



## Data User Guide

# ***LIS 0.1 Degree Very High Resolution Gridded Lightning Climatology Data Collection***

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### **Introduction**

The LIS 0.1 Degree Very High Resolution Gridded Climatology (VHRcC) data collection consist of gridded climatologies of total lightning flash rates seen by the Lightning Imaging Sensor (LIS). The Very High Resolution Gridded Lightning Climatology Collection consists of five datasets including the full (VHRFC), monthly (VHRMC), diurnal (VHRDC), annual (VHRAC), and seasonal (VHRSC) lightning climatologies. These gridded climatologies include annual mean flash rate, mean diurnal cycle of flash rate with 24 hour resolution, and mean annual cycle of flash rate with daily, monthly, or seasonal resolution. All datasets are in 0.1 degree spatial resolution, where the mean annual cycle of flash rate datasets (i.e., daily, monthly or seasonal) have both 49-day and 1 degree boxcar moving average to remove diurnal cycle and smooth regions with low flash rate to make the results more robust.

### **Citation**

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Climatology Data Collection. Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA306>

Note: Citation applies to entire data collection. Please refer to the Data Citation section at the end of the document for individual dataset citations.

### **Keywords:**

*TRMM; Lightning; Climatology; flash rate*

## Instrument Description

The LIS sensor was onboard of the *Tropical Rainfall Measuring Mission* (TRMM) satellite until the mission ended in April 2015. LIS flew in low earth orbit, viewing each Earth location for approximately 1.5 minutes as it passed overhead. The sensor monitors the 777.4 nm atomic oxygen multiplet, detecting pulses of illumination produced by lightning above background levels. Data files from each individual orbit are available, with 16 orbits per day, containing recorded lightning flash times and locations at approximately 5 km resolution. For each one second of the orbit, the orbit files record the observation time in each of the 128x128 Charged Coupled Device (CCD) pixels of LIS, in addition to warning flags describing the instrument and spacecraft performance (i.e. quality control flags). Several other lightning attributes and instrument information are recorded within the orbital files such as flash duration, radiance, and aerial extent of the illumination.

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## File Naming Convention

The LIS Very High Resolution Gridded Climatology file naming convention is as follows:

**Data:** LIS\_VHRnC\_Vx.x.yyyy.nc

**Browse Imagery:** nnnn\_COM\_FR\_Vx.x.yyyy.png

**Animation:** nnnn\_COM\_FR\_Vx.x.yyyy.mov

Table 1: File Naming Convention Variables

Variable	Description
VHRnC	File identifier (See table2)
Vx.x.	Version Number
yyyy	Four-digit year
.nc	NetCDF4 format
.png	Portable Network Graphics format
.mov	QuickTime format

Table 2: File Identifiers

Variable	Description
VHRFC	Very High Resolution Gridded Lightning Full Climatology
VHRMC	Very High Resolution Gridded Lightning Monthly Climatology
VHRDC	Very High Resolution Gridded Lightning Diurnal Climatology
VHRAC	Very High Resolution Gridded Lightning Annual Climatology
VHRSC	Very High Resolution Gridded Lightning Seasonal Climatology
VHRcC	Very High Resolution Gridded Lightning Climatology Data Collection

## Data Format Description

The LIS Very High Resolution Gridded Climatology data files are in Network Common Data Form (NetCDF) version 4. Information about NetCDF can be obtained from [Unidata Program](#). For each grid box in this Very High Resolution dataset, the total viewtime (observation duration) and flash count are summed over each one second of the orbits, and sorted by time of day and day of year. Flash counts are scaled by LIS detection efficiency which varies with time of day. The optical sensors can more easily discriminate lightning from the background scene at night, with bright daytime cloud tops being more difficult. The LIS detection efficiency ranges from about 69% near local noon to 88% overnight.

Please refer to the tables below for more information on the data set characteristics and variables provided. In addition, a collection of lower resolution LIS/OTD Gridded Lightning Climatology Data Sets are available for download. More information can be found at [https://ghrc.nsstc.nasa.gov/uso/ds\\_details/collections/loCv2.3.2014.html](https://ghrc.nsstc.nasa.gov/uso/ds_details/collections/loCv2.3.2014.html).

