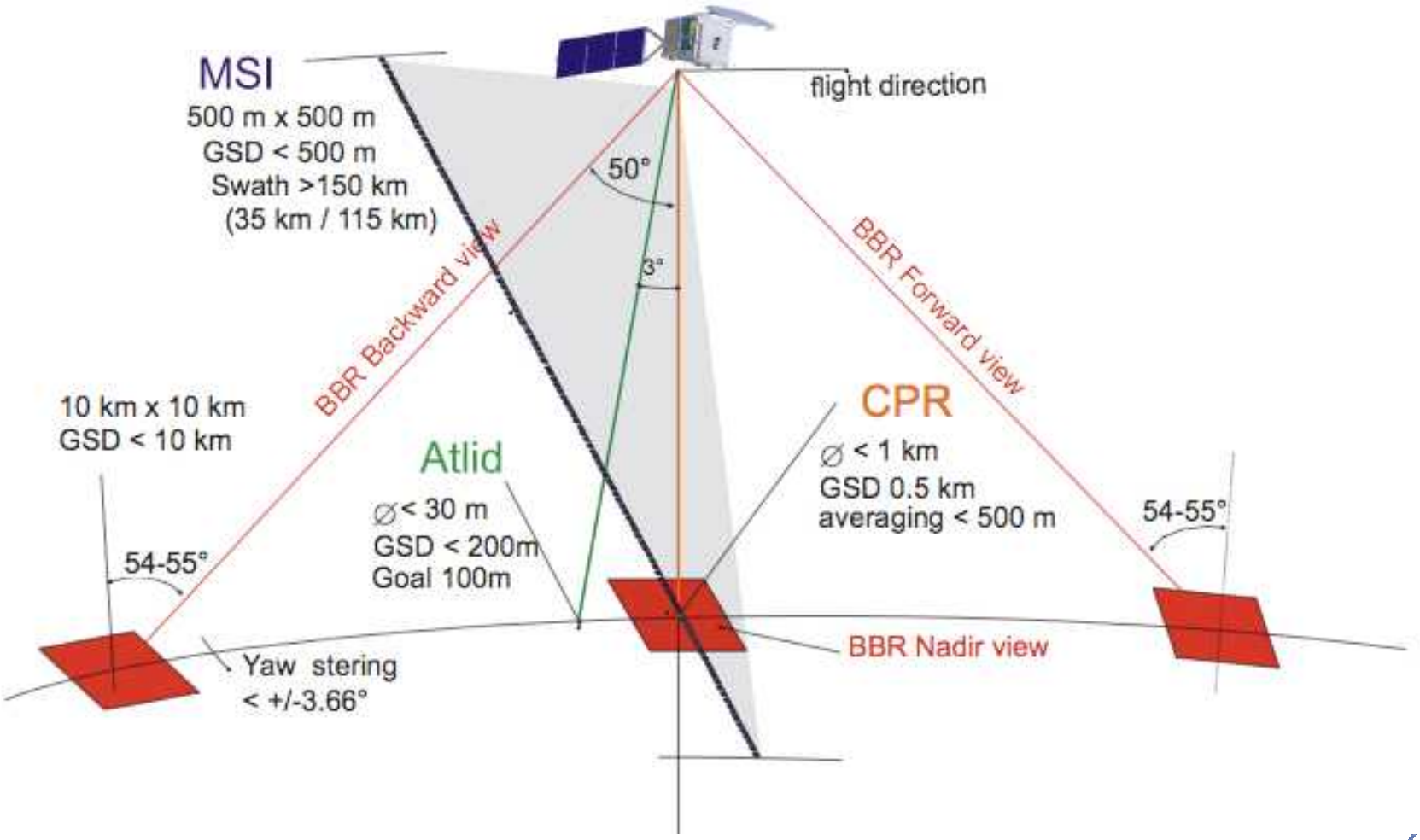
- **Mission Lifetime:** 3 years (incl. 6-month commissioning) + 1 year fuel
- **Mission Orbit and Satellite Attitude**
  - Orbit type: sun-synchronous, DN 13:45-**14:00**
  - Mean spherical altitude: 393 km (nominal) / 394.4 km (Cal/Val)
    Inclination: 97 °
  - Repeat cycle (nom./cal.): 25 / 9 days
  - Attitude control: 3-axis stabilised, yaw-steering control
- **Mass**
  - Dry mass: **1718 Kg**
  - Total launch mass (incl. 236 kg N2H4 propellant): **1954 kg**
- **Power**
  - Deployable solar array, GaAs triple junction cells
  - Solar array power (EOL): 3400 W
  - Li-ion battery (nom. capacity): 255Ah
  - Power consumption: 1522 W (nom.) / 1000W (safe mode)
- **Communication Links**
  - Generated data rate average: 15.6 kbps (HK) & 2.5 Mbps (Sci)
  - X-Band downlink (for science data): 150 Mbps
  - S-Band (for control & monitoring):
    - uplink: 64kbps
    - downlink (w/wo ranging): 128 kbps / 1 Mbps



