snowpex

SnowPEx –

The Satellite Snow Product Intercomparison and Evaluation Experiment

Digital Coding of Snow Products for SnowPEx

Technical Note

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SnowPEx Technical Note

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Technical Specification of Products from VHR/HR EO data	ENVEO

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This technical note provides information on proposed specifications of snow products selected for the intercomparison and evaluation exercises in the SnowPEx project.

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1. INTRODUCTION

1.1 Purpose

The purpose of this document is to set up a common framework and coding standards between various snow products produced by various institutes and organizations. The intention is to create a common template for which all snow products can be easily converted and standardized. This will facilitate a robust assessment and inter-comparison using a common set of tools and automatic procedures in light of large data volumes. The standard format will support the assessments carried out by any interested organization at full transparency and reproducibility. Due to the different nature of snow extent (SE) and snow water equivalent (SWE) products, and differing reference data the coding standards are written separately for each of them.

1.2 Outline

The document is organized in seven main sections. Section 2 describes the format of the snow extent products participating in SnowPEx, provided by the producing organisation. It specifies naming of products, required files and digital coding, and file format of the products. Section 3 provides the same information for SWE products.

Section 4 provides information on reprojecting the SE products to the common EASE-2 grid projection, which is required for the products intercomparison. Section 5 gives information on the EASE-2 grid map projection and related tools.

Section 6 (ANNEX-C) and Section 7 (ANNEX-D) gives an overview on the participating SE and SWE products respectively and the SnowPEx Product ID and contact information.

2. DIGITAL CODING AND FORMAT OF SNOW EXTENT PRODUCTS PROVIDED BY THE PARTICIPANTS

This section describes the digital coding and format of the SE products participating in the intercomparison and validation experiment. The format and digital coding for products and file names is mandatory.

For each snow product a FTP site will be installed by ENVEO. The access information will be send out to the contact persons.

2.1 Products

The following seasonal snowpack parameters via SE products will participate in the intercomparison and evaluation activities:

- Snow Cover Fraction (SCF)
- Binary Snow Covered Area (SEB) (to be transferred into Fractional Snow Map for intercomparison)
- Quality / Uncertainty map (QUM) attached to daily/multi-day snow product SEB or SCF (if generated by product producer)

2.2 File names and file organization

Products will be provided with a unique product identifier, which will be defined and provided by the SnowPEx Team. For example, the CCRS AVHRR Polar Pathfinder Snow Cover product will have a product ID/version CCP_V01 when first provided to the validation team. If the product is modified and provided once more to the team it will then have the product ID/version CCP_V02.

The products are uploaded in the original map projection of the product generator, but are re-coded to the SnowPEx digital values given in section 2.5.3 and 2.5.4.

All raster files have to follow the naming convention defined in Table 2.1:

`[ProductID]_V[xx]_LAYER_[YYYYMMDD]_D[YY]_[zzz].[ext]`

- Example: CRYOL_V01_SCF_20071129_D01_MAX.tif → daily SCF, maximum snow extent for 20071129
- Example: CRYOL_V01_SCF_20071119_D07_MAX.tif -> maximum SCF for a 7 day for the days 19, 20, 21, 22, 23, 24, 25 and 26 November 2007.

Table 2-1: Layer names

Element	*Description*
PRODUCTID	product ID provided by SnowPEx team (5 Digits) see ANNEX C (Section 6)
VXX	SnowPEx VERSION of Product
LAYER	Description of thematic content of LAYER. See Table 2-2.
YYYYMMDD	Start date (Year, month and day) of content in layer This is the start date of the period the product is valid; The exact start and end date of the period is given in the Metadata file.
DYY	Period in days, e.g. D01 == daily product ; D07 == 7 day product (weekly) D01 == daily product for day YYYYMMDD D07 == 7 day product (weekly), first day is YYYYMMDD
ZZZ	Specifier for for multiday or multi-orbit products : • MAX: maximum snow extent • MIN: minimum snow extent • AVG: average of SCF • COM: Composite
ext	File format GEOTIFF

2.3 Directory organization of products

The organisation of products follows the following directory structure:

PRODUCTID
- **ORIGINAL_PROJECTION** (in which the product is generated by the data provider)
  - Vxx
    - PRODUCTID_Vxx_UID.tif (required for reprojection; file generated by SnowPEx team)
    - PRODUCTID_Vxx_VAA.tif → (optionally)
    - PRODUCTID_Vxx_MAA.tif → (optionally)
    - YYYY
      - PRODUCTID_Vxx_SCF_YYYYMMDD_DYY_zzz.xml (mandatory)
      - PRODUCTID_Vxx_SCF_YYYYMMDD_Dyy_zzz.tif (mandatory
      - PRODUCTID_Vxx_QUM_YYYYMMDD_Dyy_zzz.tif (optionally – QualityUncertainty File)

2.4 Metadata

Metadata files should accompany each product, and include the following product information. A template of the metadata file will be provided on the SnowPEx website.

