Global Hydrology Resource Center

Data User Guide

GOES-R PLT Scanning High-Resolution Interferometer Sounder (S-HIS)

Introduction

The GOES-R PLT Field Campaign Scanning High-Resolution Interferometer Sounder (S-HIS) dataset consists of emitted thermal radiances measured by the Scanning High-resolution Interferometer Sounder (S-HIS) flown aboard a NASA ER-2 high-altitude aircraft during the GOES-R Post Launch Test (PLT) field campaign. The GOES-R PLT airborne science field campaign took place between March 21 and May 17, 2017 in support of the post-launch product validation of the Advanced Baseline Imager (ABI) and the Geostationary Lightning Mapper (GLM). Data files in netCDF-3 format are available for March 21, 2017 through May 17, 2017.

Notice:
This dataset is not continuous as flights did not occur every day.

Citation

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Keywords:

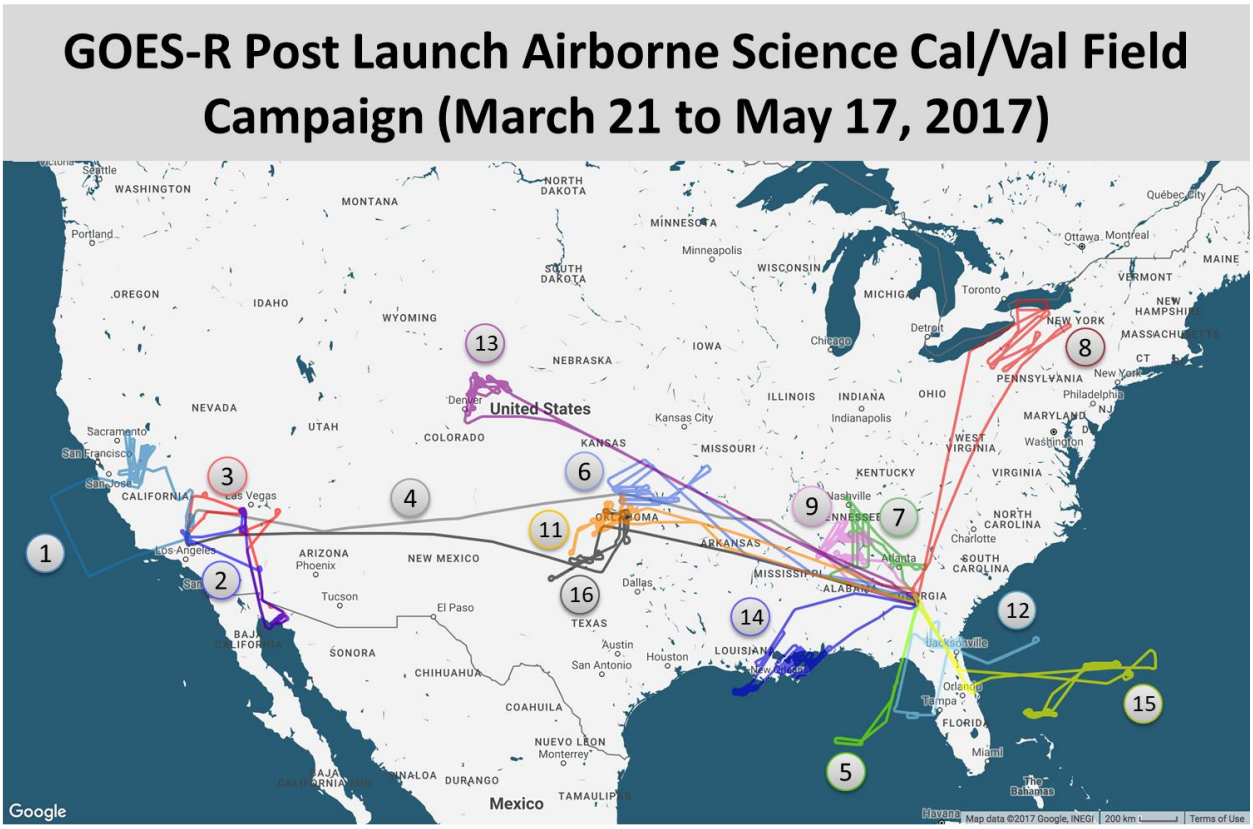
NASA, GHRC, GOES-R, PLT, HS3, S-HIS, ER-2, spectrometer, thermal radiance

Campaign

The Geostationary Operational Environmental Satellite-R (GOES-R) series is a four-satellite program including GOES-R, GOES-S, GOES-T, and GOES-U. The GOES-R Series Program is a collaborative development and acquisition effort between the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA) to develop, launch and operate the satellites. The first satellite in

the GOES-R series, GOES-R, launched on November 19, 2016 and became GOES-16 when it reached geostationary orbit. GOES-16 replaced GOES-13 as NOAA's operational GOES East satellite at 75.2 degrees west longitude on December 18, 2017. GOES-16 observes North and South America, as well as the Atlantic Ocean all the way to the west coast of Africa. GOES-16 provides high spatial and temporal resolution imagery of the Earth using its Advanced Baseline Imager (ABI). GOES-16's Geostationary Lightning Mapper (GLM) is the first operational lightning mapper flown in geostationary orbit. GOES-16 also includes four other scientific instruments for monitoring space weather and the Sun.