Technical Status – EarthCARE Satellite (3)

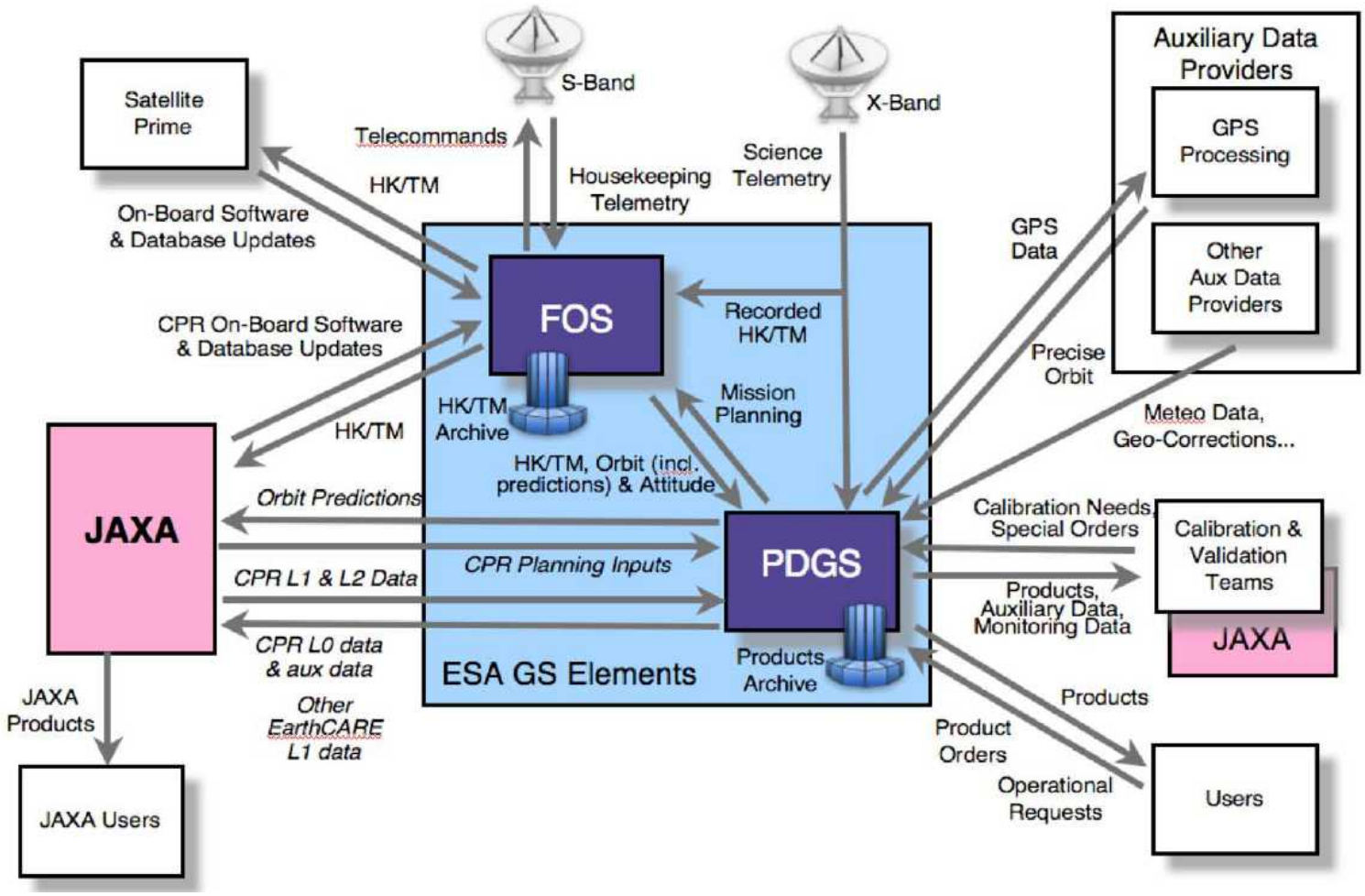


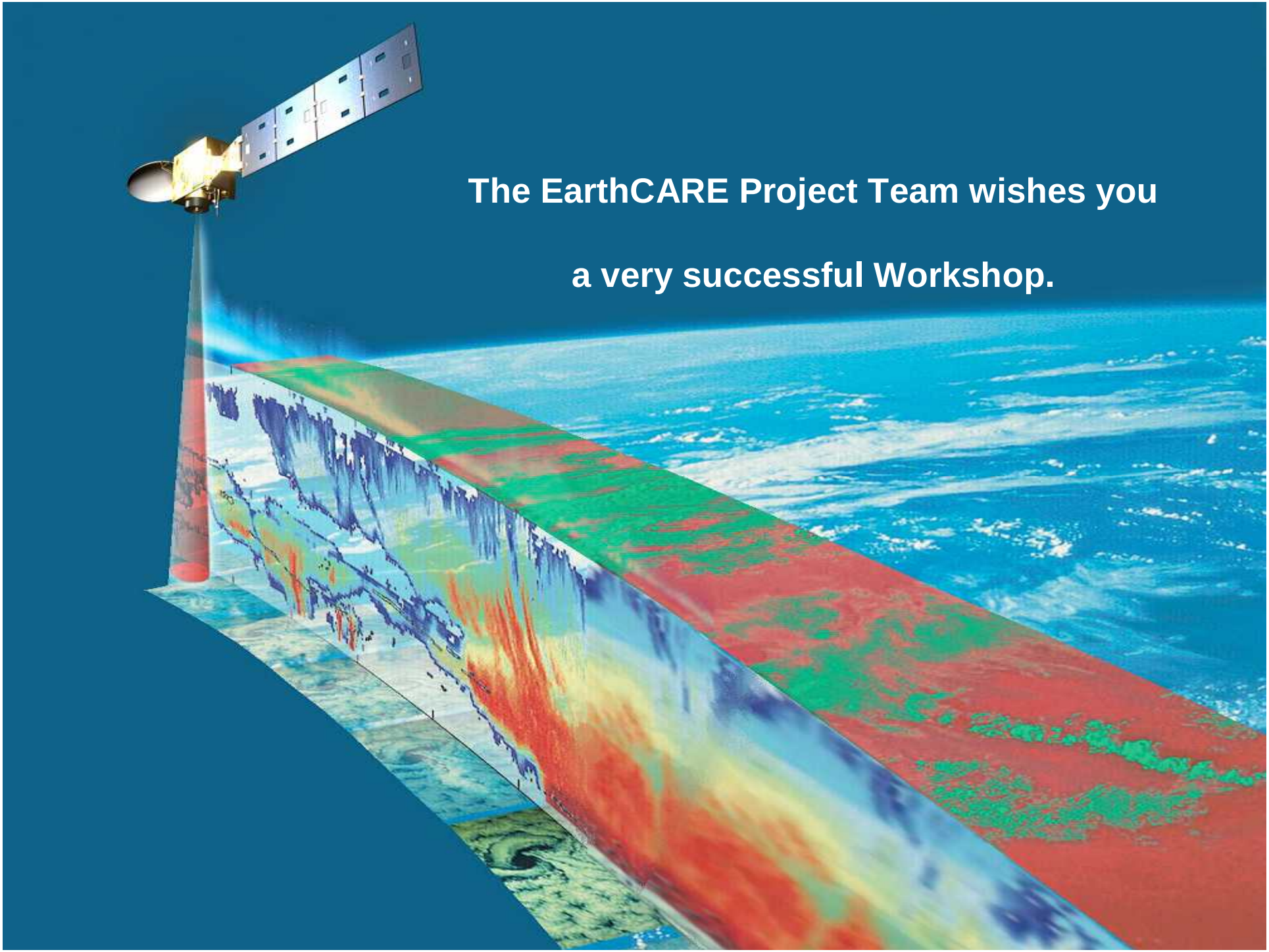
Technical Status – Instrument Pointing Geometry



Technical Status - Ground Segment Architecture

Ground segment concept & architecture as discussed – and preliminary agreed - with JAXA and ESOC/ESRIN:




The EarthCARE Project Team wishes you
a very successful Workshop.