CACATOES v1.04 Data Format

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[**Filename**]

CACATOES-REGION_YYYY0MM0DD0-YYYY1MM1DD1.ncdf
YYYY0 : yearStart
MM0 : monthStart
DD0 : dayStart
YYYY1 : yearEnd
MM1 : monthEnd
DD1 : dayEnd

ex : CACATOES-30S30N040W040E_20110801_20110831.ncdf

[**Reference**]

- Fiolleau T. and Roca R. 2013 : An Algorithm for the Detection and Tracking of Tropical Mesoscale Convective Systems Using Infrared Images From Geostationary Satellite. IEEE Transactions on Geoscience and Remote Sensing, v.99, p. 1-14
- Fiolleau, T., R. Roca, S. Cloché, D. Bouniol, P. Raberanto, 2020: Homogenization of geostationary infrared imager channels for cold cloud studies using Megha-Tropiques/ScaRaB. IEEE Trans. Geosci. Remote Sens., vol 58, no. 9, pp. 6609-6622. **doi:** 10.1109/TGRS.2020.2978171

[External datasets]

- **TOOCAN v2.08 database**
- **IBTrACS database**
    - 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): Unifying tropical cyclone best track data. *Bulletin of the American Meteorological Society*, 91, 363-376. doi:10.1175/2009BAMS2755.1
    - Knapp, K. R., H. J. Diamond, J. P. Kossin, M. C. Kruk, C. J. Schreck, 2018: International Best Track Archive for Climate Stewardship (IBTrACS) Project, Version 4. NOAA National Centers for Environmental Information. doi:10.25921/82ty-9e16.

[**Contact**]

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Variable	Units	Description	Dimensions	type
DAILY_DCS_Cloudcover	%	Daily cloud cover	Time×lat×lon	float
QCgeo_numgeo	/	ID of the geostationary platform	Time×lat×lon	short
QCgeo_nbMissingImages	/	Number of missing/corrupted geo images per day	Time×lat×lon	short
QCgeo_GEOScanMode	/	Number of GEO images per day: - total number - number in routine mode - number in rapid scan mode	time×GEO-mode×lat×lon	short
QCtoocan_Interruption	/	Indication of a tracking interruption	Time×lat×lon	short
QCtoocan_nbSegmentedImages	/	Number of segmented images created by TOOCAN per day: - total number - number in routine mode - number in rapid scan mode	Time×GEO-mode×lat×lon	short
QCtoocan_trackingOK_allplatforms	/	Quality of the Tracking over the entire tropical belt	Time×lat×lon	short
QCcacatoes_nbpixels	/	number of GEO pixels within a 1°/1day CACATOES gridpoint	Time×lat×lon	int
QCcacatoes_SurfGridPoint	/	Cumultated GEO pixels surface into a CACATOES 1°/1day gridpoint	Time×lat×lon	float
INT_DCSnumber	/	ID of the DCS	time×nmaxDCSxlat×lon	int
QC_DCS	/	Confidence on the tracked DCS	time×nmaxDCSxlat×lon	short
INT_classif	/	DCSs classification accoring to Roca etal (2017) definition	time×nmaxDCS×lat×lon	short
INT_duration	h	Life time duration	time×nmaxDCS×lat×lon	float
INT_surfmaxkm2_235K	km²	Maximum cold cloud surface reached by the DCS along its life cycle at 235K	time×nmaxDCSxlat×lon	int
INT_surfmaxkm2_220K	km²	Maximum cold cloud surface reached by the DCS along its life cycle at 220K	time×nmaxDCSxlat×lon	int
INT_surfmaxkm2_210K	km²	Maximum cold cloud surface reached by the DCS along its life cycle at 210K	time×nmaxDCSxlat×lon	int
INT_surfmaxkm2_200K	km²	Maximum cold cloud surface reached by the DCS along its life cycle at 220K	time×nmaxDCSxlat×lon	int

