

NSIDC Guidelines for netCDF Attributes

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Background

As part of the DAAC Passive Microwave (PM) Product Team work to convert select data sets to netCDF, Scott Stewart led a working group (WG) to determine **a set of guidelines for netCDF attributes** to include in the data files. The WG included Julia Collins, Siri Jodha Singh Khalsa and Ann Windnagel. The PM team further developed the guidelines to include easy-to-follow instructions that other NSIDC data management teams and data providers could refer to.

This document is **not meant to be a set of requirements** for the development of netCDF files, rather, it **provides recommendations** based on best practices set forth by the following sources of information:

NetCDF Best Practice References

These references are the source documents for the recommendations made throughout this document:

- Ramapriyan, H. K., and P. J. T. Leonard. 2020. Data Product Development Guide (**DPDG**) for Data Producers version 1.1. NASA Earth Science Data and Information System Standards Office, 21 October 2021. <https://www.earthdata.nasa.gov/esdis/esco/standards-and-practices/data-product-development-guide-for-data-producers>
 - Note: **NASA DAAC missions are requested** to follow the DPDG as appropriate.
- **DIWG**: ESDS Data Interoperability Working Group (DIWG) documents provide guidance regarding grid structures in netCDF4
 - <https://www.earthdata.nasa.gov/s3fs-public/imported/ESDS-RFC-028v1.3.pdf>
 - <https://www.earthdata.nasa.gov/s3fs-public/imported/ESDS-RFC-036v1.2.pdf>
- **CF**: NetCDF Climate and Forecast Metadata Conventions, v1.7, <https://cfconventions.org/Data/cf-conventions/cf-conventions-1.7/cf-conventions.html>
 - **CF Standard Name Table**: <https://cfconventions.org/Data/cf-standard-names/current/build/cf-standard-name-table.html>
 - **CF Standardized Region List**: <https://cfconventions.org/Data/standardized-region-list/standardized-region-list.html>
- **ACDD**: Attribute Convention for Data Discovery, v1.3, http://wiki.esipfed.org/index.php/Category:Attribute_Conventions_Dataset_Discovery
- **NCEI**: NOAA Centers for Environmental Information, NCEI NetCDF Templates v2.0, <https://www.ncei.noaa.gov/data/oceans/ncei/formats/netcdf/v2.0/index.html>
- **NUG**: NetCDF User Guide, <https://docs.unidata.ucar.edu/nug/current/>
- **COARDS**: Cooperative Ocean/Atmosphere Research Service (May 1995), <https://ferret.pmel.noaa.gov/Ferret/documentation/coards-netcdf-conventions>

Recommended CF Compliance Checkers

A data set's files are recommended to be checked for CF compliance prior to delivery to NSIDC. The following compliance checkers have been vetted and are recommended:

- cfchecks: github at <https://github.com/cedadev/cf-checker>, with detailed instructions via <https://pypi.org/project/cfchecker/>
- Integrated Ocean Observing System (IOOS) Compliance Checker: <https://compliance.ioos.us/index.html> (has a 16 MB max file size limit)



Instructions for using this document

The document contains information for dimension, data variable, and global attributes. Attributes are grouped by category in order to put similar information together. Some software programs, notably Panoply, ignore the file-ordering and list attributes alphabetically. For each attribute listed, you will find the following:

- **Attribute name:** Typical netCDF attribute names are used and described in this document. Refer to the indicated source reference: DPDG, DIWG, CF, ACDD, etc., for full descriptions of attribute names, and best-practice expectations of their use.
 - “ * ”: Identifies a *strongly recommended* attribute by one or more of the reference documents to assure the best standards conformance and usability of a file.
 - Attributes without an asterisk are those *recommended* by one or more of the reference documents for increasing the interoperability of, or providing richer metadata in, a file.
 - “ ° ”: Identifies a *suggested* attribute to provide richer metadata in a file.
 - “ * ” : Identifies an attribute where its recommendation may not be applicable to many NSIDC DAAC data sets. For example, there are recommendations specific to vertical dimension attributes (such as for: atmospheric, ocean salinity depths). These attributes have been listed in the appendix for awareness, and can be used when applicable to a data set content.
- (Source): Listed in parentheses after attribute names is/are the best practice reference source(s) supporting the attribute, and upon which the strength of the recommendation is based, e.g., strongly recommended, recommended, or suggested.
- Example attribute values shown in green are provided from the file:
NSIDC0001_TB_PS_N12.5km_20210605_v6.0.nc (<https://doi.org/10.5067/MXJL42WSXTS1>)

Grid mapping variable (CF)

This is a strongly recommended *variable* which is used as a container for the attributes that define a file's Coordinate Reference System (CRS). EASE2 and Polar Stereographic are provided in the table below as examples. CF Conventions [Appendix F: Grid Mappings](#) describes valid name values and the minimum attributes required to define a CRS. You may use <https://epsg.io> as a reference to determine the attribute values for additional projections. If the file can be interpreted by GDAL (Geospatial Data Abstraction Library), Panoply, ArcGIS, or other geospatially-aware software, that will confirm that the description is sufficient.

