EOS POLES

POLAR EXCHANGE AT THE SEA SURFACE

PATHFINDER PATH-P

UNIVERSITY OF WASHINGTON, SEATTLE

TOVS PATHFINDER PATH-P

Gridded Daily and Monthly Arctic Atmospheric Data from TOVS

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User's Guide

Version 1.1

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GENERAL DESCRIPTION

This data set contains Arctic level-3 atmospheric parameters for the Arctic, retrieved using the physical-statistical retrieval method of Chedin et al. (1985) (Improved Initialization Inversion algorithm, “3I”). The method is the same as that used for TOVS Path B, which has been improved for use in sea-ice-covered areas (Francis, 1994) The data set has been designed to address the particular needs of the polar research community. and is designated the Path-P product by the TOVS Science Working Group.

ALGORITHM

The 3I algorithm retrieves atmospheric quantities such as profiles of temperature, layer average and precipitable and cloud parameters from TOVS HIRS and MSU radiances. The method is a priori data-dependent, in that it employs a fixed library of atmospheric situations to obtain a first-guess retrieval. The first guess is corrected to observed brightness temperatures using a Bayesian optimization method. Algorithm details can be found in Chedin et al. (1985) and Francis (1994).

GRID

The retrieval of atmospheric variables is performed on the orbital data (Level 1b). The output from 3I (Level 2) is then placed into a rectangular grid (Level 3) using a simple “drop in the bucket” method. This means that an individual “retrieval cell” with given latitude and longitude coordinates is assigned to the nearest grid cell. A grid cell value is determined by the linear arithmetic average of all retrievals in a grid cell.

TOVS Path-P uses a 100-km version of the Equal Area SSM/I Earth (EASE) grid, an emerging standard grid used for a number of polar data products at NSIDC. This grid uses an equal-area azimuthal projection centered at the North Pole. The grid coordinates, *r* and *s*, are defined with axes parallel to the rows *(s)* and columns *(r)* (Fig. 1) of the grid and units equal to the sampling interval. The grid sample locations (grid-cell centers) are then the integer coordinate points. The coordinate system starts at the top left corner with *r* increasing to the right, and *s* increasing downward. A grid cell *(i,j)* in the *r,s* coordinate system is defined as the area between grid coordinates *i-0.5* and *i+0.5*, and *j-0.5* and *j+0.5*. The lower bound is included in the grid cell, while the upper bound is not; *i* and *j* are zero-based array indices for this grid cell. This definition means that grid cells are referenced in *r* and *s* by their grid cell center coordinate. A grid spacing of 100.27 km is chosen to allow a direct overlay with SSM/I and other products being developed at NSIDC.

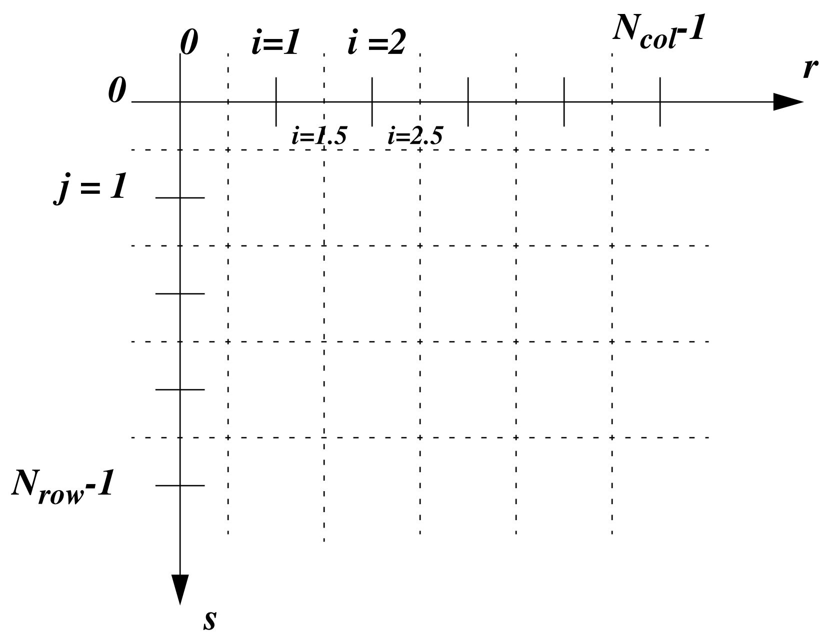

Figure 1: Coordinate system for TOVS Path P products and layout of grid. N_{col} and N_{row} are the number of colums and rows in the grid. The grid center is at i=*33, j=33*. *i* and *j* are zero-based indices so that the first (top, left) gridbox is referenced by indices *0,0*.

