HyTES Level 1 Flight Paths, Facility Instrument Collection

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Summary

This dataset contains paths of flight lines for the Hyperspectral Thermal Emission Spectrometer (HyTES) instrument from 2013 to 2023. Flight paths are provided in Keyhole Markup Language (KML) format by a single line representing the flight line nadir (2013-2016) or two parallel lines denoting the imagery swath width (2017-2023). 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 NASA's Twin Otter, Earth Resources ER-2, and GulfStream V aircraft and completed its first flights in July 2012. 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. Two companion files listing imagery pixel size and swath width by platform altitude are included.

This dataset holds 3806 files in Keyhole Markup Language (KML) format and two companion files in comma-separated values (CSV) format.

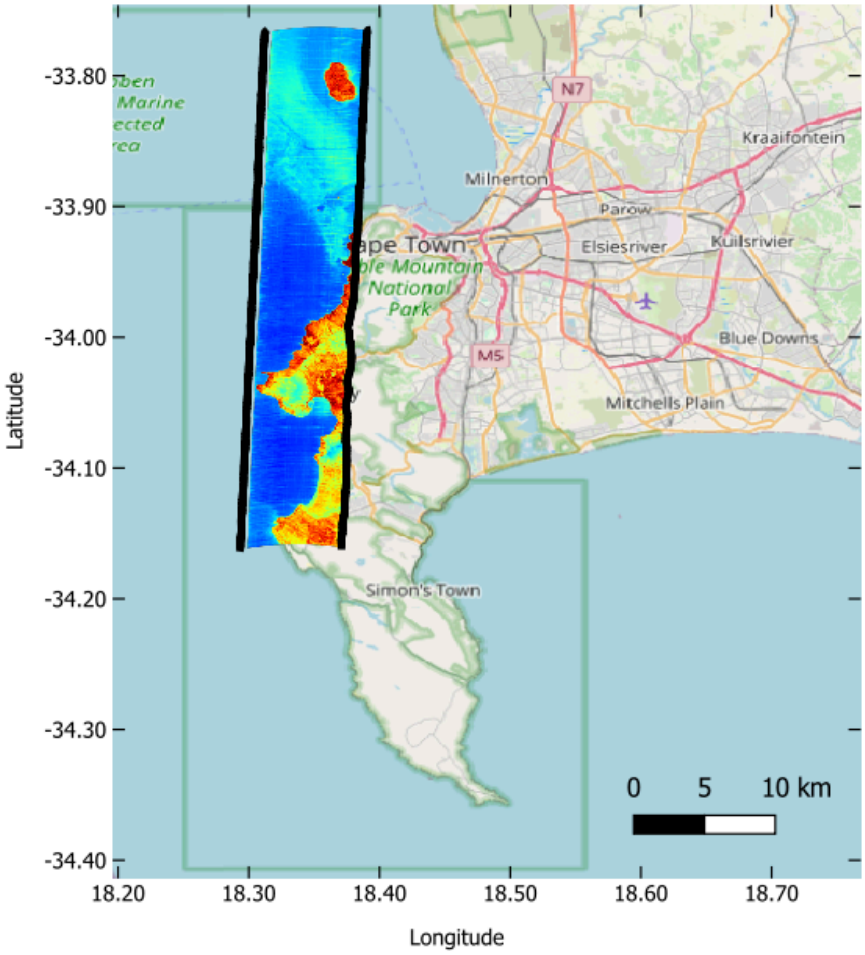

Figure 1. Left and right swath boundaries of an imagery swath (black lines) for a HyTES flight over the Table Mountain study area near Cape Town, South Africa, on November 13, 2023. A RGB overlay of land surface temperature for this acquisition is shown between the swath boundaries. Source: 20231113t144510_TableMountainBox1ZA_L1_B110_V03.kml. Basemap: copyright OpenStreetMap contributors.

Citation

Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES Level 1 Flight Paths, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2463

Table of Contents

1. Dataset Overview

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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 NASA's Twin Otter, Earth Resources ER-2, and GulfStream V aircraft and completed its first flights in July 2012. 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.

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.

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).