Grid mapping variable attributes and values for NSIDC projections:

<p>EASE2.0, Northern hemisphere, 25km grid_mapping_name = "lambert_azimuthal_equal_area" long_name = "EASE2_N25km" longitude_of_projection_origin = 0. latitude_of_projection_origin = 90. false_easting = 0. false_northing = 0. semi_major_axis = 6378137. inverse_flattening = 298.257223563 srid = "urn:ogc:def:crs:EPSG::6931"</p>	<p>Polar Stereo, Northern hemisphere, 25km grid_mapping_name = "polar_stereographic" long_name = "NSIDC_NH_PolarStereo_25km" straight_vertical_longitude_from_pole = -45. latitude_of_projection_origin = 90. standard_parallel = 70. false_easting = 0. false_northing = 0. longitude_of_prime_meridian = 0. semi_major_axis = 6378273. inverse_flattening = 298.279411123064 srid = "urn:ogc:def:crs:EPSG::3411"</p>
<p>EASE2.0, Southern hemisphere, 25km grid_mapping_name = "lambert_azimuthal_equal_area" long_name = "EASE2_S25km" longitude_of_projection_origin = 0. latitude_of_projection_origin = -90. false_easting = 0. false_northing = 0. semi_major_axis = 6378137. inverse_flattening = 298.257223563 srid = "urn:ogc:def:crs:EPSG::6932"</p>	<p>Polar Stereo, Southern hemisphere, 25km grid_mapping_name = "polar_stereographic" long_name = "NSIDC_SH_PolarStereo_25km" straight_vertical_longitude_from_pole = 0. latitude_of_projection_origin = -90. standard_parallel = -70. false_easting = 0. false_northing = 0. longitude_of_prime_meridian = 0. semi_major_axis = 6378273. inverse_flattening = 298.279411123064 srid = "urn:ogc:def:crs:EPSG::3412"</p>
<p>EASE2.0, Temperate Coverage, 25km grid_mapping_name = "lambert_cylindrical_equal_area" long_name = "EASE2_T25km" longitude_of_central_meridian = 0. standard_parallel = 30. false_easting = 0. false_northing = 0. semi_major_axis = 6378137. inverse_flattening = 298.257223563 srid = "urn:ogc:def:crs:EPSG::6933"</p>	

In this table, **bold = required attributes**. The other attributes are recommended as they serve to further define the geoid parameters (longitude_of_prime_meridian, semi_major_axis, and inverse_flattening, etc.) or add clarity to the definition (long_name, srid) for users.

GeoTransform (GDAL)

The GDAL GeoTransform attribute value is a string of six coefficients defining a 2D affine transformation from the image coordinate space (row, column), to the georeferenced coordinate space (projected or geographic coordinates). Its use is recommended in order to increase the interoperability of files in data sets for users who want to translate positions from a data set's given CRS to another. For more information, see: https://gdal.org/tutorials/geotransforms_tut.html and https://gdal.org/user/raster_data_model.html#affine-geotransform. The values for common NSIDC polar projections are listed below to copy and paste.

GeoTransform values for NSIDC grids

EPSG 6931	EASE2 NH 25km	"-9000000 25000 0 9000000 0 -25000 "
	EASE2 NH 6.25km	"-9000000 6250 0 9000000 0 -6250 "
	EASE2 NH 3.125km	"-9000000 3125 0 9000000 0 -3125 "
EPSG 6932	EASE2 SH 25km	"-9000000 25000 0 9000000 0 -25000 "
	EASE2 SH 6.25km	"-9000000 6250 0 9000000 0 -6250 "
	EASE2 SH 3.125km	"-9000000 3125 0 9000000 0 -3125 "
EPSG 6933	EASE2 Temperate 25km	"-17367530.44 25025.26000 0 6756820.2 0 -25025.26000 "
	EASE2 Temperate 6.25km	"-17367530.44 6256.31500 0 6756820.2 0 -6256.31500 "
	EASE2 Temperate 3.125km	"-17367530.44 3128.15750 0 6756820.2 0 -3128.15750 "
EPSG 3411	NSIDC Polar Stereo NH 25km	"-3850000 25000 0 5850000 0 -25000 "
EPSG 3412	NSIDC Polar Stereo SH 25km	"-3950000 25000 0 4350000 0 -25000 "

Note: the EASE2 NH and SH attribute strings for a given resolution are the same because the numerical x/y-extents of the EASE2 polar grids are the same for North and South. I.e., both NH and SH extend nine million meters out from the pole in both the positive and negative x- and y- directions.

crs_wkt (DIWG, CF)

A recommended attribute to be included within the grid mapping variable. It acts as a supplement to the single-property CF grid mapping attributes—it's not intended to replace them. The crs_wkt's extended syntax of the coordinate reference system enables the list of variables containing coordinate values being referenced to be explicitly stated, and for the axis order to be explicitly defined. To copy the crs_wkt string applicable to your data, browse to <https://epsg.io> and search for the appropriate EPSG code. At the Export section of the page, select "OGC WKT 2", and choose the "Copy Text" option atop the shaded box displaying the OGC WKT 2 definition. Common OGC WKT 2 definitions for NSIDC polar projections are listed below to copy and paste.

