



Overview and Status of the Landsat 9 Mission

Landsat 9 GOWG #2
1 October 2019

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The Landsat 9 Project is jointly managed by NASA & USGS

NASA builds, launches, and performs on-orbit checkout



USGS manages the ground stations, conducts mission operations, and processes and distributes the data



USGS Earth Resources Observation and Science (EROS) Center, Sioux Falls, SD



Landsat 8 integration, launch, and separation from rocket

Landsat 9 Mission Overview



Mission Objectives

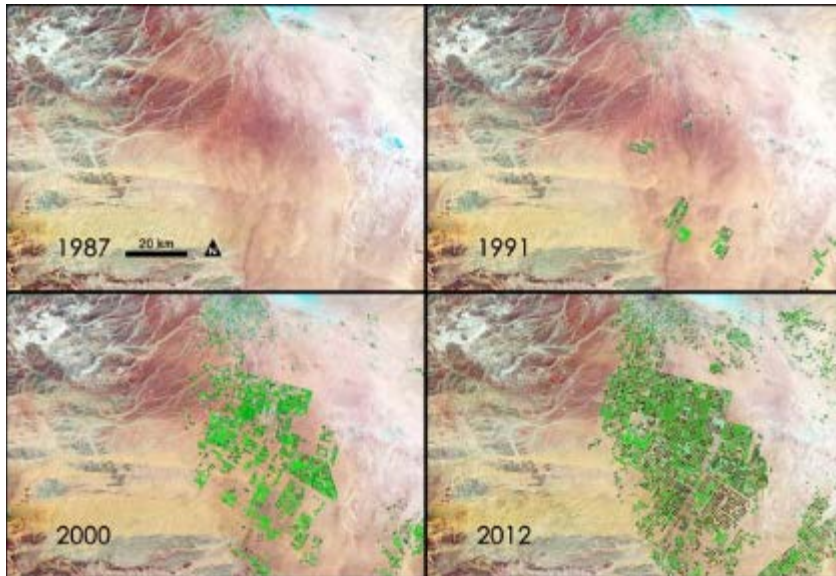
- Provide continuity in multi-decadal Landsat land surface observations to study, predict, and understand the consequences of land surface dynamics
 - Core Component of Sustainable Land Imaging program

Mission Team

- NASA Goddard Space Flight Center (GSFC)
- USGS Earth Resources Observation & Science (EROS) Center
- NASA Kennedy Space Center (KSC)

Mission Parameters

- **Single Satellite, Mission Category 1, Risk Class B**
 - 5-year design life after on-orbit checkout
 - At least 10 years of consumables
- **Sun-synchronous orbit, 705 km at equator, 98° inclination**
- **16-day global land revisit**
- **Partnership: NASA & USGS**
 - NASA: Flight segment & checkout
 - USGS: Ground system and operations
- **Category 3 Launch Vehicle**
- **Launch: Target LRD - December 15, 2020**
Management Agreement - January 2021
Agency Baseline Commitment – November 2021



Increase in pivot irrigation in Saudi Arabia from 1987 to 2012 as recorded by Landsat. The increase in irrigated land correlates with declining groundwater levels measured from GRACE (courtesy M. Rodell, GSFC)

Instruments

- **Operational Land Imager 2 (OLI-2; Ball Aerospace)**
 - Reflective-band push-broom imager (15-30m res)
 - 9 spectral bands at 15 - 30m resolution
 - Retrieves data on surface properties, land cover, and vegetation condition
- **Thermal Infrared Sensor 2 (TIRS-2; NASA GSFC)**
 - Thermal infrared (TIR) push-broom imager
 - 2 TIR bands at 100m resolution
 - Retrieves surface temperature, supporting agricultural and climate applications, including monitoring evapotranspiration

Spacecraft (S/C) & Observatory Integration & Test (I&T)

- Northrop Grumman Innovation Systems (NGIS), formerly Orbital ATK (OA)

