

# Summary of NOAA/NASA Polar Pathfinder Grid Relationships

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All NOAA/NASA Polar Pathfinder grids are based on either a north or south polar azimuthal equal-area map, and differ only in grid resolution. This document describes the map coordinate transformations and the relationships of the various resolution grids.

## MAP PARAMETERS

The polar azimuthal equal-area maps are defined by the equations listed in Table 1. Table 2 describes the variables in the projection equations.

Table 1. Polar Azimuthal Equal-Area Map Parameters

North Map Parameters	South Map Parameters
$r = 2R/C * \sin(\lambda) * \sin(\pi/4 - \phi/2) + r_0$	$r = 2R/C * \sin(\lambda) * \cos(\pi/4 - \phi/2) + r_0$
$s = -2R/C * \cos(\lambda) * \sin(\pi/4 - \phi/2) + s_0$	$s = 2R/C * \cos(\lambda) * \cos(\pi/4 - \phi/2) + s_0$
$h = \cos(\pi/4 - \phi/2)$	$h = \sin(\pi/4 - \phi/2)$
$k = \sec(\pi/4 - \phi/2)$	$k = \csc(\pi/4 - \phi/2)$

Where:

Table 2. Description of Variables in Projection Equations

Variable	Description
r	column coordinate
s	row coordinate
h	particular scale along meridians
k	particular scale along parallels
lambda	longitude in radians
phi	latitude in radians
R	radius of the Earth
C	nominal cell size
r0	map origin column
s0	map origin row



Both North and South projections are based on a spherical model of the Earth with radius  $R = 6371.228$  km. This radius gives a sphere with the same surface area as an ellipsoid using the International Datum. Table 3 lists the aspect ratios.

Table 3. Projection Aspect Ratios

latitude	k/h
90	1.00
75	1.02
60	1.07
45	1.17
30	1.33
15	1.59
0	2.00

## GRID PARAMETERS

The SSM/I North and South azimuthal grids (NL and SL, respectively) are defined with a nominal cell size of 25 km x 25 km, and all other Polar Pathfinder grid resolutions are calculated as exact multiples or factors of this cell size. The actual cell size  $C=25.067525$  km was chosen to make the SSM/I cylindrical 25 km grid exactly span the equator, and was then used for the azimuthal projections for the sake of SSM/I EASE-Grid consistency. Of course, few "25 km" cells actually have these dimensions, but they all have the same area.

The SSM/I grids represent full hemispheric coverage, and the TOVS and AVHRR grids are proper subsets of the full hemispheres.

The TOVS and AVHRR subsets of the SSM/I full Northern Hemisphere grid are shown in Figure 1. Figure 2 displays the TOVS and AVHRR subsets of the SSM/I full Southern Hemisphere grid.