Recommended crs_wkt for NSIDC polar projections

EASE2.0, Northern hemisphere, 25km PROJCRS["WGS 84 / NSIDC EASE-Grid 2.0 North",BASEGEOGCRS["WGS 84",ENSEMBLE["World Geodetic System 1984 ensemble",MEMBER["World Geodetic System 1984 (Transit)",MEMBER["World Geodetic System 1984 (G730)",MEMBER["World Geodetic System 1984 (G873)",MEMBER["World Geodetic System 1984 (G1150)",MEMBER["World Geodetic System 1984 (G1674)",MEMBER["World Geodetic System 1984 (G1762)",MEMBER["World Geodetic System 1984 (G2139)",ELLIPSOID["WGS 84",6378137,298.257223563,LENGTHUNIT["metre",1]],ENSEMBLEACCURACY[2.0]],PRIMEM["Greenwich",0,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",4326]],CONVERSION["US NSIDC EASE-Grid 2.0 North",METHOD["Lambert Azimuthal Equal Area",ID["EPSG",9820]],PARAMETER["Latitude of natural origin",90,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",8801]],PARAMETER["Longitude of natural origin",0,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",8802]],PARAMETER["False easting",0,LENGTHUNIT["metre",1],ID["EPSG",8806]],PARAMETER["False northing",0,LENGTHUNIT["metre",1],ID["EPSG",8807]]],CS[Cartesian,2],AXIS["easting (X)",south,MERIDIAN[90,ANGLEUNIT["degree",0.0174532925199433]],ORDER[1],LENGTHUNIT["metre",1]],AXIS["northing (Y)",south,MERIDIAN[180,ANGLEUNIT["degree",0.0174532925199433]],ORDER[2],LENGTHUNIT["metre",1]],USAGE[SCOPE["Environmental science - used as basis for EASE grid.",],AREA["Northern hemisphere.",],BBOX[0,-180,90,180]],ID["EPSG",6931]]	Polar Stereo, Northern hemisphere, 25km PROJCRS["NSIDC Sea Ice Polar Stereographic North",BASEGEOGCRS["Unspecified datum based upon the Hughes 1980 ellipsoid",DATUM["Not specified (based on Hughes 1980 ellipsoid)",ELLIPSOID["Hughes 1980",6378273,298.279411123064,LENGTHUNIT["metre",1]],PRIMEM["Greenwich",0,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",4054]],CONVERSION["US NSIDC Sea Ice polar stereographic north",METHOD["Polar Stereographic (variant B)",ID["EPSG",9829]],PARAMETER["Latitude of standard parallel",70,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",8832]],PARAMETER["Longitude of origin",-45,ANGLEUNIT["degree",0.0174532925199433]],ID["EPSG",8833]],PARAMETER["False easting",0,LENGTHUNIT["metre",1],ID["EPSG",8806]],PARAMETER["False northing",0,LENGTHUNIT["metre",1],ID["EPSG",8807]]],CS[Cartesian,2],AXIS["easting (X)",south,MERIDIAN[45,ANGLEUNIT["degree",0.0174532925199433]],ORDER[1],LENGTHUNIT["metre",1]],AXIS["northing (Y)",south,MERIDIAN[135,ANGLEUNIT["degree",0.0174532925199433]],ORDER[2],LENGTHUNIT["metre",1]],USAGE[SCOPE["Polar research.",],AREA["Northern hemisphere - north of 60°N onshore and offshore, including Arctic.",],BBOX[60,-180,90,180]],ID["EPSG",3411]]
EASE2.0, Southern hemisphere, 25km PROJCRS["WGS 84 / NSIDC EASE-Grid 2.0	Polar Stereo, Southern hemisphere, 25km



<p>South\",BASEGEOGCRS[\"WGS 84\",ENSEMBLE[\"World Geodetic System 1984 ensemble\",MEMBER[\"World Geodetic System 1984 (Transit)\",MEMBER[\"World Geodetic System 1984 (G730)\",MEMBER[\"World Geodetic System 1984 (G873)\",MEMBER[\"World Geodetic System 1984 (G1150)\",MEMBER[\"World Geodetic System 1984 (G1674)\",MEMBER[\"World Geodetic System 1984 (G1762)\",MEMBER[\"World Geodetic System 1984 (G2139)\",ELLIPSOID[\"WGS 84\",6378137,298.257223563,LENGTHUNIT[\"metre\",1]],ENSEMBLEACCURACY[2.0]],PRIMEM[\"Greenwich\",0,ANGLEUNIT[\"degree\",0.0174532925199433]],ID[\"EPSG\",4326]],CONVERSION[\"US NSIDC EASE-Grid 2.0 South\",METHOD[\"Lambert Azimuthal Equal Area\",ID[\"EPSG\",9820]],PARAMETER[\"Latitude of natural origin\",-90,ANGLEUNIT[\"degree\",0.0174532925199433],ID[\"EPSG\",8801]],PARAMETER[\"Longitude of natural origin\",0,ANGLEUNIT[\"degree\",0.0174532925199433],ID[\"EPSG\",8802]],PARAMETER[\"False easting\",0,LENGTHUNIT[\"metre\",1],ID[\"EPSG\",8806]],PARAMETER[\"False northing\",0,LENGTHUNIT[\"metre\",1],ID[\"EPSG\",8807]]],CS[Cartesian,2],AXIS[\"easting (X)\",north,MERIDIAN[90,ANGLEUNIT[\"degree\",0.0174532925199433]],ORDER[1],LENGTHUNIT[\"metre\",1]],AXIS[\"northing (Y)\",north,MERIDIAN[0,ANGLEUNIT[\"degree\",0.0174532925199433]],ORDER[2],LENGTHUNIT[\"metre\",1]],USAGE[SCOPE[\"Environmental science - used as basis for EASE grid.\"],AREA[\"Southern hemisphere.\"],BBOX[-90,-180,0,180]],ID[\"EPSG\",6932]]</p>	<p>PROJCRS[\"NSIDC Sea Ice Polar Stereographic South\",BASEGEOGCRS[\"Unspecified datum based upon the Hughes 1980 ellipsoid\",DATUM[\"Not specified (based on Hughes 1980 ellipsoid)\",ELLIPSOID[\"Hughes 1980\",6378273,298.279411123064,LENGTHUNIT[\"metre\",1]],PRIMEM[\"Greenwich\",0,ANGLEUNIT[\"degree\",0.0174532925199433]],ID[\"EPSG\",4054]],CONVERSION[\"US NSIDC Sea Ice polar stereographic south\",METHOD[\"Polar Stereographic (variant B)\",ID[\"EPSG\",9829]],PARAMETER[\"Latitude of standard parallel\",-70,ANGLEUNIT[\"degree\",0.0174532925199433],ID[\"EPSG\",8832]],PARAMETER[\"Longitude of origin\",0,ANGLEUNIT[\"degree\",0.0174532925199433],ID[\"EPSG\",8833]],PARAMETER[\"False easting\",0,LENGTHUNIT[\"metre\",1],ID[\"EPSG\",8806]],PARAMETER[\"False northing\",0,LENGTHUNIT[\"metre\",1],ID[\"EPSG\",8807]]],CS[Cartesian,2],AXIS[\"easting (X)\",north,MERIDIAN[90,ANGLEUNIT[\"degree\",0.0174532925199433]],ORDER[1],LENGTHUNIT[\"metre\",1]],AXIS[\"northing (Y)\",north,MERIDIAN[0,ANGLEUNIT[\"degree\",0.0174532925199433]],ORDER[2],LENGTHUNIT[\"metre\",1]],USAGE[SCOPE[\"Polar research.\"],AREA[\"Southern hemisphere - south of 60°S onshore and offshore - Antarctica.\"],BBOX[-90,-180,-60,180]],ID[\"EPSG\",3412]]</p>
<p>EASE2.0, Temperate Coverage, 25km PROJCRS[\"WGS 84 / NSIDC EASE-Grid 2.0 Global\",BASEGEOGCRS[\"WGS 84\",ENSEMBLE[\"World Geodetic System 1984 ensemble\",MEMBER[\"World Geodetic System 1984 (Transit)\",MEMBER[\"World Geodetic System 1984 (G730)\",MEMBER[\"World Geodetic System 1984 (G873)\",MEMBER[\"World Geodetic System 1984 (G1150)\",MEMBER[\"World Geodetic System 1984 (G1674)\",MEMBER[\"World Geodetic System 1984 (G1762)\",MEMBER[\"World Geodetic System 1984 (G2139)\",ELLIPSOID[\"WGS 84\",6378137,298.257223563,LENGTHUNIT[\"metre\",1]],ENSEMBLEACCURACY[2.0]],PRIMEM[\"Greenwich\",0,ANGLEUNIT[\"degree\",0.0174532925199433]],ID[\"EPSG\",4326]],CONVERSION[\"US NSIDC EASE-Grid 2.0 Global\",METHOD[\"Lambert Cylindrical Equal</p>	

