

Landsat Collection 2 Level-2 Science Products

The U.S. Geological Survey (USGS) produces research quality, applications ready, Level-2 Science Products derived from Landsat Collection 2 Level-1 data. These products are used to monitor, assess, and project changes in land use, land cover, and environmental conditions affecting the human condition, natural processes, and biological habitats. Landsat Collection 2 Level-2 Science Products are time-series observational data processed for consistency and continuity to measure effects of environmental change and serve as input into Landsat essential climate variable Level-3 Science Products.

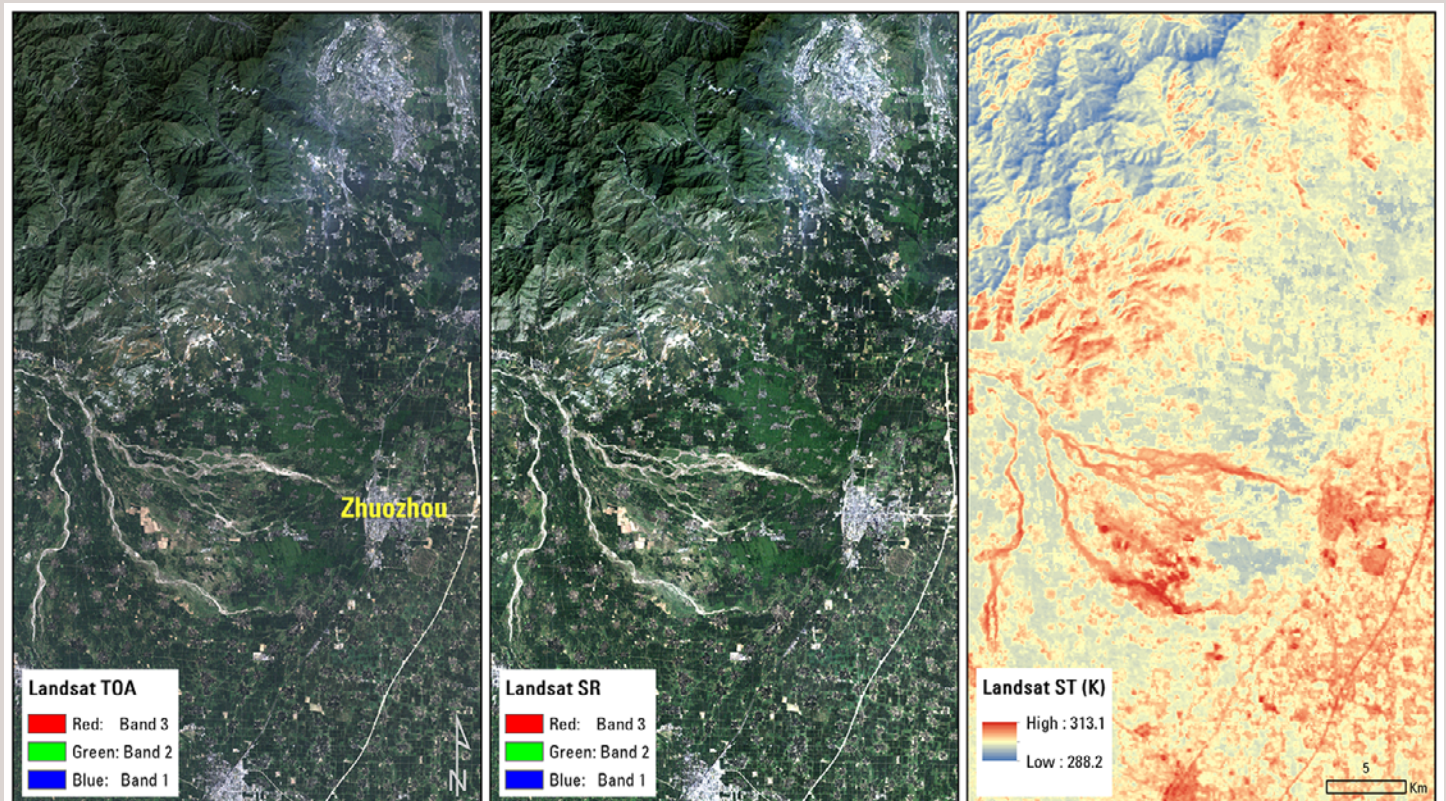
Users rely on Landsat data for historical study of land-surface change that require consistent radiometric data processed to the highest science standards. In support of the guidelines established through the World Meteorological Organization’s Global Climate Observing System, the USGS embarked on production of higher-level Landsat products to support climate variability and change studies. More information on Landsat science products is available here: <https://www.usgs.gov/core-science-systems/nli/landsat/landsat-science-products>.

