Global Hydrology Resource Center

Data User Guide

Hurricane and Severe Storm Sentinel (HS3) World Wide Lightning Location Network (WWLLN) Storms

Introduction

The World Wide Lightning Location Network (WWLLN) is a global, ground-based lightning sensor network operated by the University of Washington in Seattle. This network monitors and maps global lightning activity. WWLLN has generated quality controlled global lightning data for storms studied during the 2012-2014 Hurricane and Severe Storm Sentinel (HS3) campaign to track and analyze lightning activity.

Citation

World Wide Lightning Location Network (WWLLN). 2016. Hurricane and Severe Storm Sentinel (HS3) World Wide Lightning Location Network (WWLLN) Storms [indicate subset used]. Dataset available online [https://hs3.nsstc.nasa.gov/pub/hs3/WWLLN/] from the NASA EOSDIS Global Hydrology Resource Center Distributed Active Archive Center, Huntsville, Alabama, U.S.A. doi: http://dx.doi.org/10.5067/HS3/WWLLN/DATA201

Keywords:

GHRC, HS3, NASA, Global Hawk; Hurricane; Atlantic Ocean; Easter Pacific Ocean, Lightning; Atmospheric Electricity

Campaign

The Hurricane and Severe Storm Sentinel (HS3) was a five-year NASA mission specifically targeted to investigate the processes that underlie hurricane formation and intensity change in the Atlantic Ocean basin. Goals for HS3 included: assessing the relative roles of large-scale environment and storm-scale internal processes; and

addressing the controversial role of the Saharan Air Layer (SAL) in tropical storm formation and intensification as well as the role of deep convection in the inner-core region of storms. To achieve these goals, sustained measurements over several years was needed to get a large enough sample of storms. Therefore, field measurements took place from 2012 through 2014 for one month during each hurricane season. The HS3 campaign utilized two Global Hawks, one with instruments geared toward measurement of the environment and the other with instruments suited to inner-core structure and processes. The environmental payload included the scanning High-resolution Interferometer Sounder (S-HIS) and the AVAPS dropsonde system; the over-storm payload included the HIWRAP conically scanning Doppler radar, the HIRAD multi-frequency interferometric radiometer, and the HAMSR microwave sounder. More information about the HS3 campaign can be found here http://hs3.nsstc.nasa.gov/.

Instrument Description

WWLLN records global lightning occurrences from very low frequency (VLF) band ground-based receiver stations. Each station consists of a whip antenna, GPS receiver, VLF receiver, and processing computer. Ground-based observations in the VLF band are dominated by impulsive signals from lightning discharges called sferics. Signification radiated electromagnetic power exists from a few hertz to several hundred megahertz, with the bulk of the radiated energy at VLF. The antennas measure VLF band (3-30kHz) radiated lightning discharges to compile lightning data. For more information on the instrumentation and validation, please refer to the publications listed under the references section or visit the WWLLN webpage (http://wwlln.net/).

Investigators

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File Naming Convention

WWLLN data files are organized within storm directory folders using the file naming convention below. The associating storms studied during the HS3 campaign can be identified using the storm coverage table below.

Data

AEYYYYMMDD.loc
AEYYYYMMDD.loc.nc

Where,
YYYY = Year
MM = Month
DD = Day
.loc = ASCII text file
.loc.nc = netCDF

Storm Coverage

Where,
Storm_ID = Storm identification number by year
Name = Name of storm
Max_Category = Maximum rating on the Saffir-Simpson scale.
Basin = Ocean basin
EP = Eastern Pacific
AT = Atlantic

STORM_ID	NAME	YEAR	START	END	MAX_CATEGORY	BASIN
2012141	NADINE	2012	41162.50	41186.25	H1	AT
2013061	FERNAND	2013	41511.50	41512.75	TS	AT
2013071	GABRIELLE	2013	41521.75	41530.50	TS	AT
2014041	CRISTOBAL	2014	41874.75	41884.25	H1	AT
2014061	EDOUARD	2014	41892.75	41904.25	H3	AT
2012111	LESLIE	2012	41149.50	41164.00	H1	AT
2014051	DOLLY	2014	41883.50	41886.00	TS	AT
2013122	LORENA	2013	41521.50	41526.00	TS	EP
2013051	ERIN	2013	41501.00	41505.75	TS	AT
2013101	INGRID	2013	41529.25	41534.25	H1	AT
2014071	FAY	2014	41922.00	41925.00	H1	AT
2013091	HUMBERTO	2013	41525.00	41536.25	H1	AT
2013112	KIKO	2013	41515.75	41521.25	H1	EP
2014081	GONZALO	2014	41923.75	41932.25	H4	AT

Data Format Description

WLLN lightning stroke data is a level 2 product that has been quality controlled to remove erroneous measurements, and configured in ASCII text file and NetCDF format. Each ASCII file contains corresponding parameters on each row, where each row represents an individual lightning stroke recorded.

Spatial Coverage

North Boundary: 45°N
West Boundary: -100°
East Boundary: 0°
South Boundary: 0°

Temporal Coverage

Start Date: 09-20-2012
End Data: 10-20-2014

Parameters

The table below provides the parameter name, description, and units of the provided fields.

Parameter Name	Description	Units
YYYY/MM/DD	Date (UTC)	Microsecond
hh:mm:ss.fract	Time (UTC)	Microsecond
lat	Latitude (Geographic coordinates)	Fractional degrees
lon	Longitude (Geographic coordinates)	Fractional degrees
resid	Residual fit error	Microseconds (always <30)
Nstn	Number of WWLLN stations	(always ≥5)
Energy	Far field VLF energy of the stroke (from 1.3 ms waveform sampling between 7 and 18 kHz)	Joules (J)
Energy uncertainty	Energy error of the fit	Joules (J)
Estn	Subset of Nstn stations between 1000 - 8000 km from the stroke whose energy data were used in the energy estimate	n/a

References

For more information on past WLLN publications please visit:
http://wwlln.net/publications/

VLF lightning location by time of group arrival (TOGA) at multiple sites Dowden, R.L., Brundell, J.B.; Rodger, C.J. Source: Journal of Atmospheric and Solar-Terrestrial Physics, v 64, n 7, May 2002, p 817-30

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Contact Information

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

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