<pre>Area\,ID["EPSG",9835]],PARAMETER["Latitude of 1st standard parallel",30,ANGLEUNIT["degree",0.017453292519 9433],ID["EPSG",8823]],PARAMETER["Longitude of natural origin",0,ANGLEUNIT["degree",0.017453292519943 3],ID["EPSG",8802]],PARAMETER["False easting",0,LENGTHUNIT["metre",1],ID["EPSG",880 6]],PARAMETER["False northing",0,LENGTHUNIT["metre",1],ID["EPSG",88 07]]],CS[Cartesian,2],AXIS["easting (X)",east,ORDER[1],LENGTHUNIT["metre",1]],AXIS[" northing (Y)",north,ORDER[2],LENGTHUNIT["metre",1]],USA GE[SCOPE["Environmental science - used as basis for EASE grid.\"],AREA["World between 86°S and 86°N.\"],BBOX[-86,-180,86,180]],ID["EPSG",6933]]</pre>	
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Sample grid mapping variable

To tie all the grid mapping variable elements together, the following shows a thoroughly-attributed grid mapping variable named "crs" describing the projection definition of EPSG:3411 via the grid_mapping_name and attributes for the ellipsoid and specific projection details. It's shown here from a file as displayed in [Panoply](#)):

```
char crs;
:grid_mapping_name = "polar_stereographic";
:long_name: "NSIDC_NH_PolarStereo_25km"
:straight_vertical_longitude_from_pole = -45.0; // double
:latitude_of_projection_origin = 90.0; // double
:standard_parallel = 70.0; // double
:false_easting = 0.0; // double
:false_northing = 0.0; // double
:longitude_of_prime_meridian = 0.0; // double
:semi_major_axis = 6378273.0; // double
:inverse_flattening = 298.279411123064; // double
:crs_wkt = "PROJCRS["NSIDC Sea Ice Polar Stereographic
North",BASEGEOGCRS["Unspecified datum based upon the Hughes 1980 ellipsoid",DATUM["Not
specified (based on Hughes 1980 ellipsoid)",ELLIPSOID["Hughes
1980",6378273,298.279411123064,LENGTHUNIT["metre",1]]],PRIMEM["Greenwich",0,ANGLEUNIT["
degree",0.0174532925199433]],ID["EPSG",4054]],CONVERSION["US NSIDC Sea Ice polar
stereographic north",METHOD["Polar Stereographic (variant
B)",ID["EPSG",9829]],PARAMETER["Latitude of standard
parallel",70,ANGLEUNIT["degree",0.0174532925199433],ID["EPSG",8832]],PARAMETER["Longit
ude of origin",-
45,ANGLEUNIT["degree",0.0174532925199433],ID["EPSG",8833]],PARAMETER["False
easting",0,LENGTHUNIT["metre",1],ID["EPSG",8806]],PARAMETER["False
northing",0,LENGTHUNIT["metre",1],ID["EPSG",8807]]],CS[Cartesian,2],AXIS["easting
(X)",south,MERIDIAN[45,ANGLEUNIT["degree",0.0174532925199433]],ORDER[1],LENGTHUNIT["me
tre",1]],AXIS["northing
(Y)",south,MERIDIAN[135,ANGLEUNIT["degree",0.0174532925199433]],ORDER[2],LENGTHUNIT["m
etre",1]],USAGE[SCOPE["Polar research."],AREA["Northern hemisphere - north of 60°N
onshore and offshore, including Arctic."],BBOX[60,-180,90,180]],ID["EPSG",3411]]";
:srid = "urn:ogc:def:crs:EPSG::3411";
:GeoTransform = "-3850000 25000 0 5850000 0 -25000 ";
```



Dimension Variable Attributes

For use within dimension variables such as: time, x, y, or others as applicable for a data set's files. The examples shown are from [NSIDC0001_TB_PS_N12.5km_20210605_v6.0.nc](#)

*** standard_name** (ACDD, CF)

Specify the standard name from the [CF Standard Name Table](#) to describe the dimension (x, y, or time in this example).

projection_x_coordinate
projection_y_coordinate
time

*** coverage_content_type** (ACDD)

This specifies the source of the x, y, and time-arrays data using an ISO 19115-1 code of: image, thematicClassification, physicalMeasurement, auxiliaryInformation, qualityInformation, referenceInformation, modelResult, or coordinate.

coordinate
coordinate
image

*** long_name** (ACDD, CF, NUG, COARDS)

Specify name for the dimension (time, x, or y).

x
y
ANSI date

*** units** (ACDD, CF, NUG, COARDS)

Specify the units of the dimension coordinate (*long_name*)

meters
meters
days since 1970-01-01 00:00:00

*** valid_range** (CF)

Specify the valid minimum to maximum range of values of the dimension variables.