Launch Services

- United Launch Alliance (ULA) Atlas V 401

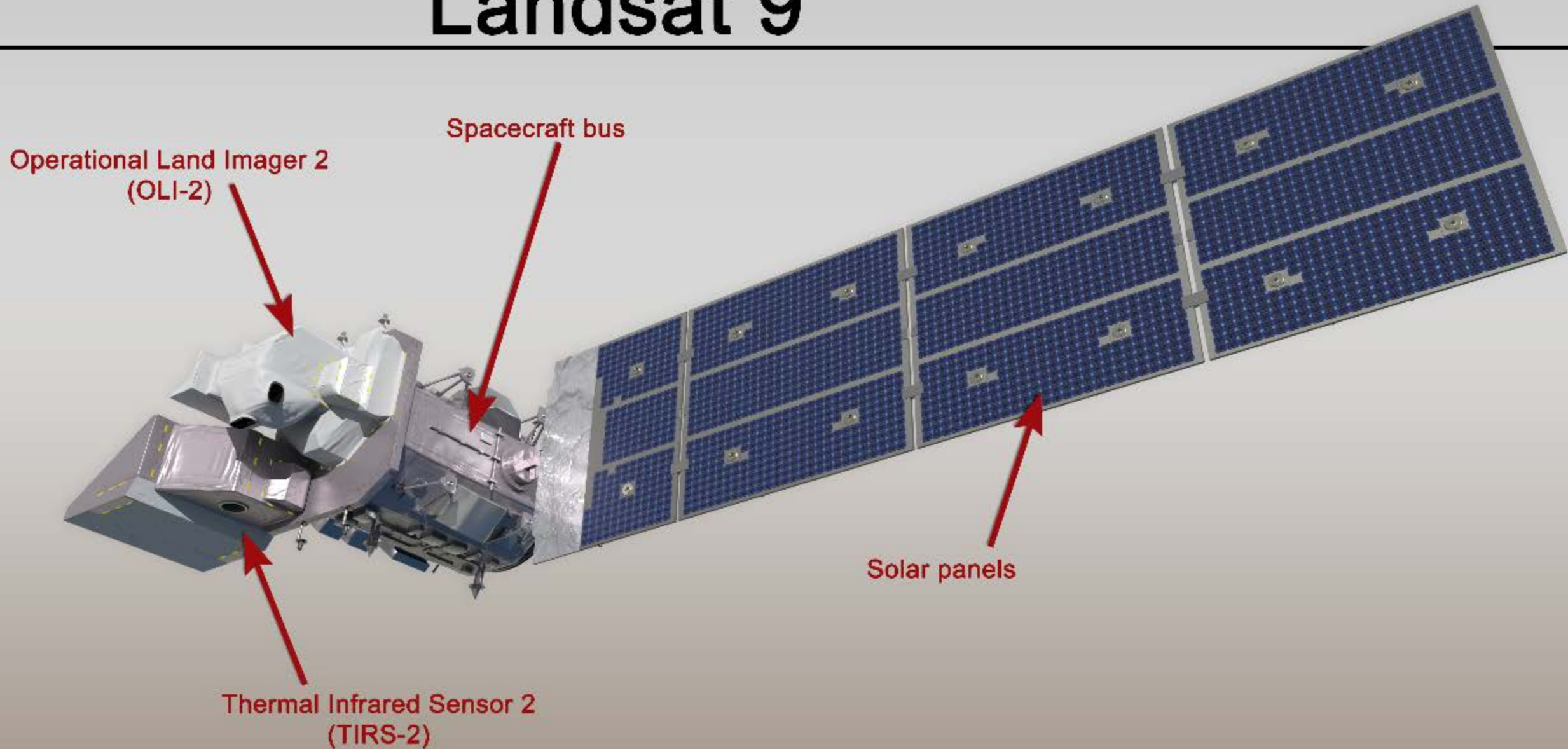
Mission Operations Center (MOC) and Mission Operations

- General Dynamics Mission Systems (GDMS)

Landsat 9 Mission Team Member Locations



Landsat 9

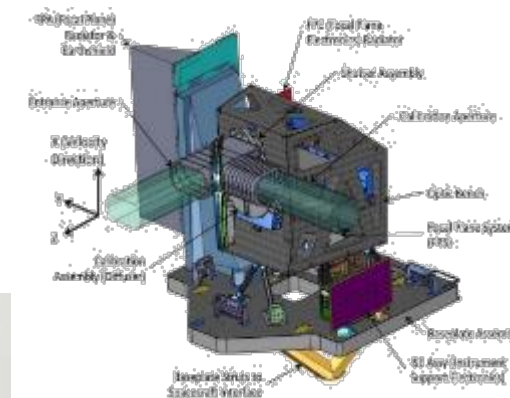


Operational Land Imager 2 (OLI-2) Status



OLI-2 is, to the extent possible, a copy of OLI for Landsat 9 to maintain data continuity with Landsat 8 and to minimize cost and risk

