BioSCape: L3 Elevation and Canopy Height derived from LVIS Standard Products, NNG, V1

Documentation Revision Date: 2026-11-06

Dataset Version: 1

Summary

This dataset provides gridded Level 3 (L3) surface elevation and canopy height products derived from the Land, Vegetation, and Ice Sensor (LVIS) Facility Instrument for the Biodiversity Survey of the Cape (BioSCape) project. BioSCape is a multi-agency, NASA-led research project integrating airborne imaging spectroscopy (e.g., AVIRIS-NG), thermal imaging, and lidar (LVIS) with biodiversity measurements. These L3 products are derived from LVIS standard Level 2 (L2) data. The L2 data were resampled onto a regular grid using a nearest-neighbor approach to match the 5-m spatial resolution of the optical mosaics generated for BioSCape, matching the same grid used by AVIRIS-NG resampled products for convenience. For BioSCape, the LVIS instrument was deployed on a Gulfstream V aircraft. The data are provided in cloud-optimized GeoTIFF format.

The data are provided in cloud-optimized GeoTIFF format and include complexity metrics for the returned waveform, vegetation relative height metrics, and mean elevation metrics from the waveform.

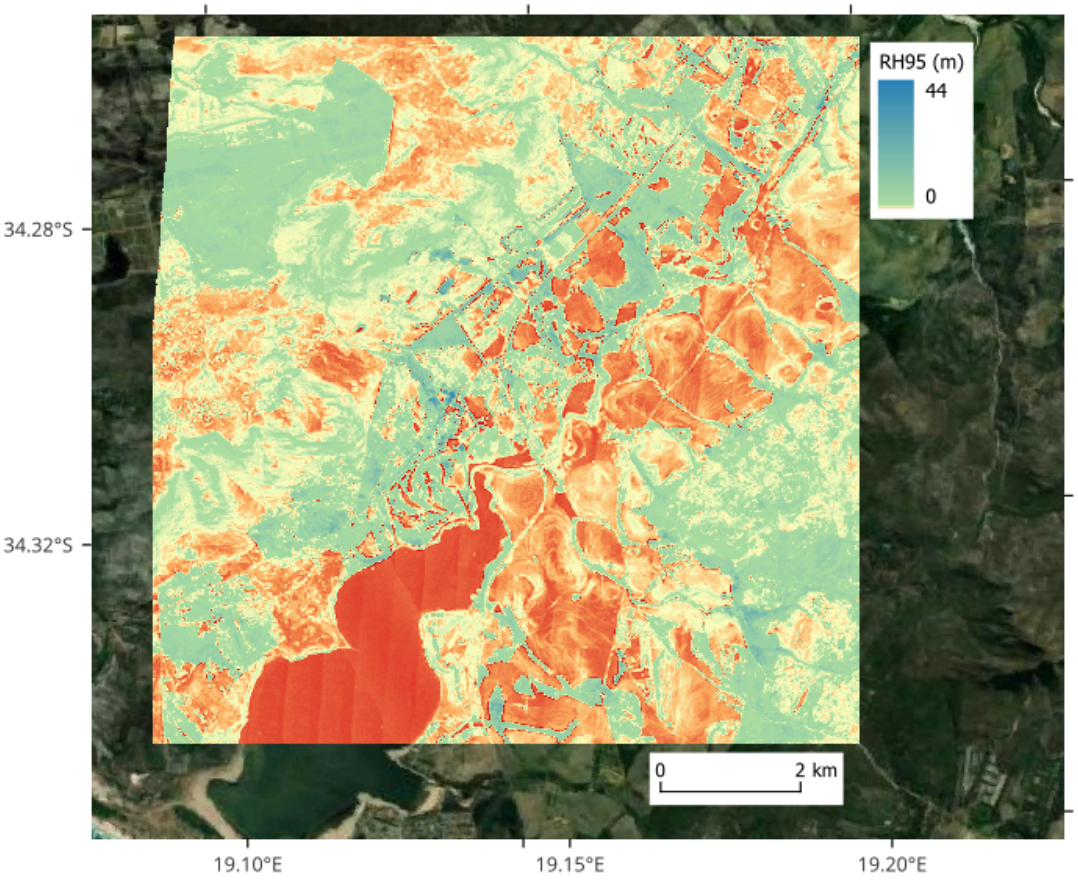


Figure 1. Vegetation canopy height (RH95) derived from Land, Vegetation, and Ice Sensor (LVIS) data acquired in October - November 2023 over a region north of the Botrivier Lagoon and Fisherhaven, Western Cape province, South Africa. Image center approximately -34.30102 latitude,19.14248 longitude. Source: LVIS_BIOSCAPE_V01_L3_38_18_RH95.tif. Basemap ESRI World Imagery.