Forward equations to convert from (λ,ϕ) to (r,s):

$$r = \rho \sin(\lambda) + r_0$$

$$s = \rho \cos(\lambda) + s_0$$

$$\rho = \left(\frac{2R}{C}\right)\sin\left(\frac{\pi}{4} - \frac{\phi}{2}\right)$$

where:

R (Earth radius) = 6371.228 km
C (Grid cell size) = 100.27 km
r_0, s_0 (grid origin in r,s) = 33.0, 33.0
λ Longitude
ϕ Latitude

Array indices i,j are found from r,s by rounding to the nearest integer

Inverse equations to convert from (r,s) to (λ,ϕ):

$$\kappa = \sqrt{x^2 + y^2}$$

if $\kappa \neq 0$ *:*

$$\phi = \operatorname{asin}(\cos c)$$

$$\lambda = \operatorname{atan}\frac{x}{y}$$

$$c = 2\operatorname{asin}\left(\frac{\kappa}{2R}\right)$$

where

$x = (r - r_0)\, C$
$y = (s - s_0)\, C$

if $\kappa = 0$ *:*

$$\phi = \frac{\pi}{2}$$

$$\lambda = 0$$

Note: In order to obtain geolocation information on the Path-P products, the user may also simply access the scientific data sets contained in each HDF-formatted file that contain latitudes and longitudes for the center of each grid cell. These are included as separate scientific data sets in the HDF-formatted files.

FORMAT

Path-P products are implemented in Hierachical Data Format (HDF) (National Center for Supercomputing Applications, 1994) files and follow standards and recommendations outlined in the EOSDIS Version 0 Data Product Implementation Guidelines (GSFC, 1994). Path-P products require version HDF 3.3r3 or higher, because they are implemented using the Multifile SD interface for scientific data sets, which was not available prior to this release. Users familiar with HDF will find it easy to access the data using the interfaces provided by the HDF library. Users unfamiliar with HDF may resort to the sample programs and utilities provided or consult the HDF users and reference guides (NCSA, 1994) that can be obtained via anonymous ftp from ftp.ncsa.uiuc.edu.

Each HDF-formatted file contains two major objects: metadata and scientific data sets. Metadata are implemented as “global attributes.” These attributes contain information about the data set such as dates, times, etc. Much of this information may not be relevant to the user, but is included for production and archiving purposes. The metadata consist of 25 such global attributes. A complete list can be found in the data dictionary in file PATH_P.DATA.DICTIONARY.TXT or Appendix A of this documents. Attributes can be obtained by the user via a call to the *SDreadattr* function as shown in the programs *creadpathP.c* and *freadpatP.f* in Appendix B. Actual TOVS retrievals are contained in 26 scientific data sets. Scientific data sets can be accessed via calls to the *SDreaddata* function from the HDF library. Example programs on how to access the data are included in Appendix B. Users unfamiliar with the HDF interface may choose to modify one of the example programs for their particular application.

Scientific data sets in the HDF formatted Path-P products are three- (temperature, water vapor) or two-dimensional. (In HDF nomenclature the quantity “rank” is equivalent to the number of dimensions in a data set). HDF stores multidimensional arrays in the same order they were stored in memory by the program that wrote the data. It is important to note the difference between accessing the data via a C or Fortran program. All scientific data sets in the Path-P products were written by a C-program with the dimensions defined as:

array[NLEVEL][NROW][NCOL]]

for three-dimensional data and:

array[NROW][NCOL]

for two-dimensional data.

Note that the the NROW and NCOL dimension correspond to the previously defined *s (j)* and *r (i)* coordinates. The C-language stores multidimensional arrays in row major order. This means that the last dimension varies fastest. Since the data were written in C, users accessing the data via a C program will want to define the dimensions of the arrays as shown above. FORTRAN users will have to reverse the order of their dimensions and define their arrays as follows:

array(NCOL,NROW, NLEVEL)

for the three-dimensional case, and

array(NCOL,NROW)

for two-dimensional arrays.

Since FORTRAN uses 1-based indexing, FORTRAN users will translate *(r,s)* coordinates to array indices in *i* and *j* by adding 1.

All scientific data sets have the 67 rows and columns. The three-dimensional data sets TEMP and WVAPOR have 9 and 5 levels in the vertical dimension, respectively. All data sets, except for OBS and IIIreject, are in 32-bit floating point format (DFNT_FLOAT). OBS and IIIreject are 32-bit integer data sets (DFNT_INT32). The data dictionary containing the definition, unit, data type, dimension and format for each metadata attribute and scientific data set, can be found in Appendix A or in the provided ASCII file PATH_P.DATA.DICTIONARY.TXT. Additional information of the file structure can be found in Appendix C of this Document.

DATA CONTAINED IN PATH-P SCIENTIFIC DATA SETS.

(for further details see Appendix A and file PATH_P.DATA.DICTIONARY.TXT)

LATITUDE_GRID

Latitude of each grid point in degrees.

