GOES-R PLT Lightning Instrument Package (LIP)

Introduction

The GOES-R PLT Lightning Instrument Package (LIP) dataset consists of electrical field measurements of lightning and navigation data collected by the Lightning Instrument Package (LIP) flown aboard a NASA ER-2 high-altitude aircraft during the GOES-R Post Launch Test (PLT) airborne science 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). These data files are available in ASCII format with browse imagery available in PDF format.

Notice:
This dataset is not continuous as flights did not occur every day. Two data files for April 6, 2017 and April 27, 2017 are not included in this dataset due to missing navigation information; however, they are available upon request.

Citation

Blakeslee, Richard J. and Douglas M. Mach. 2019. GOES-R PLT Lightning Instrument Package (LIP) [indicate subset used]. Dataset available online from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/GOESRPLT/LIP/DATA101

Keywords:

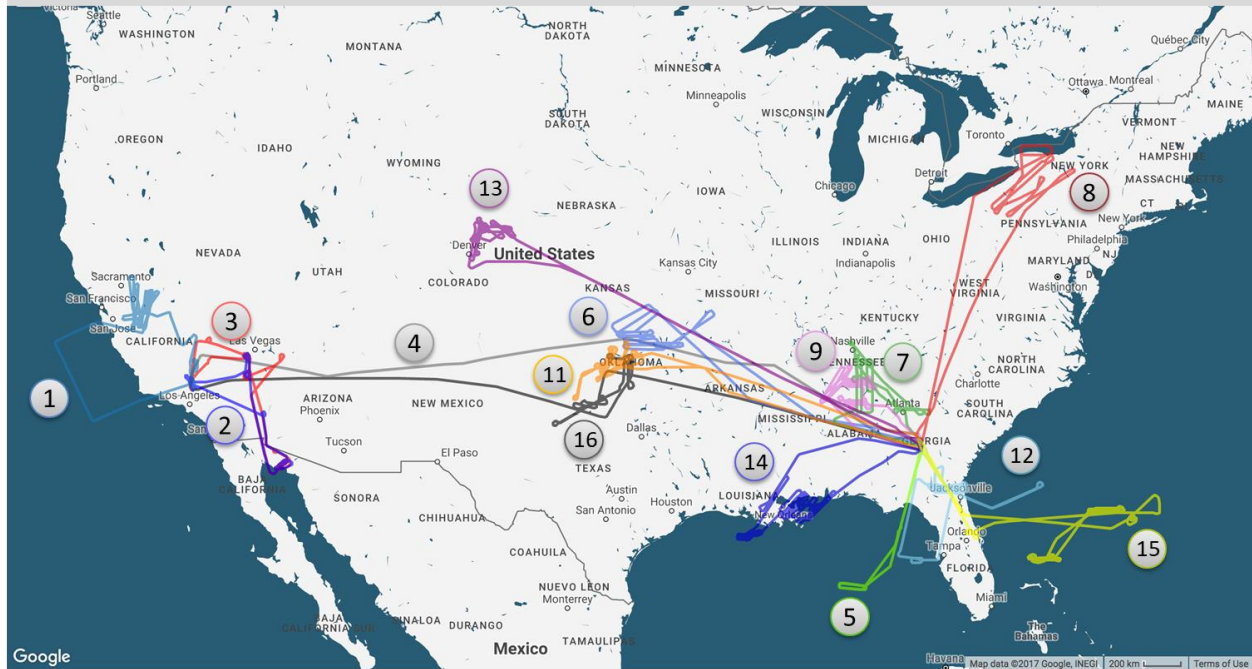*NASA, GHRC, CONUS, GOES-R, PLT, LIP, GLM, lightning*

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 mission 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.

GOES-R Post Launch Airborne Science Cal/Val Field Campaign (March 21 to May 17, 2017)

*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 Lightning Instrument Package (LIP) operated on the NASA ER-2 high-altitude aircraft and consists of eight state-of-the-art digital electric field mills, a dual-tube Gerdien conductivity probe, and a distributed computer system. The field mills are mounted on the ER-2 aircraft (Figure 2) and calibrated so that one can derive the external electric field (i.e., E_x, E_y, E_z) where the aircraft is located. The field mills also provide a measurement of the electric charge (Q) on the aircraft. These data can greatly improve knowledge of the electrical structure of storms from ER-2 overflights, particularly when the ER-2 passes storms off-center or encounters complex storm geometries.