Citation

Chen, X., P.G. Brodrick, J. Montgomery, M.C. Fitzpatrick, E.L. Hestir, J.A. Slingsby, A.M. Wilson, A.W. Cardoso, J.B. Blair, and M.A. Hofton. 2026. BioSCape: L3 Elevation and Canopy Height derived from LVIS Standard Products, NNG, V1. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2526

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1. Dataset Overview

This dataset provides gridded Level 3 (L3) surface elevation and canopy height products derived from the Land, Vegetation, and Ice Sensor (LVIS) Facility Instrument for the Biodiversity Survey of the Cape (BioSCape) project. BioSCape is a multi-agency, NASA-led research project integrating airborne imaging spectroscopy (e.g., AVIRIS-NG), thermal imaging, and lidar (LVIS) with biodiversity measurements. For BioSCape, the LVIS instrument was deployed on a Gulfstream V aircraft.

These L3 products are derived from LVIS standard Level 2 (L2) data (Blair & Hofton, 2020). The L2 data were resampled onto a regular grid using a nearest-neighbor approach to match the 5-m spatial resolution of the optical mosaics generated for BioSCape (Brodrick et al., 2025), matching the same grid used by AVIRIS-NG resampled products for convenience (Brodrick et al., 2025). The standard L2 LVIS data products should be used for analyses that require high-precision geolocation and no interpolation of the spatial footprint.

Project: Biodiversity Survey of the Cape (BioSCape)

The Biodiversity Survey of the Cape (BioSCape) is a research project that uses remote sensing and field data to understand the distribution, function, and importance of biodiversity on land and in the water around the Greater Cape Floristic Region (GCFR). Located in southwestern South Africa along the Atlantic coast, the GFCR is one of the world's 36 biodiversity hotspots. BioSCape is a collaboration between the US and South Africa. The team conducted an integrated field and airborne campaign in the hyperdiverse region in 2023. Researchers collected laser altimetry LiDAR data and UV/visible to short wavelength infrared (UVSWIR) and thermal imaging spectroscopy data over terrestrial and aquatic targets using four airborne instruments: AVIRIS-NG, PRISM, LVIS, and HyTES. This airborne dataset is unique in its size and scope and unprecedented in its instrument combination and level of detail. These airborne data are accompanied by a range of biodiversity-related field observations.

Related Datasets

Brodrick, P.G., A.M. Chlus, R. Eckert, J.W. Chapman, M. Eastwood, S. Geier, M. Helmlinger, S.R. Lundeen, W. Olson-Duvall, R. Pavlick, L.M. Rios, D.R. Thompson, and R.O. Green. 2025. BioSCape: AVIRIS-NG L3 Resampled Reflectance Mosaics, V2. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2427

Blair, J. B. and M. Hofton. 2020. LVIS Facility L2 Geolocated Surface Elevation and Canopy Height Product. (LVISF2, Version 1). NASA National Snow and Ice Data Center Distributed Active Archive Center, Boulder, Colorado USA. https://doi.org/10.5067/VP7J20HJQISD

2. Data Characteristics

Spatial Coverage: Greater Cape Floristic Region of South Africa

Spatial Resolution: 5 m

Temporal Coverage: 2023-10-22 to 2023-11-26

Temporal Resolution: Daily, weather permitting, during deployment

Study Areas: All latitudes and longitudes given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Southern Cape of South Africa	17.4243	26.2011	-31.0422	-35.0950

Data File Information

The data are provided in cloud-optimized GeoTIFF format representing various elevation, height, and structural metrics. The parameters are extracted from LVIS waveform data.