- Contract with Ball Aerospace in Boulder CO established in December 2015
- Successful OLI-2 Critical Design Review in August 2016
- Instrument completed spatial testing in August 2018 and calibration testing in December 2018
 - Excellent instrument performance
- Instrument has completed environmental testing
- Pre-ship Review (PSR) held July 2019
- Delivered to spacecraft facility September 2019
- Successful post-ship checkout
- Ready for observatory integration



OLI-2

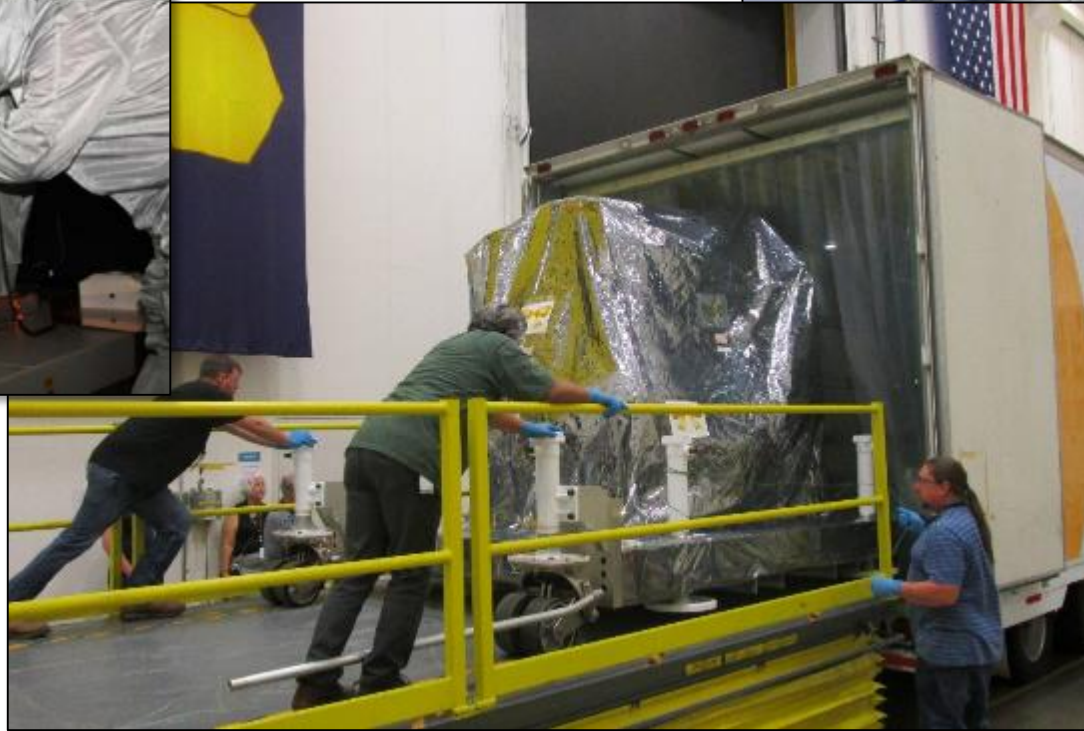


OLI-2 Hardware Glamour Shots



OLI-2 complete at Ball Aerospace

Ball Aerospace FPA Assembly Team



OLI-2 ships to the NGIS spacecraft facility in Gilbert, AZ

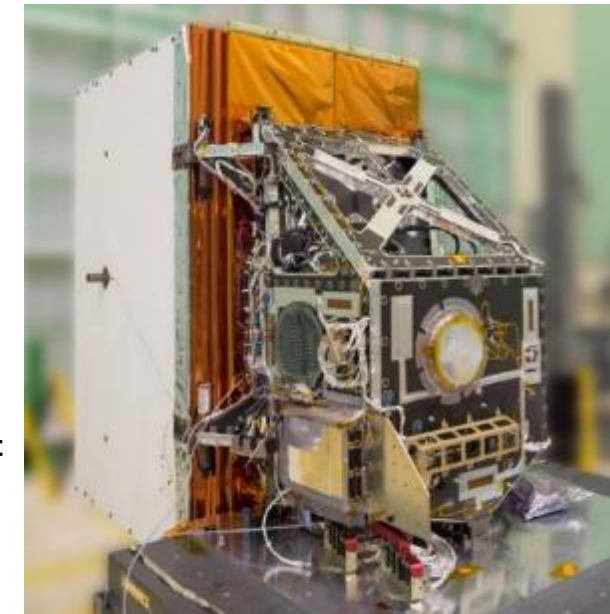
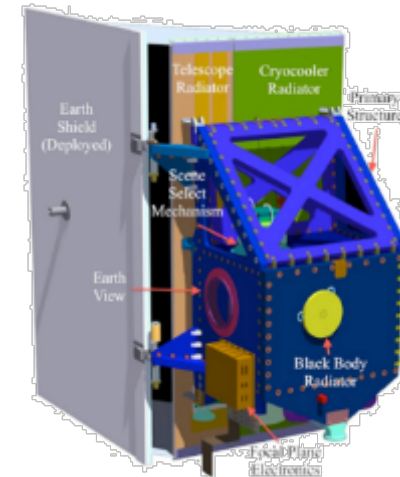
Thermal Infrared Sensor 2 (TIRS-2) Status