Note: For days where no products are available provide a Metadatafile, indicating the days with missing data, by setting: **<productAvailability>** <productGenerated>No</productGenerated > **</productAvailability >**

<?xml version="1.0" encoding="UTF-8"?> **<SNOWPEX>**	
<metadataFile> <version>V1.0</version> <generationDateOfMetadatfile>YYMMDDThhmmss </generationDateOfMetadatfile> **</metadataFile>**	Gives the Version of the Metadatfile specification (Fixed Value, changed by SnowPEx Team). Gives the date when the Metadatafile has been written (updated by Producer)
<contactPerson> <Name>FirstName LastName</Name> <email>First.Lastname@at</email> <Affiliation>ENVEO</Affiliation> **</contactPerson>**	Contact Person for product
<productAvailability> <productGenerated>YES</productGenerated > **</productAvailability >**	Keys: YES / NO IF "YES" the product is available, If "NO", the product is not available, and all other fields below are ignored.
<link> <productFile>CRYOL_V01_SCF_20140925_D01_MAX.tif</productFile> <ValidAreaFile> </ValidAreaFile> <MappedAreaFile> </MappedAreaFile> <QualityUncertaintyFile> </ QualityUncertaintyFile> **</link>**	This provides the names of the various products If one of the files is not present, let key empty
<processingInfo> <processingFacility>ENVEO</processingFacility> <software>IRSL</software> <softwareVersion>2.1</softwareVersion> **</processingInfo>**	Information on product generation
<productInfo> <SnowPExID>CRYOL</SnowPExID> <productType>SCF</productType> <SnowPExProductVersion>V01</ SnowPExProductVersion> <multiOrbitMethod>Maximum</multiOrbitMethod> <startTime>20140925T072500</startTime> <endTime>20140925T122359</endTime> <period unit="days">1</period> **<uncertainty>** **<parameter class="FractionalSnow">** <value measure="RMSD" unit="%">20</value> <value measure="BIAS" unit="%">5</value> **</parameter>** **</uncertainty>** **</productInfo>**	The SnowPEx ID can be found in Section 6 ANNEX C of this document. Information on the product itself MultiOrbitMethod: Maximum, Minimum, Average, Composite Includes also Multi-Day combinations Uncertainty: This is optional, and provides one global value for this product. Optionally a map of uncertainty can be provided.
<mapProjection> <EPSG>4326</EPSG> <OGC_WKT> GEOGCS["WGS 84", DATUM["WGS_1984",SPHEROID["WGS 84",6378137,298.257223563, AUTHORITY["EPSG","7030"]],AUTHORITY["EPSG","6326"]], PRIMEM["Greenwich",0,AUTHORITY["EPSG","8901"]], UNIT["degree",0.0174532925199433,AUTHORITY["EPSG","9122"]], AUTHORITY["EPSG","4326"]] </OGC_WKT>	Specifies the Map Projection of the product To get a WKT string use: gdalsrsinfo --help see www.gdal.org

</mapProjection>	
</grid> <upperLeftCorner_X unit="degree">-11.0</upperLeftCorner_X> <upperLeftCorner_Y unit="degree">72. 0</upperLeftCorner_Y> <upperRightCorner_X unit="degree">50.0</upperRightCorner_X> <upperRightCorner_Y unit="degree">72.0</upperRightCorner_Y > <lowerLeftCorner_X unit="degree">50.0</lowerLeftCorner_X> <lowerLeftCorner_Y unit="degree">35.0</lowerLeftCorner_Y > <lowerRightCorner_X unit="degree">-11.0</lowerRightCorner_X> <lowerRightCorner_Y unit="degree">35.0</lowerRightCorner_Y > <pixelSpacing_X unit="degree">0.005</pixelSpacing_X> <pixelSpacing_y unit= "degree">0.005</pixelSpacing_Y> **</grid>**	The corner coordinates are given in the coordinates of the map projection Note that the upperLeftCorner coordinates corresponds to the upper left corner of the upper left pixel. upperRightCorner is the upper right coordinate of the upper right pixel. lowerRightCorner is the lower right coordinate of the lower right pixel. lowerLeftCorner is the … -> should be clear now ;-) Units: degree / meter
</SNOWPEX>	

2.5 Product data files

Raster files contain gridded digital numbers, which are related to thematic information (e.g. water, clouds, etc.) or to physical quantities (e.g. fractional snow cover, snow water equivalent).