The file naming convention is *LVIS_BIOSCAPE_V01_L3_<x>_<y>_<product>.<ext>*, where

- <x> and <y> denote the scene tile (Figure 2).
- <product> = LVIS waveform, elevation, or vegetation structure product (Table 1).
- <ext> = file extension indicating file type: "tif" (GeoTIFF), "png" (quicklook PNG image)

In Earthdata, the files are organized as multi-file granules wherein each granule contains files for a given tile.
The granules are named *LVIS_BIOSCAPE_V01_L3_<x>_<y>*.

Table 1. LVIS elevation or vegetation structure products.

Product	Units	Description
COMPLEXITY	1	Complexity metric for the return waveform.
RANGE	m	Distance along the laser path from the instrument to the ground.
RH10 through *RH100*	m	Relative height (RH) metrics representing the height (relative to ZG) at which the respective percentage (10% to 100%) of the waveform energy occurs. 19 files in 5% increments.
ZG	m	Mean elevation of the lowest detected mode within the waveform.

ZG_ALT1 and *ZG_ALT2*	m	Mean elevation of the lowest detected mode within the waveform using alternate mode detection settings.
ZH	m	Mean elevation of the highest detected mode within the waveform.
ZT	m	Elevation of the highest detected signal.

Additional details for these products are available in the user guide for LVIS L2A products (Blair and Hofton, 2020).

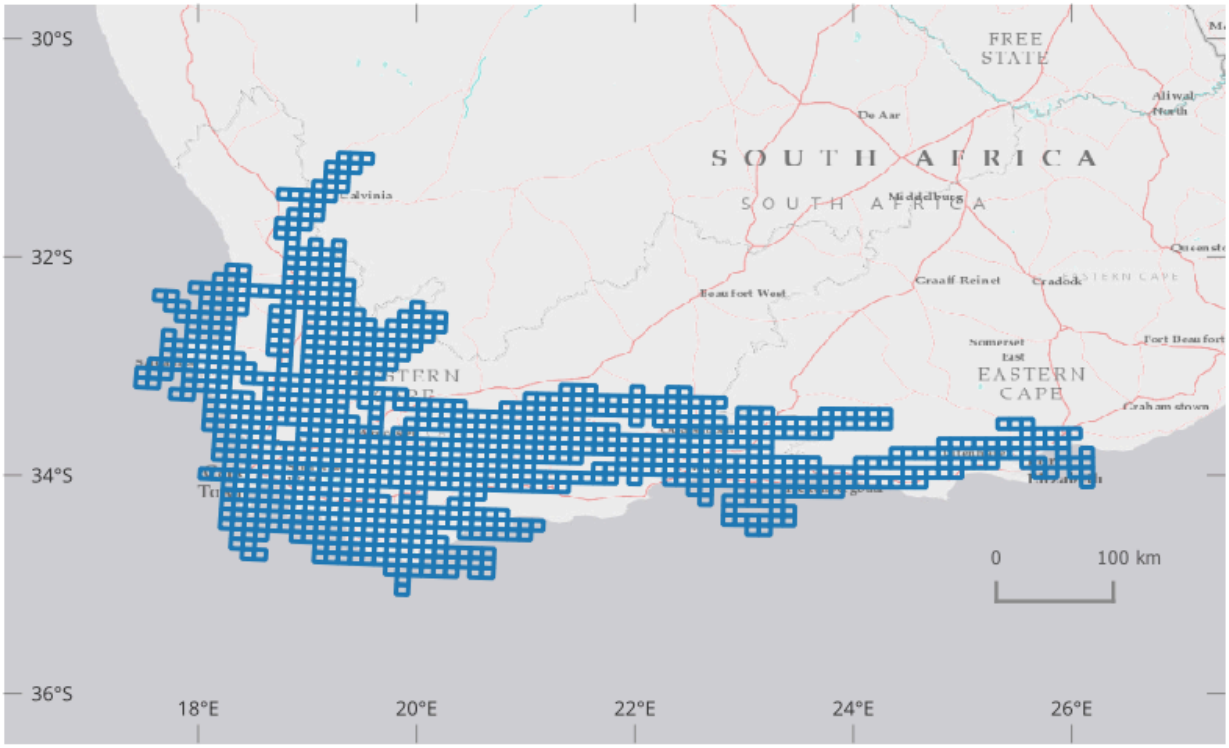


Figure 2. Distribution of scene tiles (blue rectangles) across the Western Cape, Northern Cape, and Eastern Cape provinces of South Africa.