Table 3: Dataset Characteristics

Characteristic	Description
Spatial Coverage	N: 38, S: -38, W: -180, E: 180
Spatial Resolution	0.1°
Temporal Coverage	1998-2013
Temporal Resolution	Monthly, diurnal, annual, seasonal, full
Parameter	Atmospheric Electricity
Processing Level	3

There are 5 Very High Resolution Gridded Lightning Climatology data sets available, which are described in table 4.

Table 4: LIS Very High Resolution Gridded Lightning Climatology Data Parameters

File Identifier	Dataset name	Description	Units	Dimensions*	Bin sizes	Smoothing
<b>VHRFC</b>	VHRFC_LIS_FRD	Mean annual flash rate density	fl km <sup>-2</sup> yr <sup>-1</sup>	760 x 3600	0.1° x 0.1°	none
	VHRFC_LIS_VT	Viewtime (observation time)	s	760 x 3600	0.1° x 0.1°	none
<b>VHRDC</b>	VHRDC_LIS_FRD	Mean local time flash rate density	fl km <sup>-2</sup> h <sup>-1</sup>	760 x 3600 x 24	0.1° x 0.1° x 1 h	1° x1° boxcar moving average
	VHRDC_LIS_VT	Viewtime (observation time)	s	760 x 3600 x 24	0.1° x 0.1° x 1 h	none
<b>VHRMC</b>	VHRMC_LIS_FRD	Mean monthly flash rate density	fl km <sup>-2</sup> day <sup>-1</sup>	760 x 3600 x 12	0.1° x 0.1° x 1 month	49-day and 1° x1° boxcar moving average
	VHRMC_LIS_VT	Viewtime (observation time)	s	760 x 3600 x12	0.1° x 0.1° x 1 month	49-day boxcar moving average
<b>VHRSC</b>	VHRSC_LIS_FRD	Mean seasonal flash rate density	fl km <sup>-2</sup> day <sup>-1</sup>	760 x 3600 x 4	0.1° x 0.1° x 1 trimester	49-day and 1° x1° boxcar moving average
	VHRSC_LIS_VT	Viewtime (observation time)	s	760 x 3600 x 4	0.1° x 0.1° x 1 trimester	49-day boxcar moving average
<b>VHRAC</b>	VHRAC_LIS_FRD	Mean daily flash rate density	fl km <sup>-2</sup> day <sup>-1</sup>	760 x 3600 x 365	0.1° x 0.1° x 1 day	49-day and 1° x1° boxcar moving average
	VHRAC_LIS_VT	Viewtime (observation time)	s	760 x 3600 x 365	0.1° x 0.1° x 1 day	49-day boxcar moving average

\* Latitude and Longitude span, respectively, from ±38° (i.e., 760 grid points in 0.1° resolution) and ±180° (i.e., 3600 grid points in 0.1° resolution).

*A word of caution:* It is important to note that VHRDC, VHRMC, VHRSC and VHRAC should be used appropriately with care as individual local standard time, months, seasons and day of the year may not contain significant thunderstorm sampling in places with low flash rate density, such as portions of the ocean. Diurnal, monthly, seasonal or annual cycles in those areas are subject to errors.

## Tools

A sample LIS Very High Resolution Climatology Data Reader Code is available at: <https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/doc/>.

Please note that the VHRAC dataset file (“lis\_vhrac\_1998\_2013\_v01.nc.gz”) is very large (7.5GB uncompressed) and should be read in pieces (e.g., day by day) in most computers.

## Data Citation

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Full Climatology (VHRFC). Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/VHRFC/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA301>

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Monthly Climatology (VHRMC). Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/VHRMC/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA302>

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Diurnal Climatology (VHRDC). Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/VHRDC/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA303>

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Annual Climatology (VHRAC). Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/VHRAC/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA304>

Albrecht, R., S. Goodman, D. Buechler, R. Blakeslee, and H. Christian. 2016. LIS 0.1 Degree Very High Resolution Gridded Lightning Seasonal Climatology (VHRSC). Data sets available online [<https://ghrc.nsstc.nasa.gov/pub/lis/climatology/LIS/VHRSC/>] from the NASA Global Hydrology Resource Center DAAC, Huntsville, Alabama, U.S.A. doi: <http://dx.doi.org/10.5067/LIS/LIS/DATA305>

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