

[About](#)[Get Data](#)[Submit Data](#)[Tools](#)[Resources](#)[Help](#)[Sign in](#)[DAAC Home](#)[Us](#)[in](#)

HyTES Level 1 Radiance, Facility Instrument Collection

Get Data

Documentation Revision Date: 2026-05-14

Dataset Version: 1

Summary

This dataset contains Level 1 (L1) radiance imagery as well as per-pixel geolocation information from the Hyperspectral Thermal Emission Spectrometer (HyTES) instrument. This is the NASA Earth Observing System Data and Information System (EOSDIS) facility instrument archive of these data. The NASA HyTES is an airborne imaging spectrometer with 256 spectral channels between 7.5 and 12 micrometers in the thermal infrared part of the electromagnetic spectrum and 512 pixels cross-track. HyTES has been deployed on DHC-6 Twin Otter, NASA's Earth Resources ER-2, and GulfStream V aircraft and completed its first flights in July 2012. Radiance units are $W\ m^{-2}\ \mu m^{-1}\ sr^{-1}$. Geolocation information includes latitude, longitude, height, and number of steps taken during ray-casting. HyTES was designed to provide high spectral and spatial resolution thermal infrared (TIR) data as a precursor for NASA's planned Hyperspectral Infrared Imager (HypSIIRI) orbital mission. It is useful for a number of applications, including high-resolution surface temperature and emissivity measurements, point sources of air pollution, and volcano observations. The data are provided in HDF-5 format.

NASA facility instruments operate out of a NASA research center and support multiple science disciplines, field investigations, and NASA science objectives. Facility instruments are supported by managers in the Earth Science Division (ESD) Research and Analysis Program, and/or the Earth Observation System (EOS) Project Science Office.

This set of HyTES Facility Instrument datasets will include the L1 files from the HyTES flights starting from 2017-06-08. There are four companion files in comma separated values (CSV) format that provide information on Signal Response Function (SRF) and Wave Matrix Data (WMX).



Figure 1. Portion of a false color image derived from HyTES radiance data from flight over Garfield, Colorado on 2022-03-15. Flight: GarfieldCO Line 1, 20220315t230313.

Citation

Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES Level 1 Radiance, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORN LDAAC/2462>

Table of Contents

1. [Dataset Overview](#)
2. [Data Characteristics](#)
3. [Application and Derivation](#)
4. [Quality Assessment](#)
5. [Data Acquisition, Materials, and Methods](#)
6. [Data Access](#)
7. [References](#)

1. Dataset Overview

Project: [HyTES](#)

This dataset contains Level 1 (L1) radiance imagery as well as per-pixel geolocation information from the Hyperspectral Thermal Emission Spectrometer (HyTES) instrument. This is the NASA Earth Observing System Data and Information System (EOSDIS) facility instrument archive of these data. The NASA HyTES is an airborne imaging spectrometer with 256 spectral channels between 7.5 and 12 micrometers in the thermal infrared part of the electromagnetic spectrum and 512 pixels cross-track. HyTES has been deployed on DHC-6 Twin Otter, NASA's ER-2, and GulfStream V aircraft and completed its first flights in July 2012. Radiance units are $\text{W m}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$. Geolocation information includes latitude, longitude, height, and number of steps taken during ray-casting.

HyTES was designed to provide high spectral and spatial resolution thermal infrared (TIR) data as a precursor for NASA's planned Hyperspectral Infrared

Imager (HypSIIRI) orbital mission. It is useful for a number of applications, including high-resolution surface temperature and emissivity measurements, detection of trace gases such as methane, and volcano observations.

NASA facility instruments operate out of a NASA research center and support multiple science disciplines, field investigations, and NASA science objectives. Facility instruments are supported by managers in the Earth Science Division (ESD) Research and Analysis Program, and/or the Earth Observation System (EOS) Project Science Office.

This set of HyTES Facility Instrument datasets will include all L1 files from the HyTES flights starting from 2017-06-08. There are four companion files in comma separated values (CSV) format that provide information on Signal Response Function (SRF) and Wave Matrix Data (WMX).