2.5.1 Product file format

As discussed and agreed at the first International Satellite Snow Product Intercomparison Workshop, held from 21 – 23 July 2014 at NOAA, Maryland, USA, snow products should be provided as 8-bit data in a GDAL compatible file format:

- GeoTIFF (including OGC WKT projection information) (see Annex)

In order to check map projection of raster files use the open source tool GDAL (see http://www.gdal.org).

Conversion from Pixel / Line into Georeferenced Coordinates

We follow the common GDAL relationship between raster positions (in pixel/line coordinates) and georeferenced coordinates (see http://www.gdal.org/gdal_datamodel.html).

The map pixel/line coordinates into georeferenced space using the following relationship:

Xgeo = GT(0) + Xpixel*GT(1)

Ygeo = GT(3) + Xpixel*GT(4)

In case of north up images,

- GT(0) and GT(3) are position (Easting, Northing) of the **top left corner of the top left pixel of the raster.**
- GT(1) is pixel width
- GT(5) is pixel height

Note that the pixel/line coordinates in the above are from (0.0,0.0) at the top left corner of the top left pixel to (width_in_pixels,height_in_pixels) at the bottom right corner of the bottom right pixel. The pixel/line location of the center of the top left pixel would therefore be (0.5, 0.5).

How To get a WKT String

WKT strings can be retrieved using gdal tools (see www.gdal.org). To get a WKT-STRING use:

> gdalsrsinfo --help

Example for WKT String for EASE Grid 2:

```
<OGC_WKT>
    PROJCS["WGS 84 / NSIDC EASE-Grid North",
    GEOGCS["WGS 84",
        DATUM["WGS_1984",
            SPHEROID["WGS 84",6378137,298.257223563,
                    AUTHORITY["EPSG","7030"]],
            AUTHORITY["EPSG","6326"]],
        PRIMEM["Greenwich",0,
            AUTHORITY["EPSG","8901"]],
        UNIT["degree",0.0174532925199433,
            AUTHORITY["EPSG","9122"]],
        AUTHORITY["EPSG","4326"]],
    PROJECTION["Lambert_Azimuthal_Equal_Area"],
    PARAMETER["latitude_of_center",90],
    PARAMETER["longitude_of_center",0],
    PARAMETER["false_easting",0],
    PARAMETER["false_northing",0],
    UNIT["metre",1,
        AUTHORITY["EPSG","9001"]],
    AXIS["X",EAST],
    AXIS["Y",NORTH],
    AUTHORITY["EPSG","3973"]]
<\OGC_WKT>
```

2.5.2 Product map projection

All product files should be provided in the highest available resolution with map projection identified by EPSG code and OGC WKT string with the original map projection.

Product files correspond to thematic layers listed in Table 2-2 . The SCF and SEB layers correspond to mapped geophysical quantities, and typically only one of these will be present in a product archive.

Of the other layers, the Valid Area (VAA) and Unique Pixel Identified (UniqueID) layers are mandatory to apply validation tools. However, they could be defaulted to a single fixed layer for all provided

dates. All other layers are optional with default values assumed as specified in subsequent sections if they are not provided.

Table 2-2 Layers of snow extent products for intercomparison and validation

Layer Name	*Description*	*Reference*	*Required in Original Projection*	*Required for Reprojected product in EASE2 Grid*
SCF	Snow Cover Fraction	Section 2.5.3	Mandatory	Mandatory
SEB	Snow Extent Binary	Section 2.5.4	Mandatory	Mandatory
QUM	Quality / Uncertainty Map	Section 2.5.5	Optional	Optional
UID	Unique product grid identifier	Section 4.1	-	Mandatory
VAA	Valid Area	Section 4.2	Optional	Mandatory
MAA	Mapped Area	Section 4.3	Optional	Optional
CIH	Confidence Interval, High	Section 4.4	Optional	Optional
CIL	Confidence Interval, Low	Section 4.5	Optional	Optional
STM	Static Maps	Section 4.6	Mandatory	Mandatory

