Climate Data Record (CDR) Program

NetCDF Metadata Guidelines for IOC NOAA Climate Data Records
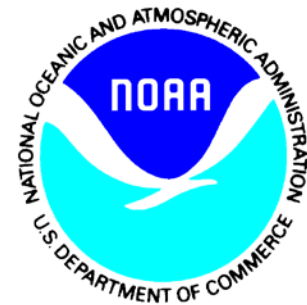
NetCDF Metadata Guidelines for IOC NOAA Climate Data Records

This document provides guidance on a recommended set of netCDF metadata attributes to be implemented for the Initial Operating Capability (IOC) NOAA Climate Data Records (CDRs). It is intended to be used by the persons who write and review the netCDF files. Originating sources of the attributes include the Climate and Forecast (CF) Metadata Convention, Unidata Attribute Convention for Dataset Discovery (ACDD), and the GHRSST Data Specification (GDS) Revision 2.0. Attributes specific to the NOAA CDR Program are identified as "CDR Attributes". Additional attributes that are not specified here but yet are relevant to the CDR, such as those in the GHRSST conventions, are acceptable. These guidelines are not a comprehensive set of requirements. See the CF Conventions (at http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.5/cf-conventions.html) for complete details on CF compliance.

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GLOBAL ATTRIBUTES [top]

The recommended global attributes to use for the CDR files are identified in the tables below.

TABLE GA.1: CF Metadata Convention

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
Conventions	YES	string	The name of the conventions followed by the dataset. The value of the `Conventions' attribute is a text string containing the name of the version of the CF conventions followed in the file.	:Conventions = "CF-1.5";
title	YES	string	A succinct description of what is in the dataset.	The value will be used by THREDDS as the name of the dataset and therefore should be human readable and reasonable to display in a list of such names. Title should match corresponding product documentation.
source*	YES	string	Comma separated list of source data used to create this file.	List the input file names/identifiers of the observation sources first followed by auxiliary sources.
references	NO	string	Published references that describe the data or methods used to produce it.	Use only persistent and unique identifiers suitable for long-term archiving, such as a DOI. Identifiers may be listed as part of a reference URL or ID resolver, e.g., "http://dx.doi.org/10.1175/2009JAMC2314.1".

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
history	NO	string	An audit trail for modifications to the original data.	Any modifications made to the original netCDF file, such as modifications for netCDF format version or convention updates. It should contain a separate line for each modification with each line including a timestamp, user name, modification name, and modification arguments.
comment	NO	string	Miscellaneous information about the dataset.	Include supplemental Information as applicable, or use "None".

NOTE: *Indicates that the attribute value would likely be dynamic (vary between files for a product).

TABLE GA.2: Unidata ACDD

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
Metadata_Conventions	YES	string	NetCDF files conforming to the Unidata Dataset Discovery specification must use this global attribute.	Multiple metadata conventions should be listed with a comma separator. E.g., :Metadata_Conventions = "CF-1.5, Unidata Dataset Discovery v1.0, NOAA CDR v1.0, GDS v2.0";
standard_name_vocabulary	YES	string	The CF controlled list of variable names used for the "standard_name" variable attribute.	E.g., :standard_name_vocabulary = "CF Standard Name Table (v16, 11 October 2010)";
Id	YES	string	The "id" and "naming_authority" (of the identifier) are intended to provide a globally unique identification for the dataset.	Unless the provider has an assigned unique ID for this file, use the archive file name.
naming_authority	YES	string		:naming_authority = "gov.noaa.ncdc";
date_created*	YES	string	The date and time the data file was created.	Time must be ISO 8601 compliant, in the form <date>T<time>Z or "[yyyy]-[MM]-[DD]T[hh]:[mm]:[ss]Z".

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
date_modified*	NO	string	The date on which this data file was last modified.	Date should agree with the any modifications documented in the "history" attribute. If file has not been modified from the original then date may be the same as "date_created".
license	YES	string	Restrictions on data access, use and distribution.	Indicate constraints on data access or use, and the dates for when the constraints apply. Specify none as applicable, e.g., "No constraints on data access or use."
date_issued	NO	string	The date when this data was formally issued as in the product version release date.	Date must be ISO 8601 compliant, in the form "[yyyy]-[MM]-[DD]".
summary	YES	string	A longer description of the dataset. In some discovery systems, the "title" and the "summary" will be displayed in the results list from a search.	Recommended summary information for this field includes the type of data contained in the dataset, how the data was created (e.g., instrument X; or model X, run Y), the creator of the dataset, the project for which the data was created, the geospatial coverage of the data, and the temporal coverage of the data.
keywords	YES	string	A list of key words and phrases relevant to the dataset separated by commas.	Select the applicable keywords from the NASA GCMD Science Keywords list (see PDF reference or copy from TXT).
keywords_vocabulary	YES	string	The controlled list of keywords used for the values in the "keywords" attributes.	:keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 6.0";
cdm_data_type	YES	string	The THREDDS data type appropriate for this dataset.	Use "Grid", "Image", "Profile", "Radial", "Station", "Swath" or "Trajectory" as appropriate for the data.
project	NO	string	Name of the scientific project for which the data was created.	Use as needed. If available, select a project name from the NASA GCMD Project Keywords list (see PDF reference or copy from TXT).