LONGITUDE_GRID

Longitude for each grid point in degrees (-180 west, 180 east)

WARNING: Because data sets LATITUDE_GRID and LONGITUDE_GRID are identical for each HDF file of the this data set, they are stored as external files but accessible through the SD interface of the HDF library. The user will have to make sure that the files LatGrd.exhdf and LonGrd.exhdf are present and readable in the current working directory ($PWD). This is due to a current limitation of the HDF system and will be changed in future releases.

TEMP*

Temperatures [K] at pressure levels 50, 70, 100, 300, 400, 500, 600, 700 and 850 mb.

*WVAPOR**

Precipitable water [mm] in layers bounded by 300-400, 400-500, 500-700, 700-850 and 850-1000 mb.

SKTEMP

Surface skin temperature [K].

FCLD

Total effective cloud fraction[%]. Effective cloud fraction is the retrieved radiatively effective cloud fraction and is the product of the actual cloud fraction and the cloud emissivity. It corresponds to the actual cloud fraction if clouds had unit emissivity.

CLPRESS

Cloud-top pressure [mb].

CLTEMP

Cloud top temperature [K].

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* *Temperature is given to correspond to standard levels, wheras preciptable water (WVAPOR) is given in layer averages. Note that any satellite based sounding produces layer averages. Termperature levels given in TEMP are interpolated from layer averages to* ease integration with correlative atmospheric data.

ZANGLE

Effective satellite zenith angle defined as the arccosine of the average value of the cosines of the individual satellite zenith angles [deg].

EMISS

Surface emissivity at 50 GHz (MSU Channel 1). This variable maybe used to provide a surface type classification.

PBLSTRAT

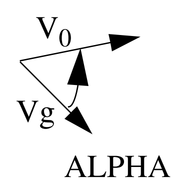
Boundary layer bulk stratification [K]. This parameter is the difference in potential temperature between the surface and 900 mb.

Cg

Geostrophic drag coefficient over sea ice. This value is parameterized after Overland and Davidson, 1992. This variable is only calculated over sea ice.

ALPHA

Turning angle between the geostrophic wind and surface stress over sea ice [deg]. This variable is based on the parameterization of Overland and Davidson (1992) and is only calculated over sea ice. Positive values represent counter clockwise turning angles



IIIreject

Number of rejections by the retrieval algorithm per grid cell. Under certain conditions the algorithm is not able to perform a retrieval. These conditions are often associated with thick clouds. Only actual rejections are counted. A value of 0 may mean that 0 rejections occured or that no observations were available for this grid cell.

OBS

Number of valid (non-rejected) observations per grid cell. By examining values of OBS and IIIreject the user can find out the fraction of rejected observations. This fraction may provide an indication of the representativeness for a given time period

TEMP-SD, WVAPOR-SD, SKTEMP-SD, FCLD-SD, CLPRESS-SD, CLTEMP-SD, ZANGLE-SD, EMISS-SD, PBLSTRAT-SD,Cg-SD, ALPHA-SD

These scientific data sets are the sample standard deviations for the time period over all observations in a grid cell. Standard deviation should be used with care, since for daily data often only a few observations are available.

VALIDATION AND ACCURACY ASSESSMENT

Results have been validated directly through comparisons with surface observations from the CEAREX experiment (Francis, 1994) and radiosonde data from Soviet ice stations. Comparisons with other TOVS retrieval algorithms represented in the TOVS pathfinder sinence working group provide indirect validation. Further investigations are underway and future versions of this document will include a more detailed description of validation results and point to appropriate documents. Table 1 shows an initial assessment of the accuracy of some of the parameters included in the Path-P products.

Table 1: Estimated Accuracy of Path-P Level 3 parameters

Parameter	Description	Units	Estimated Accuracy (rms)
TEMP	Level temperatures	K	3K
WVAPOR	Layer Precipitable water	mm	~50%
SKTEMP	Surface Skin Temparature	K	3K
FCLD	Effective Cloud Fraction	%	0.3
CLTMP	Cloud-top temperature	K	TBD
CLPRESS	Cloud-top pressure	mb	TBD
EMISS	Surface Emissivity (50 GHz)		5%
PBLSTRAT	Boundary Layer Stratification	K	5K
Cg	Geostrophic drag coefficient		30 %
ALPHA	Turning angle	deg	10°

DATA AVAILABILITY

TOVS PATH-P data sets will initially be available for the PATHFINDER benchmark period 1987-04-01 to 1988-10-31. Data for the time period 1978 until present will be made available at later date.

