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LANDSAT 8 (L8) DATA USERS HANDBOOK

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March 29, 2016

Approved By:

K. Zanter
LSDS CCB Chair
USGS

Date

EROS
Sioux Falls, South Dakota

Executive Summary

This Landsat 8 (L8) Data Users Handbook is a living document prepared by the U.S. Geological Survey (USGS) Landsat Project Science Office at the Earth Resources Observation and Science (EROS) Center in Sioux Falls, SD, and the National Aeronautics and Space Administration (NASA) Landsat Project Science Office at NASA's Goddard Space Flight Center (GSFC) in Greenbelt, Maryland.

The purpose of this handbook is to provide a basic understanding and associated reference material for the L8 Observatory and its science data products. In doing so, this document does not include a detailed description of all technical details of the L8 mission, but instead focuses on the information that the users need to gain an understanding of the science data products.

This handbook includes various sections that provide an overview of reference material and a more detailed description of applicable data user and product information. This document includes the following sections:

- Section 1 describes the background for the L8 mission as well as previous Landsat missions
- Section 2 provides a comprehensive overview of the current L8 Observatory, including the spacecraft, the Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS) instruments, and the L8 concept of operations
- Section 3 includes an overview of radiometric and geometric instrument calibration as well as a description of the Observatory component reference systems and the Calibration Parameter File (CPF)
- Section 4 includes a comprehensive description of Level 1 products and product generation
- Section 5 addresses the conversion of Digital Numbers (DNs) to physical units
- Section 6 includes an overview of data search and access using the various online tools
- Appendix A contains the applicable reference materials, along with the list of known issues associated with L8 data
- Appendix B contains an example of the Level 1 product metadata

This document is controlled by the Land Satellites Data System (LSDS) Configuration Control Board (CCB). Please submit changes to this document, as well as supportive material justifying the proposed changes, via a Change Request (CR) to the Process and Change Management Tool.

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Section 1 Introduction

1.1 Foreword



The Landsat Program has provided over 40 years of calibrated high spatial resolution data of the Earth's surface to a broad and varied user community. This user community includes agribusiness, global change researchers, academia, state and local governments, commercial users, national security agencies, the international community, decision-makers, and the public. Landsat images provide information that meets the broad and diverse needs of business, science, education, government, and national security.

The mission of the Landsat Program is to provide repetitive acquisition of moderate-resolution multispectral data of the Earth's surface on a global basis. Landsat represents the only source of global, calibrated, moderate spatial resolution measurements of the Earth's surface that are preserved in a national archive and freely available to the public. The data from the Landsat spacecraft constitute the longest record of the Earth's continental surfaces as seen from space. It is a record unmatched in quality, detail, coverage, and value.

The Landsat 8 (L8) Observatory offers the following features:

- **Data Continuity:** L8 is the latest in a continuous series of land remote sensing satellites that began in 1972.
- **Global Survey Mission:** L8 data systematically build and periodically refresh a global archive of Sun-lit, substantially cloud-free images of the Earth's landmass.
- **Free Standard Data Products:** L8 data products are available through the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center at no charge.
- **Radiometric and Geometric Calibration:** Data from the two sensors, the Operational Land Imager (OLI) and the Thermal Infrared Sensor (TIRS), are calibrated to better than 5 percent uncertainty in terms of Top Of Atmosphere (TOA) reflectance or absolute spectral radiance, and have an absolute geodetic accuracy better than 65 meters circular error at 90 percent confidence (CE 90).
- **Responsive Delivery:** Automated request processing systems provide products electronically within 48 hours of order (normally much faster).

The continuation of the Landsat Program is an integral component of the U.S. Global Change Research Program (USGCRP) and will address a number of science priorities, such as land cover change and land use dynamics. L8 is part of a global research

program known as National Aeronautics and Space Administration's (NASA's) Science Mission Directorate (SMD), a long-term program that studies changes in Earth's global environment. In the Landsat Program tradition, L8 continues to provide critical information to those who characterize, monitor, manage, explore, and observe the land surfaces of the Earth over time.

The USGS has a long history as a national leader in land cover and land use mapping and monitoring. Landsat data, including L8 and archive holdings, are essential for USGS efforts to document the rates and causes of land cover and land use change, and to address the linkages between land cover and use dynamics on water quality and quantity, biodiversity, energy development, and many other environmental topics. In addition, the USGS is working toward the provision of long-term environmental records that describe ecosystem disturbances and conditions.

1.2 Background

The Land Remote Sensing Policy Act of 1992 (U.S. Code Title 15, Chapter 82) directed the Federal agencies involved in the Landsat Program to study options for a successor mission to Landsat 7 (L7), ultimately launched in 1999 with a five-year design life, that maintained data continuity with the Landsat System. The Act further expressed a preference for the development of this successor System by the private sector as long as such a development met the goals of data continuity.

The L8 Project suffered several setbacks in its attempt to meet these data continuity goals. Beginning in 2002, three distinct acquisition and implementation strategies were pursued: (1) the purchase of Observatory imagery from a commercially owned and operated satellite system partner (commonly referred to as a government "data buy"), (2) flying a Landsat instrument on National Oceanic and Atmospheric Administration's (NOAA's) National Polar-orbiting Operational Environmental Satellite System (NPOESS) series of satellites, and finally (3) the selection of a "free-flying" Landsat satellite. As a result, the Project incurred considerable delays to L8 implementation. The matter was not resolved until 2007, when it was determined that NASA would procure the next mission space segment and the USGS would develop the Ground System and operate the mission after launch.

The basic L8 requirements remained consistent through this extended strategic formulation phase of mission development. The 1992 Land Remote Sensing Policy Act (U.S. Code Title 15, Chapter 82) established data continuity as a fundamental goal and defined continuity as providing data "sufficiently consistent (in terms of acquisition geometry, coverage characteristics, and spectral characteristics) with previous Landsat data to allow comparisons for global and regional change detection and characterization." This direction has provided the guiding principal for specifying L8 requirements from the beginning, with the most recently launched Landsat satellite at that time, L7, serving as a technical minimum standard for system performance and data quality.