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
processing_level	NO	string	The processing (or quality control) level of the data.	Use the appropriate processing level prefaced by the associated processing level authority, e.g., NOAA or NASA. See NOAA definitions and NASA definitions for guidance. E.g., :processing_level = "NOAA Level 2";
creator_name	NO	string	These attributes provide the name, URL, and email contact information for the creator of the data file.	Contact name responsible for the production of the data file. May be the PI or other processor contact.
creator_url	NO	string		URL address of the "creator" organization as indicated in "institution".
creator_email	NO	string		Email address of the "creator" organization as indicated in "institution".
institution	YES	string		Organization name of the facility that produced the data file. Select center name, if available, from the NASA GCMD Data Center Keywords list (see PDF reference or copy from TXT).
geospatial_lat_min*	YES	float	These min and max attributes describe a simple latitude and longitude bounding box area.	Decimal degrees north, range -90 to +90. May be generalized for swath datasets.
geospatial_lat_max*	YES	float		Decimal degrees north, range -90 to +90. May be generalized for swath datasets.
geospatial_lon_min*	YES	float		Decimal degrees east, range -180 to +180. May be generalized for swath datasets.
geospatial_lon_max*	YES	float		Decimal degrees east, range -180 to +180. May be generalized for swath datasets.
geospatial_lat_units	NO	string	Units of the latitudinal resolution.	Typically "degrees_north".
geospatial_lat_resolution	NO	float	Latitude Resolution in units matching "geospatial_lat_units".	None.
geospatial_lon_units	NO	string	Units of the longitudinal resolution.	Typically "degrees_east".

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
geospatial_lon_resolution	NO	float	Longitude Resolution in units matching "geospatial_lon_units".	None.
time_coverage_start*	YES	string	Date and time of the first value in the data file.	Time must be ISO 8601 compliant. Recommended form: <date>T<time>Z or "[yyyy]-[MM]-[DD]T[hh]:[mm]:[ss]Z". Should agree with the beginning time stamp in the file name.
time_coverage_end*	YES	string	Date and time of the last value in the data file.	Time must be ISO 8601 compliant. Recommended form: <date>T<time>Z or "[yyyy]-[MM]-[DD]T[hh]:[mm]:[ss]Z". Should agree with the ending time stamp in the file name.
time_coverage_duration*	NO	string	Provides a description of the time period covered by the dataset.	File duration must be ISO 8601 compliant time duration. Recommended form: "P[n]Y[n]M[n]DT[n]H[n]M[n]S". Do not include date and time elements that have a zero value "[n]". E.g., a one month duration would be represented as "P1M".
time_coverage_resolution	NO	string	The density of the data inside the time range.	Represent as a time duration that's ISO 8601 compliant. Recommended form: "P[n]Y[n]M[n]DT[n]H[n]M[n]S". Do not include date and time elements that have a zero value "[n]". E.g., data from an observing platform in a sun-synchronous orbit would be represented as "PT12H".
contributor_name	NO	string	Name and role of individuals or institutions that contributed to the creation of the data.	The "contributor_name" and "contributor_role" attributes can be comma-separated lists, with each element of "contributor_name" matching the corresponding element of "contributor_role". E.g., the name of project PI.

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
contributor_role	NO	string		Use roles from the CI_RoleCode in ISO 19115: - resourceProvider - custodian - owner - user - distributor - originator - pointOfContact - principalInvestigator - processor - publisher - author E.g., :contributor_role = "principalInvestigator";
acknowledgment	NO	string	Acknowledges the types of support for the project that produced the data.	:acknowledgment = "This project was supported in part by a grant from the NOAA Climate Data Record (CDR) Program for satellites." Could also acknowledge the CDR grant source, i.e., Applied Research Center (ARC), Cooperative Institute for Climate and Satellites (CICS), or Scientific Data Stewardship (SDS).