Related Publications

Hook, S.J., W.R. Johnson, and M.J. Abrams. 2013. NASA's Hyperspectral Thermal Emission Spectrometer (HyTES). In: C. Kuenzer and S. Dech (eds). *Thermal Infrared Remote Sensing. Remote Sensing and Digital Image Processing*, vol 17. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6639-6_5

Hulley, G.C., R.M. Duren, F.M. Hopkins, S.J. Hook, N. Vance, P. Guillevic, W.R. Johnson, B.T. Eng, J.M. Mihaly, V.M. Jovanovic, S.L. Chazanoff, Z.K. Staniszewski, L. Kuai, J. Worden, C. Frankenberg, G. Rivera, A.D. Aubrey, C.E. Miller, N.K. Malakar, J.M. Sánchez Tomás, and K.T. Holmes. 2016. High spatial resolution imaging of methane and other trace gases with the airborne Hyperspectral Thermal Emission Spectrometer (HyTES). *Atmospheric Measurement Techniques* 9:2393–2408. <https://doi.org/10.5194/amt-9-2393-2016>

Related Datasets

Hook, S., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES L1 Geolocation, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2459>

- Provides per-pixel geolocation information for these radiance data.

Hulley, G.C., S. Hook, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES L2 Emissivity and Land Surface Temperature, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2460>

- Provides Level 2 products derived from these radiance data.

Hook, S., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES L1 Radiance, Facility Instrument Collection, 2013-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2476>

- This dataset holds radiance data from HyTES for years 2013 to 2016.

Acknowledgement

The HyTES instrument is maintained and operated by the Airborne Sensor Facility (ASF) at NASA Ames Research Center in Mountain View, California, under the oversight of the EOS Project Science Office at NASA Goddard. Data processing was conducted at NASA Ames Research Center and the Jet Propulsion Laboratory at the California Institute of Technology in Pasadena, California.

2. Data Characteristics

Spatial Resolution: variable (altitude dependent)

Temporal Coverage: 2017-06-08 to present

Temporal Resolution: One-time estimate

Data File Information

The file naming convention is *<flight prefix>_<loc>_L1_<build>_<ver>.hdf5*, where

- *<flight prefix>* = flight line identifier, *YYYYMMDDthmmss*, encoding the date and time by year (YYYY), month (MM), day (DD), hour (hh), minute (mm), and second (ss) of the flight (e.g., 20231115t105320).
- *<loc>* = location name, e.g., "GarfieldCO".
- *<build>* = software build ID: "B100". The files before 2019 do not have *<build>* in their names.
- *<ver>* = incremental version number, e.g., "V03". The files before 2019 do not have *<ver>* in their names.

Example file names: *20231115t105320_RooibergBox12ZA_L1_B110_V03.hdf5*, *20170608t230921_GarfieldCO_L1.hdf5*

These HDF-5 files hold calibrated radiance data, raw radiance measurements, per-pixel geolocation information, and the wave matrix. The radiance data, while georeferenced, are not georectified.

Data File Details

- Radiance units: $W\ m^{-2}\ \mu m^{-1}\ sr^{-1}$
- 512 samples (pixels in across-track direction)
- A variable number of lines (pixels in along-track direction)
- 256 bands from wavelengths 7.5-12 μm
- Locational metadata from the instrument's Next Generation Data Capture System (NGDCS) is included

Per-pixel geolocation information includes latitude, longitude, height, and number of steps taken during ray-casting. The line dimension of the geolocation is typically slightly less than that of the radiance data. Due to the slight variation from nadir (as is represented in the camera model), there is not enough geolocation (GPS) information for the last few lines of the scene.

All the specific dimensions for geolocation information for each file are described within the HDF-5 file. The "lines" dimension is the pixel identifier in the along-track (flight path) direction, indicating the row location of a pixel from the sensor image. The "samples" dimension is the pixel identifier in the across-track direction, indicating the column location of a pixel from the sensor image.

Table 1. Variables in radiance dataset in the HDF-5 files*.

Variable	Description	Units	Dimensions
----------	-------------	-------	------------

radiance_data	Radiance image cube	$W m^{-2} \mu m^{-1} sr^{-1}$	lines x samples x 256 bands
raw_data	Raw instrument data	1	lines x samples x 256 bands [#]
altitude	Pixel altitude above sea level	m	lines x samples
latitude	Pixel latitude	degrees north	lines x samples
longitude	Pixel longitude	degrees east	lines x samples
max_geolocation_line	Defines the start and stop lines for geolocated pixels	1	-
min_geolocation_line		1	-
pixel_geolocation	Per-pixel geolocation information, namely latitude, longitude, height, and number of steps taken during ray-casting		lines x samples x 4
ray_path	Ray path distance from surface to sensor	m	lines x samples
sun_azimuth	Parameters related to the observation and illumination of each pixel	degrees	lines x samples
sun_distance		au	lines x samples
sun_zenith		degrees	lines x samples
view_azimuth		degrees	lines x samples
view_zenith		degrees	lines x samples
wave_matrix		Wavelength information for each band. Use this matrix in combination with a signal response table to generate the signal response function for each band.	μm

*All the HDF-5 files have “radiance_data”, “raw_data”, and “wave_matrix” variables. The remaining variables may not be available in all the files.