TOVS PATH-P data sets will be available through NSIDC. Specific access methods are TBD

News, updates and utilities for PATH-P data products can be obtained via anonymous ftp

TBD

or via MOSAIC page http:

TBD

UTILITY PROGRAMS

Several programs are provided to ease user access to these data. Users are encouraged to modify these programs for there own needs. Users who develop programs that are of general interest are encourage to deposit source code along with a README file to describe function on anonymous ftp site:

psc.apl.washington.edu /pub/PathP/deposit

fortran_sample_readpathP.f:

Sample FORTRAN program that shows how to access HDF formatted Path-P data sets via function read_pathP_sub. Each scientific data set is written to a separate output file.

freadpathP.f:

This file contains a number of functions that allow the access to the HDF formatted data files. This file contains the function read_pathP_sub which provides a single function interface to all the user relevant variables in the HDF file.

c_sample_readpathP.c

Sample C program that shows how to access HDF formatted Path-P data sets via function creadpathP. Each scientific data set is written to a separate output file.

creadpathP.c

This file contains a number of C functions that allow access to the HDF-formatted data files. This file contains the function creadpathP which provides a single function interface to all the user-relevant variables in the HDF file.

Makefile

Use this makefile to build sample programs or as a template for developing your own applications. Edit macro HDFROOT to point to your local HDF installation and type:

make <program>

Notes

IDL does not support the multifile SD interface at present. It will be supported in version 3.6 due for release at the end of 6/94. We will make utility programs available shortly after the release.

The data set and access programs have only been tested on SUN Sparc Architectures under SUN-OS 4.1.X. The HDF library is supported on a wide range of architectures and access should be identical.

Warning

Access of to scientific data sets via FORTRAN programs requires a “work around” due to a known bug in version 3.3r3 of the HDF library. The STRIDE variable in function ppgetsds (call to sfrdata) is set to 1,1,1 instead of the 0,0,0 as would be expected from the documentation. Future versions for HDF will fix this bug, so that the STRIDE variable in the sfrdata call will have to be changed to 0,0,0.

REQUIREMENTS

- HDF libraries version 3.3 release 3 or higher. If your site doesn not have the HDF libaries, you can obtain a copy via anonymous ftp from

  ftp.ncsa.uiuc.edu

- ANSI-C compiler if you are planning to use the supplied C-programs. Fortran 77 compiler if you are planning to use the supplied Fortran programs.

CONTACTS

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Chedin, A., N.A. Scott, C. Wahiche, and P. Moulinier, The Improved Initialization Inversion method: A high resolution physical method for temperature retrievals from satellites of the TIROS-N series, *J. Clim. Appl. Meteorol.*, 24, 128-143, 1985.

Francis, J.A., Improvements to TOVS retrievals over sea ice and applications to estimating Arctic energy fluxes, *J. Geophys. Res.*, 99 (D5), 10,395-10,408, 1994.

GSFC. EOSDIS Version 0 Data Product Implementation Guidelines. Draft version 1.0. GSFC 50-003-04, GSFC

NCSA. HDF users and reference manual, University of Illinois, Champagne/ Urbana, 1994

Overland, J.E. and K.L. Davidson, Geostropic drag coefficients for the central Arctic derived from Soviet drifting station data,*Tellus, 44A*, 54-66, 1992.

ACRONYMS AND GLOSSARY

TOVS	TIROS-N Operational Vertical Sounder System
HIRS	High-resolution Infrared Radiation Sounder
MSU	Microwave Sounding Unit
HDF	Hierachical Data Format
EASE	Equal Area SSM/I Earthgrid
SSM/I	Special Sensor Microwave/Imager
NSIDC	National Snow and Ice Data Center
3I	Improved Initialization Inversion algorithm
Level 3	Gridded geophysical data

Level 2	Geophysical data in orbital swaths
Level 1b	Georeferenced sensor data in orbital swaths
Granule	Unit of a data set, for example a file.

APPENDIX-A DATA DICTIONARY

Object = Global Attributes

Element

Parameter Name	= PROJECT
Definition	= Name of current project
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	=Current Value: TOVS PATHFINDER PATHP

Element

Parameter Name	= DATASET_NAME
Definition	= Producers name of data set
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= Possible values for this Project: Gridded Daily Arctic Atmospheric Data from TOVS (PathP) Gridded Monthly Arctic Atmospheric Data from TOVS (PathP)

Element

Parameter Name	= SOURCE_NAME
Definition	= Satellite Platform
Format	= string
Type	= character
Length	= Max 256
Range	= NOAA-10
Comment	= Currently only NOAA-10 data are used in this project

Element

Parameter Name	= PROCESSING_LEVEL
Definition	= Level of processing Number (Orbital, geophys etc.)
Format	= string
Type	= character
Length	= Max 256
Range	= 3

Comment =

Element
Parameter Name = REFERENCE_DATE
Definition = Date or time period for which this granule is representative
Format = yyyy-mm-dd
Type = character
Length = Max 10
Range =
Comment =