NOTE: *Indicates that the attribute value would likely be dynamic (vary between files for a product).

TABLE GA.3: CDR Attributes

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
cdr_program	YES	string	Reference for the supporting CDR program.	:cdr_program = "NOAA Climate Data Record Program for satellites, FY 2011." Above statement assumes that all CDR variables are supported by the one program.
cdr_variable	YES	string	Comma separated list of all CDR variables present in this file.	Use the CDR variable names in the file.

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
software_version_id	NO	string	Identifier of the producer's (creator's) software used to create the data file.	Could be the subversion tag ID of the CDR source code package. E.g., :software_version_id = "gov.noaa.ncdc:$Id:";

TABLE GA.4: GDS Attributes

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
metadata_link	YES	string	File identifier of the parent metadata file to which this metadata is a subset (child).	The archive metadata ID for the collection-level CDR product to be assigned and registered by the NCDC Archive Branch.
product_version	YES	string	The product version of this data file.	The product version of the data contained in the file, which should match the product version field in the file name. Acceptable version number formats: "v[XX]r[XX]" for version and revision number, or "v[yy]-[MM]-[DD]" for version release date.
platform*	YES	string	Keywords for the platforms that contribute to the dataset.	Select keywords from the NASA GCMD Platform Keywords list as applicable (see PDF reference or copy from TXT).
sensor*	YES	string	Keywords for the instruments that contribute to the dataset.	Select keywords from the NASA GCMD Instrument Keywords list as applicable (see PDF reference or copy from TXT).
spatial_resolution	YES	string	Free text description of the nominal spatial resolution of the variables.	For example, "1.1km at nadir".

NOTE: *Indicates that the attribute value would likely be dynamic (vary between files for a product).

VARIABLE ATTRIBUTES [top]

The recommended variable attributes to use, at a minimum, for the CDR variables.

TABLE VA.1: CF Metadata Convention

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
long_name**	YES	string	A long descriptive name for the variable.	Preface the descriptive name of the CDR variable with "NOAA Climate Data Record of..." or "NOAA FCDR", etc. E.g., "NOAA Climate Data Record of Weekly Mean of Sea Surface Temperature"
standard_name	YES	string	A descriptive name for the variable taken from the CF controlled vocabulary of variable names.	NCDC POCs to select appropriate CF name for the CDR variable(s) from CF standard name table, v16. Do not use this attribute if an appropriate CF standard name does not exist for the CDR variable.
units	YES	string	The units of the variables data values. This attributes value should be a valid udunits string.	The type of the units attribute is a string that should be SI and must be recognizable by the udunits-2 package. The units of a variable that specifies a standard_name must be consistent with the units given in the standard name table.
coordinates	YES	string	A blank separated list of the names of auxiliary coordinate variables.	There is no restriction on the order in which the auxiliary coordinate variables appear in the coordinates attribute string. The dimensions of an auxiliary coordinate variable must be a subset of the dimensions of the variable with which the coordinate is associated. If there are no auxiliary coordinates for a variable, this attribute is not required.

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
_FillValue	NO	Same as variable	A special value that indicates values that were not written.	This value should be outside the valid range of the values in the variable, but it is not required. If a valid range is not specified for the variable values, this attribute may be automatically used to define a range. Should be present unless this condition does not occur in the file.
missing_value	NO	Same as variable	A scalar or vector containing values indicating missing data. These values are intended to mark variable elements where an algorithm was unable to produce a valid result.	This value should be outside the valid range of the values in the variable, but it is not required. Should be present if any unique variable values indicate abnormal conditions, or things of that sort.
valid_max	YES[++]	Same as variable	The maximum valid value for this variable.	These attributes specify the valid range of the variable values. If valid_min and/or valid_max are defined, valid_range must not be defined. If valid_range is defined, the others must not be defined.
valid_min	YES[++]	Same as variable	The minimum valid value for this variable.	
valid_range	YES[++]	Same as variable	A vector of two numbers specifying the minimum and maximum valid values for this variable.	
flag_values	NO	String	The attributes, flag_values, flag_masks and flag_meanings, are intended to make variables that contain flag values self-describing. Note that these are only applicable to variables that contain flags. The flag_values and flag_meanings attributes describe a	The flag_values attribute is the same type as the variable to which it is attached, and contains a list of the possible flag values.
flag_masks	NO	String		The flag_masks attribute is the same type as the variable to which it is attached, and contains a list of values matching unique bit fields.