TIRS-2 is a rebuild of Landsat 8 TIRS except it's upgraded from Risk Class C to Class B for Landsat 9

- **NASA GSFC TIRS-2 team formed in 2015**
- **Successful TIRS-2 Critical Design Review in February 2017**
- **TIRS-2 image performance and cryogenic evaluation (TIPCE) testing completed**
- **Instrument completed performance and environmental testing at NASA GSFC**
 - Excellent instrument performance
- **TIRS-2 Pre-ship Review held in July 2019**
- **Instrument delivered to spacecraft facility in August 2019**
- **Successful post-ship checkout**
- **Ready for observatory integration**

TIRS-2 Improvements

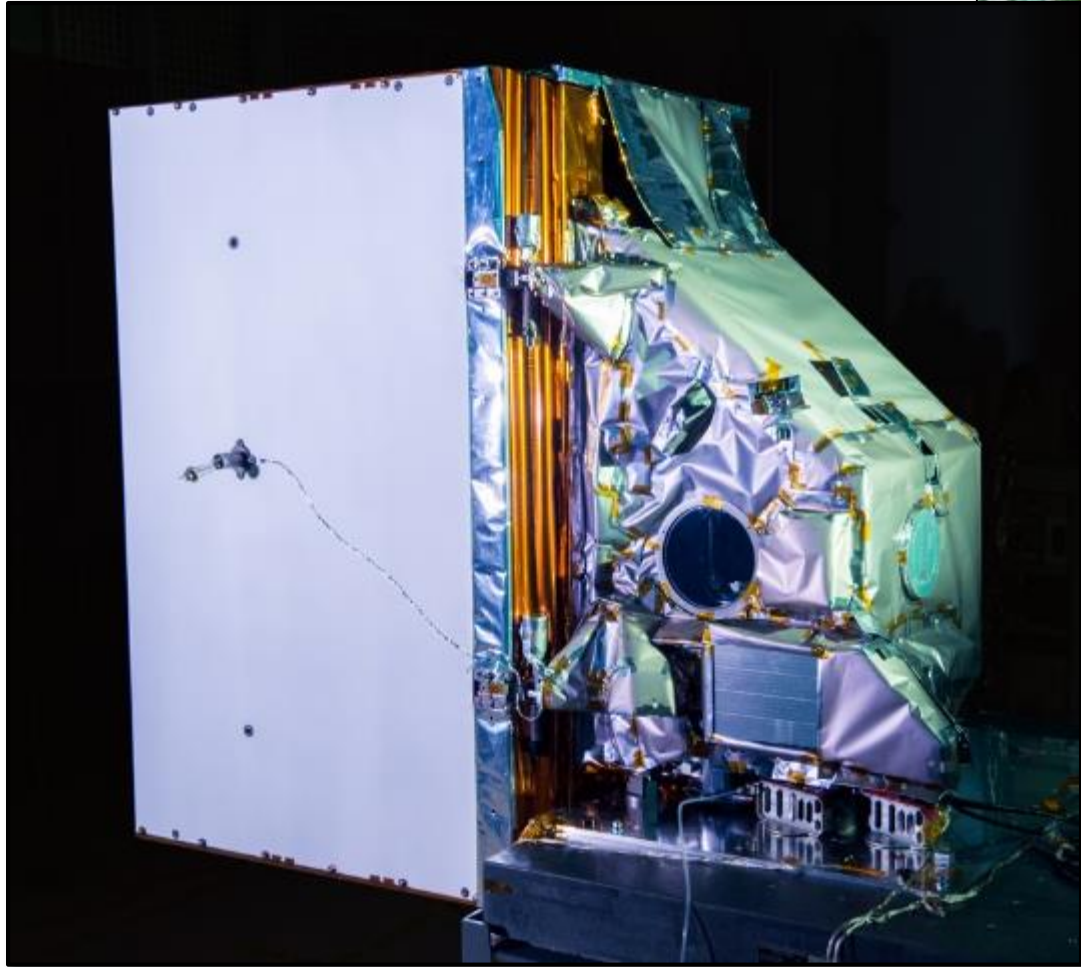
- Increased redundancy to satisfy Class B reliability standards
- Improved stray light performance through improved telescope baffling
- Improved position encoder for scene select mirror to address problematic encoder on Landsat 8 TIRS