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.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/ORNLDAAC/2462

Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026. HyTES Level 1 Radiance Overlays, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2463

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

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 Coverage: Portions of North America, Europe, South Africa, and Hawaii

Temporal Coverage: 2013-06-24 to 2023-11-15

Temporal Resolution: One-time estimate

Study Area: Latitude and longitude are given in decimal degrees.

Site	Northernmost Latitude	Southernmost Latitude	Easternmost Longitude	Westernmost Longitude
North America, Europe, South Africa, and Hawaii	68.57103	-34.92163	26.27891	-160.02731

Data File Information

This dataset holds 3806 files in Keyhole Markup Language (.kml) format and two companion files in comma-separated values (.csv) format.

Flight paths KMLs are either a single line representing the flight nadir (2013-2016) or two parallel lines denoting imagery swath width (2017-2023) (e.g., Figure 1).

The KML file naming convention varies by year:

2013-2016: *<flight prefix>.<loc>.Line<a>-Run<b>-Segment<c>-110000.kml*, where

- <flight prefix> = flight line identifier with date and time of acquisition, *YYYY-MM-DD.hhmmss*, encoding the date and time by year (YYYY), month (MM), day (DD), hour (hh), minute (mm), and second (ss) of the flight (e.g., 2013-06-24.182842).
- <loc> = location name, e.g., “GarfieldCO”.
- <a>, <b>, and <c> indicate the line, run, and segment, respectively, numbers of the flight scene.

2017-2018: *<flight prefix>_<loc>.kml*, where

- <flight prefix> = flight line identifier, *YYYYMMDDthhmmss*, encoding the date and time by year (YYYY), month (MM), day (DD), hour (hh), minute (mm), and second (ss) of the flight (e.g., 20180118t191911).
- <loc> = location name, e.g., “PlacerCA”.

2019-2023: *<flight prefix>_<loc>_L1_<build>_<ver>.kml*, where

- <flight prefix> = flight line identifier, *YYYYMMDDthhmmss*, encoding the date and time by year (YYYY), month (MM), day (DD), hour (hh), minute (mm), and second (ss) of the flight (e.g., 20230426t205423).
- <loc> = location name, e.g., “Division2CA”.
- <build> = software build ID: “B103”.
- <ver> = incremental version number, e.g., “V03”.

Example KML file names:

- 2015-05-01.200329.Tipton.Line12-Run1-Segment01-110000.kml
- 20180918t204825_MegaboxLine52CA.kml
- 20190501t195101_PlacerCA_L1_B103_V01.kml

The KML files use geographic coordinates based on the WGS 84 datum (EPSG: 4326). Flight paths are stored in XYZ line geometry with longtitude, latitude, and altitude (m) coordinates.

Companion files

- *hytes_altitude_pixel_size.csv* provides approximate pixel sizes (m) of HyTES imagery for various flight altitudes in units of m.
- *hytes_altitude_swath_width.csv* provides approximate swath widths (m) of HyTES imagery for various flight altitudes (m).

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.

These flight paths are viewable in Google Earth as well as other GIS software, and allow the user to visualize the location of HyTES image scenes. Files for the related L1 radiance (Hook et al., 2026a) and L2 emissivity/land surface temperature (Hulley et al., 2026) data share the same naming convention as the these flight path files.

4. Quality Assessment

None provided for the KML files.

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 and Quantum Well Infrared Photodetector (QWIP). It has been deployed on NASA’s Twin Otter, ER-2, and GulfStream V aircraft.

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) and geological studies. Additional details about the HyTES instrument are available at https://hytes.jpl.nasa.gov.

These flight paths were created from navigation data collected during each deployment and include longitude, latitude, and altitude (m) coordinates based on the WSG 84 datum.

Figure 2. Global distribution of HyTES flght paths (red) during 2013-2023 over North America, Hawaii, South Africa, and Europe. Basemap: ©OpenStreetMap contributors.

6. References

Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2025. HyTES Campaign Calibration Data, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2468

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

Hook, S.J., G.C. Hulley, T.T. La, G. Rivera, W.R. Johnson, and B.T. Eng. 2026b. HyTES Level 1 Radiance Overlays, Facility Instrument Collection. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/2463

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., 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

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

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