ATTRIBUTE NAME	REQ'D	TYPE	DEFINITION	RECOMMENDATION / COMMENT
flag_meanings	NO	string	status flag consisting of mutually exclusive coded values. The flag_masks and flag_meanings attributes describe a number of independent Boolean conditions using bit field notation by setting unique bits in each flag_masks value. The flag_masks, flag_values and flag_meanings attributes, used together, describe a blend of independent Boolean conditions and enumerated status codes.	The flag_meanings attribute is a string whose value is a blank separated list of descriptive words or phrases, one for each flag value. Each word or phrase should consist of characters from the alphanumeric set and the following five: '_', '-', '.', '+', '@'. If multi-word phrases are used to describe the flag values, then the words within a phrase should be connected with underscores.

NOTE: ** Recommended implementation of long_name is specific to NOAA CDR Program.

++ Mutually exclusive attributes. See the Recommendation/Comment field for more information.

SAMPLE CDR NetCDF Common Data Language (CDL) [top]

```
netcdf RSS_V06R00_SSMI_FCDR_F08_D19870919_S1711_E1857_R01294 {
dimensions:
   pixel_lores = 64 ;
   pixel_hires = 128 ;
   nscan_lores = 1675 ;
   nscan_hires = 3350 ;
   twelve_flags = 12 ;
   numchar = 20 ;
variables:
   byte quality_flags(nscan_lores, twelve_flags) ;
        quality_flags:long_name = "instrument/channel quality flag" ;
        quality_flags:Note = "Our advice to the user is to exclude all scans for which any of the first 4 flags are set to 1.  Furthermore, do not use
any channels for which the channel flag is set to 1.  The 12th flag is not used; 1st flag = Scan is missing, there are no data.  Missing scans that
occur in the middle of an orbit are included in the orbital file as zero-filled spacers; 2nd flag = Scan occurs during a period of erroneous data (see
SSM/I TA Users Manual, Revision 2, December 1993.) can is missing, there are no data.  Missing scans that occur in the middle of an orbit are
included; 3rd flag = Scan affected by calibration errors due to scan averaging (see SSM/I TA Users Manual, Revision 2, December 1993.); 4th flag
= Thermistor readings for scan are out-of-bounds; 5th-11th flag = individual channel flags in the order 19V, 19H, 22V, 37V, 37H, 85V, 85H;" ;
   char scan_time_lores(nscan_lores, numchar) ;
        scan_time_lores:standard_name = "time" ;
        scan_time_lores:long_name = "Scan start time (UTC) for low resolution scans in ISO8601 date/time (YYYY-MM-DD HH-MM-SSZ) format" ;
        scan_time_lores:_FillValue = "0" ;
   char scan_time_hires(nscan_hires, numchar) ;
        scan_time_hires:standard_name = "time" ;
        scan_time_hires:long_name = "Scan start time (UTC) for high resolution scans in ISO8601 date/time (YYYY-MM-DD HH-MM-SSZ) format" ;
        scan_time_hires:_FillValue = "0" ;
   double scan_time_since87_lores(nscan_lores) ;
        scan_time_since87_lores:standard_name = "time" ;
        scan_time_since87_lores:long_name = "Scan start time (UTC) for low resolution scans in a referenced or elapsed time format" ;
        scan_time_since87_lores:units = "seconds since 1987-01-01 00:00:00" ;
        scan_time_since87_lores:_FillValue = 0. ;
```

```
double scan_time_since87_hires(nscan_hires) ;
      scan_time_since87_hires:standard_name = "time" ;
      scan_time_since87_hires:long_name = "Scan start time (UTC) for high resolution scans in a referenced or elapsed time format" ;
      scan_time_since87_hires:units = "seconds since 1987-01-01 00:00:00" ;
      scan_time_since87_hires:_FillValue = 0. ;
short latitude_lores(nscan_lores, pixel_lores) ;
      latitude_lores:standard_name = "latitude" ;
      latitude_lores:long_name = "Latitude for low resolution channels" ;
      latitude_lores:scale_factor = 0.01f ;
      latitude_lores:valid_range = -9000s, 9000s ;
      latitude_lores:_FillValue = -30000s ;
      latitude_lores:units = "degrees_north" ;
short longitude_lores(nscan_lores, pixel_lores) ;
      longitude_lores:standard_name = "longitude" ;
      longitude_lores:long_name = "Longitude for low resolution channels" ;
      longitude_lores:scale_factor = 0.01f ;
      longitude_lores:valid_range = -18000s, 18000s ;
      longitude_lores:_FillValue = -30000s ;
      longitude_lores:units = "degrees_east" ;
short latitude_hires(nscan_hires, pixel_hires) ;
      latitude_hires:standard_name = "latitude" ;
      latitude_hires:long_name = "Latitude for high resolution channels" ;
      latitude_hires:scale_factor = 0.01f ;
      latitude_hires:valid_range = -9000s, 9000s ;
      latitude_hires:_FillValue = -30000s ;
      latitude_hires:units = "degrees_north" ;
short longitude_hires(nscan_hires, pixel_hires) ;
      longitude_hires:standard_name = "longitude" ;
      longitude_hires:long_name = "Longitude for high resolution channels" ;
      longitude_hires:scale_factor = 0.01f ;
      longitude_hires:valid_range = -18000s, 18000s ;
      longitude_hires:_FillValue = -30000s ;
      longitude_hires:units = "degrees_east" ;
short antenna_temperature_19V(nscan_lores, pixel_lores) ;
```

```
        antenna_temperature_19V:standard_name = "antenna_temperature" ;
        antenna_temperature_19V:long_name = "19.35 GHz vertically polarized antenna temperature" ;
        antenna_temperature_19V:scale_factor = 0.01f ;
        antenna_temperature_19V:valid_range = 5000s, 32500s ;
        antenna_temperature_19V:_FillValue = 0s ;
        antenna_temperature_19V:units = "kelvin" ;
        antenna_temperature_19V:coordinates = "longitude_lores latitude_lores" ;
