

# LANDSAT PRODUCTS

## Overview

The Landsat image archive is an invaluable resource that supports change detection and environmental monitoring studies. To support these studies and to ensure consistent quality through time and across all sensors, the Landsat image archive was reprocessed and organized into Landsat Collections. Landsat Collection 1 marked the first major reprocessing effort to streamline data and archive management. Landsat Collection 2, which was released in December 2020, represents the second major reprocessing effort to enhance the image archive.

Landsat Collections consist of both data products and science products. Landsat Level-1 data products are scene-based data that are generated using standard processing parameters and the best geometric processing level for each scene. Higher-level products, which include Level-2 and Level-3 science products, are derived from Landsat Level-1 data. These science products provide research-quality, applications-ready information that can be used by scientists and natural resource managers to support improved land cover assessments, monitoring, and projections.

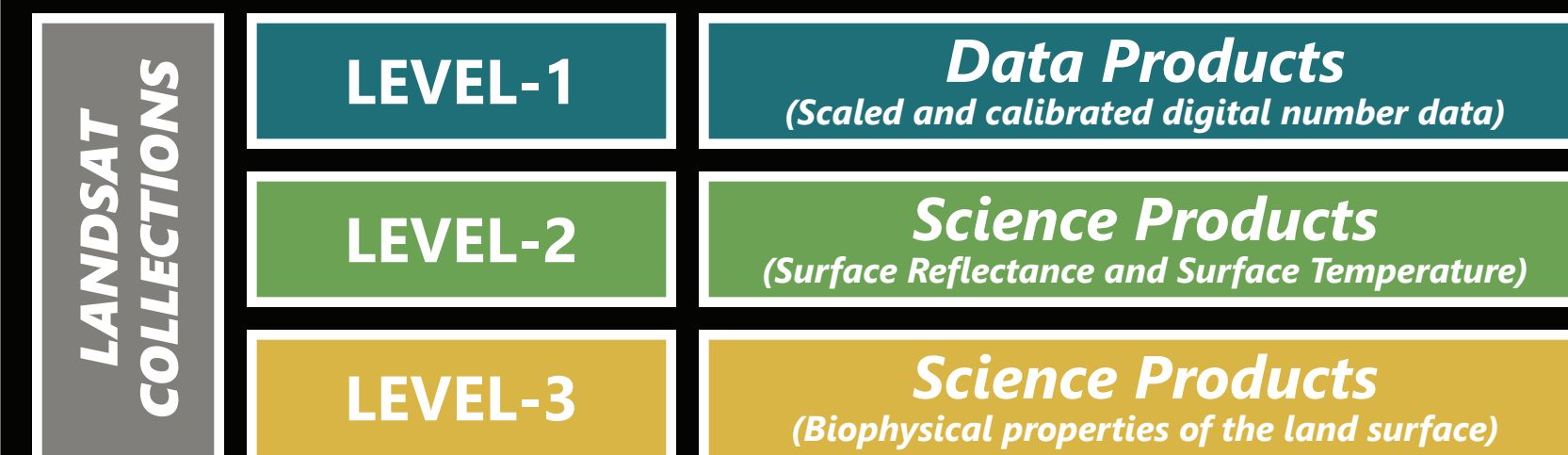


Figure 1. Landsat Collections data products and science products.

## Landsat Level-1 Data Products

Landsat Level-1 data products contain radiometrically and geometrically corrected image data from all sensors since 1972. Each Collection 2 Level-1 data product bundle includes image files for each of the spectral bands, Quality Assessment (QA) bands, solar illumination and sensor viewing angle files, and scene-based metadata files. The image files are distributed as scaled and calibrated digital numbers (DN). Level-1 data can be rescaled to top of atmosphere (TOA) reflectance or radiance by applying the radiometric rescaling coefficients provided in the metadata files.