INT_surfcumkm2_235K	km²	Cumulated cold cloud surface of the DCS along its life cycle at 235K	time×nmaxDCSxlat×lon	int
INT_Tmax	%	Time of maximum extent at 235K	time×nmaxDCSxlat×lon	float
INT_SurfDCS_220K_at_Tmax	km²	Deep Convective System size at 220K at Tmax	time×nmaxDCSxlat×lon	float
INT_SurfDCS_210K_at_Tmax	km²	Deep Convective System size at 210K at Tmax	time×nmaxDCSxlat×lon	float
INT_SurfDCS_200K_at_Tmax	km²	Deep Convective System size at 200K at Tmax	time×nmaxDCSxlat×lon	float
INT_Tbavg235K_at_Tmax	K	average Tb lower than 235K at Tmax	time×nmaxDCSxlat×lon	float
INT_Tbavg208K_at_Tmax	K	average Tb lower than 208K at Tmax	time×nmaxDCSxlat×lon	float
INT_Tbavg200K_at_Tmax	K	average Tb lower than 200K at Tmax	time×nmaxDCSxlat×lon	float
INT_Tb90th_at_Tmax	K	90th percentile of Tb at Tmax	time×nmaxDCSxlat×lon	float
INT_Ecc220K_at_Tmax	$\frac{Sminor\_220K}{Smajor\_220K}$	eccentricity of the Deep Convective System at Tmax for a 220K threshold	time×nmaxDCSxlat×lon	float
INT_Ecc235K_at_Tmax	$\frac{Sminor\_235K}{Smajor\_235K}$	eccentricity of the Deep Convective System at Tmax for a 235K threshold	time×nmaxDCSxlat×lon	float
INT_orientation220K_at_Tmax	°	orientation of the Deep Convective System at Tmax for a 220K threshold	time×nmaxDCSxlat×lon	float
INT_orientation235K_at_Tmax	°	orientation of the Deep Convective System at Tmax for a 235K threshold	time×nmaxDCSxlat×lon	float
INT_Distance	km	Propagated distance covered by the DCS	time×nmaxDCSxlat×lon	float
INT_Tbmin	K	Minimum brightness temperature of the DCS along its life cycle	time×nmaxDCSxlat×lon	short
INT_SurfDCS_235K	km²	DCS Integrated Surface at a 235K threshold within a CACATOES 1°/1day gridpoint	time×nmaxDCSxlat×lon	float
INT_SurfDCS_220K	km²	DCS Integrated Surface at a 220K threshold within a CACATOES 1°/1day gridpoint	time×nmaxDCSxlat×lon	float
INT_SurfDCS_210K	km²	DCS Integrated Surface at a 210K threshold within a CACATOES 1°/1day gridpoint	time×nmaxDCSxlat×lon	float
INT_SurfDCS_200K	km²	DCS Integrated Surface at a 200K threshold within a CACATOES 1°/1day gridpoint	time×nmaxDCSxlat×lon	float

INT_GridFraction_235K	%	Fraction of the CACATOES 1°/1day gridpoint occupied by a DCS at a 235K threshold	time×nmaxDCSxlat×lon	float
INT_GridFraction_220K	%	Fraction of the CACATOES 1°/1day gridpoint occupied by a DCS at a 220K threshold	time×nmaxDCSxlat×lon	float
INT_GridFraction_210K	%	Fraction of the CACATOES 1°/1day gridpoint occupied by a DCS at a 210K threshold	time×nmaxDCSxlat×lon	float
INT_GridFraction_200K	%	Fraction of the CACATOES 1°/1day gridpoint occupied by a DCS at a 200K threshold	time×nmaxDCSxlat×lon	float
INT_gridtimeOccupation_start	Hours since the start of the day	start time of the gridpoint occupation by a Deep Convective System	time×nmaxDCSxlat×lon	short
INT_gridtimeOccupation_end	Hours since the start of the day	End time of the gridpoint occupation by a Deep Convective System	time×nmaxDCSxlat×lon	short
INT_Sfract_235k	%	Fraction of the DCS within the CACA-TOES 1°/1day gridpoint at a 235K threshold	time×nmaxDCSxlat×lon	Float
INT_Sfract_220K	%	Fraction of the DCS within the CACA-TOES 1°/1day gridpoint at a 220K threshold	time×nmaxDCSxlat×lon	Float
INT_Sfract_210K	%	Fraction of the DCS within the CACA-TOES 1°/1day gridpoint at a 210K threshold	time×nmaxDCSxlat×lon	Float
INT_Sfract_200K	%	Fraction of the DCS within the CACA-TOES 1°/1day gridpoint at a 220K threshold	time×nmaxDCSxlat×lon	Float
INT_TSnature_IBTRACS	/	nature of the Tropical Storm in the iBTRACS file	time×nmaxDCSxlat×lon	short
INT_TSnumber_IBTRACS	/	number of the Tropical Storm in the iBTRACS file associated with the DCS in a 1000km radius	time×nmaxDCSxlat×lon	short
INT_TSmindistance_IBTRACS	Km	Distance of DCS to the iBTRACS Trop-ical Storm	time×nmaxDCSxlat×lon	float
INT_classif_JIRAK	/	DCS classification according to the Ji-rak etal (2003) definition	time×nmaxDCSxlat×lon	short
INT_classif_MADDOX	/	DCS classification according to the Maddox (1980) definition	time×nmaxDCSxlat×lon	short
INIT_Time	seconds since 1st January 1970	time of the DCS initiation	time×nmaxDCSxlat×lon	int

