

Landsat Collection 2 Level-3 Fractional Snow Covered Area Science Product

The Landsat Collection 2 (C2) Level-3 Fractional Snow Covered Area (fSCA) science product indicates the percentage of pixels covered by snow for Landsat 4–8 imagery. Landsat’s spatial resolution offers the capability to map snow cover patterns across topographically complex mountainous regions (fig. 1). Snow cover is spatially and temporally variable and is often concentrated in remote or inaccessible land regions, making spaceborne remote sensing the most feasible approach to measure and monitor snow cover change.

The Landsat fSCA science product is processed to a 30-meter spatial resolution in the Albers Equal-Area Conic projection using the World Geodetic System of 1984 (also known as WGS 84) datum and gridded to a common tiling scheme. The product is delivered in various formats, including Cloud Optimized GeoTIFF (also known as COG) files for the fSCA raster files and Extensible Markup Language (XML) for metadata files. Spatial reference information is embedded within the Cloud Optimized GeoTIFF files.

Product Availability

The Landsat C2 fSCA science product is available for the western, northern, and northeastern conterminous United States and Alaska for the following date ranges:

- Landsat 8 Operational Land Imager: April 2013 to present
- Landsat 7 Enhanced Thematic Mapper Plus: July 1999 to April 2022

- Landsat 5 Thematic Mapper: March 1984 to May 2012
 - Landsat 4 Thematic Mapper: March 1984 to December 1993
- The Landsat 9 C2 fSCA science product has a planned release date of early 2023.

Product Improvements

The C2 fSCA science product has several improvements over the Collection 1 (C1) product.

- The C2 fSCA science product is expanded to include northern areas of the conterminous United States and the Aleutian Islands.
- The C1 fSCA band was expanded in C2 to separate the fSCA and Canopy Adjusted fSCA bands to show if the snow cover area and grain size (SCAG) results are adjusted for the canopy cover.
- New SCAG Shade Endmember fractions and SCAG Model Mask bands were added (see fSCA band files description in the next section).

Package Contents

The Landsat C2 fSCA science product contains an acquisition-based per-pixel snow cover fraction, a canopy adjusted fSCA, a fractional shade map, a model mask, a quality assessment mask, and a product metadata file. The bands