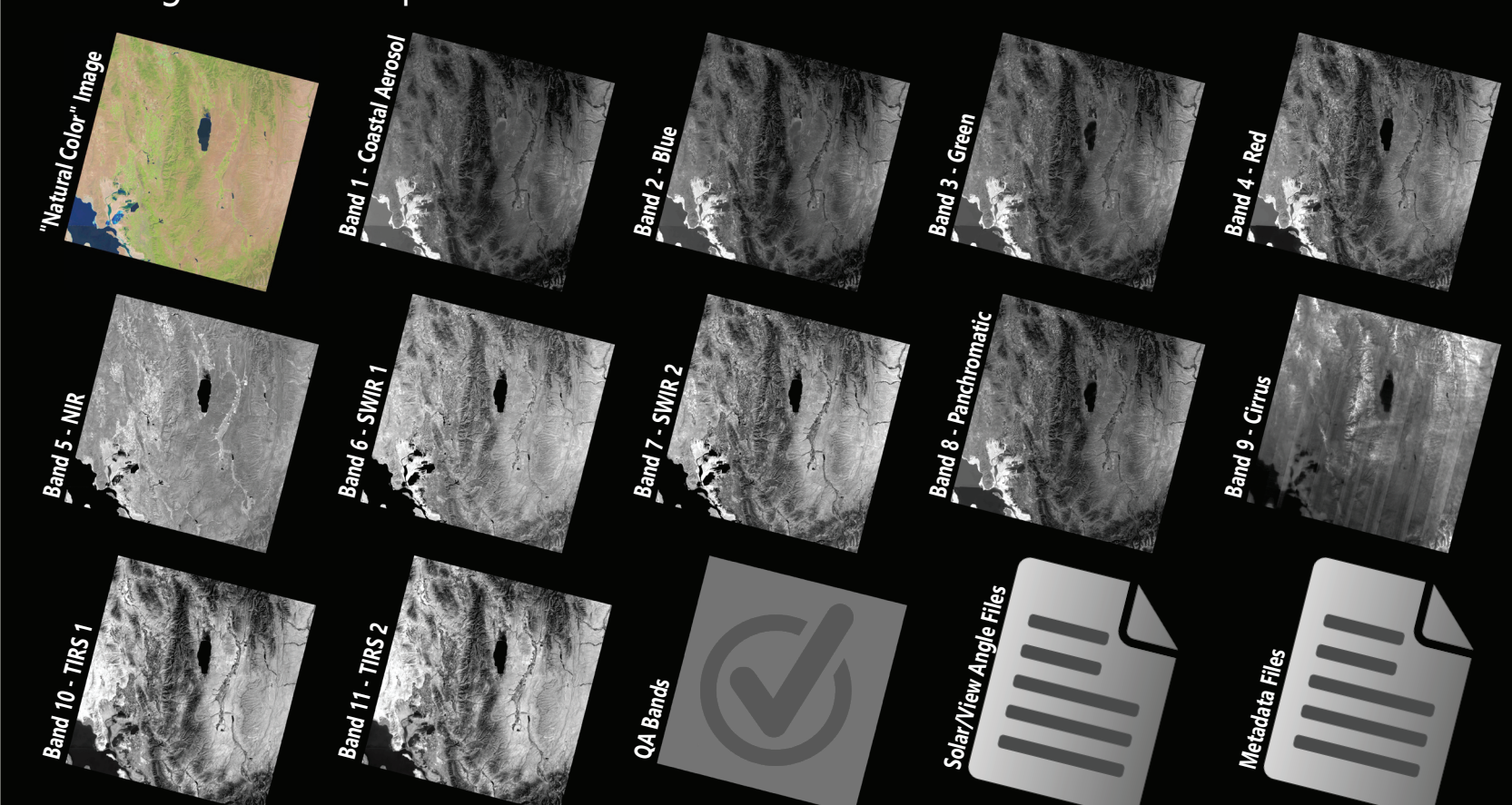


Figure 2. Landsat Collection 2 Level-1 Full-Resolution Browse "Natural Color" Image and Product Bundle for Landsat 8 P38R31 scene.

## Landsat Level-2 Science Products

Landsat Level-2 Science Products consist of Surface Reflectance and Surface Temperature. These science products are generated from Level-1 inputs that meet the <76 degrees Solar Zenith Angle constraint and include the required auxiliary data inputs to generate scientifically viable products. Level-2 Science Products are available within both Collection 1 and Collection 2. However, with the release of Collection 2, certain enhancements were made to improve the quality and availability of the products.