INIT_Lon	°	Longitude of the DCS center of mass at its initiation	time×nmaxDCSxlat×lon	float
INIT_Lat	°	Latitude of the DCS center of mass at its initiation	time×nmaxDCSxlat×lon	float
END_Time	seconds since 1st January 1970	time of the DCS dissipation	time×nmaxDCSxlat×lon	int
END_Lon	°	Longitude of the DCS center of mass at its dissipation	time×nmaxDCSxlat×lon	float
END_Lat	°	Latitude of the DCS center of mass at its dissipation	time×nmaxDCSxlat×lon	Float

Dimensions:

- **Time**: number of days within a month
- **nmaxDCS**: maximum number of DCS within a 1°/1day gridpoint, set at 25
- **GEOmode**: GEO scan mode used for a 1°/1day gridpoint (Routine mode / Rapid scan mode for the GOES platforms)
- **lat**: 60
- **lon**: 360

Fill_Value

- A gridpoint is set at -999 when a given region can't be monitored by a geostationary satellite at a 30-minute temporal frequency.

QCtoocan_trackingOK_allplatforms

- No issues on the tracking over the entire tropics = 1
- No issues on the tracking over the Northern part of the tropics = 2
- Tracking issues at least in one region of Tropics = 3

QCtoocan_nbSegmentedImages

- QCtoocan_nbSegmentedImages[0]: total number of segmented images per day by TOOCAN.
- QCtoocan_nbSegmentedImages[1]: number of segmented images per day by TOOCAN for geostationary images occurring in a routine/global mode.
- QCtoocan_nbSegmentedImages[2]: number of segmented images per day by TOOCAN for geostationary images occurring in a Rapid Scan mode (GOES-13/GOES-15). In that case, the South part is not observed.

QCgeo_GEOScanMode

- QCgeo_GEOScanMode [0]: total number of GEO images per day.

- QCgeo_GEOScanMode[1]: number of GEO images per day occurring in a routine mode.
- QCgeo_GEOScanMode[2]: number of GEO images per day occurring in a Rapid Scan mode (GOES-13/GOES-15).

QCtoocan_Interruption:

- Indication of the interruption/restart of the tracking process during the day
  1 ➔ indication of the interruption/restart of tracking the tracking process for GEO images in a routine (global) mode
  2 ➔ indication of the interruption/restart of tracking the tracking process for GEO images in a Rapid Scan mode occurring for the GOES-13/GOES-15 platforms. In this case, the tracking process is stopped for the South scan of the AMERICAN and EASTERNPACFIC region.

QCDCS_Flag

- first digit = DCS Initiation error

1: OK
2: DCS initiation explained by a recovery of the tracking due to a minimum of 5 successive missing GEO images
3: DCS initiation explained by the transition from a GEO global mode to a rapid scan mode.

- second digit = DCS Dissipation error

1: OK
2: DCS dissipation explained by a recovery of the tracking due to a minimum of 5 successive missing GEO images
3: DCS dissipation explained by the transition from a GEO global mode to a rapid scan mode.

- third digit = DCS Edge error

1: OK
2: DCS impacted by the GEO image boundaries along its life cycle
3: DCS impacted by the GEO image boundaries in a rapid scan mode along its life cycle.
4: DCS impacted by missing/bad pixels

- two last digits = number of images interpolated along the DCS life cycle

Example:

QCDCS_Flag = 11100

First digit =1 ➔ DCS initiation OK

Second digit = 1 ➔ DCS dissipation OK

Third digit = 1 ➔ DCS not impacted by the image boundaries

Two last digit = 00 ➔ No interpolated GEO images during the DCS tracking

QCDCS_Flag = 11108

First digit =1 ➔ DCS initiation OK

Second digit = 1 ➔ DCS dissipation OK

Third digit = 1 ➔ DCS not impacted by the image boundaries

Two last digit = 08 ➔ 8 interpolated GEO images during the DCS tracking

QCDCS_Flag = 11200

First digit =1 ➔ DCS initiation OK

Second digit = 1 ➔ DCS dissipation OK

Third digit = 2 ➔ DCS impacted by the image boundaries

Two last digit = 00 ➔ No interpolated GEO images during the DCS tracking

QCDCS_Flag = 11300

First digit =1 ➔ DCS initiation OK

Second digit = 1 ➔ DCS dissipation OK

Third digit = 3 ➔ DCS impacted by the image boundaries in a rapid scan mode (GOES-13 and GOES-15)