    short antenna_temperature_19H(nscan_lores, pixel_lores) ;
        antenna_temperature_19H:standard_name = "antenna_temperature" ;
        antenna_temperature_19H:long_name = "19.35 GHz horizontally polarized antenna temperature" ;
        antenna_temperature_19H:scale_factor = 0.01f ;
        antenna_temperature_19H:valid_range = 5000s, 32500s ;
        antenna_temperature_19H:_FillValue = 0s ;
        antenna_temperature_19H:units = "kelvin" ;
        antenna_temperature_19H:coordinates = "longitude_lores latitude_lores" ;
    short antenna_temperature_22V(nscan_lores, pixel_lores) ;
        antenna_temperature_22V:standard_name = "antenna_temperature" ;
        antenna_temperature_22V:long_name = "22.235 GHz vertically polarized antenna temperature" ;
        antenna_temperature_22V:scale_factor = 0.01f ;
        antenna_temperature_22V:valid_range = 5000s, 32500s ;
        antenna_temperature_22V:_FillValue = 0s ;
        antenna_temperature_22V:units = "kelvin" ;
        antenna_temperature_22V:coordinates = "longitude_lores latitude_lores" ;
    short antenna_temperature_37V(nscan_lores, pixel_lores) ;
        antenna_temperature_37V:standard_name = "antenna_temperature" ;
        antenna_temperature_37V:long_name = "37.0 GHz vertically polarized antenna temperature" ;
        antenna_temperature_37V:scale_factor = 0.01f ;
        antenna_temperature_37V:valid_range = 5000s, 32500s ;
        antenna_temperature_37V:_FillValue = 0s ;
        antenna_temperature_37V:units = "kelvin" ;
        antenna_temperature_37V:coordinates = "longitude_lores latitude_lores" ;
    short antenna_temperature_37H(nscan_lores, pixel_lores) ;
        antenna_temperature_37H:standard_name = "antenna_temperature" ;
        antenna_temperature_37H:long_name = "37.0 GHz horizontally polarized antenna temperature" ;
```

```
        antenna_temperature_37H:scale_factor = 0.01f ;
        antenna_temperature_37H:valid_range = 5000s, 32500s ;
        antenna_temperature_37H:_FillValue = 0s ;
        antenna_temperature_37H:units = "kelvin" ;
        antenna_temperature_37H:coordinates = "longitude_lores latitude_lores" ;
    short antenna_temperature_85V(nscan_hires, pixel_hires) ;
        antenna_temperature_85V:standard_name = "antenna_temperature" ;
        antenna_temperature_85V:long_name = "85.5 GHz vertically polarized antenna temperature" ;
        antenna_temperature_85V:scale_factor = 0.01f ;
        antenna_temperature_85V:valid_range = 5000s, 32500s ;
        antenna_temperature_85V:_FillValue = 0s ;
        antenna_temperature_85V:units = "kelvin" ;
        antenna_temperature_85V:coordinates = "longitude_hires latitude_hires" ;
    short antenna_temperature_85H(nscan_hires, pixel_hires) ;
        antenna_temperature_85H:standard_name = "antenna_temperature" ;
        antenna_temperature_85H:long_name = "85.5 GHz horizontally polarized antenna temperature" ;
        antenna_temperature_85H:scale_factor = 0.01f ;
        antenna_temperature_85H:valid_range = 5000s, 32500s ;
        antenna_temperature_85H:_FillValue = 0s ;
        antenna_temperature_85H:units = "kelvin" ;
        antenna_temperature_85H:coordinates = "longitude_hires latitude_hires" ;
    short fcdr_brightness_temperature_19V(nscan_lores, pixel_lores) ;
        fcdr_brightness_temperature_19V:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_19V:long_name = "NOAA FCDR of 19.35 GHz vertically polarized brightness temperature" ;
        fcdr_brightness_temperature_19V:scale_factor = 0.01f ;
        fcdr_brightness_temperature_19V:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_19V:_FillValue = -8s ;
        fcdr_brightness_temperature_19V:units = "kelvin" ;
        fcdr_brightness_temperature_19V:coordinates = "longitude_lores latitude_lores" ;
    short fcdr_brightness_temperature_19H(nscan_lores, pixel_lores) ;
        fcdr_brightness_temperature_19H:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_19H:long_name = "NOAA FCDR of 19.35 GHz horizontally polarized brightness temperature" ;
        fcdr_brightness_temperature_19H:scale_factor = 0.01f ;
        fcdr_brightness_temperature_19H:valid_range = 5000s, 32500s ;
```

```
        fcdr_brightness_temperature_19H:_FillValue = -8s ;
        fcdr_brightness_temperature_19H:units = "kelvin" ;
        fcdr_brightness_temperature_19H:coordinates = "longitude_lores latitude_lores" ;
    short fcdr_brightness_temperature_22V(nscan_lores, pixel_lores) ;
        fcdr_brightness_temperature_22V:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_22V:long_name = "NOAA FCDR of 22.235 GHz vertically polarized brightness temperature" ;
        fcdr_brightness_temperature_22V:scale_factor = 0.01f ;
        fcdr_brightness_temperature_22V:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_22V:_FillValue = 199s ;
        fcdr_brightness_temperature_22V:units = "kelvin" ;
        fcdr_brightness_temperature_22V:coordinates = "longitude_lores latitude_lores" ;
    short fcdr_brightness_temperature_37V(nscan_lores, pixel_lores) ;
        fcdr_brightness_temperature_37V:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_37V:long_name = "NOAA FCDR of 37.0 GHz vertically polarized brightness temperature" ;
        fcdr_brightness_temperature_37V:scale_factor = 0.01f ;
        fcdr_brightness_temperature_37V:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_37V:_FillValue = -3s ;
        fcdr_brightness_temperature_37V:units = "kelvin" ;
        fcdr_brightness_temperature_37V:coordinates = "longitude_lores latitude_lores" ;
