Earth Observing One (EO-1) Celebrates 10 Years

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Launched from Vandenburg Air Force Base on November 21, 2000, the E One (EO-1) satellite is the first Earth observing platform of NASA's New I Program (NMP). The NMP developed new technologies and strategies fo ing the quality of observations for NASA's future planetary and Earth miss while reducing cost and development time. EO-1 launched with Satellite c Aplicaciones Cientifico–C (SAC-C), an Argentine Earth observing satellit onboard a *Delta-II* rocket.

The initial EO-1 orbit was slightly to the east of Landsat-7, with an equatorial crossing time one minute later than that of Landsat-7. EO-1 passed over the same ground-track as Landsat-7, one minute later, allowing for direct comparisons with the Landsat-7 sensor system. EO-1's formation-flying capability provided the basis for establishing the first *constellation* of Earth observing satellites—consisting of Landsat, EO-1, SAC-C, and Terra. This *AM Constellation* demonstrated the use of multiple observing platforms to examine electromagnetic radiation along the same ground track with different swath widths and ranges of spatial and spectral resolutions.

The EO-1 mission has proven to be highly successful in identifying technologies and techniques to be employed in future Earth observing missions. It has provided a testbed for refining specifications and expectations in the Landsat Data Continuity Mission (LDCM), and a powerful platform for investigating the power of using spaceborne spectral imaging to extract information about surface processes.

The EO-1 satellite contains two primary observing instruments supported by a variety of newly developed space technologies. The Advanced Land Imager (ALI) is a prototype for the Landsat Data Continuity Mission (LDCM) Operational Land Imager (OLI). The Hyperion Imaging Spectrometer is the first high-spatial-resolution imaging spectrometer to orbit Earth and is a prototype for procedures and products for the future NASA Decadal Survey Hyperspectral Infrared Imager (HyspIRI) mission. Even after a decade of operations, Hyperion is still the only source of spaceborne imaging spectrometer data available to the general research community.

The entire EO-1 validation mission data-gathering phase was scheduled to last one year, with the satellite having a design life of less than two years. The *Accelerated Mission* and the *Basic Mission* comprised the first two operational phases of the EO-1 validation mission. The *Extended Mission* began in February 2002 with the transfer of acquisition planning and scheduling, as well as data processing and distribution responsibilities, to the U.S. Geological Survey (USGS) Earth Resources Observation Systems (EROS) data center. Subsequently, in 2008, Goddard Space Flight Center (GSFC) resumed full responsibility for acquisition planning and scheduling.

In response to many requests for data acquisitions beyond those collected for the validation activities, NASA decided to extend the mission, making the EO-1 resources available to the larger user community. The operational flexibility of the EO-1 satellite has presented opportunities for carrying on many unique experiments to help quantitatively analyze the performance of each of the instruments. Active illumination experiments, lunar views, planetary views, and stellar views have provided the ability to assess stray-light performance as well as the radiometric and geometric characteristics of ALI and Hyperion.

The EO-1 mission has proven to be highly successful in identifying technologies and techniques to be employed in future Earth-observing missions. It has provided a testbed for refining specifications and expectations in the LDCM, and a powerful platform for investigating the power of spaceborne spectral imaging to extract information about surface processes. Since EO-1 is pointable, it has proven to be a valuable tool for monitoring catastrophic events—see example on page 26. In addition, the inherent band-to-band registration, due to the ALI chip design and platform yaw steering capability, facilitates the creation of pan-enhanced color composites.