2.5.3 Snow Cover Fraction

Layer Name	SCF
Description	This layer maps the fraction of snow cover in each grid cell. The uncertainty in the mapped fraction of snow cover can be included optional confidence interval layers
Data type	8 bit unsigned

Code range	*Class*
0-100	Mapped snow cover fraction in per cent Note: 0 = snow free; 100 = fully snow covered
205	Clouds (incl. cloud shadow) Note: snow retrieval not possible due masking of earth surface
206	Polar Night / satellite data available, but polar night does not allow classification
252	ERROR Code: Retrieval / Classification failed
253	ERROR Code: Input data error (e.g. bad pixels, etc)
254	ERROR Code: No satellite data value
255	Not Valid Pixel in Original Projection Products / (e.g. Sea)
All other values	Not used

2.5.4 Snow Extent, Binary

Layer Name	SEB
Description	This layer maps the presence or absence of snow according to a binary flag
Data type	8 bit unsigned

Code range	*Class*
0	Mapped as “no snow”
100	Mapped as “snow”
205	Clouds (incl. cloud shadow) Note: snow retrieval not possible due masking of earth surface
206	Polar Night / satellite data available, but polar night does not allow classification
252	ERROR Code: Retrieval / Classification failed
253	ERROR Code: Input data error (e.g. bad pixels, etc)
254	ERROR Code: No satellite data value
255	Not Valid Pixel / (e.g. Sea)
All other values	Not used

2.5.5 Quality / Uncertainty Map

Layer Name	QUM
Required	Optional
Description	This layer specifies the quality of the associated geophysical quantity over the mapped area of a grid cell. The units vary with geophysical quantity. This is an optional layer. A description on how to interpret the quality map is mandatory.
Data type	8 bit unsigned

3. PRODUCT DESCRIPTION: SNOW WATER EQUIVALENT

3.1 Products

The initial assessment will focus on snow water equivalent (SWE) products over terrestrial seasonal snow covered regions. Auxiliary information embedded within some of the SWE products (such as retrieval uncertainty estimates), with the possible exception of snow extent derived from dry/wet snow masks, will not be assessed. A threshold of 2 cm snow depth or 5 mm water equivalent will be applied to identify snow covered grid cells. Pixels with water fraction above 25% will be omitted from the assessment. The assessment will be based on daily SWE estimates and maximum SWE within a five day sliding window. The seasonal maximum SWE and the date of maximum SWE will also be computed by the SnowPEx team and is not required from the dataset providers. The currently existing SWE datasets are provided in NSIDC EASE-Grid North projection, so this was defined as the standard projection to be used in the SnowPEx assessments.

3.2 File names and file organization

3.2.1 Daily SWE data

The daily SWE data products will be named according to the following convention:

`[ProductID]_V[xx]_LAYER_[YYYYMMDD]_D[YY]_[zzz].[ext]`

Where the elements are:

Element	*Description*
PRODUCTID	SnowPEx product ID provided by validation team (5 Digits) (see ANNEX D (Section 7)
VXX	SnowPEx VERSION of Product
LAYER	Thematic Layer: SWE (3 characters)
YYYYMMDD	Year, month and day of content in layer in UTC. (this is the 1 day of the period the product is valid) (e.g. 20050315, for 15 March 2005)
DYY	Period in days, e.g. D01 == daily product for day YYYYMMDD D07 == 7 day product (weekly), first day is YYYYMMDD
ZZZ	Specifier for multi-day products : • MAX, MIN, AVG, etc. • for daily products use MAX ????
ext	File format TIFF (GEOTIFF)

- Example: GLSWE_V01_20050315_D01_MAX_SWE.tif: For GlobSnow 2.0 SWE data of 15 March 2005). Each file will contain a single layer with the SWE values for the given day. Additional information, such as uncertainty estimates, are provided as external data files.
- Example: GLSWE_V01_20050315_D05_MAX_SWE.tif (For GlobSnow 2.0 5 day maximum SWE data of 15 March 2005) The five day maximum data will be calculated as a "sliding-window" product. The product is calculated for every day, indicating the maximum SWE for each pixel. For example, the SWEmax product for 15 March 2005 is calculated as the maximum SWE for each pixel from the daily SWE products of 15, 16, 17, 18, and 19 March 2005.

Additional information, such as uncertainty estimates (if available), will be provided as external data files.

3.3 Metadata

Metadata for each product **(TBD)** and for each dataset will be provided separately.