[#]“raw_data” may have different numbers of lines than that of “radiance_data” for some files.

Companion files

HyTES_SRF_v4.csv, HyTES_SRF_v6.csv, HyTES_WMX_v4.csv, and HyTES_WMX_v6.csv

For each of the 256 bands, the Signal Response Function (SRF) files provide intensity values for corresponding seven wavelength (microns) locations, which are provided in the Wave Matrix Data (WMX) files. The SRF and WMX file names for 2013-2020 include “v4”, and those for 2021-present include “v6”.

3. Application and Derivation

HyTES was designed to provide high spectral and spatial resolution thermal infrared (TIR) data. It is useful for a number of applications, including high-resolution surface temperature and emissivity measurements, detection of trace gases such as methane, and volcano observations.

4. Quality Assessment

Wave matrix data are provided in each HDF-5 file. The campaign calibration files are available at <https://doi.org/10.3334/ORNLDAAAC/2468>, and spectral response functions are available as companion files with this dataset.

5. Data Acquisition, Materials, and Methods

The HyTES is an airborne imaging spectrometer with 256 spectral channels between 7.5 and 12 micrometers in the thermal infrared part of the electromagnetic spectrum and 512 pixels cross-track. HyTES incorporates several technologies including a Dyson spectrometer, long, straight slit, curved diffraction grating. The first version of HyTES used a Quantum Well Infrared Photodetector (QWIP). In 2021, the QWIP was replaced by a Barrier InfraRed Detector Focal Plane Array (BIRD FPA) to improve detector uniformity. HyTES has been deployed on DHC-6 Twin Otter, NASA's ER-2, and GulfStream V aircraft and completed its first flights in July 2012.

HyTES was developed to support the [Hyperspectral Infrared Imager \(HyspIRI\) mission](#) and has been flown since 2012. (Johnson et al., 2011; Hook et al., 2013). It provides high spatial and high spectral resolution data on surface temperature and emissivity (Hulley et al., 2016b). Its capabilities include identification of air pollution point sources (Hulley et al., 2016a), measuring ecosystem functions (e.g., Pascolini-Campbell et al., 2024), and geological studies. Additional details about the HyTES instrument are available at <https://hytes.jpl.nasa.gov>.

Table 3. HyTES Instrument Specifications.

Instrument.Characteristic	Specification
Mass (Scanhead)	12 kg
Power	400 W
Volume	1 m x 0.5 m (cylinder)
Number of pixels x track	512

Number of bands	256
Spectral Range	7.5 - 12 μm
Spectral Sampling Interval	4.5 $\mu\text{m}/256$, i.e. 17 nm
Frame speed	35 or 22 fps
Integration time (1 scanline)	28 or 45 ms
Total Field of View	50 degrees
Calibration (preflight)	Full Aperture Blackbody
Detector Temperature	40 K
Spectrometer Temperature	100 K
Slit Length and Width	20 mm x 39 μm
IFOV	1.7065999999999999
Pixel Size/Swath at 2,000 m flight altitude	3.41 m/1868.33 m
Pixel Size/Swath at 20,000 m flight altitude	34.13 m/18683.31 m
Saturation Temperatures	see Figure 2