Element
Parameter Name = START_DATE
Definition = Date and time of first datapoint in granule
Format = yyyy-mm-ddTHH:MM:SS
Type = character
Length = Max 10
Range =
Comment = example: 1987-10-01T01:41:51

Element
Parameter Name = STOP_DATE
Definition = Date and time of last datapoint in granule
Format = yyyy-mm-ddTHH:MM:SS
Type = character
Length = Max 256
Range =
Comment = example: 1987-10-01T01:41:51

Element
Parameter Name = POSITION_TYPE
Definition =
Format =
Type = character
Length = Max 256
Range =
Comment = NSIDC required, Value: FIXED GRID

Element

Parameter Name	= GRID_TYPE
Definition	= Northern or Southern Hemisphere
Format	=
Type	= character
Length	= 1
Range	=
Comment	= Possible Values N, S

Element

Parameter Name	= GRID_NAME
Definition	= Name of Grid
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= VALUE for this project: EASE GRID

Element

Parameter Name	= PROJECTION
Definition	= Geographical projection of this grid
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= Value: Azimuthal Equal Area

Element

Parameter Name	= EASE_GPD
Definition	= Grid description file for NSIDC gridding software
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= This file is used by the NSIDC gridding software to describe the grid.

Element

Parameter Name	= EASE_MPP
Definition	= Map projection description file for NSIDC gridding software
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= This file decribes the projection.

Element

Parameter Name	= LATITUDE
Definition	= Latitude of corner points of grid
Format	= f6.3
Type	= float32
Length	= 4 * float32
Range	= -90,90
Comment	=Points correspond to grid coordinatesx,y: [0,0],[0,66],[66,66],[66,0].

Element

Parameter Name	= LONGITUDE
Definition	= Longitude of corner points of grid
Format	= f6.3
Type	= float32
Length	= 4 * float32
Range	= -180 (west), 180 (east)
Comment	= Points correspond to grid coordinatesx,y: [0,0],[0,66],[66,66],[66,0]. (-180w, 180 east)

Element

Parameter Name	= Temporal_Res
Definition	= Temporal Resolution of data set
Format	= string
Type	= character
Length	= Max 256
Range	= daily,monthly
Comment	=

Element
Parameter Name = Spatial_X_Res
Definition = Spatial Resolution of data set in x direction
Format = string
Type = character
Length = Max 256
Range = 100.27 km
Comment =

Element
Parameter Name = Spatial_Y_Res
Definition = Spatial Resolution of data set in y direction
Format = string
Type = character
Length = Max 256
Range = 100.27 km
Comment =

Element
Parameter Name = PRODUCER_GRANULE_ID
Definiton = Name of granule on producer systems
Format = string
Type = character
Length = Max 256
Range =
Comment = Unix system file name on POLES SCF system

Element
Parameter Name = PRODUCER_DATE
Definiton = Date of production
Format = eg: Mon May 16 11:21:38 1994
Type = character
Length = Max 256
Range =
Comment =

Element

Parameter Name	= PRODUCER_PROGRAM
Definiton	= RCS header for production program
Format	= eg: $Header: /home/n1/PathP/development/src/l3/gridgen/RCS/ PPgridL2.c,v 1.1 1994/05/11 23:08:09 axel Exp axel $
Type	= character
Length	= Max 256
Range	=
Comment	=

Element

Parameter Name	= PRODUCER_REVISION_DATE
Definiton	= Last modification date of producer program
Format	= eg: Mon May 16 11:14:23 1994
Type	= character
Length	= Max 256
Range	=
Comment	=

Element

Parameter Name	= PRODUCER_ARCHITECTURE
Definiton	= Production machine architecture and OS
Format	= eg: SunOS.4.1.3_U1 node: nansen
Type	= character
Length	= Max 256
Range	=
Comment	=

Element

Parameter Name	= PRODUCER_COMMENT
Definiton	= Any comment the producer may feel necessary to add
Format	= eg: SunOS.4.1.3_U1 node: nansen
Type	= character
Length	= Max 256
Range	=
Comment	=

Element

Parameter Name	= PRODUCER_DOCUMENT
Definiton	= Document that describes this data set
Format	= string
Type	= character
Length	= Max 256
Range	=
Comment	= Value PATH-P_USERS_GUIDE.TXT

OBJECT = Scientific Data Sets

Element

Parameter Name	= LATITUDE_GRID
Definition	= Latitude for each grid point
Format	= f6.3
Type	= 32 bit floating point Scientific Data Set
units	= degrees
size	= 67x67
Comment	= This SD is stored in an external SD file:LatGrd.exhdf

Element

Parameter Name	= LONGITUDE_GRID
Definition	= Longitude for each grid point
Format	= f6.3
Type	= 32 bit floating point Scientific Data Set
units	= degrees
size	= 67x67
Comment	= This SD is stored in an external SD file: LonGrd.exhdf

