

HyTES Level 1 Radiance, Facility Instrument Collection, 2013-2016

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Summary

This dataset contains Level 1 (L1) radiance imagery 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 $\text{W m}^{-2} \text{micron}^{-1} \text{sr}^{-1}$. HyTES was designed to provide high spectral and spatial resolution thermal infrared (TIR) data as a precursor for NASA's planned Hyperspectral Infrared Imager (HyspIRI) 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. This Facility Instrument dataset includes the L1 radiance files from the HyTES flights in years 2013 to 2016. The data are provided in ENVI 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 dataset includes the L1 radiance data from the HyTES flights during the years 2013-2016.

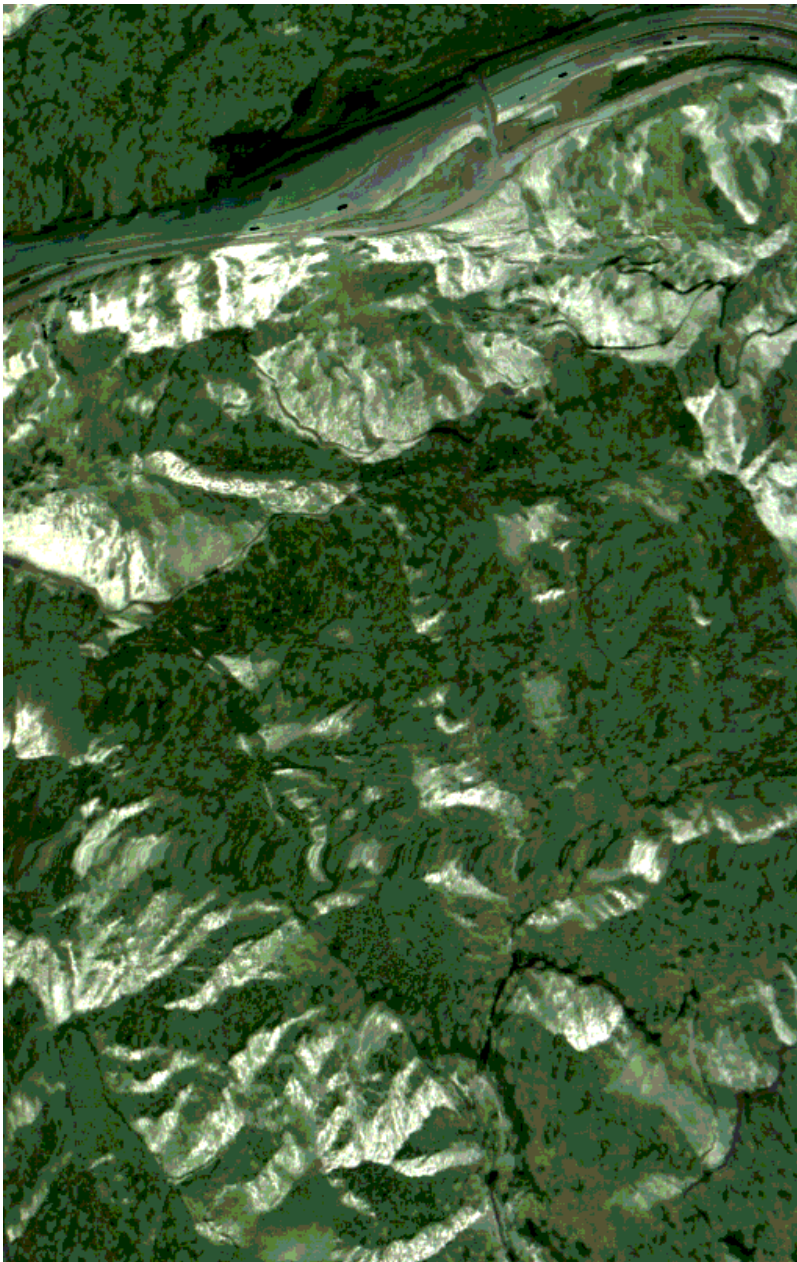


Figure 1. Portion of a false color image derived from HyTES radiance data from flight over Aliso Canyon east of Rancho Mission Viejo, California. Flight 2016-01-26.233621.

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, 2013-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2476>

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1. Dataset Overview

Project: [HyTES](#)

The Hyperspectral Thermal Emissions Spectrometer (HyTES) is an airborne pushbroom imaging spectrometer developed by the Jet Propulsion Laboratory (JPL). It was designed to support the previous Hyperspectral Infrared Imager (HyspIRI) mission study and has been used in several research missions since July 2012. HyTES offers high spatial and spectral resolution measurements of brightness temperature (radiance), emissivity, and land surface temperature. It operates across 256 spectral channels between 7.5 and 12 μm wavelengths. HyTES instrument has 512 pixels across track with pixel sizes in the range of 5 to 50 m depending on the flight altitude. HyTES was funded through NASA's Earth Science Technology Office (ESTO) Instrument Incubator Program (IIP).