Metadata information for each individual product will contain **(TBD)**:

- information on input data

Metadata information for each assessed dataset will contain

- temporal extent of the dataset
- auxiliary data used for retrieval
- product version
- software version
- contact information

An example of metadata file structure is given in Section 2.4 for the SCF and SEB products.

3.4 Product data files

The product data files will be defined so that each individual file contains a single layer of data, describing the SWE information in NSIDC EASE-Grid North projection. Each product file describes either the daily SWE conditions or the 5-day maximum SWE conditions.

- The proposed file format is NetCDF / GEOTIFF
- The SWE data are to be coded as 16 bit unsigned integers (uint16 ieee-le format).

- For coding purposes, the following values are to be used in the products:

Code range	Class
0	bare ground (SWE of 0 mm)
1-1000	SWE in mm
65500	Not mapped (no input data or retrieval failure)
65501	Wet snow (if applicable)
65502	Water (oceans, or for pixels with water fraction above 25%)
65503	Permanent ice
65504	Mountains (if applicable)

3.5 Auxiliary data files

To assist the SWE assessment, auxiliary datasets used in the SWE retrieval by different data providers will be gathered by the SnowPEx SWE assessment team. A combined thematic mask (that will be provided to all interested parties) is created that best agrees with the general classification used by the different existing data providers.

The following auxiliary information, typically utilized in product generation, is requested from the SWE data providers (where applicable):

- permanent ice mask (glaciers and ice sheets)
- water mask (pixels with water fraction above the applied threshold e.g. 25%)
- forest mask (including stem volume information), if applicable
- mountain mask (including elevation information), if applicable
- urban areas mask

A unified mask that can be applied by all (existing and future) product providers will be constructed by the SnowPEx SWE team. Each data provider can choose to apply the thematic mask (i.e. mask out the permanent ice and water bodies) from their respective products, to ensure that the assessments are not affected by differences in the thematic layers.

4. ANNEX A – LAYERS GENERATED FOR REPROJECTION INTO EASE-2 GRID

The snow products are provided by organisation in their original map projection (e.g. geographic Lat / Lon). For the product intercomparison all products are re-projected into a common map projection. According to the ISSPI-1 WS the common map projection for SE product is EASE-2 GRID.

Reprojection of products will be performed by the SnowPEx team, but will be openly discussed by the community.

4.1 Unique product grid cell identifier

Layer Name	UID
Required	Mandatory (this layer is valid for all dates)
Description	This is a fixed layer for each product that provides a lookup table of the EASE-2 grid to the column and row number of the product in original projection., This allows to identify duplication of pixels while reprojection from the original projection to the EASE-2 grid projection. This Layer is generated by the SnowPEx TEAM
Data type	16bit Integer unsigned

Code range	*Class*
0	Area not contained in original product layer
1-65536	Random value extracted from original product layer

4.2 Valid Area

Layer Name	VAA
Required	Mandatory (layer in general applied to all dates)
Description	This layer maps the fraction in % of a grid cell for which the associated geophysical quantity (SCF, SEB) could potentially occupy. The layer can be provided on a daily basis or alternatively as a single layer applied to all dates. When coded with only 0 or 100 values the layer serves as a definitive land/water mask for the product. Geophysical retrievals over invalid areas will generate an exception.
Data type	8 bit unsigned

Code range	*Class*
0-100	Valid area fraction of grid cell in %
101-255	Out of range

4.3 Mapped Area

Layer Name	MAA
Required	Optional (layer applied to all dates, or daily)
Description	This layer maps the fraction of a grid cell for which the associated geophysical quantity (SCF, SEB) was actually mapped over (e.g. cloud free areas that are also valid). This is an optional layer with MA assumed equal; to VA if not provided. The layer can be provided on a daily basis or alternatively as a single layer applied to all dates. A mapped area exceeding the valid area will generate an exception. The absence of valid geophysical retrievals over mapped areas will not generate an exception but the mapped area will assume to be 0.
Data type	8 bit unsigned

Code range	*Class*
0-100	Mapped area fraction of grid cell in %
101-255	Grid cell unmapped

4.4 Confidence Interval, High

Layer Name	CIH
Required	Optional
Description	This layer specifies the magnitude of upper confidence interval of the associated geophysical quantity over the mapped area of a grid cell. The units vary with geophysical quantity. This is an optional layer only if a fixed confidence interval is provided in metadata. Confidence intervals that imply geophysical quantities exceed physical bounds (negative SCF, SEB or SWE or values greater than 1 for SCF and SEB) will be truncated following a protocol depending on the statistical comparison applied.
Data type	8 bit unsigned