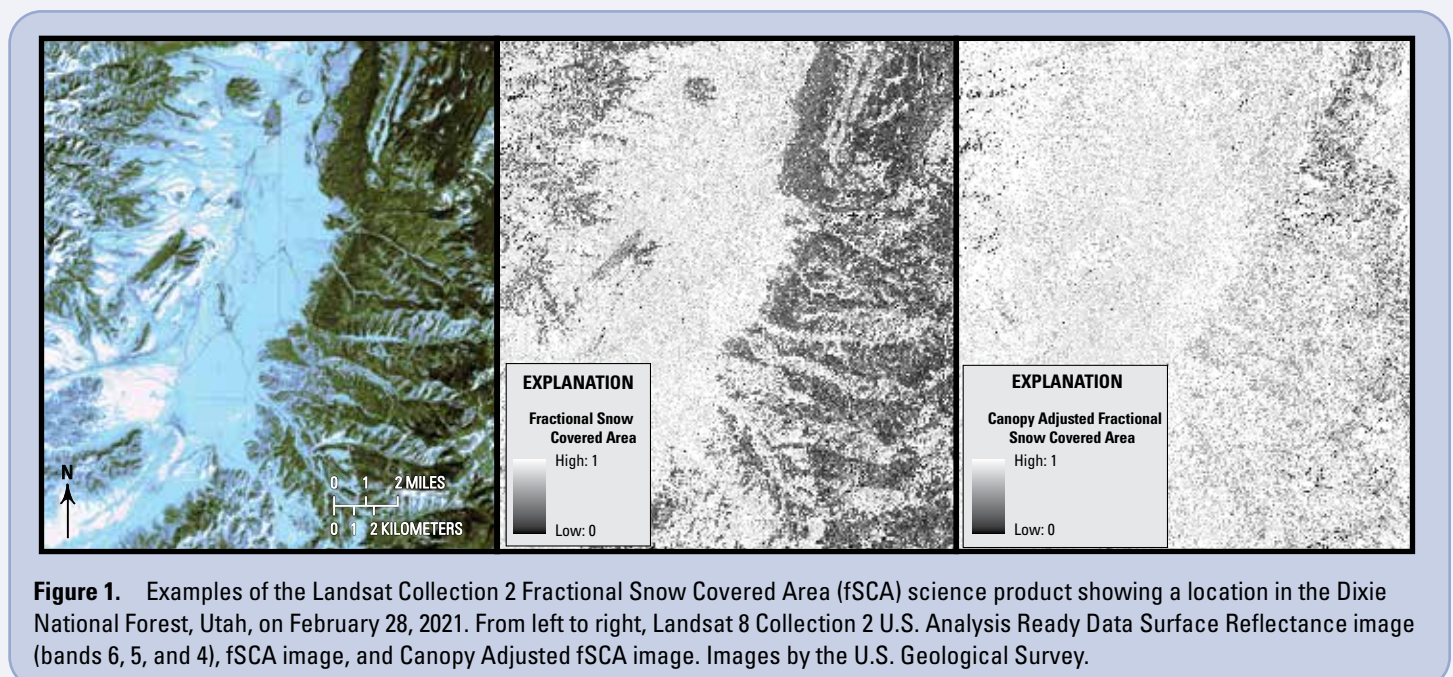


Figure 1. Examples of the Landsat Collection 2 Fractional Snow Covered Area (fSCA) science product showing a location in the Dixie National Forest, Utah, on February 28, 2021. From left to right, Landsat 8 Collection 2 U.S. Analysis Ready Data Surface Reflectance image (bands 6, 5, and 4), fSCA image, and Canopy Adjusted fSCA image. Images by the U.S. Geological Survey.

included in the fSCA science product are as follows (* indicates new bands in C2 fSCA products):

- fSCA* (raster layer): Indicates the percentage of the pixel covered by snow visible from the instrument.
- Canopy Adjusted fSCA* (raster layer): Indicates the canopy adjusted percentage of the pixel covered by snow.
- SCAG Shade Endmember* (raster layer): Indicates the percentage of the pixel covered by shade visible from the instrument.
- SCAG Model Mask* (raster layer): Identifies whether pixels were successfully modeled and identifies which saturation run was used to populate the pixels for Thematic Mapper/Enhanced Thematic Mapper Plus.
- fSCA QA (raster layer): This mask (based on the input Level-1 pixel quality assessment flags pixels identified as fill, cloud, cirrus, revised cloud, water, terrain shadow, and National Land Cover Database fill.

Statistics Product

New for Collection 2 are fSCA statistics, including mean snow cover fraction and clear pixel count for unique time steps for 1984–current year. These time steps include 5-year date ranges and the whole U.S. Analysis Ready Data stack period. Each fSCA statistics package contains monthly (whole U.S. Analysis Ready Data stack only), annual, and mean annual viewable or ground snow cover statistics files for each unique time step over a single tile location. The fSCA statistics are updated annually each February.

Data Access

The Landsat fSCA science product and Landsat C2 Analysis Read Data are available for download from EarthExplorer (<https://earthexplorer.usgs.gov/>) and through the commercial cloud.

In EarthExplorer, the data are available under the “Landsat” category and the “Landsat Collection 2 Level-3 Science Products” or “Landsat C2 U.S. Analysis Ready Data (ARD)” subcategory and are listed as “Landsat 4-8 C2 Fractional Snow Covered Area.” The fSCA statistics are available in the same location on EarthExplorer and are contained as a separate dataset and listed as “Landsat 4-8 C2 fSCA Statistics.”

Visit the “Landsat Data Access” web page (<https://www.usgs.gov/landsat-missions/landsat-data-access>) for additional information about cloud access and bulk download options.

Documentation

Information about the Landsat C2 fSCA science product is available at <https://www.usgs.gov/landsat-missions/landsat-collection-2-level-3-fractional-snow-covered-area-science-product>. Please refer to the “Documents” section of the web page for the product guide and algorithm description document.

Citation Information

The use of Landsat science products is not restricted. Although not a requirement of data use, the following citations may be used in publication or presentation materials to acknowledge the U.S. Geological Survey as a data source and to credit the original research:

Landsat Collection 2 Level-3 Fractional Snow Covered Area science product courtesy of the U.S. Geological Survey.

Painter, T.H., Rittger, K., McKenzie, C., Slaughter, P., Davis, R.E., and Dozier, J., 2009, Retrieval of subpixel snow covered area, grain size, and albedo from MODIS: Remote Sensing of Environment, v. 113, no. 4, p. 868–879, <https://doi.org/10.1016/j.rse.2009.01.001>.

Rittger, K., Bormann, K.J., Bair, E.H., Dozier, J., and Painter, T.H., 2021, Evaluation of VIIRS and MODIS Snow Cover Fraction in High-Mountain Asia using Landsat 8 OLI: Frontiers in Remote Sensing, v. 2, art. 647154, 15 p., <https://doi.org/10.3389/frsen.2021.647154>.

The Fractional Snow Covered Area science product is based directly on work described in this publication:

Selkowitz, D., Painter, T., Rittger, K., Schmidt, G., and Forster, R., 2017, The USGS Landsat Snow Covered Area Product—Methods and preliminary validation, chap. 5 of Selkowitz, D., Automated approaches for snow and ice cover monitoring using optical remote sensing: Salt Lake City, University of Utah, Ph.D. dissertation, p. 76–119. [Also available at https://www.researchgate.net/publication/331024289_The_USGS_Landsat_Snow_Covered_Area_Products_Methods_and_Preliminary_Validation.]

Visit <https://www.usgs.gov> for more information about the U.S. Geological Survey and <https://www.usgs.gov/programs/national-land-imaging-program> for specifics about the National Land Imaging Program.

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