The conductivity probe is installed on either the right or left hand superpod nose cone (Figure 2). It measures the air conductivity at the aircraft flight altitude. The probe consists of a pair of Gerdien capacitor type sensors so that the contributions to the total conductivity due to positive and negative ions are obtained simultaneously throughout each flight. Storm electric currents can be derived using the electric field and air conductivity measurements. The distributed computer system records and transmits decimated data to the ground. The system also capable of being commanded from the ground to change various parameters.
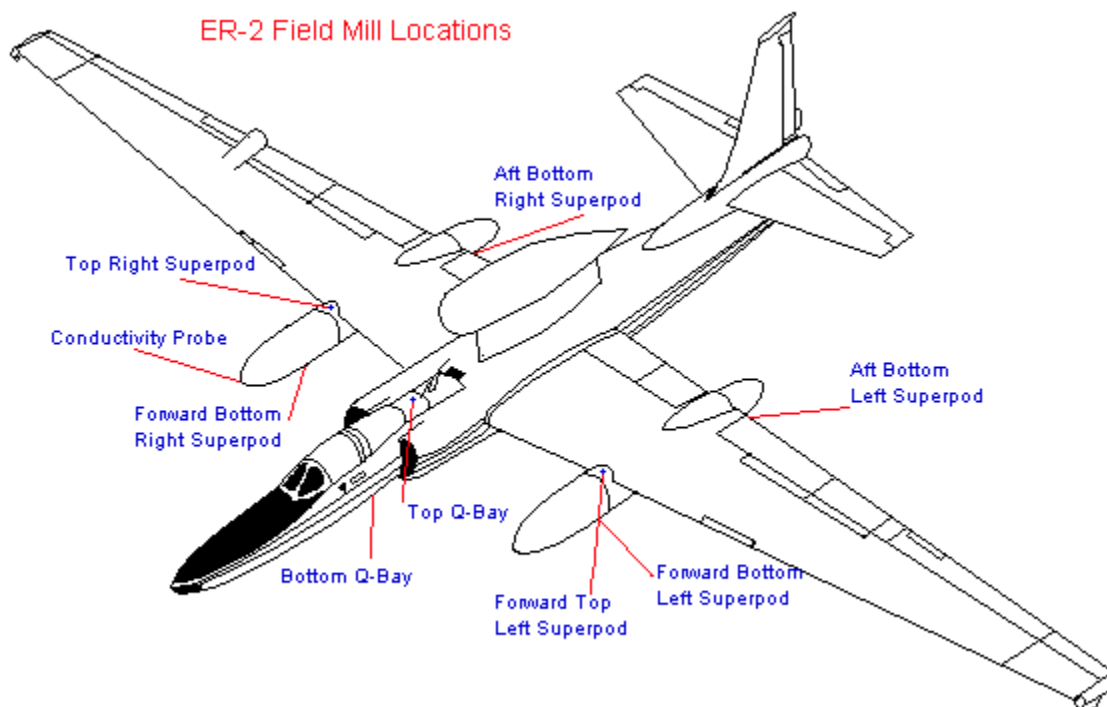
Figure 2: Locations of the eight field mills and the conductivity probe as mounted on the ER-2 aircraft.
(Image source: Richard J. Blakeslee)

Investigators

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Data Characteristics

The GOES-R PLT LIP dataset contains data files in ASCII format and browse imagery files in PDF format at a Level 1A 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	Lightning Instrument Package (LIP)
Spatial Coverage	N: 43.573, S: 26.449, E: -72.202, W: -124.625 (Continental United States)
Spatial Resolution	point
Temporal Coverage	March 21, 2017 - May 17, 2017
Temporal Resolution	Daily -< Weekly
Sampling Frequency	0.02 seconds
Parameter	Atmospheric electricity
Version	1
Processing Level	1A

File Naming Convention

The GOES-R PLT LIP data files are available at a Level 1A processing level in ASCII format with browse imagery available in PDF format. These data and browse files have the following file naming convention.