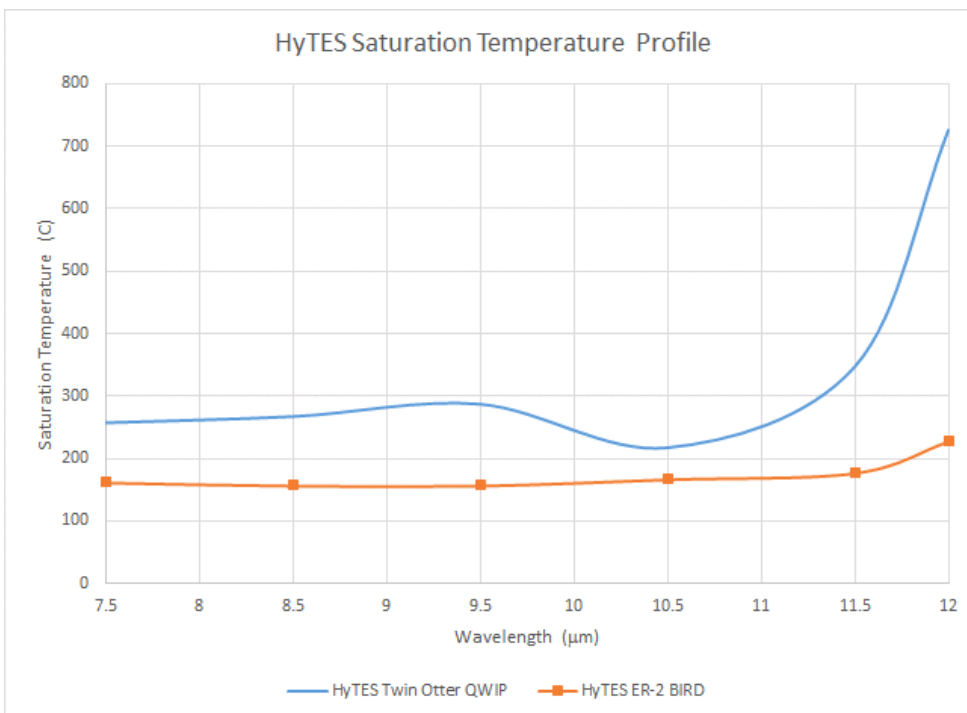


Figure 2. Saturation temperature profiles for QWIP and BIRD FPA photodetectors.