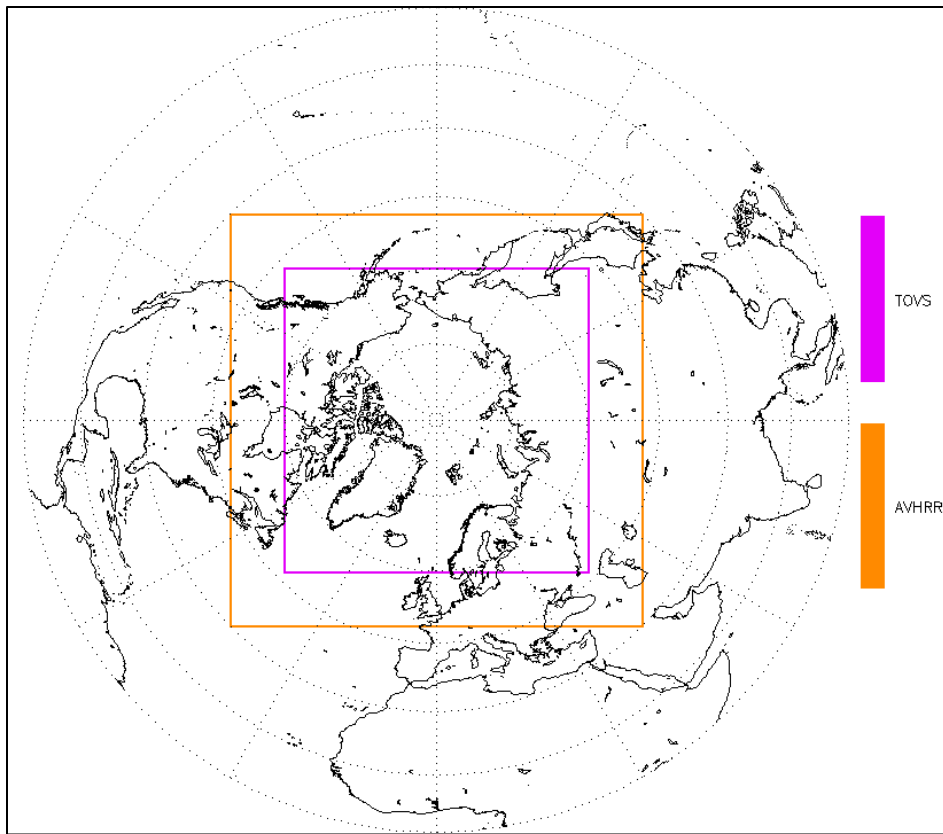


Figure 1. TOVS and AVHRR Polar Pathfinder Northern Hemisphere Grid Subsets

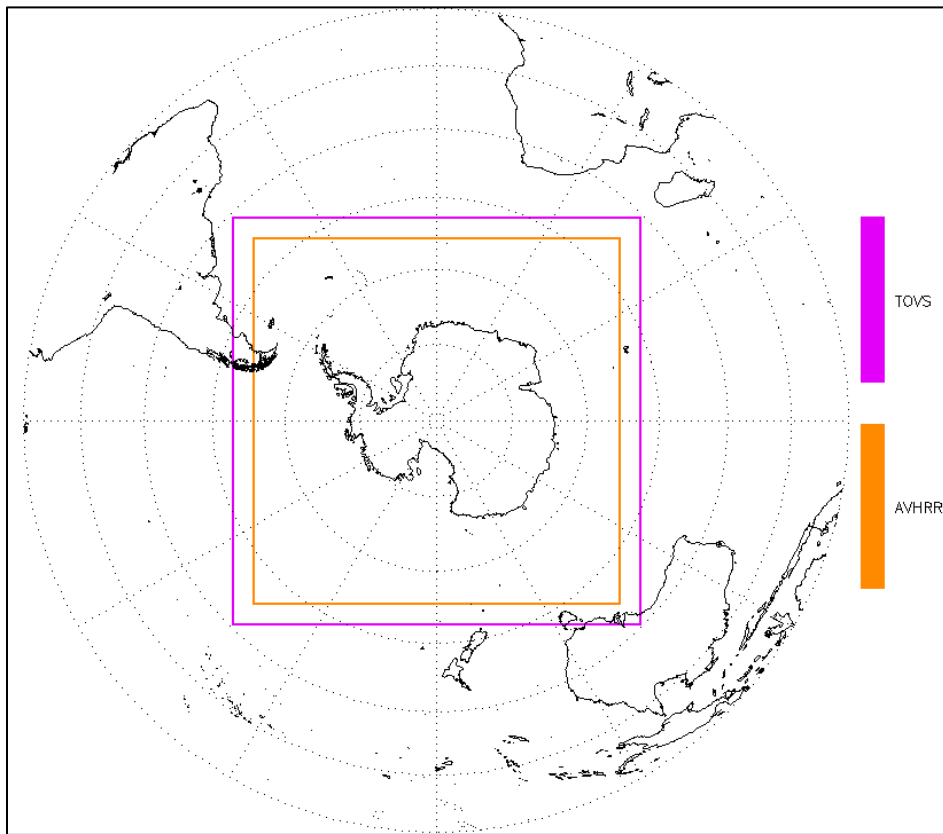


Figure 2. TOVS and AVHRR Polar Pathfinder Southern Hemisphere Grid Subsets

Grid coordinates (r,s) start in the upper left corner with r increasing to the right and s increasing downward. Rounding the grid coordinates up at .5 yields the grid cell number. Grid cell i,j is centered at grid coordinates (i,j) and bounded by:

$$i - 0.5 < r \leq i + 0.5, j - 0.5 < s \leq j + 0.5$$

With the exception of the AVHRR 1.25 km grids (Na1 and Sa1), each Polar Pathfinder grid is defined such that the grid coordinates are coincident, or bore-centered, at the respective pole. All of these grids are square, symmetric about the pole, with an odd number of rows and columns, and the location of the center pixel of each grid is the (North or South) pole. The AVHRR 1.25 km grids are the only exceptions, being exact multiples of the AVHRR 5 km grids, and so location of the pole in each of these is at the intersection of the four center pixels.

There are four SSM/I grids, six AVHRR polar grids, and two TOVS grids. Table 4 lists grid details by sensor.

Table 4. Grid Details by Sensor

<b>Grid Name</b>	<b>Sensor</b>	<b>Resolution (km)</b>	<b>Hemisphere</b>
NpathP	TOVS	100	Northern
SpathP	TOVS	100	Southern
TOVS	TOVS	100	Northern
NL	SSM/I	25	Northern
SL	SSM/I	25	Southern
NA25	AVHRR	25	Northern
SA25	AVHRR	25	Southern
NH	SSM/I	12.5	Northern
SH	SSM/I	12.5	Southern
NA5	AVHRR	5	Northern
SA5	AVHRR	5	Southern
NA1	AVHRR	1.25	Northern
SA1	AVHRR	1.25	Southern

The dimensions and latitude extent of each grid are summarized in Table 5. The map projections used for all grids are defined with the origin at the respective pole. For the AVHRR and TOVS grids, the latitude extent listed is the latitude of the center of the corner pixels on the grid. For the SSM/I grids, the latitude extent listed is the latitude of the center of the center pixel on a side.