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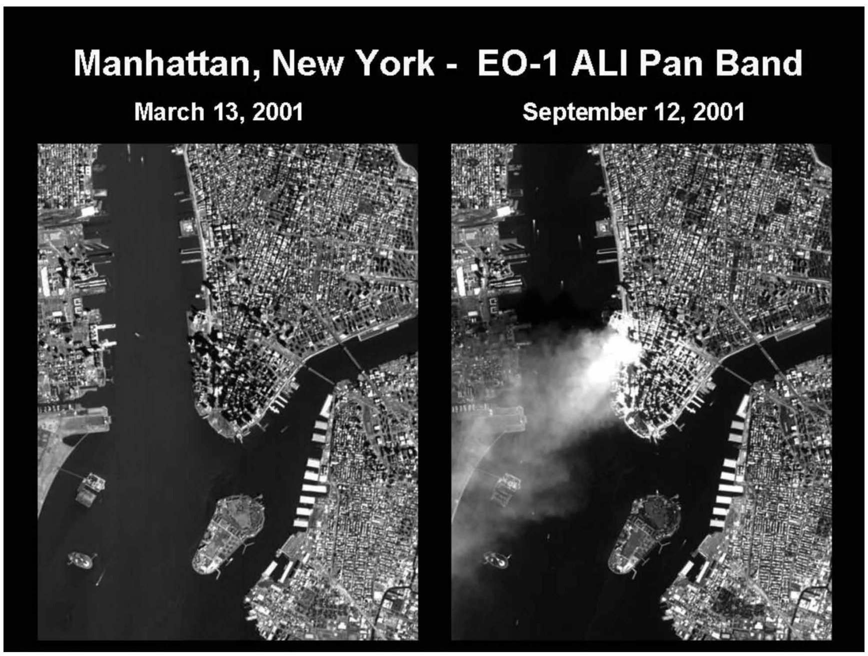
More than 50,000 images of targets all over the globe have been archived from each EO-1 instrument at EROS. Currently, 130-160 images are added to the archive each week. Hyperion data are being repetitively collected at established validation and calibration sites, in collaboration with the Committee on Earth Observing Satellites (CEOS), the Global Earth Observing System of Systems (GEOSS), and the International Spaceborne Imaging Spectroscopy Working Group (ISIS WG). EO-1's ALI scenes have routinely been collected to fill gaps in the missing Landsat-7 coverage, especially coral reef and atoll acquisitions, in support of NASA's Mid-Decadal Global Land Surveys. LDCM continues to rely on ALI as a testbed to resolve many questions regarding instrument and platform performance and calibration strategies. Researchers wishing to schedule acquisitions or order data acquired during all phases of the mission should access the EROS website at: *eo1.usgs.gov.*



The EO-1 Mission Science Office exploited EO-1 spacecraft's agility by commanding it to point to the World Trade Center on the next possible pass after the September 11, 2001 attacks. The March 13, 2001 image was drawn from the archive for comparative purposes.

The installation of onboard autonomic software onto EO-1 and the installation of ground-based Open Geospatial Consortium (OGC) SensorWeb Enablement (SWE)-compliant software have facilitated pathfinder experiments and/or demonstrations in the international disaster management community through the Group on Earth Observations (GEO) and CEOS. As a key component of the Global Flood Sensor Web Pilot, EO-1 was used extensively during the 2008 hurricane season by contributing observations to the USGS Hazards Data Distribution System (HDDS) for Hurricanes Fay, Gustav, Hannah, and Ike. EO-1 data are used by U.S. national and state disaster response agencies to improve situational awareness. Images of the flooding in Haiti were delivered to the Caribbean Disaster and Emergency Response Agency (CDERA) and were crucial to identifying the extent of the flooding in Gonaives. Going forward, the EO-1 team is leading the GEO Task—the Caribbean Flood Pilot—that will combine the use of satellite data with *in situ* measurements and local/regional infrastructure collections, in coordination with global providers and local emergency response/disaster management personnel.

The EO-1 mission has exceeded its primary goals to enable more-effective hardware and data strategies for Earth science orbital missions in the 21st century. From the onset, EO-1 has provided advanced technology capabilities, including extraordinary spacecraft agility, onboard intelligent processing, a variety of highly reliable support technologies, and unique passive optical imagery. Both the Hyperion and ALI have paved the way for future, essential Earth observing satellite missions, including LDCM planned for launch in 2012-2013, and HyspIRI. After 10 years, EO-1 is still fully functional and has enough fuel to last into 2012. After its fuel is expended, the mission can still continue data acquisitions, although the equatorial crossing time will begin to drift earlier than the current 10 AM mean local time. ■