        fcdr_brightness_temperature_37V:Note = "37.0 GHz vertically polarized channel" ;
    short fcdr_brightness_temperature_37H(nscan_lores, pixel_lores) ;
        fcdr_brightness_temperature_37H:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_37H:long_name = "NOAA FCDR of 37.0 GHz horizontally polarized brightness temperature" ;
        fcdr_brightness_temperature_37H:scale_factor = 0.01f ;
        fcdr_brightness_temperature_37H:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_37H:_FillValue = -3s ;
        fcdr_brightness_temperature_37H:units = "kelvin" ;
        fcdr_brightness_temperature_37H:coordinates = "longitude_lores latitude_lores" ;
    short fcdr_brightness_temperature_85V(nscan_hires, pixel_hires) ;
        fcdr_brightness_temperature_85V:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_85V:long_name = "NOAA FCDR of 85.5 GHz vertically polarized brightness temperature" ;
        fcdr_brightness_temperature_85V:scale_factor = 0.01f ;
        fcdr_brightness_temperature_85V:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_85V:_FillValue = -726s ;
```

```
        fcdr_brightness_temperature_85V:units = "kelvin" ;
        fcdr_brightness_temperature_85V:coordinates = "longitude_hires latitude_hires" ;
    short fcdr_brightness_temperature_85H(nscan_hires, pixel_hires) ;
        fcdr_brightness_temperature_85H:standard_name = "brightness_temperature" ;
        fcdr_brightness_temperature_85H:long_name = "NOAA FCDR of 85.5 GHz horizontally polarized brightness temperature" ;
        fcdr_brightness_temperature_85H:scale_factor = 0.01f ;
        fcdr_brightness_temperature_85H:valid_range = 5000s, 32500s ;
        fcdr_brightness_temperature_85H:_FillValue = -3s ;
        fcdr_brightness_temperature_85H:units = "kelvin" ;
        fcdr_brightness_temperature_85H:coordinates = "longitude_hires latitude_hires" ;
    byte surface_type_lores(nscan_lores, pixel_lores) ;
        surface_type_lores:long_name = "Surface type flag for low resolution channels" ;
        surface_type_lores:flag_values = 0b, 1b, 2b ;
        surface_type_lores:flag_meanings = "open_ocean near_coast land" ;
        surface_type_lores:coordinates = "longitude_lores latitude_lores" ;
        surface_type_lores:_FillValue = 10b ;
    byte surface_type_hires(nscan_hires, pixel_hires) ;
        surface_type_hires:long_name = "Surface type flag for high resolution channels" ;
        surface_type_hires:flag_values = 0b, 1b, 2b ;
        surface_type_hires:flag_meanings = "open_ocean near_coast land" ;
        surface_type_hires:coordinates = "longitude_hires latitude_hires" ;
        surface_type_hires:_FillValue = 10b ;
    byte sea_ice_hires(nscan_hires, pixel_hires) ;
        sea_ice_hires:long_name = "Sea ice climatology flag" ;
        sea_ice_hires:flag_values = 0b, 1b ;
        sea_ice_hires:flag_meanings = "no_sea_ice sea_ice_possible" ;
        sea_ice_hires:coordinates = "longitude_hires latitude_hires" ;
        sea_ice_hires:_FillValue = 10b ;
    float fractional_orbit_position(nscan_lores) ;
        fractional_orbit_position:long_name = "fractional orbit position" ;
        fractional_orbit_position:valid_range = -0.02f, 1.02f ;
        fractional_orbit_position:_FillValue = -300.f ;
    float spacecraft_latitude(nscan_lores) ;
        spacecraft_latitude:long_name = "spacecraft latitude for B-scan time" ;
```

```
        spacecraft_latitude:valid_range = -90.f, 90.f ;
        spacecraft_latitude:_FillValue = -300.f ;
        spacecraft_latitude:units = "degrees_north" ;
    float spacecraft_longitude(nscan_lores) ;
        spacecraft_longitude:long_name = "spacecraft longitude for B-scan time" ;
        spacecraft_longitude:valid_range = -180.f, 180.f ;
        spacecraft_longitude:_FillValue = -300.f ;
        spacecraft_longitude:units = "degrees_east" ;
    float spacecraft_altitude(nscan_lores) ;
        spacecraft_altitude:long_name = "spacecraft altitude for B-scan time" ;
        spacecraft_altitude:_FillValue = -300.f ;
        spacecraft_altitude:units = "km" ;
    short earth_incidence_angle_hires(nscan_lores, pixel_hires) ;
        earth_incidence_angle_hires:long_name = "earth incidence angle for A-scan only" ;
        earth_incidence_angle_hires:scale_factor = 0.01f ;
        earth_incidence_angle_hires:_FillValue = 0s ;
        earth_incidence_angle_hires:units = "degree" ;
    float earth_azimuth_angle_hires(nscan_lores, pixel_hires) ;
        earth_azimuth_angle_hires:long_name = "earth azimuth angle for A-scan only" ;
        earth_azimuth_angle_hires:_FillValue = -300.f ;
        earth_azimuth_angle_hires:units = "degree" ;
    short earth_sunglitter_angle_hires(nscan_lores, pixel_hires) ;
        earth_sunglitter_angle_hires:long_name = "Sun glitter angle for A-scan only" ;
        earth_sunglitter_angle_hires:scale_factor = 0.01f ;
        earth_sunglitter_angle_hires:_FillValue = 0s ;
        earth_sunglitter_angle_hires:units = "degree" ;
        earth_sunglitter_angle_hires:Note = "The sun-glitter angle is defined as the angle between two vectors a and b.  Vector a is the vector
going from the SSM/I footprint to the SSM/I antenna.  Vector b is the vector pointing in the direction of sunlight reflected of the Earth surface at
the location of the SSM/I footprint, assuming that the earth surface is a specular reflector.Low sun-glitter angles mean that reflected sunlight is
being received by the SSM/I." ;

// global attributes:
        :Conventions = "CF-1.5" ;
        :Metadata_Conventions = "CF-1.5, Unidata Dataset Discovery v1.0, NOAA CDR v1.0, GDS v2.0" ;
```