The GOES-R Post Launch Test (PLT) airborne science field campaign took place between March 21 and May 17, 2017 in support of the post-launch validation of NOAA's new generation of geostationary Earth observing instruments: ABI and GLM (Figure 1). The validation effort included targeted data collections from a NASA ER-2 high-altitude aircraft integrated with nine payloads (both passive and active instruments) coordinated with ground based and low earth-orbit referenced data from several operational and research satellite missions. Sixteen ER-2 aircraft validation missions, totaling 105.1 flight hours, were conducted over ideal Earth validation targets, such as deserts and oceans, thunderstorms, active wildfires, and an expansive set of cloud and moisture phenomenology. Dedicated ABI 30-second mesoscale (MESO) imagery collections were conducted concurrent with the ER-2 high-altitude aircraft based sensors during each GLM mission. The GOES-R PLT field campaign provided critical reference data and new insights into the performance NOAA's new generation of geostationary Earth observing instrument products. More information about the GOES-R PLT field campaign is available at https://www.goes-r.gov/mission/fieldCampaignBegins.html and https://www.goes-r.gov/multimedia/events/goes16FieldCampaign.html.



*Flight #10 - April 27, 2017 - Huntsville, AL not shown due to aircraft navigation not reporting

Figure 1: GOES-R PLT airborne science field campaign

(Image Source: Frank Padula)

Instrument Description

The S-HIS is a cross-track scanning interferometer sounder which measures emitted thermal radiation at high spectral resolution between 3.3 and 18 microns. The measured spectrally resolved radiance is used for a variety of applications, including retrieval of temperature and water vapor profiles of the Earth's atmosphere, determination of surface emissivity and temperature, and validation of radiative transfer models and satellite measurements. The S-HIS produces sounding data with 2 kilometer spatial resolution (at nadir) across a 40 kilometer ground swath from an altitude of 20 kilometers (0.100 mrad field of view). The S-HIS instrument flies on a number of airborne platforms including the NASA ER-2, DC-8, Proteus, WB-57, and Global Hawk. On the Proteus and WB-57 aircraft, a zenith view is available, providing a means for calibration verification and studies of upper level water vapor. More information on the S-HIS interferometer can be found in Revercomb et al. (1998), Revercomb et al. (2004), Tobin et al. (2006) and at http://shis.ssec.wisc.edu.

The S-HIS was flown aboard the NASA ER-2 aircraft during the GOES-R PLT field campaign between March 21 and May 17, 2017 in support of the post-launch product validation of the ABI.

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Data Characteristics

The GOES-R PLT S-HIS dataset consists of emitted thermal radiances measured from the S-HIS on board the NASA ER-2 aircraft during the GOES-R PLT field campaign. This dataset contains data files in netCDF-3 format at a Level 1B processing level. More information about the NASA data processing levels are available on the EOSDIS Data Processing Levels webpage. Table 1 shows the characteristics of this dataset.

Table 1: Data Characteristics

Characteristic	Description
Platform	NASA ER-2 aircraft
Instrument	Scanning High-resolution Interferometer Sounder (S-HIS)
Spatial Coverage	N: 43.925, S: 26.113, E: -71.862, W: -125.016 (Continental United States)
Spatial Resolution	2 km at nadir when flown at 20 km altitude
Temporal Coverage	March 21, 2017 - May 17, 2017
Temporal Resolution	Hourly -< Daily
Sampling Frequency	0.5 seconds
Parameter	Thermal radiance
Version	1
Processing Level	1B

File Naming Convention

The GOES-R PLT S-HIS data files are available at a Level 1B processing level in netCDF-3 format. These data files have the following file naming convention.

Data files: goesr_plt_SHIS_<start_time>_<end_time>_sdr<sdr_time>_rad.nc

Table 2: File naming convention variables

Variable	Description
<start_time>	UTC start-time of the raw instrument data files in YYYYMMDD_hhmmss format.