Table 1. Landsat Level-2 Science Product descriptions for Surface Reflectance and Surface Temperature.

LANDSAT LEVEL-2 SCIENCE PRODUCTS	
<b>SURFACE REFLECTANCE</b>	Surface Reflectance measures the fraction of incoming solar radiation that is reflected from the Earth's surface to the Landsat sensor. This science product improves the comparison between multiple Landsat images over the same region by accounting for atmospheric effects such as aerosol scattering and thin clouds. Landsat 8 Surface Reflectance products are generated using the Land Surface Reflectance Code (LaSRC) algorithm. Landsat 4, 5, and 7 Surface Reflectance products are generated using the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) algorithm.
<b>SURFACE TEMPERATURE</b>	Surface Temperature measures the temperature of the Earth's surface in Kelvin. This science product is an important geophysical parameter that can be used in studies relating to global energy balance, hydrologic modeling, crop monitoring, extreme heat events, and urban heat island effects. Landsat Surface Temperature products are generated from the Level-1 thermal infrared bands using Top of Atmosphere (TOA) Reflectance, TOA Brightness Temperature, 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.

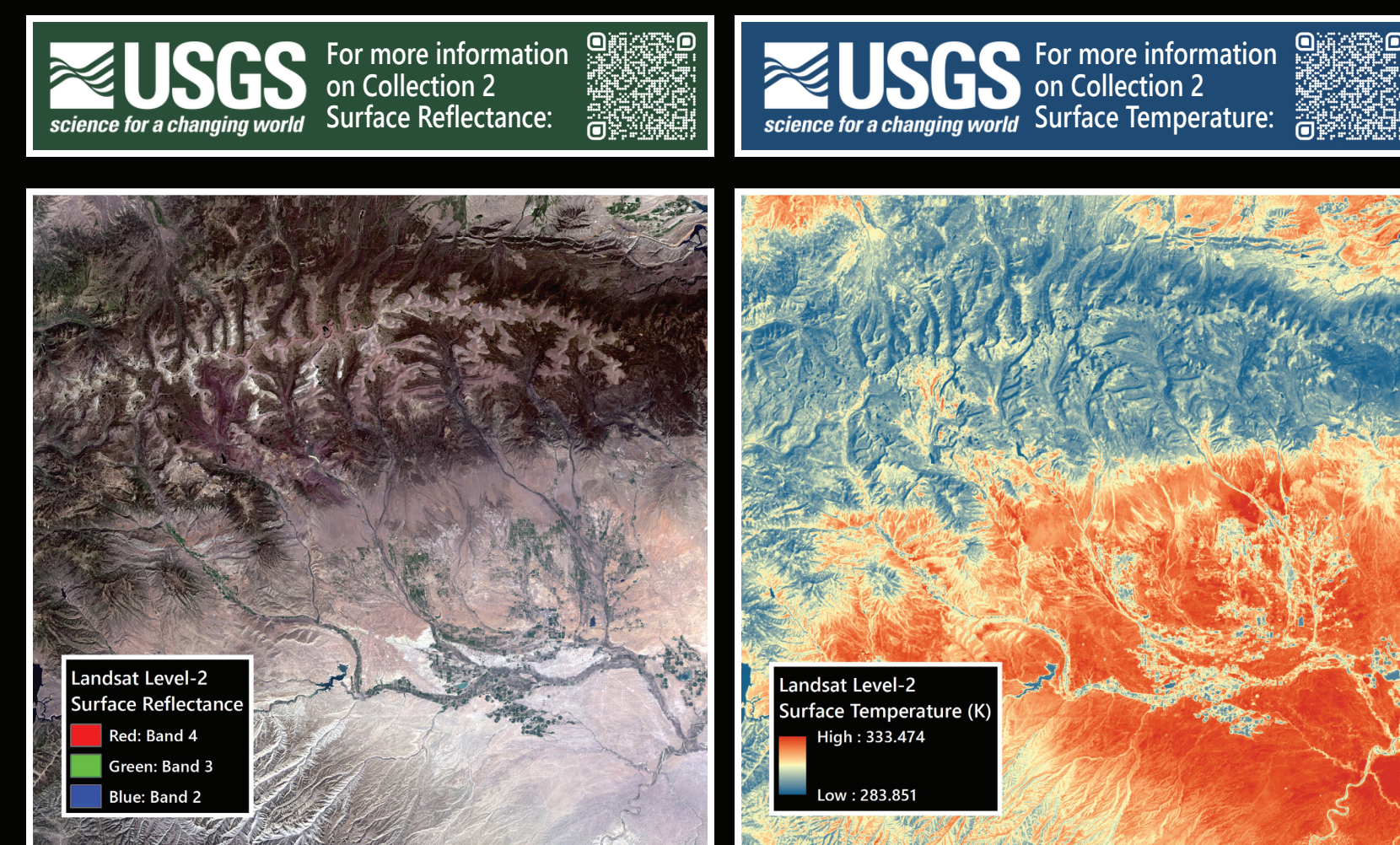


Figure 3. Landsat Collection 2 Level-2 Surface Reflectance (left) and Surface Temperature (right) for Landsat 8 P37R32 scene.

Table 2. Comparison of Level-2 Science Products within Collection 1 and Collection 2.

COLLECTION	COLLECTION 1*		COLLECTION 2	
	SURFACE REFLECTANCE	SURFACE TEMPERATURE	SURFACE REFLECTANCE	SURFACE TEMPERATURE
TEMPORAL AVAILABILITY	1982 - Present	1982 - Present	1982 - Present	1982 - Present
DATA SOURCES	Landsat 4-8	Landsat 4-8	Landsat 4-9	Landsat 4-9
PRODUCT AVAILABILITY	CONUS, AK, HI <sup>1</sup>	CONUS, AK, HI	Global	Global
DATA DELIVERY FORMAT	U.S. Analysis Ready Data (ARD) Tiles <sup>2</sup>	U.S. Analysis Ready Data (ARD) Tiles	Landsat Path/Row WRS-2 Scenes	Landsat Path/Row WRS-2 Scenes
SCALING FACTOR	0.0001	0.1	0.0000275 + -0.2	0.00341802 + 149.0
FILL VALUE	-9999	-9999	0	0