3. Application and Derivation

NASA's BioSCape is an integrated field and airborne campaign occurring in the hyperdiverse Cape Floristic Region of South Africa in 2023. The campaign collected UV/visible to short wavelength infrared (UVSWIR) and thermal imaging spectroscopy and laser altimetry LiDAR data over terrestrial and aquatic targets using four airborne instruments: AVIRIS-NG, PRISM, LVIS, and HyTES. The anticipated airborne data set is unique in its size and scope and unprecedented in its instrument combination and level of detail. These airborne data will be accompanied by a range of biodiversity-related field observations. BioSCape's primary objective is to understand the structure, function, and composition of the region's ecosystems, and to learn about how and why they are changing in time and space.

The LVIS lidar data provide three-dimensional surface structure and elevation information. For the BioSCape campaign, variable footprints were acquired from multiple altitudes. To generate this dataset, flight lines were selected for more uniform coverage, and data were resampled to match the common 5 m grid used for other L3 products.

4. Quality Assessment

These products have not been thoroughly assessed for accuracy. Values have been resampled from the original LVIS footprint locations onto a regular grid using a nearest-neighbor approach. Gridded values may be spatially displaced from the locations of the original LVIS observations, the magnitude of which depends on grid spacing, and the LVIS sampling geometry. This resampling may introduce errors or artifacts for applications that require precise geolocation.

Furthermore, because nearest-neighbor resampling was used, the represented footprints are not strictly tied to the grid, meaning the spatial resolution is variable and independent from the ground sampling distance (GSD). For studies over large landscapes, this gridding approach likely provides a practical advantage, but for precise spatial alignment, lower-level products (Blair and Hofton, 2020) are authoritative.

It is strongly recommended that the standard L2 LVIS data products be used for analyses that require high-precision geolocation, or want no interpolation of the spatial footprint.

5. Data Acquisition, Materials, and Methods

The LVIS instrument is an airborne scanning laser altimeter that collects elevation and 3D structure information (Blair et al, 1999). LVIS uses a waveform-based measurement technique, digitizing both transmitted and reflected laser pulse energies versus time to record the vertical distribution of reflecting surfaces (such as canopy top, branches, and ground) within each laser footprint.

For this dataset, LVIS standard L2 products (Geolocated Surface Elevation and Canopy Height; Blair and Hofton, 2020) were processed into a simplified L3 grid. To match the common 5-m grid used by BioSCape (e.g., Brodrick et al., 2025), the LVIS lines were selected and sorted using the same temporal ordering as the optical mosaics. The values were then mapped to a 5-m spatial grid using a simple nearest-neighbor interpolation method. This approach mitigates the risk of non-correlated interpolation errors (where vegetation structure does not extrapolate linearly to adjacent areas) by solely applying location-based assignments; however, it may incur geolocation or resolution mismatch with the grid depending on the footprint of the acquisition.

6. References

Blair, J.B., D.L. Rabine, and M.A. Hofton. 1999. The Laser Vegetation Imaging Sensor (LVIS): A medium-altitude, digitization-only, airborne laser altimeter for mapping vegetation and topography. ISPRS Journal of Photogrammetry and Remote Sensing 54:115-122. https://doi.org/10.1016/S0924-2716(99)00002-7

Blair, J. B. and M. Hofton. 2020. LVIS Facility L2 Geolocated Surface Elevation and Canopy Height Product. (LVISF2, Version 1). NASA National Snow and Ice Data Center Distributed Active Archive Center, Boulder, Colorado USA. https://doi.org/10.5067/VP7J20HJQISD

Brodrick, P.G., A.M. Chlus, R. Eckert, J.W. Chapman, M. Eastwood, S. Geier, M. Helmlinger, S.R. Lundeen, W. Olson-Duvall, R. Pavlick, L.M. Rios, D.R. Thompson, and R.O. Green. 2025. BioSCape: AVIRIS-NG L3 Resampled Reflectance Mosaics, V2. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2427