Element

Parameter Name	= TEMP
Definition	= temperatures [K] at pressure levels 50,70,100,300,400,500,600,700,850
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= degrees K
size	= 9x67x67
Comment	=

Element

Parameter Name	= WVAPOR
Definition	= precipitable water [mm] of layers bounded by 300-400,400-500,500-700,700-850,850-1000 mb
Format	= f6.3
Type	= 32 bit floating point Scientific Data Set
units	= mm
size	= 5x67x67
Comment	=

Element

Parameter Name	= SKTEMP
Definition	= surface skin temperature [K]
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= degrees K
size	= 67x67
Comment	=

Element

Parameter Name	= FCLD
Definition	= total effective cloud fraction
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= NONE
size	= 67x67
Comment	=

Element

Parameter Name	= CLPRESS
Definition	= Cloudtop pressure (mb)
Format	= f3.0
Type	= 32 bit floating point Scientific Data Set
units	= millibars
size	= 67x67
Comment	=

Element

Parameter Name	= CLTEMP
Definition	= Cloudtop temperature
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= degrees K
size	= 67x67
Comment	=

Element

Parameter Name	= ZANGLE
Definition	= effective satellite zenith angle defined as the arccosine of the average value of the cosines of the individual satellite zenith angles (deg)
Format	= f5.2
Type	= 32 bit floating point Scientific Data Set
units	= degrees
size	= 67x67
Comment	=

Element

Parameter Name	= EMISS
Definition	= surface emissivity at 50 GHz (MSU Channel 1)
Format	= f3.0
Type	= 32 bit floating point Scientific Data Set
units	=
size	= 67x67
Comment	=

Element

Parameter Name	= PBLSTRAT
Definition	= Boundary layer bulk stratification (difference in potential temperature between the surface and at 900 mb)
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= degrees K
size	= 67x67
Comment	=

Element

Parameter Name	= Cg
Definition	= Geostrophic Drag Coefficient over sea ice (Overland and Davidson, 1992)
Format	= f3.0
Type	= 32 bit floating point Scientific Data Set
units	=
size	= 67x67

Element

Parameter Name	= ALPHA
Definition	= Turning angle between the geostrophic wind and the surface wind stress over sea ice (Overland and Davidson, 1992).
Format	= f3.0
Type	= 32 bit floating point Scientific Data Set
units	= degrees
size	= 67x67
Comment	= Positive values represent turning angles to the left of the geostrophic wind.

Element

Parameter Name	= IIIreject
Definition	= IIIreject: Number of rejections by the III algorithm per grid cell.
Format	= f3.0
Type	= 32 bit integer Scientific Data Set
units	=
size	= 67x67
Comment	= All other values set to 0.

Element

Parameter Name	= OBS
Definition	= Number of valid (non-rejected) observations per grid cell
Format	= f3.0
Type	= 32 bit integer Scientific Data Set
units	=
size	= 67x67
Comment	= -99999 for values not present

Element
Parameter Name = TEMP-SD
Definition = Time standard deviation of temperatures [K] at pressure levels 50,70,100,300,400,500,600700,850
Format = f5.1
Type = 32 bit floating point Scientific Data Set
units = degrees K
size = 9x67x67
Comment =

Element
Parameter Name = WVAPOR-SD
Definition = Time standard deviation of precipitable water [mm] of layers bounded by 300-400,400-500,500-700,700-850,850-1000 mb
Format = f6.3
Type = 32 bit floating point Scientific Data Set
units = mm
size = 5x67x67
Comment =

Element
Parameter Name = SKTEMP-SD
Definition = Time standard deviation of surface skin temperature (K)
Format = f5.1
Type = 32 bit floating point Scientific Data Set
units = degrees K
size = 67x67
Comment =

Element
Parameter Name = FCLD-SD
Definition = Time standard deviation of total effective cloud fraction
Format = f5.1
Type = 32 bit floating point Scientific Data Set
units = %
size = 67x67
Comment =

Element
  Parameter Name = CLPRESS-SD
  Definition = Time standard deviation of Cloudtop pressure (mb)
  Format = f3.0
  Type = 32 bit floating point Scientific Data Set
  units = millibars
  size = 67x67
Comment =

Element
  Parameter Name = CLTEMP-SD
  Definition = Time standard deviation of Cloudtop temperature
  Format = f5.1
  Type = 32 bit floating point Scientific Data Set
  units = degrees K
  size = 67x67
Comment =

Element
  Parameter Name = ZANGLE-SD
  Definition = Time standard deviation effective satellite zenith angle defined as the arccosine of the average value of the cosines of the individual satellite zenith angles (deg)
  Format = f5.2
  Type = 32 bit floating point Scientific Data Set
  units = degrees
  size = 67x67
  Comment =