DATA TYPE	Signed 16-bit integer	Signed 16-bit integer	Unsigned 16-bit integer	Unsigned 16-bit integer
DATA RANGE	1-10000	1500-3730	1-65455	1-65535

\* Landsat Collection 1 processing will remain in effect through December 31, 2021.

<sup>1</sup> Global Surface Reflectance products for Collection 1 are available through ESPA On-Demand Interface.

<sup>2</sup> Scene-based Surface Reflectance products for Collection 1 are available through ESPA On-Demand Interface.

## Landsat Level-3 Science Products

Landsat Level-3 Science Products consist of Dynamic Surface Water Extent, Fractional Snow Covered Area, and Burned Area. These science products are generated from U.S. Analysis Ready Data (ARD) inputs collected from Landsat TM, ETM+, and OLI/TIRS instruments. Level-3 Science Products are currently only available within Collection 1, but Collection 2 Level-3 products are expected to be released in 2022.

Table 3. Landsat Level-3 Science Product descriptions, product availability, and access to USGS product guides.

LANDSAT COLLECTION 1 LEVEL-3 SCIENCE PRODUCTS			
PRODUCT	DESCRIPTION	PRODUCT AVAILABILITY	PRODUCT GUIDE
<b>DYNAMIC SURFACE WATER EXTENT</b>	The Dynamic Surface Water Extent (DSWE) product provides information about the existence of terrestrial surface water. This science product can be useful in assessing the impacts of water demands, climatic conditions, and land cover/use changes on the dynamics of hydrological systems.	CONUS, AK, HI	
<b>FRACTIONAL SNOW COVERED AREA</b>	The Fractional Snow Covered Area (fSCA) product depicts the percentage, or fraction, of a pixel covered by snow. This science product supports the measurement and monitoring of snow cover patterns across topographically complex mountainous regions.	WESTERN US, AK	
<b>BURNED AREA</b>	The Burned Area (BA) product identifies burned areas across all ecosystems and includes two raster datasets that represent the burn classification and burn probability. This science product can be used to quantify trends and patterns of fire occurrence, characterize drivers of fire occurrence, and inform projections of future fire pattern behavior.	CONUS	