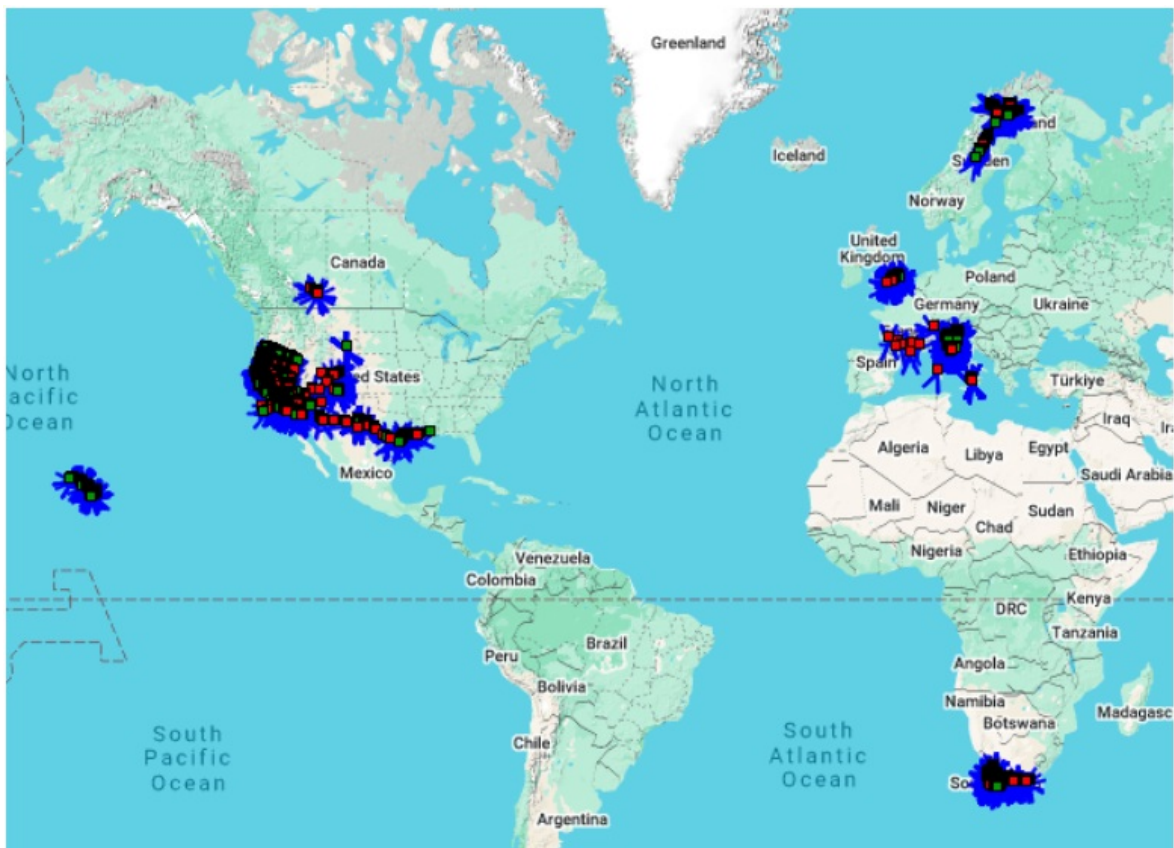


Figure 3. Global distribution of HyTES flights.

6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[HyTES Level 1 Radiance, Facility Instrument Collection](#)

Contact for Data Center Access Information:

- E-mail: uso@daac.ornl.gov
- Telephone: +1 (865) 241-3952

7. References

- Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2025. HyTES L1 Geolocation, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2459>
- Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2025. HyTES L1 Radiance, Facility Instrument Collection, 2013-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2476>
- Hook, S.J., W.R. Johnson, and M.J. Abrams. 2013. NASA's Hyperspectral Thermal Emission Spectrometer (HyTES). In: C. Kuenzer and S. Dech (eds). *Thermal Infrared Remote Sensing. Remote Sensing and Digital Image Processing*, vol 17. Springer, Dordrecht. https://doi.org/10.1007/978-94-007-6639-6_5
- Hulley, G.C., R.M. Duren, F.M. Hopkins, S.J. Hook, N. Vance, P. Guillevic, W. R. Johnson, B.T. Eng, J.M. Mihaly, V.M. Jovanovic, S.L. Chazanoff, Z.K. Staniszewski, L. Kuai, J. Worden, C. Frankenberg, G. Rivera, A.D. Aubrey, C.E. Miller, N.K. Malakar, J.M. Sánchez Tomás, and K.T. Holmes. 2016a. High spatial resolution imaging of methane and other trace gases with the airborne Hyperspectral Thermal Emission Spectrometer (HyTES). *Atmospheric Measurement Techniques* 9:2393–2408. <https://doi.org/10.5194/amt-9-2393-2016>
- Hulley, G.C., S. Hook, W. Johnson, P. Guillevic, and N. Malakar. 2016b. Hyperspectral Thermal Emission Spectrometer (HyTES) Level-2 Land Surface Temperature and Emissivity Algorithm Theoretical Basis Document. NASA Jet Propulsion Laboratory, California Institute of Technology; Pasadena, California. https://hytes.jpl.nasa.gov/downloads/atbds/HyTES_L2_ATBD.pdf
- Hulley, G.C., S.J. Hook, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2025. HyTES L2 Emissivity and Land Surface Temperature, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2460>
- Johnson, W.R., S.J. Hook, P. Mouroulis, D.W. Wilson, S.D. Gunapala, v. Realmuto, A. Lamborn, C. Paine, J.M. Mumolo, and B.T. Eng. 2011. HyTES: Thermal imaging spectrometer development. IEEE Explore: Conferences, 2011 Aerospace Conference, Big Sky, Montana, USA. <https://doi.org/10.1109/AERO.2011.5747394>
- Pascolini-Campbell, M., S. Hook, K. Mallick, M. Langsdale, G. Hulley, K. Cawse-Nicholson, T. Hu, G. Halverson, R. Freepartner, G. Rivera, L. Genesio, and F. Rabuffi. 2024. A first assessment of airborne HyTES-based land surface temperature and evapotranspiration. *Remote Sensing Applications: Society and Environment* Volume 36:101344. <https://doi.org/10.1016/j.rsase.2024.101344>



Home

About Us

- Mission
- Data Use and Citation Guidelines
- User Working Group Partners

Get Data

- Science Themes
- NASA Projects
- All Datasets

Submit Data

- Submit Data Form
- Data Scope and Acceptance Practices
- Data Authorship Guidance
- Data Publication Timeline
- Detailed Submission Guidelines

Tools

- TESVIS
- THREDDS
- SDAT
- Daymet
- Airborne Data Visualizer
- Soil Moisture Visualizer

Resources

- Learning
- Data Management
- News

Help

- Earthdata Forum [↗](#)
- Email Us [✉](#)