-3850000.0, 3750000.0
-5350000.0, 5850000.0
No valid range specified for time

*** valid_min** (CF)

Specify the minimum valid value of the dimension variables. Not required if valid_range is used.

*** valid_max** (CF)

Specify the maximum valid value of the dimension variables. Not required if valid_range is used.

calendar (CF)

Specify the calendar used for the time dimension.

standard

Data Variable Attributes

Describes the following set of attributes for each data variable in a file. The examples shown are from NSIDC0001_TB_PS_N12.5km_20210605_v6.0.nc's **TB_F17_91H** data variable.

* **_FillValue** (CF)

Specify the value and type (e.g. S = short, 2 byte integer) used when information is not available for the grid cell. This should be a numeric value outside the range of valid data values, and used consistently (e.g., -9999, but *not* NaN).

0S

* **units** (CF, ACDD)

Specify the units of the grid cells.

K

* **long_name** (CF, ACDD)

Specify the long name of what that variable describes. If multiple gridding methodologies are used for a data set, then this variable should describe which methodology was used for the data file.

Brightness Temperature

* **standard_name** (CF, ACDD)

Specify the standard name from the [CF Standard Name Table](#) that describes the variable. If no standard_name can be found that's appropriate for the variable, this attribute should be excluded.

brightness_temperature

standard_name_vocabulary (ACDD)

Specify the current version of the [CF Standard Name Table](#) used.

CF Standard Name Table (v77, 19 January 2021)

* **grid_mapping** (CF)

Used to specify the name of the grid mapping variable, and therefore establish the coordinate reference system for the **TB_F17_91H** variable.

crs

° **packing_convention**

Specify the convention if the data are packed.

netCDF

° **packing_convention_description**

Describe the packing convention if the data are packed.

unpacked = scale_factor*packed + add_offset

Data Variable Attributes, continued

* **scale_factor** (CF)

Specify the scale factor if the data are packed.

0.1

* **add_offset** (CF)

Specify the offset factor if the data are packed.

0.0

* **valid_range** (CF)

Specify the smallest and largest valid values within a data variable. Not necessary if `valid_min` and `valid_max` are used.

500S, 3500S

* **valid_min** (CF)

Specify the smallest valid value of a data variable. Not necessary if `valid_range` is specified.

Did not provide attribute

* **valid_max** (CF)

Specify the largest valid value of a data variable. Not necessary if `valid_range` is specified.

Did not provide attribute

* **coordinates** (CF)

Specify the names of the dimension variables of time, y- and x- respectively. Provide this attribute to ensure tools like Panoply are able to properly geolocate the data.

time y x

* **flag_values** (CF)

Specify the value if a sentinel value(s) is used (e.g. pole hole, missing data) in the data file. Omit if a flag is not being used. These values do not refer to an observation.

0S

* **flag_meanings** (CF)

Describe the meanings of each *flag_value*.

No_TB_observation

Global Attributes

General Data Product and Data File Global Attributes

* **title** (CF, ACDD, NUG)

Specify the data set title.

DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures

* **summary** (ACDD)

Describe the data set with a concise description. For NSIDC-derived data sets, this may be the same as the summary used in the NSIDC Enterprise Database (EDB).

This data set provides daily gridded brightness temperatures derived from passive microwave sensors and distributed in a polar stereographic projection. NSIDC produces daily gridded brightness temperatures from orbital swath data generated by the Special Sensor Microwave/Imager (SSM/I) aboard the Defense Meteorological Satellite Program (DMSP) F8, F11, and F13 platforms and the Special Sensor Microwave Imager/Sounder (SSMIS) aboard DMSP F17 and F18. The SSM/I and SSMIS channels used to calculate brightness temperatures include 19.3 GHz vertical and horizontal, 22.2 GHz vertical, 37.0 GHz vertical and horizontal, 85.5 GHz vertical and horizontal (on SSM/I), and 91.7 GHz vertical and horizontal (on SSMIS). Data at 85.5 GHz and 91.7 GHz are gridded at a resolution of 12.5 km, with all other frequencies at a resolution of 25 km. Orbital data for each 24-hour period are mapped to respective grid cells using a simple sum-and-average method, also known as the drop-in-the-bucket method.

* **keywords** (ACDD)

Specify keywords using Global Change Master Directory (GCMD) nomenclature described in <https://wiki.earthdata.nasa.gov/display/CMR/GCMD+Keyword+Access>.

EARTH SCIENCE > SPECTRAL/ENGINEERING > MICROWAVE > BRIGHTNESS TEMPERATURE

° **keywords_vocabulary** (ACDD)

Specify current version of GCMD referenced.

NASA Global Change Master Directory (GCMD) Earth Science Keywords, Version 8.1

* **Conventions** (CF, ACDD, NUG)

Specify all conventions that are followed for this netCDF file. A netCDF file may adhere to more than one set of conventions, in which case the value of the Conventions attribute should be a single text string listing the convention names separated by blank space (recommended) or commas (if a convention name contains blanks).

"CF-1.6, ACDD-1.3"

id (ACDD)

Specify the DOI for the data product. During development the NSIDC will have to reserve the DOI. There are cases where it may not be possible to reserve the DOI prior to data production and publication.

