National Climatic Data Center

DATA DOCUMENTATION

FOR

DATASET 3641

Hurricane Satellite (HURSAT-B1): ISCCP B1 observations of tropical cyclones worldwide

Version 6

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1. Abstract

The "Hurricane Satellite (HURSAT-B1): ISCCP B1 observations of tropical cyclones worldwide" data consist of raw satellite observations derived from the ISCCP B1 data (Knapp 2008) centered on historical tropical cyclones (TC). The data derive from the global constellation of meteorological geostationary satellites (e.g., the GOES, GMS and Meteosat series) spanning 1978 through present. The data are available at 3-hour intervals and are gridded to roughly 8km resolution. The data include infrared window, visible and other channels available from the satellite instruments. In particular, the infrared window brightness have been intercalibrated to ensure long term stability (Knapp 2008). IBTrACS data were temporally-interpolated to match the satellite data resolution. The satellite data were then gridded to 8km, with grid centers fixed on the tropical cyclone center of circulation. Data are provided in a convenient NetCDF format which is self-documenting and follows standard storage and meta-data conventions. This data set will be updated annually at customer request if resources exist.

2. Element Names and Definitions

2.1 File Storage Format and Conventions

File storage format:
NetCDF version 4

File storage format URL:
http://www.unidata.ucar.edu/netcdf/

File storage convention:
CF (Climate and Forecasting convention)

File storage convention URL:
http://cfconventions.org/

2.2 File naming convention:

(Note: All times referenced in the naming convention are to the Universal Time Code, UTC)

YyysJjjHLtLon.<Name>.Yyyn.Mm.Dd.Hhmm.Vv.Sat-Nn.Www.hursat-b1.Ver.nc

YyysJjjHLtLon = IBTrACS Serial Number

Where:

- Yyys — The year the tropical cyclone began (this may be different than Yyyn, below).
- Jjj — The day of the year the tropical cyclone began.
- H — Hemisphere:
  - S = Southern Hemisphere
  - N = Northern Hemisphere
- Lt — The latitude (absolute value and rounded to the nearest integer) of the first observation of the cyclone (units=degrees)
- Lon — The longitude (rounded to the nearest integer) of the first observation of the cyclone (units=degrees East of the Prime Meridian ranging from 0-359).

Name The storm name (Variable number of characters).
'MISSING' means that the storm was not named.
Yyyn Year of acquisition of the satellite image
Mm Integer representing the month of the image acquisition 01=Jan., 02=Feb., … , 12=Dec.
Dd Day of month of the image acquisition (Range=01-31)
Hhmm Optimal time of the satellite acquisition where Hhmm is Hh:mm UTC.
(Generally rounded to the nearest synoptic hour: 0000, 0300, …, 2100)
Vv View zenith angle (degrees) from the satellite to the tropical cyclone center of circulation.
Sat-Nn ISCCP Satellite ID where:
SMS = SMS (pre-GOES) (U.S.A.)
GOE = GOES (U.S.A.)
MET = Meteosat (Europe)
GMS = GMS (Japanese)
MTS = MTSAT (Japanese)
FY2 = FY2 (Chinese)
Www Representative wind speed (knots). Not to be used in calculations,
but for qualitative analysis (to aid in identifying strong vs weak systems)
A value of 000 means the wind speed was not reported
hursat-b1 file suffix that identifies the data file and the file format
Ver file version. Current version = v06.
nc file suffix for a NetCDF file.

Example:

2009073S09131.ILSA.2009.03.16.0300.23.MTS-1.000.hursat-b1.v05.nc Means:

Year storm began	2009
Day of Year storm began	073
Hemisphere	S (Southern Henisphere)
Latitude where storm began	09 (9 deg South)
Longitude where storm began	131E
Storm name	Ilsa
Image obtained – Year	2009
Image obtained – Month	03 (March)
Image obtained – Day of Month	16
Image obtained – Time	0300 = 03:00 UTC
Satellite view zenith angle	23 deg
Satellite	MTS-1
Tropical Cyclone Wind Speed	00 knots (missing)
Dataset id	hursat-b1
Version	5
File type	nc (NetCDF file)

2.3 Global Attributes:

Note: Information on the Global Attributes can be obtained using the netCDF utility: ncdump
The bulk of the global attributes derive from the "Unidata Dataset Discovery v1.0" which is described at:

http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html

or the COARDS convention described at:
http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html

A description of the attributes not listed in these conventions follows:

Attribute: **TC_id**
Description: The tropical cyclone ID. The actual format is TC_serial_number and TC_name connected with a period. If TC_name is blank, then 'MISSING' is used as a filler.

