Small Instruments

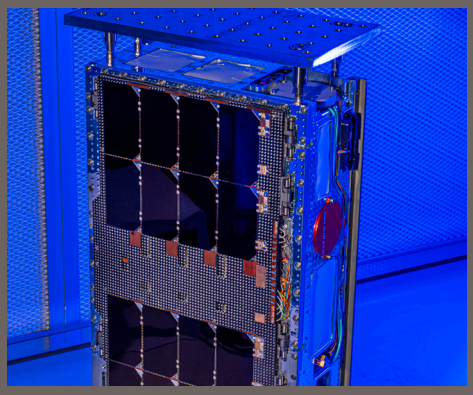
BAE Systems is at the forefront of miniaturizing instruments for air and space-based applications, offering new, affordable solutions to our customers while continuing to deliver the high-quality data they need to perform their missions.

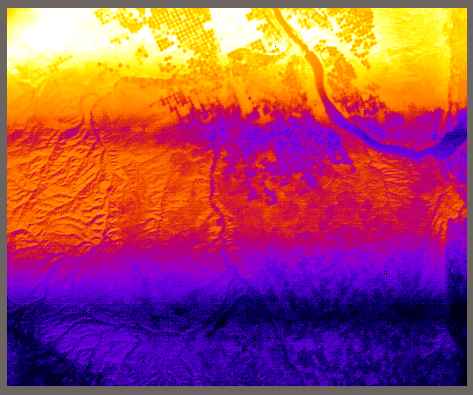
Compact Hyperspectral Prism Spectrometer (CHPS)

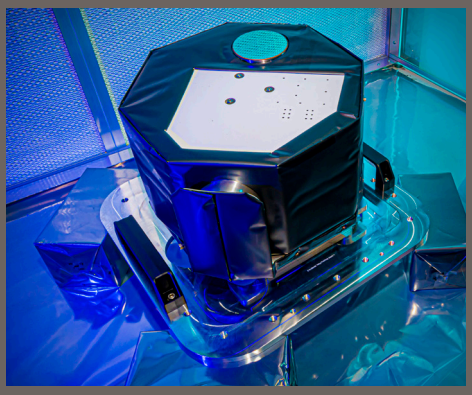
BAE SYSTEMS

Smaller Size, Same Results

Just as consumer technologies, such as computers and cell phones, have gotten smaller over the years, the same is happening in the aerospace industry. Customers seek systems capable of delivering scientifically-significant data at a fraction of the cost and size. Leveraging our heritage in sensor and instrument development, we are aligning our investments with customer needs to develop and deliver smaller, more capable technologies that meet the needs of tomorrow's missions.







Left image: CIRiS Spacecraft; Middle image: CIRiS image in three spectral bands of the Columbia River near Hermiston, Oregon; Right image: L-CIRiS instrument

CIRiS

The Compact Infrared Radiometer in Space (CIRiS) instrument collects highly calibrated infrared images of the Earth and atmosphere from a 6U spacecraft, which is about the size of a shoe box. Funded through NASA's In-Space Validation of Earth Science Technologies (InVEST) program, CIRiS demonstrates the ability of new cubesat-compatible, miniaturized instruments to return highly calibrated data for scientific and operational applications. CIRiS deployed from the International Space Station in January 2020. The data collected by CIRiS is helping scientists better understand cloud phenomena and conditions prior to extreme storms and also generates maps to show variations in drought and moisture across land.

For on-orbit calibration, CIRiS carries two flat-panel carbon nanotube sources with performance that equals or exceeds older, bulkier technology. CIRiS' next-generation uncooled infrared imaging detector delivers the required sensitivity to scene radiance without the need of a cryocooler – this reduces the power draw, volume, complexity and system risk. Weighing only 1.8 kg (3.6 lbs), the instrument's small size and weight dramatically reduces the cost of launch.

L-CIRiS

Following the success of the CIRiS program, we adapted the instrument for the NASA Artemis program. Lunar-CIRiS (L-CIRiS) will study the mineral composition, temperature and other surface and sub-surface characteristics of the Moon. L-CIRiS will be a payload aboard one of the robotic moon landers to be provided through NASA's Commercial Lunar Payload Services (CLPS) initiative.