Element
  Parameter Name = EMISS-SD
  Definition = Time standard deviation of surface emissivity at 50 GHz (MSU Channel 1)
  Format = f3.0
  Type = 32 bit floating point Scientific Data Set
  units =
  size = 67x67
  Comment =

Element

Parameter Name	= PBLSTRAT-SD
Definition	= Time standard deviation Boundary layer bulk stratification (difference in potential temperature between the surface and at 900 mb)
Format	= f5.1
Type	= 32 bit floating point Scientific Data Set
units	= degrees K
size	= 67x67
Comment	=

Element

Parameter Name	= Cg-SD
Definition	= Time standard deviation Geostrophic Drag Coefficient over sea ice (Overland and Davidson, 1992)
Format	= f3.0
Type	= 32 bit floating point Scientific Data Set
units	=
size	= 67x67

Element

Parameter Name	= ALPHA-SD
Definition	=Time standard deviation of Turning angle between the geostrophic wind and the surface wind over sea ice (Overland and Davidson, 1992).
Format	= f3.0
Type	=32 bit floating point Scientific Data Set
units	= degrees
size	= 67x67
Comment	= Positive values represent turning angles to the left of the geostrophic wind.

APPENDIX-B SAMPLE AND UNTILITY PROGRAMS

(the programs can be found in:

ftp://sidads.colorado.edu/pub/DATASETS/TOVS?

APPENDIX-C FILE ORGANIZATION

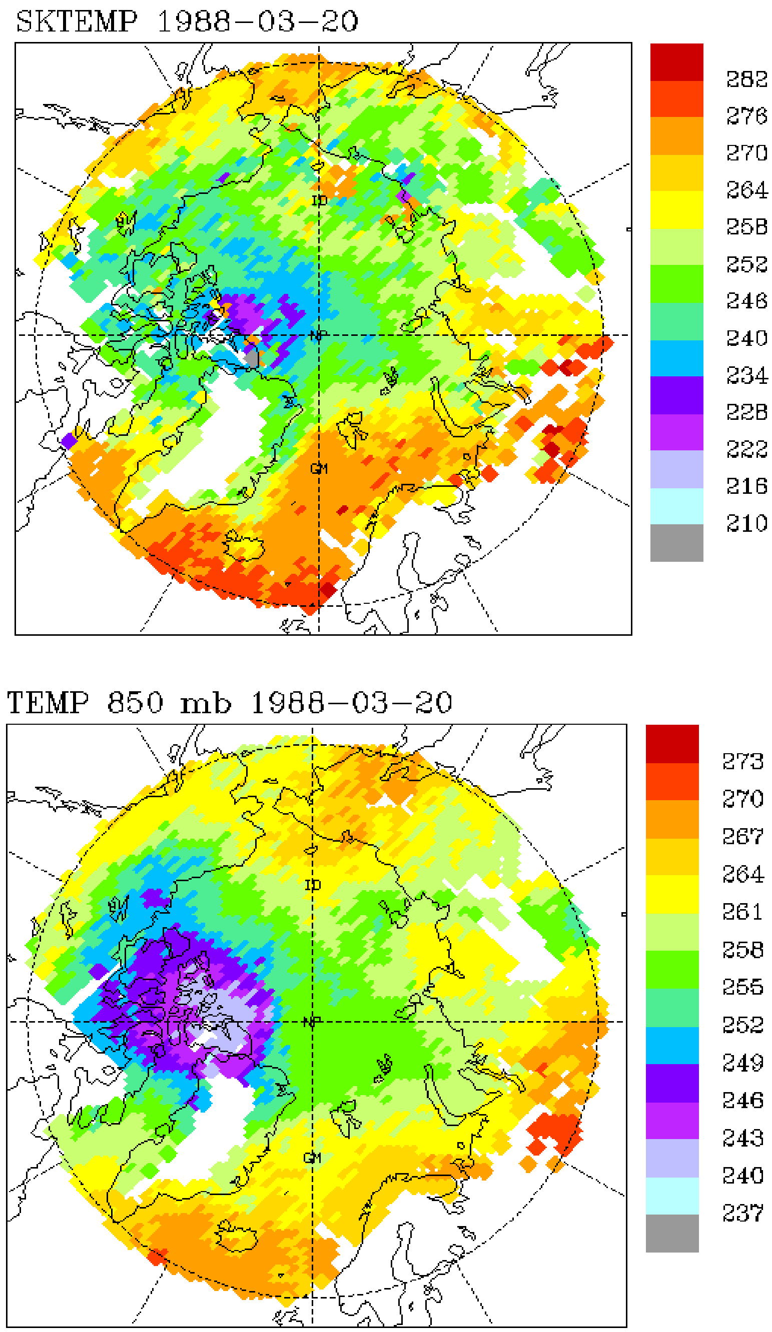
Path-P HDF files are formatted to conform with the standard defined in the EOSDIS Version 0 Data Product Implementation Guidelines (Draft Version 1.0). For most users, knowledge of the HDF SD interface is sufficient to read and use metadata and scientific data sets. For compatibility with Version 0 standards and with tools in development, the data are organized as a single HDF Vgroup with the names “Gridded Daily Arctic Atmospheric Data from TOVS (Path-P)” for the daily data, or as “Gridded Monthly Arctic Atmospheric Data from TOVS (Path-P)” for monthly data. In this Vgroup are included the HDF Vdata for the metadata attributes, the Vdata for the scientific data sets and a Vdata with class “Geometry” and name “EASE GRID” that describe the projection and grid parameters for this grid. This Vdata contains the following information:*M*