Surface Reflectance

Landsat Collection 2 surface reflectance (SR) measures the fraction of incoming solar radiation that is reflected from Earth’s surface to the Landsat sensor where atmospheric effects are removed or reduced. Landsat SR approximates what a sensor at nadir would measure when the atmosphere has been compensated. The removal of atmospheric effects increases the consistency and comparability between images of the Earth’s surface. Many higher-level remote sensing products including vegetation indexes, albedo, leaf area index (LAI), burned area, land cover, and land cover change rely on SR products.

Landsat 8 SR data are generated using the Land Surface Reflectance Code (LaSRC), and Landsat 4–7 SR data are generated using the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) algorithm.

More information is available at <https://www.usgs.gov/core-science-systems/nli/landsat/landsat-collection-2-surface-reflectance>.



Landsat 5 images of Zhuozhou, China, on September 7, 1999, showing top-of-atmosphere (TOA) reflectance; Level-2 surface reflectance (SR); and Level-2 surface temperature (ST), in Kelvin (K).

Surface Temperature

Landsat Collection 2 surface temperature (ST) measures the Earth's ST in Kelvin where atmospheric effects are removed or reduced. Remote sensing ST is an important geophysical parameter used in global energy balance studies and hydrologic modeling. Landsat ST products are useful for monitoring crop and vegetation health, extreme heat events such as natural disasters (for example, volcanic eruptions and wildfires), and urban heat island effects.

The ST science product uses a single-channel algorithm across Landsat sensors that measure emitted thermal infrared radiation. Landsat ST products are generated from the Landsat Collection 2 Level-1 thermal infrared spectral bands and include top-of-atmosphere (TOA) reflectance, TOA brightness temperature (BT), Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Emissivity Database (GED) data, ASTER Normalized Difference Vegetation Index (NDVI) data, and atmospheric profiles of geopotential height, specific humidity, and air temperature extracted from Goddard Earth Observing System (GEOS) Model Version 5 Forward Processing Instrument Teams (FP-IT) (for acquisitions from 2000 to present) or Modern Era Retrospective analysis for Research and Applications Version 2 (MERRA-2) (for acquisitions from 1982 to 1999) as inputs to retrieve ST.

For Landsat 7 Enhanced Thematic Mapper Plus (ETM+) products, Band 6 TOA, BT, and ST data are generated from ETM+ Band 6 high (6H) and Band 6 low (6L) merged together. The merged band contains unsaturated pixels from Band 6H. If Band 6H pixels have a BT outside of the band's dynamic range (240 to 322 Kelvin), then Band 6L pixels are used. Pixels that are saturated in Band 6L remain saturated in the merged Band 6 product. The merged thermal radiance is then used to create the TOA BT and ST data. More information is available at <https://www.usgs.gov/core-science-systems/nli/landsat/landsat-collection-2-surface-temperature>.

Data Access

Landsat Collection 2 SR and ST products are available globally as scenes or as Landsat Analysis Ready Data (ARD) tiles for the United States from the USGS Earth Resources Observation and Science (EROS) Center by accessing Earth Explorer at <https://earthexplorer.usgs.gov> (see “Landsat—Landsat Collection 2 Level-2” or “Landsat C2 Analysis Ready Data (ARD)” on the “Data Sets” tab). Landsat Level-1 data that meet the less than 76 degrees Solar Zenith Angle constraint and include the required auxiliary data inputs are processed into SR and ST products for the following sensors and date ranges:

- Landsat 9 Operational Land Imager (OLI): Early 2022 and beyond
- Landsat 8 Operational Land Imager (OLI): April 2013 to present
- Landsat 7 Enhanced Thematic Mapper Plus (ETM+): July 1999 to present
- Landsat 5 Thematic Mapper (TM): March 1984 to May 2012
- Landsat 4 Thematic Mapper (TM): July 1982 to December 1993

For more information, please contact:

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Or visit <https://www.usgs.gov/core-science-systems/nli/landsat/landsat-science-products>