:standard_name_vocabulary = "CF Standard Name Table (v16, 11 October 2010)" ;
:id = "RSS_V06R00_SSMI_FCDR_F08_D19870919_S1711_E1857_R01294.nc" ;
:naming_authority = "gov.noaa.ncdc" ;
:metadata_link = "gov.noaa.ncdc:C00801" ;
:title = "RSS Version-6 SSM/I FCDR" ;
:product_version = "v06r00" ;
:date_issued = "2011-09-30" ;
:summary = "Remote Sensing Systems (RSS) Version-6 Special Sensor Microwave/Imager (SSM/I) Fundamental Climate Data Record
(FCDR); intercalibrated and homogenized brightness temperature polar-oribiting product with quality flags from July 1987-August 2010." ;
:keywords = "EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > ANTENNA TEMPERATURE, EARTH SCIENCE >
SPECTRAL/ENGINEERING > MICROWAVE > BRIGHTNESS TEMPERATURE" ;
:keywords_vocabulary = "NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 6.0" ;
:platform = "DMSP 5D-2/F08 > Defense Meteorological Satellite Program-F08" ;
:sensor = "SSM/I > Special Sensor Microwave/Imager" ;
:cdm_data_type = "Swath" ;
:cdr_program = "NOAA Climate Data Record Program for satellites, FY 2011" ;
:cdr_variable = "fcdr_brightness_temperature_19V, fcdr_brightness_temperature_19H, fcdr_brightness_temperature_22V,
fcdr_brightness_temperature_37V, fcdr_brightness_temperature_37H, fcdr_brightness_temperature_85V, fcdr_brightness_temperature_85H" ;
:source = "RSS_SSMI_TDR_V06_F08_D19870919_S1711_E1857_R01294.dat" ;
:date_created = "2011-04-11 14:37:59Z" ;
:creator_name = "Hilawe Semunegus" ;
:creator_url = "http://www.ncdc.noaa.gov/cdr/operationalcdrs.html" ;
:creator_email = "NCDC.Satorder@noaa.gov" ;
:institution = "DOC/NOAA/NESDIS/NCDC > National Climatic Data Center, NESDIS, NOAA, U.S. Department of Commerce" ;
:processing_level = "NOAA Level 2" ;
:references = "http://dx.doi.org/10.1175/2007JAMC1635.1, http://dx.doi.org/10.1126/science.1140746,
http://www.ncdc.noaa.gov/oa/rsad/ssmi/swath/fnoc-ssmi-manual.pdf" ;
:history = "1) 2011-09-30, Hilawe Semunegus, NOAA/NCDC, created initial netCDF file converted from the original RSS data format" ;
:geospatial_lat_min = -87.81f ;
:geospatial_lat_max = 87.67f ;
:geospatial_lon_min = -179.99f ;
:geospatial_lon_max = 180.f ;
:geospatial_lat_units = "degrees_north" ;
:geospatial_lon_units = "degrees_east" ;