	YYYYMMDD: 4-digit year, 2-digit month, 2-digit day hhmmss: 2-digit hour, 2-digit minute and 2-digit second in UTC
<end_time>	UTC end-time of the raw instrument data files in YYYYMMDD_hhmmss format. YYYYMMDD: 4-digit year, 2-digit month, 2-digit day hhmmss: 2-digit hour, 2-digit minute and 2-digit second in UTC
<str_time>	UTC start-time of the radiance calibration data processing in YYYYMMDDThhmmss format. YYYYMMDD: 4-digit year, 2-digit month, 2-digit day hhmmss: 2-digit hour, 2-digit minute and 2-digit second in UTC
rad	Radiance product
.nc	netCDF-3 format

Data Format and Parameters

There are 16 data files in netCDF-3 format, one for each GOES-R PLT field campaign flight, with this dataset.

Table 3: Data Fields

Field Name	Description	Data Type	Unit
aircraftExtPressure	Pressure measurement external to aircraft	float	hPa
aircraftHeading	Direction of instrument travel: 0 = North 90 = East	float	degree
aircraftPitch	Instrument aircraft pitch: 0 = level positive = upward	float	degree
aircraftRoll	Instrument aircraft roll: 0 = level positive = clockwise from behind	float	degree
barometricAltitude	Aircraft pressure-derived altitude	float	m
Altitude	Observation altitude	float	m
base_time	Base time in UNIX epoch seconds	int	Seconds since 1970-1-1 00:00:00
date	Date in format YY/MM/DD	float	counts
dateYYMMDD	Date in format YY/MM/DD	float	-
FOVangle	Angle from nadir Negative = left of track	float	degree

HBB_NESR	Noise equivalent spectral radiance (NESR) estimated from the calibrated hot blackbody (HBB) spectra	float	$mW/(m^2\ sr\ cm^{-1})$
instrumentLatitude	Latitude of nadir point	float	°N
instrumentLongitude	Longitude of nadir point	float	°E
Latitude	Observation latitude (surface-projected)	float	°N
Longitude	Observation longitude (surface-projected)	float	°E
radiance	Radiance spectrum	float	$mW/(m^2\ sr\ cm^{-1})$
refTimeDay	Reference time, integer day-of-month	float	day
refTimeMonth	Reference time, integer month	float	month
refTimeSec	Reference time, seconds from 00:00:00, not to exceed 86,400	float	Seconds since 1970-1-1 00:00:00
refTimeUsec	Reference time, microseconds and fractions of microseconds offset	float	microseconds
redTimeYear	Reference time, integer four-digit year	float	year
sceneMirror Angle	Scene mirror angle, relative to instrument zenith	float	degrees
segments	Integer value that represents what flight segment this is part of (positive for level flight, negative for steady turn)		
time_offset	Time offset from base_time	double	Seconds since 2017-03-21 18:32:18
timeOfDay	Time since 0000UTC	float	-
timeUTC	Time since 0000UTC	float	hours
wavenumber	Wavenumber in reciprocal centimeters	double	cm^{-1}

Algorithm

Stages of data processing currently include but are not limited to:

1. De-multiplexing of data packets into raw complex interferograms and engineering data.
2. Conversion to uncalibrated spectra.
3. “Tilt” correction for vibration-induced optical path jitter.
4. Nonlinearity correction to long wave (LW) and medium wave (MW) bands.
5. Radiometric calibration reference window selection and characterization.
6. Radiometric calibration.
7. Forward-backward spectral correction.

8. Finite field-of-view correction.
9. Spectral resampling to from effective to reference wavenumber scale.
10. Band radiance merging with rolloffs (combining LW, MW, shortwave (SW)).
11. QC filtering and contiguous flight segment checks.
12. Principal Component Analysis noise filtering (optional) (Antonelli et al., 2004; Tobin et al., 2007).
13. Packaging from internal workspace format into netCDF files.

Quality Assessment

Examination of the imaginary part of the calibrated radiance is used to test for potential issues in the radiometric calibration for all radiances included in the netCDF-3 distribution. Significant spectral signature in the imaginary part of the calibrated radiance indicates a potential problem with the radiometric calibration of that record. Comparison of a selected wavenumber band average, in each of the three S-HIS bands, versus an empirically determined threshold value is used to identify spectra with potential calibration issues.

Software

No software is required since these data are in netCDF-3 format; however, Panoply can be used to easily view the data.

Known Issues or Missing Data

This dataset is not continuous as flights did not occur every day. Missing values are set as -9999.0.

References

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Related Data

All datasets from GOES-R PLT field campaign can be considered related to this GOES-R PLT S-HIS dataset. Other GOES-R PLT campaign data can be located using the GHRC HyDRO 2.0 search tool, by entering the term 'GOES-R PLT'.

In addition, S-HIS was flown onboard the NASA Global Hawk unmanned aircraft during the Hurricane and Severe Storm Sentinel (HS3) field campaign: http://dx.doi.org/10.5067/HS3/SHIS/DATA201

Contact Information

To order these data or for further information, please contact:

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