Attribute: **TC_serial_number**
Description: The purpose of a storm serial number is an identifier which is unlikely to change given changes to storm intensity, begin or end dates, or position. The format of the serial number is provided above as the first 13 digits of the filename.

Attribute: **TC_name**
Description: The tropical cyclone name (if available) as provided in IBTrACS.

Attribute: **IBTrACS_Version**
Description: IBTrACS version of the data used for the tracks.

Attribute: **base_date**
Description: This is the year/month/day_of_month of the satellite image.

Attribute: **Satellite_Name**
Description: The name of the satellite making the observation.

Attribute: **Sensor_Name**
Description: Name of the satellite instrument making the observation.

Attribute: **B1_file**
Description: File name of the ISCCP B1 file in the NCDC archive from which this data was derived.

Attribute: **B1U_file**
Description: File name of the ISCCP B1U file in the NCDC archive from which this data was derived.

Attribute: **svn_info**
Description: Subversion information regarding the routine used to extract the tropical cyclone grids from the ISCCP B1 data

Other global attributes from the IBTrACS dataset are also appended to the file.

2.4 Variables:

Note: Information on the variables can be obtained using the netCDF utility: ncdump

CF conventions define the variable attributes.
The following is meant to supplement the information in the netCDF file.

Element Name: lat

Definition: Latitude dimension vector of the corresponding satellite observation grids.

Element Name: lon
Definition: Longitude dimension vector of the corresponding satellite observation grids.

Element Name: htime
Definition:

Element Name: fname
Definition:

Element Name: sid
Definition:

Element Name: NomDate
Definition: Nominal starting date (UTC) of the satellite image. This is generally of the form YYJJJ where YY is the last two digits of the year and JJJ is the day of the year. Note: It may also be of a format which includes a 4-digit year. That is, YYYYJJJ.

Element Name: NomTime
Definition: The nominal starting time (UTC) of the satellite image, of the format HHMMSS

Element Name: sss
Definition: Sensor ID. The missing value is -9999. A table of the McIDAS sensor IDs is available at: http://www.ssec.wisc.edu/mcidas/doc/misc_doc/area2.html (sensor source numbers)

Element Name: nchan
Definition: Dimension describing the number of available channels from the instrument.

Element Name: SubSatLat
Definition: The satellite nadir point latitude at the time of the image observation.

Element Name: SubSatLon
Definition: The satellite nadir point longitude at the time of the image observation.

Element Name: WindSpd
Definition: Cyclone wind speed linearly interpolated from the best track data.

Element Name: CentPrs
Definition: Cyclone central pressure linearly interpolated from the best track data.

Element Name: CentLat
Definition: Cyclone latitude interpolated (using splines) from the best track data.

Element Name: CentLon
Definition: Cyclone longitude interpolated (using splines) from the best track data.

Element Name: vza
Definition:

Element Name: IRWIN
Definition: Infrared window channel brightness temperature observation. The data is provided in scaled termperature. The original B1 data were calibrated using the ISCCP absolute calibration (version was that as of May 2006). The data were further calibrated using coincident HIRS observations and provided corrections to the ISCCP calibration. The application of the correction is described below.

<u>IRWIN Attributes</u>

Calibration_Correction_Equation: This is the equation on how the calibration correction should be applied.
Cal_Scale: The scale used in the calibration correction.
Cal_Offset: The offset used in the calibration correction.
Calibration_Correction_AppendDate: The date the calibration correction was appended to the file.
Calibration_Correction_TableVersion: The filename and version of the calibration correction from which the correction derives.

Depending on the availability of channels the following channels are optional for all data sets.

Element Name: VSCHN (optional)
Definition: Visible channel observations.

Element Name: IRWVP (optional)
Definition: Infrared window channel observations.

Element Name: IRSPL (optional)
Definition: Split window channel observations.