10.5067/MXJL42WSXTS1



Global Attributes, continued

license (ACDD)

Specify access and use constraint messaging as required by NASA's Common Metadata Repository (CMR). All NSIDC collection/file level metadata fall under this requirement.

DAAC data sets are required to use the following constraint messages:

- Access Constraint: These data are freely, openly, and fully accessible, provided that you are logged into your NASA Earthdata profile (<https://urs.earthdata.nasa.gov/>).
- Use Constraint: These data are freely, openly, and fully available to use without restrictions, provided that you cite the data according to the recommended citation at <https://nsidc.org/about/data-use-and-copyright>. For more information on the NASA EOSDIS Data Use Policy, see <https://earthdata.nasa.gov/earth-observation-data/data-use-policy>.

NOAA data sets should use the following constraint messages:

- Access Constraints: These data are freely, openly, and fully accessible without restrictions.
- Use Constraints: These data are freely, openly, and fully available to use without restrictions, provided that you cite the data according to the recommended citation at <https://nsidc.org/about/data-use-and-copyright>.

Data outside of these programs should consider messaging similar to the DAAC and NOAA examples.

Access Constraint: These data are freely, openly, and fully accessible, provided that you are logged into your NASA Earthdata profile (<https://urs.earthdata.nasa.gov/>); Use Constraint: These data are freely, openly, and fully available to use without restrictions, provided that you cite the data according to the recommended citation at https://nsidc.org/about/use_copyright.html. For more information on the NASA EOSDIS Data Use Policy, see <https://earthdata.nasa.gov/earth-observation-data/data-use-policy>.

acknowledgment (ACDD)

Specify the name of the funding source and funding program, as well as the grant number. It is at the discretion of the data producer to provide any further information. This example acknowledgement is specific to a DAAC-produced data set:

These data are produced and supported by the NASA National Snow and Ice Data Center Distributed Active Archive Center.

° product_version (DPDG, ACDD)

Specify major and minor version (vX.X)

v6.0

source (DPDG, CF, ACDD)

Specify source of input data. Spell out the source when possible.

Remote Sensing Systems

° instrument (ACDD, NCEI)

Specify using Global Change Master Directory (GCMD) conventions

Include an instrument description for each listed *platform*, even if the instrument is the same. For instance, SSMIS could be listed twice if the platform lists both F17 and F18.

SSMIS > Special Sensor Microwave Imager/Sounder; SSMIS > Special Sensor Microwave Imager/Sounder



Global Attributes, continued

◦ **instrument_vocabulary** (ACDD)

Specify current version of GCMD

[NASA Global Change Master Directory \(GCMD\) Earth Science Keywords, Version 8.1](#)

◦ **platform** (ACDD, NCEI)

Specify using Global Change Master Directory (GCMD) conventions. Include a platform description for all platforms represented in the data file. For instance, F17 and F18 may be represented in the data file, so each should be described in the attribute value.

[DMSP 5D-3/F17 > Defense Meteorological Satellite Program-F17; DMSP 5D-3/F18 > Defense Meteorological Satellite Program-F18](#)

◦ **platform_vocabulary** (ACDD)

Specify current version of GCMD

[NASA Global Change Master Directory \(GCMD\) Earth Science Keywords, Version 8.1](#)

◦ **references** (ACDD, CF)

Specify references that are specific to the data set production (e.g. ATBD). For long standing data products produced at NSIDC, this type of reference may not be available.

[Did not provide attribute](#)

history (ACDD, NUG)

Auto generated when using certain netCDF programs (e.g. nctools). Running “nctools” will append the command-line program. Source files may also be listed here, though it is recommended to use the *input_file(n)* and *ancillary_file(n)* attributes.

[Did not provide attribute](#)

◦ **metadata_link** (ACDD)

Specify the DOI for the data product, as done in *id*.

<https://doi.org/10.5067/MXJL42WSXTS1>

◦ **date_modified** (ACDD, NCEI)

The date on which the data was last modified. Note that this applies just to the data, not the metadata. Use of the [ISO 8601:2004](#) extended date format is recommended, as described in the Attributes Content Guidance section.

[2021-05-20](#)

◦ **date_metadata_modified** (NCEI)

The date on which the metadata was last modified. Use of the [ISO 8601:2004](#) extended date format is recommended. For data products produced at NSIDC, Near-real-time data are an example where this is most likely to be used, as the file is regenerated as new input data are ingested.

[2021-05-20](#)

Global Attributes, continued

date_created (ACDD)

Specify the date the netCDF file was created.

2021-07-01

◦ **cdm_data_type** (ACDD)

Specify the type of information within the grid cell (Grid, Image, Swath)

Grid

processing_level (ACDD)

Specify the data file processing level. Gridded files are typically referred to as level 3.

Level 3

comment (ACDD, CF)

Describe anything in the data that does not have another home in the metadata. This is at the discretion of the data producer.

Did not provide attribute

citation (NSIDC)

Specify the data set citation using the NSIDC format. Providing the citation coincides with providing the *id* attribute (see description of *id*). The *id* (DOI) is a requirement as part of the citation. There are cases where it may not be possible to list the citation prior to data production and publication.

Meier, W. N., J. S. Stewart, H. Wilcox, D. J. Scott, and M. A. Hardman. 2021. DMSP SSM/I-SSMIS Daily Polar Gridded Brightness Temperatures, Version 6. [Indicate subset used]. Boulder, Colorado USA. NASA National Snow and Ice Data Center Distributed Active Archive Center. doi: <https://doi.org/10.5067/MXJL42WSXTS1>. [Date Accessed].