This dataset contains Level 1 (L1) radiance imagery 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 and 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 $\text{W m}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$.

HyTES was designed to provide high spectral and spatial resolution thermal infrared (TIR) data as a precursor for NASA's planned Hyperspectral Infrared Imager (HyspIRI) 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 Facility Instrument dataset includes the L1 radiance files from the HyTES flights in years 2013 to 2016.

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, 2013-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2467>

- 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. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2462>

- This dataset holds radiance data from HyTES for years 2017 to present.

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: 2013-04-23 to 2016-01-26

Temporal Resolution: One-time estimate

Site Boundaries: Latitude and longitude are given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Hawaii, North America, Europe, South Africa	-121.9585	-106.1647	43.3545	32.7943

Data File Information

These L1 calibrated radiance data are provided in ENVI format. Each ENVI includes a binary file holding the data and an associated header file in plain text format. The header includes metadata such as the numbers of samples, lines, and bands as well as data type, interleave, and wavelength centers for each band.

The file naming convention is `<date>.<time>.<loc>.Line<a>-Run<b>-Segment<c>-110000-level_1a.<ext>`, where

- `<date>` = image acquisition date in YYYY-MM-DD, UTC
- `<time>` = image acquisition time in hhmmss, UTC.
- `<loc>` = location name, e.g., "Cuprite".
- `<a>`, `<b>`, and `<c>` indicate the line, run, and segment, respectively, numbers of the flight scene.
- `<ext>` = file type, either "dat" for ENVI binary or "hdr" for ENVI header.

Example file names:

`2013-04-24.173126.Cuprite.Line2-Run1-Segment13-110000-level_1a.dat`,
`2013-04-24.173126.Cuprite.Line2-Run1-Segment13-110000-level_1a.hdr`

Data File Details

- Radiance units: $\text{W m}^{-2} \mu\text{m}^{-1} \text{sr}^{-1}$
- 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

These radiance data images are not georectified. The ENVI files are structured by the instrument coordinates: lines x samples. 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. Per-pixel geolocation information is available in <https://doi.org/10.3334/ORNLDAAC/2467>. The ENVI header files also include wavelength information for each band.

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

Wavelength centers for each band are in the ENVI header files. The spectral response functions are available in <https://doi.org/10.3334/ORNLDAAC/2462> as companion files named *HyTES_SRF_v4.csv* and *HyTES_WMX_v4.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 campaign calibration files are available at <https://doi.org/10.3334/ORNLDAAC/2468>.

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 1. 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 μm /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