    :spatial_resolution = "19 V/H GHz: 45km X 70km, 22 V GHz: 40km X 60km, 37 V/H GHz: 30km X 38km, 85 V/H GHz: 14km X 16km" ;
    :time_coverage_start = "1987-09-19 17:11:21Z" ;
    :time_coverage_end = "1987-09-19 18:57:21Z" ;
    :time_coverage_duration = "P6360S" ;
    :license = "No restrictions on access or use" ;
    :contributor_name = "Frank Wentz, Hilawe Semunegus" ;
    :contributor_role = "Principal Investigator and originator of input/source data and brightness temperature output, Processor and author of entire driver routine (rss_v6_ssmi_fcdr.pro) and converted RSS-written read_ssmi_l1a_file.f and ta_to_tb.f files to IDL with FCDR output data being written out in netCDF-4" ;
}

REFERENCES [top]

1. Climate and Forecast (CF) Conformance Requirements and Recommendations, v1.5: http://cf-pcmdi.llnl.gov/conformance/requirements-and-recommendations/1.5

2. Climate and Forecast (CF) Metadata Conventions, Version 1.5, 25 October, 2010: http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.5/cf-conventions.html

3. The Recommended GHRSST Data Specification (GDS) Revision 2.0: https://www.ghrsst.org/modules/documents/documents/GDS2.0_TechnicalSpecifications_v2.0.pdf

4. Unidata NetCDF Attribute Convention for Dataset Discovery: http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html and https://geo-ide.noaa.gov/wiki/index.php?title=NetCDF_Attribute_Convention_for_Dataset_Discovery

5. Unidata NetCDF Users' Guide, Appendix B: Attribute Conventions: http://www.unidata.ucar.edu/software/netcdf/docs/netcdf.html#Attribute-Conventions

6. Unidata, Writing NetCDF Files: Best Practices: http://www.unidata.ucar.edu/software/netcdf/docs/BestPractices.html