Two last digit = 00 ➔ No interpolated GEO images during the DCS tracking

QCDCS_Flag = 13100

First digit =1 ➔ DCS initiation OK

Second digit = 3 ➔ DCS dissipation due to the transition from a GEO global mode to a rapid scan mode

Third digit = 1 ➔ DCS not impacted by the image boundaries

Two last digit = 00 ➔ No interpolated GEO images during the DCS tracking

QCDCS_Flag = 21100

First digit =2 ➔ DCS initiation explained by a recovery of the tracking due to a minimum of 5 successive missing GEO images.

Second digit = 1 ➔ DCS dissipation OK

Third digit = 1 ➔ DCS not impacted by the image boundaries

Two last digit = 00 ➔ No interpolated GEO images during the DCS tracking

QCDCS_Class:

- Classification of the DCSs according to Roca etal (2017)

1➔ DCS with a duration < 5hr

2➔ DCS with a duration ≥ 5hr and described by a unique maximum of their cold surfaces along their life cycles

3➔ DCS with a duration ≥ 5hr and described by several maximums of their cold surfaces along their lifecycles

INT_TSnature_IBTRACS:

- the IBTrACS data are used to determine whether a Convective system is embedded into a tropical storm meteorological event. We can have access to the nature of the Tropical Storm in the iBTRACS file, associated with the DCS within a maximum distance of 1000km.
- The tropical cyclones are classified according to the Saffir-Simpson hurricane wind scale (SSHS).

Nature of the tropical storm in the IBTrACS database	value
Mixture (contradicting nature reports from different agencies)	1
Not reported	2
Disturbance	3
subtropical	4
Extratropical	5
Tropical	6
SSHS category 1	11
SSHS category 2	12
SSHS category 3	13
SSHS category 4	14
SSHS category 5	15

https://www.ncdc.noaa.gov/ibtracs/pdf/IBTrACS_version4_Technical_Details.pdf
https://www.ncdc.noaa.gov/ibtracs/pdf/IBTrACS_v04_column_documentation.pdf

INT_TSnumber_IBTRACS

- The IBTRACS cardinal number of the Tropical Storm for a given season, associated with the DCS within a maximum distance of 1000km.

INT_TSmindistance_IBTRACS

- distance of the DCS to the center of the IBTRACS Tropical storm (max distance = 1000km)

INT_classif_JIRAK

Classification of the DCS according to the definitions given in Jirak etal(2003)

DCS Category	Size / Duration / Shape	Value
MCC	- Cold cloud region ≤-52° with area ≥ 50 000 km² - Size definition met for ≥ 6 h - Eccentricity > 0.7 at time of maximum extent	1
PECS	- Cold cloud region ≤-52° with area ≥ 50 000 km² - Size definition met for ≥ 6 h - 0.2 ≤ Eccentricity < 0.7 at time of maximum extent	2
MβCCS	- Cold cloud region ≤-52° with area ≥ 30 000 km² - Maximum size ≥ 50000km² - Size definition met for ≥ 3 h - Eccentricity > 0.7 at time of maximum extent	3
MβECS	- Cold cloud region ≤-52° with area ≥ 30 000 km² - Maximum size ≥ 50000km² - Size definition met for ≥ 3 h - 0.2 ≤ Eccentricity < 0.7 at time of maximum extent	4

0 ➔ DCS does not display the physical characteristics defined by Jirak etal (2003)

INT_classif_MADDOX

0 ➔ DCS does not display the physical characteristics of MCC defined by Maddox (1980)

1➔ DCS displays the physical characteristics of MCC defined by Maddox (1980)

DCS Category	Size / Duration / Shape	Value
MCC	**Size**: A- cloud shield with continuously low IR temperature ≤ -32°C with an area ≥ 100.000 km² B – interior cold cloud region with temperature ≤ -52°C must have an area ≥ 50.000 km² **Initiate**: Size definitions A and B are first satisfied **Duration**: Size definitions A and B must be met for a period ≥ 6h **Maximum extent shape:** Contiguous cold cloud shield (IR temperature ≤ -32°C) reaches maximum size **Shape:** Eccentricity (minor axis/ major axis) ≥ 0.7 at time of maximum extent. **Terminate:** Size definitions A and B no longer satisfied	1