TIRS-2 being prepared for blanketing at NASA/GSFC



TIRS-2 Hardware Glamour Shots



TIRS-2 complete at NASA/GSFC



TIRS-2 ships to the NGIS spacecraft facility in Gilbert, AZ



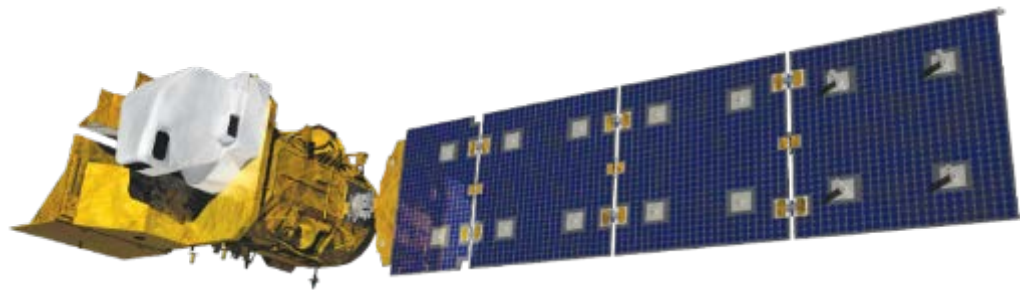
TIRS-2

NASA's Goddard Space Flight Center
Greenbelt, MD

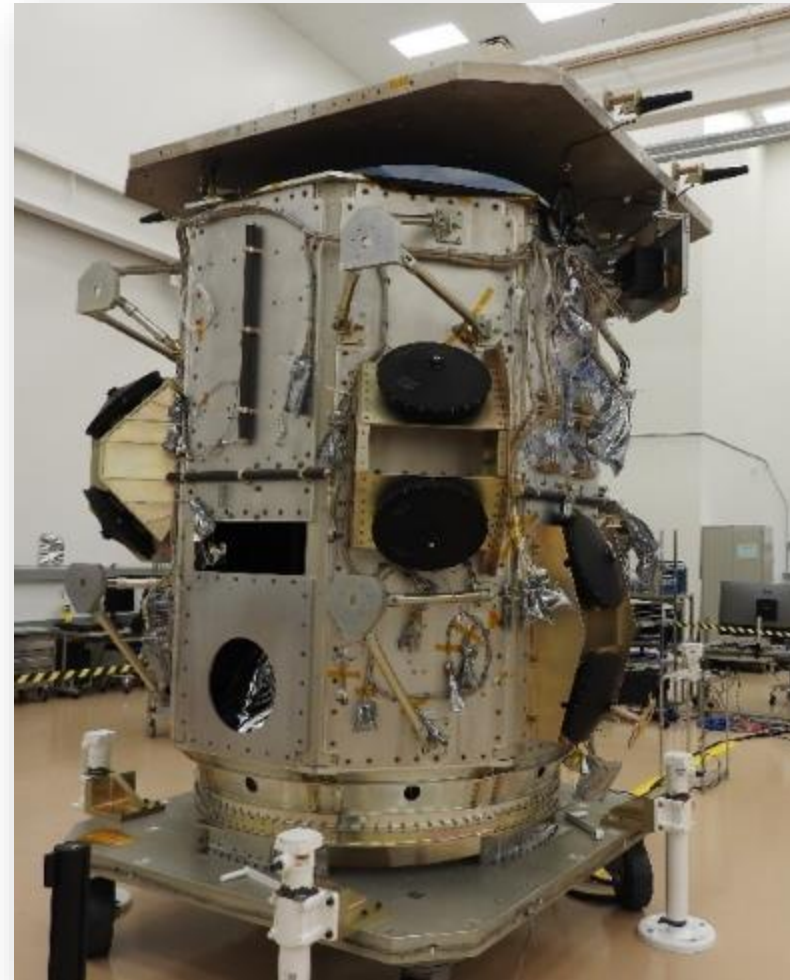
Spacecraft Bus

Landsat 9 spacecraft is similar to Landsat 8 that draws upon component heritage from ICESat-2 and JPSS-2 missions

- **Contract competitively awarded to Orbital ATK (now NGIS) in Gilbert, AZ in October 2016**
- **Spacecraft successfully completed**
 - ❑ System Requirements Review in February 2017
 - ❑ Preliminary Design Review in July 2017
 - ❑ Critical Design Review in February 2018
- **Spacecraft bus integration nearing completion**
 - ❑ Spacecraft performance testing began in September
 - ❑ Last flight electronics boxes expected to arrive this winter
- **Instrument Integration Readiness Review planned for October**



Spacecraft Hardware Glamour Shots



Landsat 9 spacecraft bus being assembled at Northrop Grumman Innovation Systems in Gilbert, AZ

USGS Landsat 9 Ground System



➤ Landsat Multi-satellite Operations Center (LMOC)

- ❑ Contract for LMOC/bLMOC development and Flight Ops Team awarded to General Dynamics Mission Systems (GDMS) in June 2017
- ❑ Landsat Mission Operations (LMO) contract provides Landsat 8 and Landsat 9 MOC development and FOT services
- ❑ Landsat Multi-satellite Operations Center (LMOC) and bLMOC facilities at GSFC

➤ Ground Network Element (GNE)