For other non-DAAC NSIDC programs: Follow the DAAC example above, however remove the phrase 'Distributed Active Archive Center'.

naming_authority (ACDD)

Specify the naming authority of the *id*. If the *id* is unable to be reserved, then this field would be left blank.

org.doi.dx

Data Provider-Related Global Attributes

institution (ACDD, CF)

Specify the publishing institution

DAAC: Provide the GCMD long name - NASA National Snow and Ice Data Center Distributed Active Archive Center

NOAA: Provide the GCMD long name - National Oceanic and Atmospheric Administration at the National Snow and Ice Data Center

For groups outside of the DAAC and NOAA: National Snow and Ice Data Center\Cooperative Institute for Research in Environmental Sciences\University of Colorado at Boulder\Boulder, CO

NASA National Snow and Ice Data Center Distributed Active Archive Center



Data Provider-Related Global Attributes, continued

◦ **contributor_name** (ACDD)

Specify the names of contributors. Contributors are specific to the version of the data product/file that is being referenced.

Meier, W. N., J. S. Stewart, H. Wilcox, D. J. Scott, and M. A. Hardman

◦ **contributor_role** (ACDD)

Specify the role for each *contributor_name(s)*.

project_scientist, scientific_programmer, software_developer, project_lead, software_developer

◦ **program** (ACDD)

Specify the program that funded the data product. If this is not known, it should be left blank

NASA Earth Science Data and Information System (ESDIS)

project (ACDD)

Specify the project(s) principally responsible for originating this data.

DAAC-produced data sets (e.g. Passive Microwave Product Team), would show “DAAC”.

A NASA example: Greenland Ice sheet Mapping Project (GrIMP) under the MEaSUREs program.

Did not provide attribute

publisher_name (ACDD, NCEI)

Specify the publishing person, group, or entity.

DAAC: NASA National Snow and Ice Data Center Distributed Active Archive Center

NOAA: NOAA at the National Snow and Ice Data Center

Other data management programs or projects should use their appropriate title/name.

NASA National Snow and Ice Data Center Distributed Active Archive Center

creator_name (ACDD, NCEI)

Used in NSIDC DAAC-produced data sets to distinguish the products as one the DAAC actually creates, and populated with the same information found in **publisher_name**. Not likely relevant for externally-produced data sets.

◦ **publisher_type** (ACDD)

Specify the person, group, institution, or position of the *publisher_name*.

institution

◦ **publisher_institution** (ACDD, NCEI)

Specify the institution where the *publisher_name* resides (e.g. the DAAC is part of NSIDC). The following text is recommended: “National Snow and Ice Data Center\Cooperative Institute for Research in Environmental Sciences\University of Colorado at Boulder\Boulder, CO”

National Snow and Ice Data Center\nCooperative Institute for Research in Environmental Sciences\nUniversity of Colorado at Boulder\nBoulder, CO



Data Provider-Related Global Attributes, continued

creator_institution (ACDD, NCEI)

Used in NSIDC DAAC-produced data sets to distinguish the products as one the DAAC actually creates, and populated with the same information found in **publisher_institution**. Not likely relevant for externally-produced data sets.

publisher_url (ACDD)

Specify the URL for the *publisher_name*.

DAAC: <https://nsidc.org/daac>

NOAA: <https://nsidc.org/noaa>

For other NSIDC groups: <https://nsidc.org>

<https://nsidc.org/daac>

publisher_email (ACDD)

Specify the email for the NSIDC User Services Office

nsidc@nsidc.org

Temporal Description Global Attributes

time_coverage_resolution (ACDD)

Specify the targeted time period between each value in the data set. Use ISO 8601:2004 duration format, preferably the extended format as recommended in the Attribute Content Guidance section."

Wikipedia has a pretty good explanation of the ISO 8601 format for time "Durations":

https://en.wikipedia.org/wiki/ISO_8601#Durations. P1D is Period of 1 Day. P1M is the monthly equivalent.

[P1D](#)

time_coverage_start (ACDD)

Specify the start time of the data in the file.

[2021-01-01 00:00.00](#)

time_coverage_end (ACDD)

Specify the end time of the data in the file.

[2021-01-01 23:59.99](#)

time_coverage_duration (ACDD)

Specify the time period between the *time_coverage_start* and the *time_coverage_end*.

[P01T00:00.00](#)

Geospatial Description Global Attributes

geospatial_bounds_crs (ACDD)

Specifies the coordinate reference system EPSG code for which the vertices of the geospatial_bounds polygon (see below) are expressed.

geospatial_bounds_crs values for NSIDC grids

Grid Name	geospatial_bounds_crs attribute value
Polar Stereo, Northern Hemisphere	"EPSG:3411"
Polar Stereo, Southern Hemisphere	"EPSG:3412"
EASE2.0, Northern Hemisphere	"EPSG:6931"
EASE2.0, Southern Hemisphere	"EPSG:6932"
EASE2.0, Global	"EPSG:6933"
EASE2.0, Temperate	"EPSG:6933"

geospatial_bounds (ACDD)

Specifies a closed polygon indicating the data's geospatial extent. The well-known text string values for common NSIDC polar projection grids are listed below and can be copied and pasted. They begin by listing the upper left vertex of the grid as an (x y) pair followed by each subsequent vertex as the grid extent is traversed, ending with the first vertex repeated to close the polygon.

geospatial_bounds values for NSIDC grids

Grid Name	geospatial_bounds attribute value
Polar Stereo, Northern Hemisphere	"POLYGON ((-3850000 5850000, 3750000 5850000, 3750000 - 5350000, -3850000 -5350000, -3850000 5850000))"
Polar Stereo, Southern Hemisphere	"POLYGON ((-3950000 4350000, 3950000 4350000, 3950000 - 3950000, -3950000 -3950000, -3950000 4350000))"
EASE2.0, Northern Hemisphere	"POLYGON ((-9000000 9000000, 9000000 9000000, 9000000 - 9000000, -9000000 -9000000, -9000000 9000000))"
EASE2.0, Southern Hemisphere	"POLYGON ((-9000000 9000000, 9000000 9000000, 9000000 - 9000000, -9000000 -9000000, -9000000 9000000))"
EASE2.0, Global	"POLYGON ((-17367530.44 7307375.92, 17367530.44 7307375.92, 17367530.44 -7307375.92, -17367530.44 - 7307375.92, -17367530.44 7307375.92))"
EASE2.0, Temperate	"POLYGON ((-17367530.44 6756820.2, 17367530.44 6756820.2, 17367530.44 -6756820.2, -17367530.44 -6756820.2, - 17367530.44 6756820.2))"

geospatial_lat_min (ACDD)

geospatial_lat_min specifies the southernmost latitude covered by the dataset.