Data files: goesr_plt_lip_YYYYMMDD.txt
Browse files: goesr_plt_lip_YYYYMMDD_hhmm.pdf

Table 2: File naming convention variables

Variable	Description
YYYY	Four-digit year
MM	Two-digit month
DD	Two-digit day
hh	Two-digit hour in UTC
mm	Two-digit minute in UTC
.pdf	Portable Document Format
.txt	ASCII format

Data Format and Parameters

The GOES-R PLT LIP data files are in ASCII format. There are 12 data fields in each data file (Table 3). The browse imagery files are in PDF format and each file contains four time series plots: the three vector components of the ambient electric field data (Ex, Ey, Ez), and the electric field due to charge on the aircraft (Eq).

Table 3: Data fields in GOES-R PLT LIP data files.

Column	Data field	Unit
1	Date string 1 (year-month-day of month) (i.e., 2017-03-21)	-
2	Date string 2 (Hour:Minute:Seconds.Milliseconds) (i.e., 18:30:00.000)	-
3,4,5	Vector components of the electric field (Ex, Ey, Ez) in the aircraft frame of reference	kV/m

6	Electric field due to charge on the aircraft (Eq)	kV/m
7	Lat	Degrees North
8	Lon	Degrees East
9	Alt	km
10	Roll	degrees
11	Pitch	degrees
12	Heading	degrees

Quality Assessment

Each electric field mill incorporates self-calibration capabilities that reduce the time required to obtain a full aircraft calibration (Mach and Koshak, 2007). In addition, the electric field signals are digitized at each mill and transmitted as a digital data stream, reducing signal noise and simplifying aircraft integration (Bateman et al., 2007).

Software

No software is required to view these ASCII data files and PDF browse imagery.

Known Issues or Missing Data

This dataset is not continuous as flights did not occur every day. Missing values are set as 'NaN'. Two data files for April 6, 2017 and April 27, 2017 are not included in this dataset due to missing navigation information; however, they are available upon request.

References

Koshak, W. J., D. M. Mach, H. J. Christian, M. F. Stewart, and M. G. Bateman (2006). Retrieving storm electric fields from aircraft field mill data. Part II: Applications. J. Atmos. Oceanic Technol., 23, 1302–1322. doi: https://doi.org/10.1175/JTECH1918.1

Mach, D. M., and W. J. Koshak (2007). General matrix inversion technique for the calibration of electric field sensor arrays on aircraft platforms. J. Atmos. Oceanic Technol., 24, 1576-1587. doi: https://doi.org/10.1175/JTECH2080.1

Bateman, M. G., M. F. Stewart, R. J. Blakeslee, S. J. Podgorny, H. J. Christian, D. M. Mach, J. C. Bailey, and D. Daskar (2007). A low-noise, microprocessor-controlled, internally digitizing rotating-vane electric field mill for airborne platforms. J. Atmos. Ocean. Tech., 24, 1245–1255. doi: https://doi.org/10.1175/JTECH2039.1

Related Data

All datasets from GOES-R PLT field campaign can be considered related to this GRIP LIP 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, LIP was flown in six other field campaigns. These other LIP datasets are listed below and may be of interest.

TCSP ER-2 LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/TCSP/LIP/DATA101)

CAMEX-4 DC-8 LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/CAMEX-4/LIP/DATA001)

CAMEX-3 LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/CAMEX-3/LIP/DATA001)

GRIP LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/GRIP/LIP/DATA201)

TRMM-LBA LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/LIS/LIP/DATA101)

CAMEX-4 ER-2 LIGHTNING INSTRUMENT PACKAGE (LIP)
(http://dx.doi.org/10.5067/CAMEX-4/LIP/DATA002)

Contact Information

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

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      User Services
      320 Sparkman Drive
      Huntsville, AL 35805
      Phone: 256-961-7932
      E-mail: support-ghrc@earthdata.nasa.gov
      Web: https://ghrc.nsstc.nasa.gov/

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