A multi-spectral infrared imaging radiometer, L-CIRiS will produce images in the infrared region of the electromagnetic spectrum. Further processing will reveal features at never-before-seen scales at less than 1 cm across. Data from L-CIRiS will support lunar geological studies, as well as preparation for future lander, rover and astronaut missions by determining the density and compactness of lunar soil. As a candidate for landing near the lunar south pole under the CLPS program, L-CIRiS will potentially go where no astronaut has been before. This will support NASA's long-term lunar ambitions.

Like CIRiS, L-CIRiS incorporates miniaturized, high performance, on-board calibration systems that greatly increase the scientific value of the data they acquire. Features of L-CIRiS specifically added for lunar operation include a mechanism for panoramic scanning of the lunar scene and an enclosure to regulate the instrument's temperature while on the Moon.

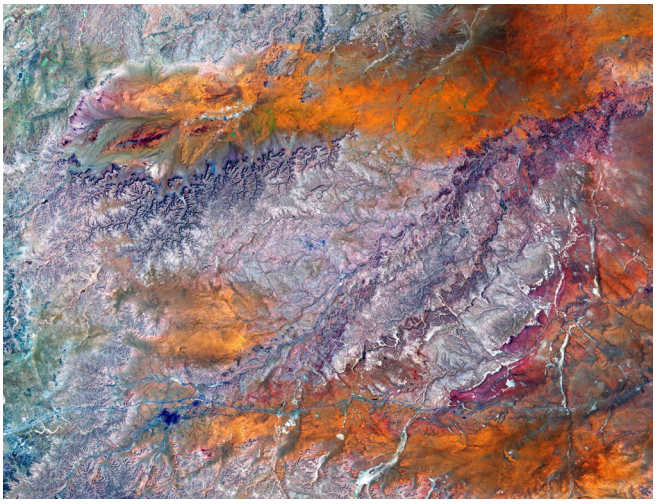
Sustainable Land Imaging

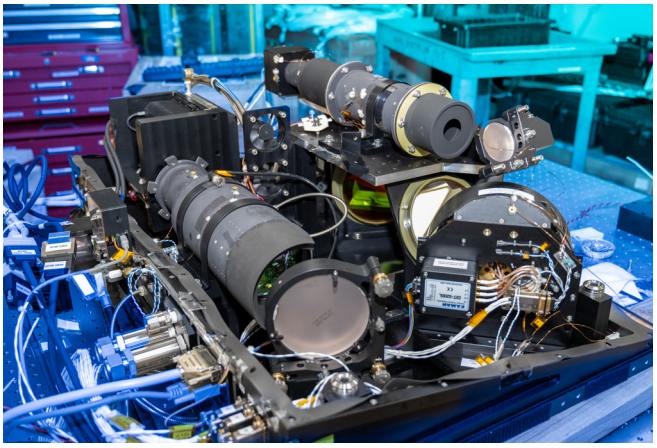
For decades, Landsat satellites have provided essential scientific measurements to help the nation make informed decisions about natural resource management.

The instruments on Landsat satellites have evolved significantly over the years, with the BAE Systems-built Operational Land Imager (OLI) on Landsat 8 and OLI-2 for Landsat 9. Instrument innovation is continuing under NASA's Sustainable Land Imaging-Technology (SLI-T) program. SLI-T has yielded a partnership with industry to design and demonstrate the Landsat instruments of the future, focusing on reducing size and cost and incorporating emerging technologies.