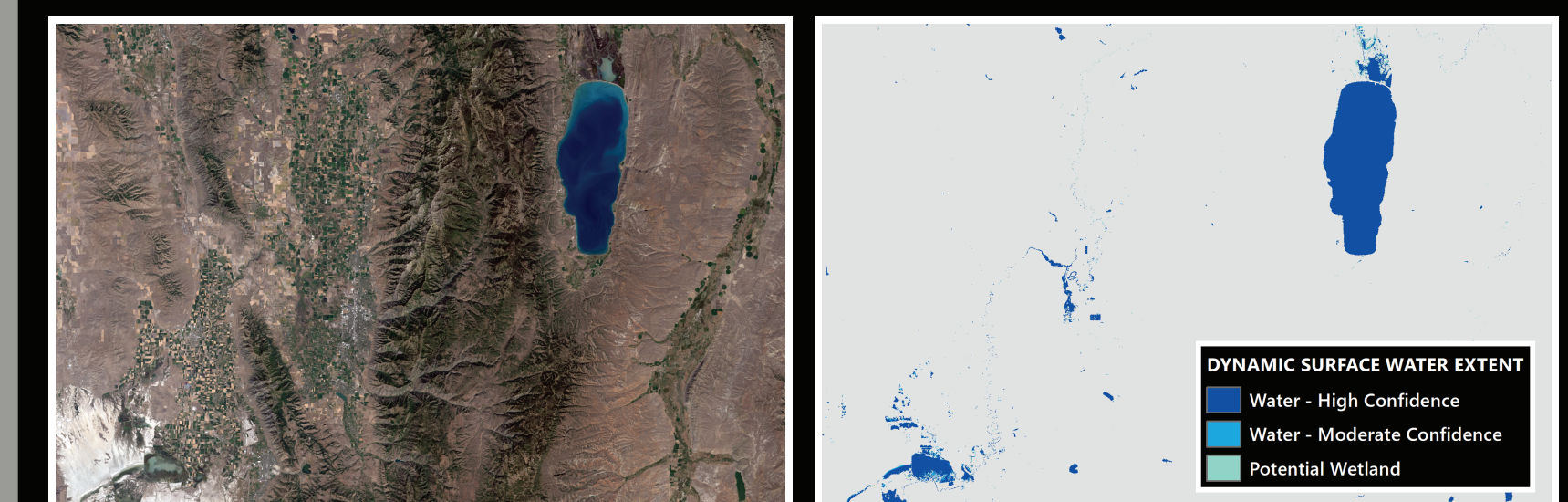


Figure 4. Landsat Collection 1 Level-3 Dynamic Surface Water Extent for Landsat 8 U.S. ARD Tile h08v07, showing (1) Water - High Confidence, (2) Water - Moderate Confidence, and (3) Potential Wetland from the interpreted layer with mask applied (INWM).