Element Name: IRNIR (optional)
Definition: Near-infrared channel observations.

The following variables derive from the ARCHER algorithm version 2.7 that attempts to identify the center of circulation in a storm image. The attributes provide some information. The following is meant to provide a bit more depth and context for the variables provided.

Element Name: archer_lat
Definition: Center fix latitude determined by ARCHER using the IRWIN brightness temperatures

Element Name: archer_lon
Definition: Center fix longitude determined by ARCHER using the IRWIN brightness temperatures

Element Name: archer_combo_score
Definition: The ARCHER algorithm estimate storm center location based on two score: a ring score and a spiral score. This is the sum of the two.

Element Name: archer_ring_score
Definition: This is the ARCHER ring score. The Spiral score can then be found by the difference

between this and the combo score.

Element Name: archer_weak_flag
Definition: This flag is set when ARCHER can't find a significantly strong storm center. To my understanding, the weak version of the centering is a less accurate approach.

Element Name: eye_prob
Definition: Probability that it is an eye. This is based on the confidence score and the ring score.

Element Name: eye_comp
Definition: Eyewall completeness. This is the fraction of the eyewall with temperatures 10-20 K colder than the warmest eye temperature. When eye_comp > 0.9, it is a good indication of a strong eye.

Element Name: rad_eye
Definition: Radius of the eye.

Element Name: rad_eye_con1
Definition: This is the center fix uncertainty in terms of radius of the 50% confidence interval – The system center is 50% likely to be within this distance from the ARCHER center.

Element Name: rad_eye_con2
Definition: This is the center fix uncertainty in terms of radius of the 95% confidence interval – The system center is 95% likely to be within this distance from the ARCHER center.

Element Name: eye_conf
Definition: Center-fix confidence (not the confidence it is an eye, which is the eye_prob variable) "defined as the difference between the maximum combined score and the highest score $ 0.758 away from the location of the image's combined score."

Element Name: rad_eyewall
Definition: Radius of the coldest ring (i.e., the ring with coldest maximum temperature) within 0.3 degrees latitude of the edge of the eye.

Element Name: bt_eye
Definition: Warmest temperature within the eye.

Element Name: bt_eyewall
Definition: Warmest temperature within the eyewall. From the code: "is the ring with the lowest maximum brightness temperature (kind of the "least broken ring")"

Element Name: odt84
Definition: Estimate of storm intensity based on a polynomial fit of the Objective Dvorak technique from 1984. It uses bt_eye and bt_eyewall to estimate intensity, hence isn't very accurate when the eye completeness is low.

The following two variables derive storm center using the axisymmetric algorithm.
Element Name: vlat

Definition: Storm center latitude based on axisymmetric algorithm.

Element Name: vlon
Definition: Storm center longitude based on axisymmetric algorithm.

The following set of variables derive from 3 separate estimates of the center of the storm system. They include:

- **ICEN –** The image center. This is derive by interpolating the IBTrACS storm tracks (usually every 6 hours) to the image times (usually every 3 hours). Usually this is sufficient. However, this may not be the most accurate when: a) the image navigation is poor, resulting in offsets to the storm center, b) when the interpolation is not accurate, c) when the storm positions are inaccurate (common when the system is very weak) or d) when there is an eye (very clearly defined center) but it is not exactly in the image center.
- **ACEN –** This is the ARCHER center of the storm. This will be more accurate when an eye is present. It can correct for some navigation errors, but the algorithm only searches 50 km from the estimated storm center, so larger navigation problems continue to be an issue. These are generally limited to the earlier satellites (e.g., 1980s).
- **VCEN –** This is the center based on axisymmetry from the (Pineros, Ritchie et al. 2008) method for determining storm systems.

Element Name: var_icen
Definition: Angular variance from axisymmetry at the image center (ICEN).

Element Name: ang_icen
Definition: Mean angle from axisymmetry at ICEN

Element Name: tavg_icen
Definition: Azimuthally-averaged brightness temperatures of IRWIN based on ICEN. This data can be used to replicate the analysis of Kossin, Knapp et al. (2007).