- ❑ Landsat Ground Network (LGN) stations provide X- and S-band communications with the Observatory
- ❑ LGN stations in Sioux Falls, SD; Fairbanks, AK; and Svalbard, Norway
- ❑ Neustrelitz, Germany and Alice Springs, Australia for use after commissioning
- ❑ Data Collection and Routing Subsystem (DCRS) gathers mission data from LGN stations into complete intervals to transfer to the DPAS

➤ Data Processing and Archive System (DPAS)

- ❑ Provides data ingest, storage and archive, image assessment, product generation, and data access and distribution
- ❑ Includes scope to integrate the Landsat 4-8 Level-2 algorithms into the operational system
- ❑ DPAS facility at USGS EROS Center



GSFC, Greenbelt, MD



EROS, Sioux Falls, SD

Landsat 9 Mission Status Summary



➤ Overall, project is healthy and on course

- ❑ Instrument development continues to be a huge success
 - » Performance of OLI-2 and TIRS-2 is excellent
 - » Both instruments delivered to NGIS for observatory integration
- ❑ Spacecraft bus integration is nearing completion
 - » Some schedule challenges
- ❑ USGS ground/operations development in excellent shape
- ❑ Launch services in excellent shape
- ❑ Integrated mission testing is getting underway

➤ Project is prepared for Mission I&T

- ❑ Added significant horsepower to project team

➤ Drawing heavily from successful LDCM experience & lessons learned

➤ Coordination between NASA and USGS continues to be extremely tight

➤ Continue to target December 15, 2020 LRD, but will be challenging