

USGS-NASA Landsat Science Team Statement on Landsat Continuity

Prepared January 2014

Background

- Landsat Science Team (LST) developed a continuity statement at the request of the Future of Land Imaging Architecture Study Team and from NASA and USGS representatives of the Future of Land Imaging Steering Committee.
- The LST was asked to describe and prioritize the characteristics of the Landsat data record essential to data continuity.
- A continuity statement was prepared during a meeting held January 7–8, 2014 at the U.S. Department of the Interior in Washington DC.

Why Landsat continuity is important...

- Ensure the scientific integrity and objectivity of global land and climate change research.
- Ensure the continued accrual of benefits from past Landsat investments by extending the long-term record.
- Protect the investments of agencies, organizations, and businesses that rely on Landsat data to meet their objectives.
- Deliver the benefits to society for which the Landsat program was established.
- Ensure our nation's food and environmental security.

LST Continuity Definition

The LST defines Landsat data continuity as the collection, archival, and distribution of image data of the Earth's continents and surrounding coastal regions with the content, quality and coverage needed to map, monitor and assess the Earth's characteristics and its response to natural and human-induced change over time. To accomplish this, continuity includes:

- Long-term calibrated measurements that are consistent across the evolving instrument record.
- A continuous record since the initiation of observations in 1972 with no significant temporal or geographic data gaps.
- Measurements that enable backward and forward assessments of the conditions and changes in the Earth's surface. A period of overlap between missions is needed to ensure measurement consistency.
- Measurements with comparable spectral, spatial, temporal, and geographic properties that result in sufficiently consistent and accurate documentation of surface characteristic and dynamics.

Recommended Continuity Specifications

- **Data Accessibility:** Landsat data must be freely available to anyone in order to guarantee the return on investment.
- **Geographic Coverage:** Must be near-global and include continental surfaces, ice sheets, coastal regions, islands, and coral reefs imaged using the Long Term Acquisition Plans implemented with the start of the Landsat 7 mission.
- **Temporal Frequency:** Eight or 9-day coverage of the global land surface by two orbiting Landsat satellites has occurred over 2/3s of the program's history. This is the standard for continuity.
- **Latency:** Twenty-four hour turn around from acquisition to downloadable data, with capabilities for near real time access in emergencies is required.

Recommended Continuity Specifications

- **Spectral Bands:** The full set of 11 Landsat 8 spectral bands (VNIR, SWIR, TIR) collected in a near-simultaneous mode is the standard for data continuity. The LST priorities for spectral bands are from greatest priority to least priority: VNIR / SWIR, Cirrus, TIR, Enhanced blue (coastal/aerosol band), Panchromatic.
- **Spatial Resolution:** The heritage 30 m spatial resolution of the TM, ETM+, and OLI sensors has proven eminently suitable for the applications of Landsat data and the scientific objectives of the Landsat program. Continuation of the 30 m resolution for reflective bands is one of the highest priorities for the future of land imaging. The heritage 15 m spatial resolution of the ETM+ and OLI panchromatic bands is considered a maximum ground sample distance for future panchromatic images, and 120 m spatial resolution is the coarsest acceptable resolution for the TIRS thermal bands.

Recommended Continuity Specifications

- **Radiometric Calibration and Accuracy:** Radiometric accuracy and stability are essential for monitoring change over time, a major Landsat program objective and the rationale behind the goal of continuity for future land imaging. Continuity requires either an uncertainty of less than 5% with respect to absolute spectral radiance or less than 3% with respect to top-of-atmosphere reflectance in the case of images for reflective spectral bands. Continuity requires an uncertainty of less than 2% with respect to at-sensor spectral radiance in the case of thermal bands.
- **Radiometric Performance:** The LST considers the Landsat 8 radiometric performance specifications to be the continuity standard. The radiometric performance requirements of the Landsat 8 OLI and TIRS instruments were stringently specified in terms of signal-to-noise ratios (SNR's), cross-track radiometric and spectral response uniformity, coherent noise, stray light, and a number of additional characteristics.

Recommended Continuity Specifications

- **Geometric and Geodetic Accuracy and Stability:** Geometric/geodetic accuracy and stability are critical to observing change over time and other land image analyses, and the LST considers the Landsat 8 performance with respect to geometric accuracy, geodetic accuracy (registration to a cartographic project with ground control), orthorectification, band-to-band registration, and multi-temporal image-to-image registration, to be the continuity standard.