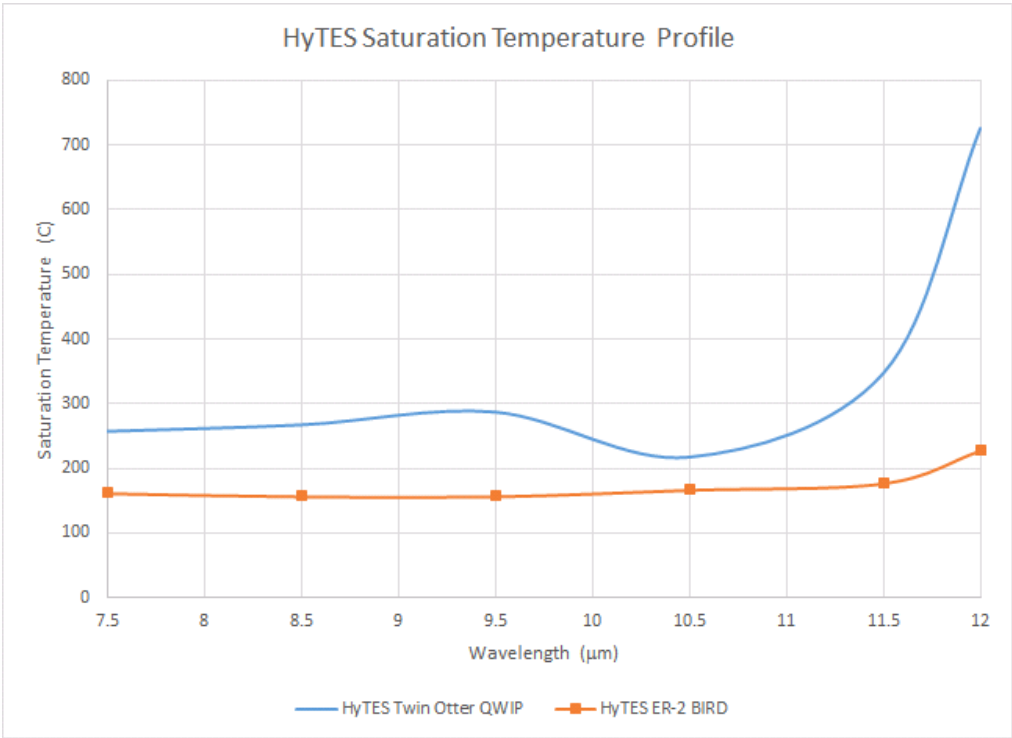


Figure 2. Saturation temperature profiles for QWIP and BIRD FPA photodetectors. The 2013-2016 flights used the QWIP sensor.

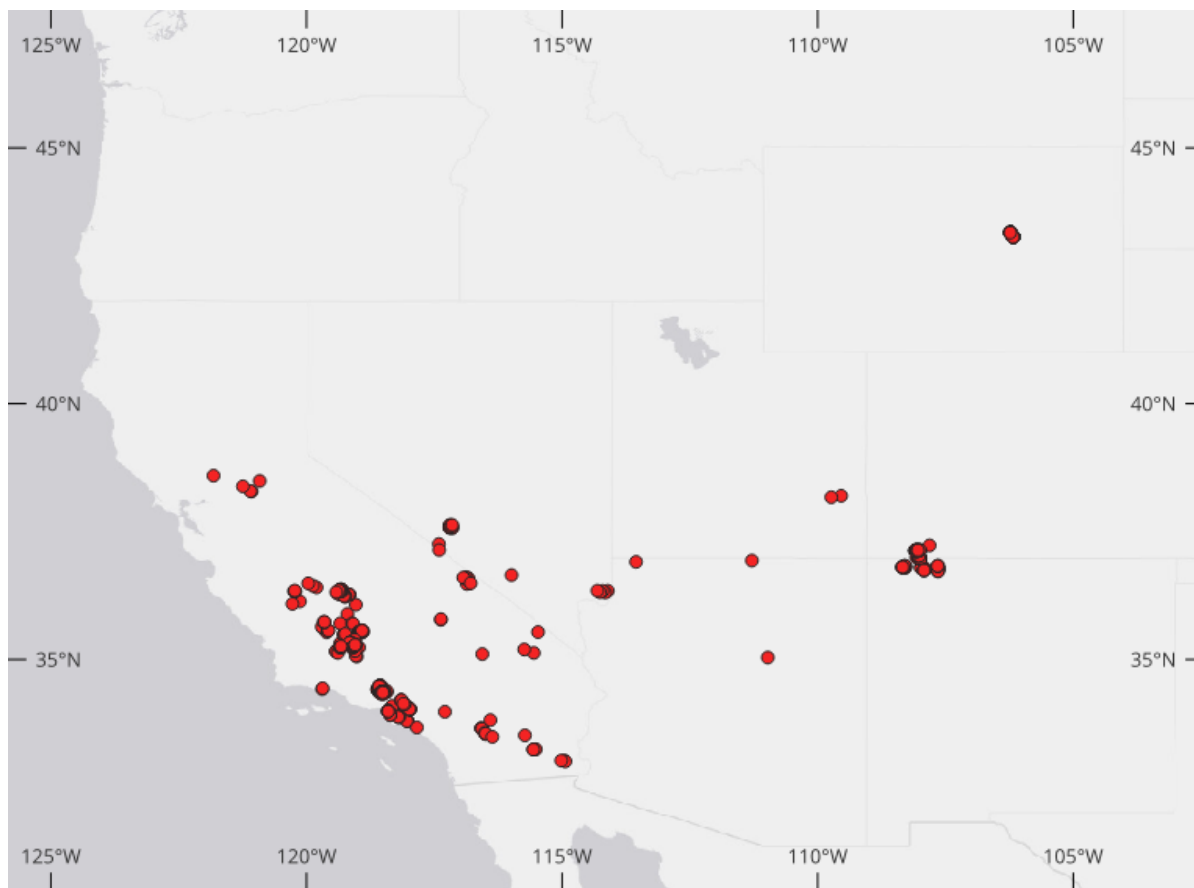


Figure 3. Locations of HyTES flights in 2013 to 2016.

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- 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, 2013-2016. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2467>
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