geospatial_lat_max (ACDD)

geospatial_lat_max specifies the northernmost latitude covered by the dataset.

geospatial_lat_units (ACDD)

Units for the latitude axis described in "geospatial_lat_min" and "geospatial_lat_max" attributes. These are presumed to be "degrees_north".

geospatial_lat_min/max values and units for NSIDC grids

Grid Name	geospatial_lat_min attribute value	geospatial_lat_max attribute value	geospatial_lat_units
Polar Stereo, Northern Hemisphere	30.98	90.00	degrees_north
Polar Stereo, Southern Hemisphere	-90.00	-39.23	degrees_north
EASE2.0, Northern Hemisphere	0.00	90.00	degrees_north
EASE2.0, Southern Hemisphere	-90.00	0.00	degrees_north
EASE2.0, Global	-90.00	90.00	degrees_north
EASE2.0, Temperate	-67.057541	67.057541	degrees_north

geospatial_lon_min (ACDD)

geospatial_lon_min specifies the westernmost longitude covered by the dataset

geospatial_lon_max (ACDD)

geospatial_lon_max specifies the easternmost longitude covered by the dataset

geospatial_lon_units (ACDD)

Units for the longitude axis described in "geospatial_lon_min" and "geospatial_lon_max" attributes. These are presumed to be "degrees_east"

Note: for every NSIDC grid included in the table above, the geospatial longitude min/max and unit attributes are all the same, being:

geospatial_lon_min = -180.00

geospatial_lon_max = 180.00

geospatial_lon_units = degrees_east

Appendix

The following attributes are rarely used for NSIDC data sets, however can be considered for use if appropriate for a data set. Refer to the specification references noted in parenthesis following each in the [NetCDF Best Practice References](#) section to learn more about the use of these attributes.

Global Attributes:

- * **geospatial_lat_resolution** (ACDD) Used for lat/lon grids
- * **geospatial_lon_resolution** (ACDD) Used for lat/lon grids
- * **bounds** (CF) Describe the region where a data point (datum) exists
- * **cell_measures** (CF)
- * **cell_methods** (CF)
- * **sea_name** (NCEI) This attribute is specific to data following the NOAA NCEI guide
- * **NCEI_name** (NCEI) This attribute is specific to data following the NOAA NCEI guide
- * **NCEI_template_version** (NCEI) This attribute is specific to data following the NOAA NCEI guide
- * **date_issued** (ACDD, NCEI)
- * **software_version_id**
- * **software_repository**
- * **ancillary_variables** (CF)
- * **creator_type** (ACDD, NCEI)
- * **creator_url** (ACDD, NCEI)
- * **creator_email** (ACDD)

Variable Attributes:

- * **comment** (ACDD, CF) Refer to *comment* under the [Global NetCDF Attributes section](#)
- * **climatology** (CF)
- * **compress** (CF)
- * **sample_dimension** (CF)

Change Log

Major version changes are those that significantly impact the intended audience. Major changes of the document must be reviewed by Donna Scott.

Minor version changes are those that do not significantly impact the intended audience and, in general, no one would likely dispute (e.g., update a reference to another document, update a point-of-contact). Minor changes do not need to be reviewed.

Revision	Effective Date	Description of Changes	Author(s)
1.4	November 28, 2023	For data variable attributes, added to the <code>standard_name</code> attribute description that this attribute should be excluded if an appropriate value isn't found in the CF Standard Name Table.	Amy FitzGerrell

1.3	June 27, 2023	Removed spatial_ref attribute, leaving just crs_wkt since it's CF & DIWG-recommended; broke out CF best practices references as a TOC section, and added links to CF Standard Name, Standardized Regions, and DIWG Interoperability Recommendations guides; added Compliance Checker reference list; unified styling so all attribute names are black, and additional iconography is explained in instructions; added axis order to crs_wkts, and changed recommendation to advise copying text from epsg.io 's WKT2 option ; added GeoTransform as recommendation + table for NSIDC grids; removed proj4text as it's no longer a promoted standard.	Amy FitzGerrell, J. Scott Stewart
1.2	January 24, 2023	Corrected EASE2 Northern Hemisphere 25 KM GeoTransform value to be "-9000000 25000 0 9000000 0 -25000" (formerly had been incorrectly defined as "-3850000 25000 0 5850000 0 -25000"). Noted proj4text as a functional requirement. Capitalized cdm_data_type value. Updated _FillValue guidance to align with DPDG and ESDS Data Interoperability Working Group (DIWG) guidance; data use policy link updated.	Amy FitzGerrell, J. Scott Stewart
1.1	October 17, 2022	Revisions made to properly display geospatial_bounds_crs attribute; tabularized geospatial_bounds examples for NSIDC grids; tabularized geospatial_lat/lon_max/min + units examples; removed references to geospatial_x/y_<anything> attributes, as these do not exist in ACDD guidelines as had been originally indicated for the attributes; adjusted ToC to break out Temporal and Geospatial Description sections separately;	Amy FitzGerrell, J. Scott Stewart

		updated the link to the CF Standard Name Table; re-titled CRS details section to “Grid mapping variable” from “CRS variable”; added content showing a sample grid mapping variable.	
1.0	July 23, 2021	Original document	J. Scott Stewart, D.J. Scott, J. Collins, S.J. Khalsa, A. Windnagel