With study funding from the SLI-T program, BAE Systems developed and flight tested two land imaging technologies with significantly reduced size and mass: the Compact Hyperspectral Prism Spectrometer (CHPS) and the Reduced Envelope Multi-Spectral Imager (REMI). Through continued SLI-T funding, REMI (only visible short wavelength infrared) is being extended to collect both short and long wavelength infrared in a single instrument—Reduced Envelope Multispectral Infrared Radiometer (REMIR). BAE Systems has two additional SLI-T projects focused on calibration, TransCal and LandCalSat Breadboard (LCS-B). TransCal is an innovative on-board calibration approach using Polymer Dispersed Liquid Crystal (PDLC) material to continue precise solar diffuser based radiometric calibration. The second project, LandCalSat Breadboard (LCS-B), demonstrates the capability of a single sensor with appropriate resolution both spatially and spectrally to bridge the spatial resolution gap between low resolution, radiometrically calibrated observations designed for climate applications and higher-resolution land imaging sensors.

As the provider of Landsat's current Operational Land Imager instruments, we are leveraging our expertise in Earth observation technologies, radiometric cross-calibration and small spacecraft development to enable a more flexible and sustainable next-generation Landsat architecture.





Left images: (from top to bottom): Credit: NASA, Landsat 8 with OLI, the transformative power of water, wind and gravity in Iraq's Ga'ara Depression; REMIR (under development) extends the capability of REMI into longwave IR; Right Image: OLI-2

SMBA

We are executing a Phase A study to develop a Sounder for Microwave-Based Applications (SMBA). SMBA is part of NOAA's Near Earth Orbit Network (NEON) program dedicated to developing the next generation of low Earth orbit (LEO) environmental satellites. SMBA will play an important role in maintaining continuity of atmospheric temperature and humidity sounding data. This information is critical for operational weather models to improve early warning of extreme weather events.

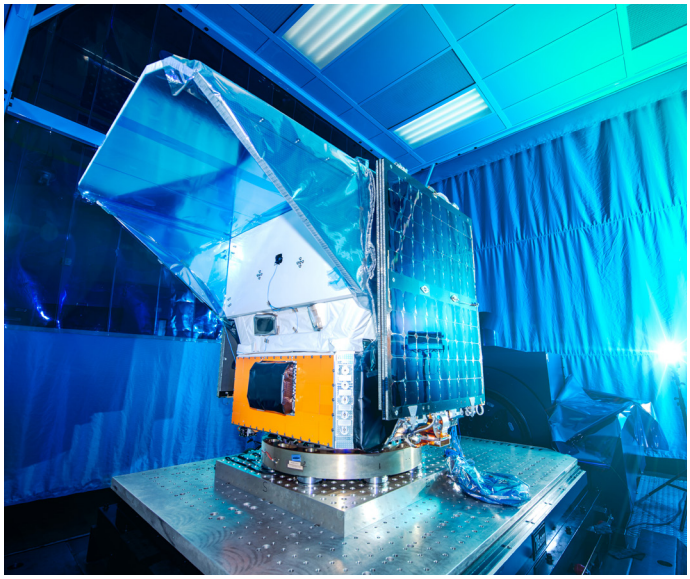
MethaneSAT

We developed the high-performance instrument at the heart of MethaneSAT, a small satellite mission. Launched in 2024, MethaneSAT is designed to identify, quantify, and track sources of methane emissions around the world. The satellite will improve the scale and accuracy of global remote methane monitoring capabilities by providing high-precision mapping of emissions over large areas, giving decisionmakers valuable data to drive reductions in the future.

A 200-kilometer (124 miles) swath width coupled with high-resolution sensors makes MethaneSAT unique from other methane monitoring satellites in that it delivers methane measurements across large geographic areas and at pre-determined locations. This allows stakeholders to track area trends, while also identifying specific emission locations and rates, filling a key measurement gap between point source and global mapping satellites.

BAE Systems is responsible for designing and building the MethaneSAT instrument, as well as providing flight systems integration and testing, launch support and commissioning services. Two extremely sensitive spectrometers sit at the heart of the instrument that measure a narrow part of the shortwave infrared spectrum where methane absorbs light, allowing it to detect concentrations as low as two parts per billion.

The mission is run by MethaneSAT, LLC, a wholly owned subsidiary of Environmental Defense Fund (EDF), Incorporated, a leading international nonprofit organization.



Top image: MethaneSAT rendering; Bottom image: MethaneSAT

BAE Systems, Inc.
303-939-4000 • www.baesystems.com

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