Element Name: tmin_icen
Definition: Minimum brightness temperature of IRWIN in each azimuthal ring based on ICEN

Element Name: tmax_icen
Definition: Maximum brightness temperature of IRWIN in each azimuthal ring based on ICEN

Element Name: tstd_icen
Definition: Standard deviation of IRWIN brightness temperatures in each azimuthal ring based on ICEN

Element Name: tnum_icen
Definition: Number of pixels in each azimuthal ring

Element Name: var_acen
Definition: Angular variance from axisymmetry at the ARCHER storm center (ACEN).

Element Name: ang_acen
Definition: Mean angle from axisymmetry at ACEN

Element Name: tavg_acen
Definition: Azimuthally-averaged brightness temperatures of IRWIN based on ACEN.

Element Name: tmin_acen
Definition: Minimum brightness temperature of IRWIN in each azimuthal ring based on ACEN

Element Name: tmax_acen
Definition: Maximum brightness temperature of IRWIN in each azimuthal ring based on ACEN

Element Name: tstd_acen
Definition: Standard deviation of IRWIN brightness temperatures in each azimuthal ring based on ACEN

Element Name: tnum_acen
Definition: Number of pixels in each azimuthal ring

Element Name: var_vcen
Definition: Angular variance from axisymmetry at the axisymmetric storm center (VCEN).

Element Name: ang_vcen
Definition: Mean angle from axisymmetry at VCEN

Element Name: tavg_vcen
Definition: Azimuthally-averaged brightness temperatures of IRWIN based on VCEN

Element Name: tmin_vcen
Definition: Minimum brightness temperature of IRWIN in each azimuthal ring based on VCEN

Element Name: tmax_vcen
Definition: Maximum brightness temperature of IRWIN in each azimuthal ring based on VCEN

Element Name: tstd_vcen
Definition: Standard deviation of IRWIN brightness temperatures in each azimuthal ring based on VCEN

Element Name: tnum_vcen
Definition: Number of pixels in each azimuthal ring

3. Start Date

19780530

4. Stop Date

Ongoing.

5. Coverage

a. Southernmost Latitude: 90S
b. Northernmost Latitude: 90N
c. Westernmost Longitude: 180W
d. Easternmost Longitude: 180E

6. How to Order Data

Ask NCDC's Climate Services about costs of obtaining this dataset.

Phone 828-271-4800
Fax 828-271-4876
e-mail NCDC.Orders@noaa.gov

7. Archiving Data Center

a. Name: National Center for Environmental Information
Address: Federal Building
151 Patton Ave.
Asheville, NC 28801-5001
Voice: 828-271-4800

8. Technical Contact

a. Name: Ken Knapp
Address: National Center for Environmental Information
151 Patton Ave.
Asheville, NC 2801-5001
Voice: 828-271-4339
Fax: 828-271-4328
Email: Ken.Knapp@noaa.gov

9. Known Uncorrected Problems

None.

10. Quality Statement

Disclaimer: While every effort has been made to ensure that these data are accurate and reliable within the limits of the current state of the art, NOAA cannot assume liability for any damages caused by any errors or omissions in the data, nor as a result of the failure of the data to function on a particular system. NOAA makes no warranty, expressed or implied, nor does the fact of distribution constitute such a warranty.

This dataset has undergone extensive quality checks on all parameters, including range checks and elimination of reporting sites with extensive missing data.

11. Essential Companion Datasets

The IBTrACS data set (Knapp, Kruk et al. 2010) is the source data for the locations of the tropical cyclones. More information on this data is available at:
https://www.ncdc.noaa.gov/ibtracs/

12. References

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Knapp, K. R., M. C. Kruk, D. H. Levinson, H. J. Diamond and C. J. Neumann (2010). "The International Best Track Archive for Climate Stewardship (IBTrACS): Centralizing tropical cyclone best track data." Bulletin of the American Meteorological Society **91**(3): 363-376.

Kossin, J. P., K. R. Knapp, D. J. Vimont, R. J. Murnane and B. A. Harper (2007). "A globally consistent reanalysis of hurricane variability and trends." Geophysical Research Letters **34**: L04815.

Pineros, M. F., E. A. Ritchie and J. S. Tyo (2008). "Objective Measures of Tropical Cyclone Structure and Intensity Change From Remotely Sensed Infrared Image Data." IEEE Transactions on Geoscience and Remote Sensing **46**(11): 3574 - 3580