Table 5. Grid Dimensions and Latitude Extent

Grid Name	Dimensions		Latitude Extent	
	Width	Height	Minimum	Maximum
NpathP	67	67	46.90928 N	90.00000 N
SpathP	89	89	90.00000 S	30.63221 S
NL	721	721	0.33836 S	90.00000 N
SL	721	721	90.00000 S	0.33836 N
NA25	361	361	29.89694 N	90.00000 N
SA25	321	321	90.00000 S	37.13584 S
NH	1441	1441	0.25845 S	90.00000 N
SH	1441	1441	90.00000 S	0.25845 N
NA5	1805	1805	29.74956 N	90.00000 N
SA5	1605	1605	90.00000 S	36.99339 S
NA1	7220	7220	29.72191 N	90.00000 N
SA1	6420	6420	90.00000 S	36.96667 S

The relationships of the various grids are shown in Figure 3.

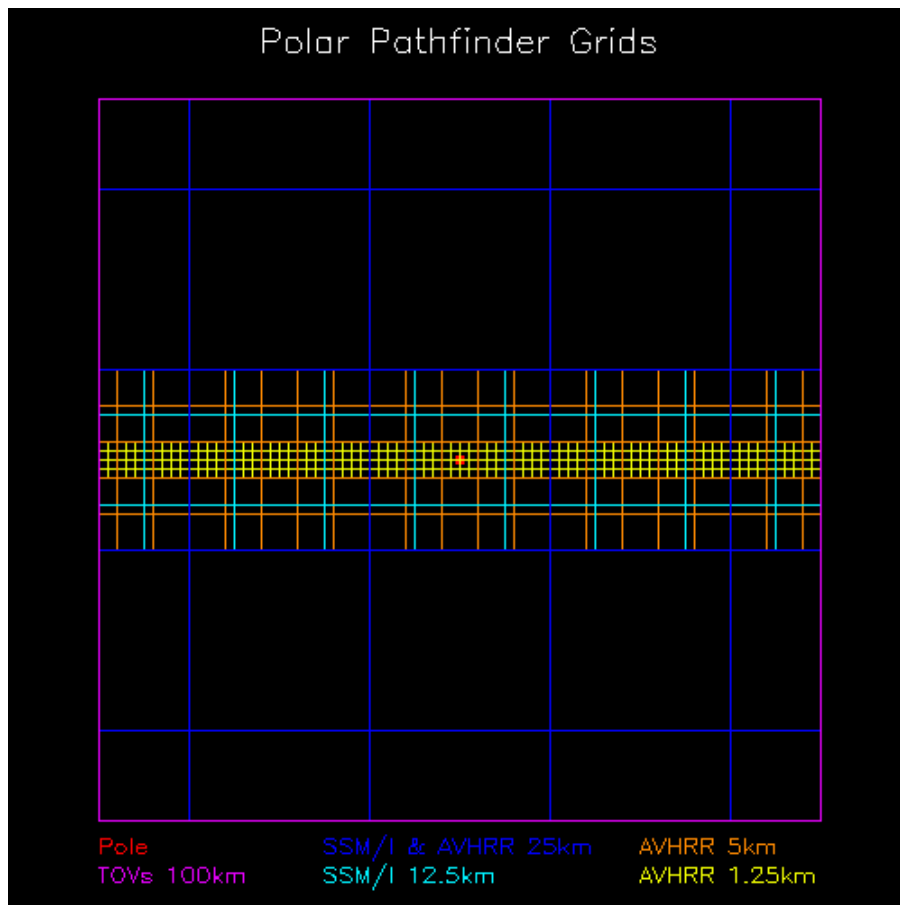


Figure 3. Relationships of Polar Pathfinder Grid Resolutions Within the TOVS 100 km Pixel

## REFERENCES AND RELATED FILES

- Brodzik, M. J. and K. W. Knowles. 2002. “[Chapter 5: EASE-Grid: A Versatile Set of Equal-Area Projections and Grids.](#)” in Michael F. Goodchild (Ed.) *Discrete Global Grids: A Web Book*. Santa Barbara, California USA: National Center for Geographic Information & Analysis. <https://escholarship.org/uc/item/9492q6sm>.
- *A Mapping and Gridding Primer: Points, Pixels, Grids, and Cells*. Unpublished report to the National Snow and Ice Data Center, Boulder, CO.
- [DMSP SSM/I Pathfinder Daily EASE-Grid Brightness Temperatures](#)
- [TOVS Pathfinder Path-P Daily Arctic Gridded Atmospheric Parameters](#)
- .mpp files
  - [N200correct.mpp](#) Used for AVHRR and SSM/I grids.
  - [S200correct.mpp](#) Used for AVHRR and SSM/I grids.
  - [NpathP.mpp](#) Used for TOVS grid.
- .gpd files
  - [NpathP.gpd](#) TOVS grid.
  - [Nl.gpd](#) NL grid.
  - [Sl.gpd](#) SL grid.
  - [Na25.gpd](#) NA25 grid.
  - [Sa25.gpd](#) SA25 grid.
  - [Nh.gpd](#) NH grid.
  - [Sh.gpd](#) SH grid.
  - [Na5.gpd](#) NA5 grid.
  - [Sa5.gpd](#) SA5 grid.
  - [Na1.gpd](#) NA1 grid.
  - [Sa1.gpd](#) SA1 grid.