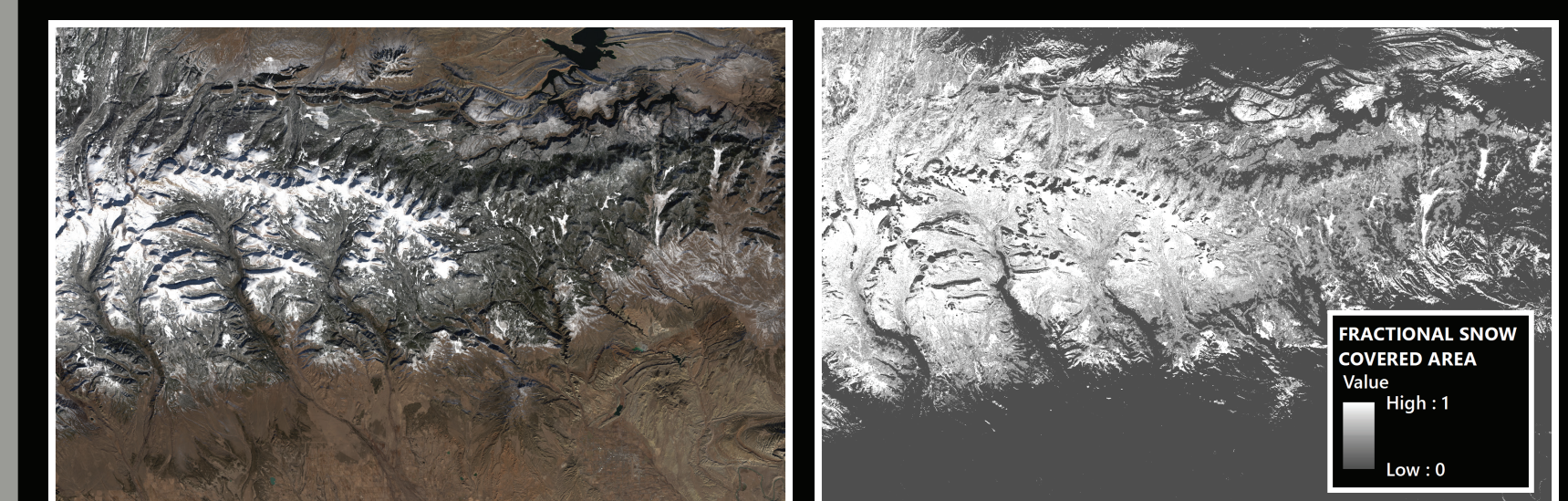


Figure 5. Landsat Collection 1 Level-3 Fractional Snow Covered Area for Landsat 8 U.S. ARD Tile h09v08, showing the unscaled range from 0 to 1, where 0 indicates no snow cover and 1 indicates 100 percent snow cover.

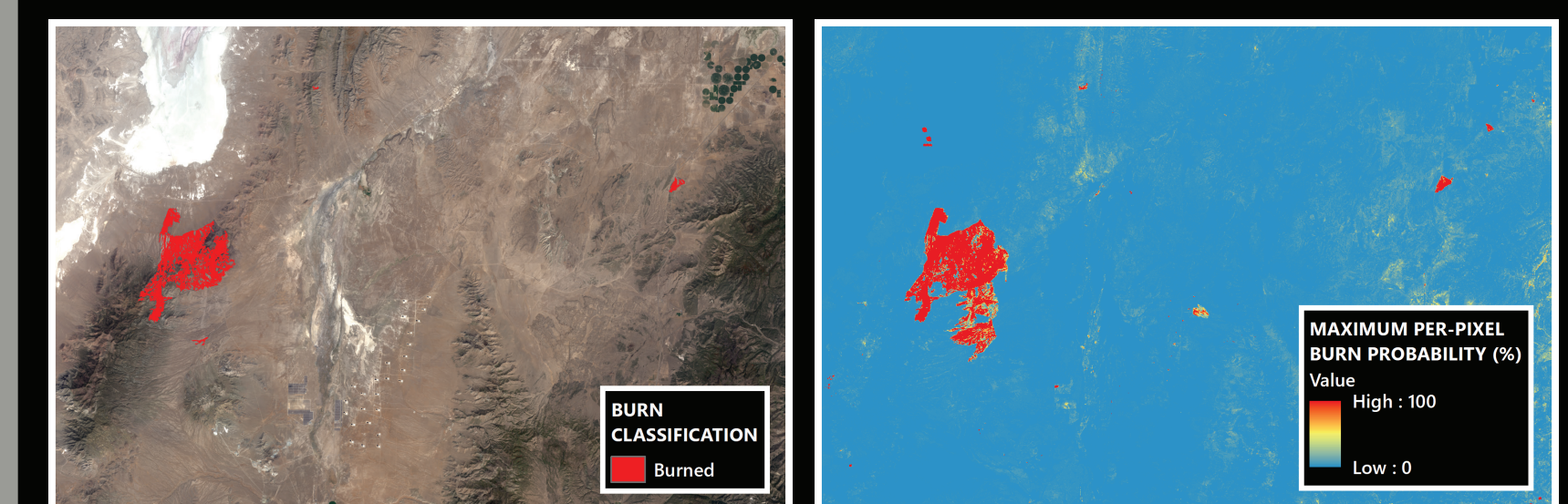


Figure 6. Landsat Collection 1 Level-3 Burned Area for Landsat 8 U.S. ARD Tile h07v09, showing the Burn Classification (left) and Burn Probability (right).