Table 2: Geometry Class Vdata for Path-P products

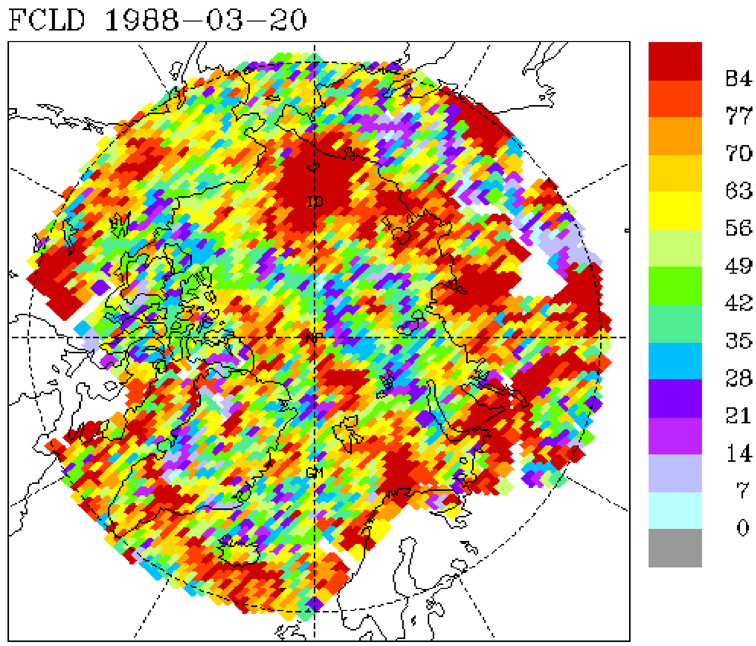
bin_meth	registration	map_origin_col	map_origin_row	cols_per_mapunit	rows_per_mapuint
cols	rows	lat0	lat1	rotation	

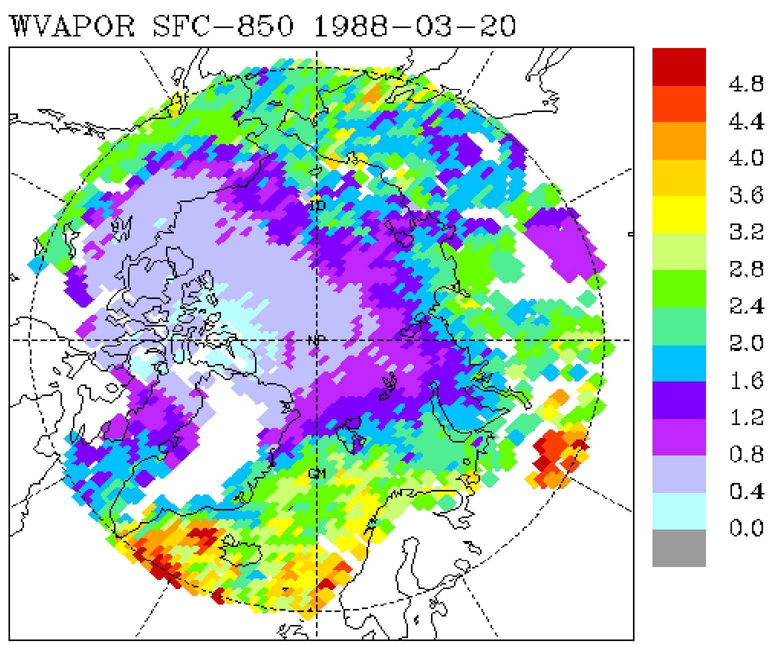
These parameters correspond to the parameters used by a set of gridding and projection programs used for creating the EASE grid standard at NSIDC.

APPENDIX-D EXAMPLE IMAGES



Surface skin temperature and (SKTEMP) and 850 mb temperature (TEMP Level 9) for March 20 1988.





Cloud fraction [%] (FCLD) and precipitable water [mm] between the surface and 850 mb (WVAPOR, level 5) for March 20 1988.