Geophysical Quantity	*Code range*	*Value*
SCF	0-100	Size of 95%ile upper confidence interval in %SCF
	101-255	Unspecified, default interval applied from metadata
SEB	0-100	Vertex of threshold SCF% for no-snow
	101-255	Unspecified, default interval applied from metadata
SWE	0-250	Size of 95%ile upper confidence interval in SWE*0.25 mm
	251-255	Unsp[ecified, default interval applied from metadata

4.5 Confidence Interval, Low

Layer Name	CIL
Required	Optional
Description	This layer specifies the magnitude of the magnitude of lower confidence interval of the associated geophysical quantity over the mapped area of a grid cell. The units vary with geophysical quantity. This is an optional layer only if a fixed confidence interval is provided in metadata. Confidence intervals that imply geophysical quantities exceed physical bounds (negative SCF, SEB or SWE or values greater than 1 for SCF and SEB) will be truncated following a protocol depending on the statistical comparison applied.
Data type	8 bit unsigned

Geophysical Quantity	*Code range*	*Value*
SCF	0-100	Size of 95%ile lower confidence interval in %SCF
	101-255	Unspecified, default interval applied from metadata
SEB	0-100	Vertex of threshold SCF% for snow
	101-255	Unspecified, default interval applied from metadata
SWE	0-250	Size of 95%ile lower confidence interval in SWE*0.25 mm
	251-255	[ecified, default interval applied from metadata

4.6 Static Mask Information provided by SnowPEx Team

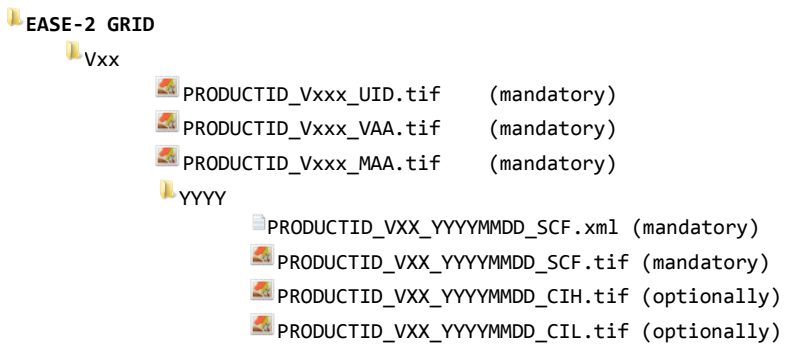
Layer Name	STM
Description	This layer corresponds to static land mask information. For backward compatibility with the CRYOLAND and GlobSnow validation products the following code values are reserved. In general the land mask validation is the same for all products and will be available in various pixel spacing e.g. 500 m and 1 km resolution. These layers will be used to support the intercomparison of snow products for various surface classes. It also provides a common sea and open water mask.
Data type	8 bit unsigned

Code range	*Class*
210	Open Land
211	Sea
212	Lake/River mask

Code range	Class
215	Glaciers, icecaps, ice sheets
220	Forest
221	Dense forest
230	Urban area
240	Mountains
245	Mountains Forested
246	Mountains Unforested

4.7 Directory Structure for Re-projected product

Note that re-projection is done by the SnowPEx team. Reprojected data are stored at the FTP site of the product.



5. ANNEX B – EASE-2 MAP PROJECTION

For details see: http://nsidc.org/data/ease/versions.html

Feature	EASE-Grid 2.0
Projection ellipsoid	WGS 84
Pole location	Intersection of center cells
Scale (data-set specific)	Azimuthal: Exact (such as 25.0 km or 36.0 km) Cylindrical: Integer-multiples across latitude of true scale
Dimensions	Even-numbered (720 x 720)
Nested Grids	Coverage can stay the same, only number of cells changes
Corner Points	No undefined corner cells
GeoTIFF	Supported without reprojection
Software Issues	Most software supported

Software & Codes	EASE-Grid 2.0(WGS 84 Projection)	Current Status
HDFEOS 2.xx HDFEOS 5.xx	Cylindrical projection is supported. Azimuthal is not supported.	HDF depends on GCTP. NSIDC may propose a change to GCTP to support Lambert Azimuthal with ellipsoid.
PROJ.4	Azimuthal and cylindrical EASE-Grid 2.0 supported in PROJ 4.8.0 (13 March 2012). Azimuthal projection was supported in PROJ 4.7.0 (23 September 2009). Bug in PROJ 4.7.0 resulted in error of ~15 km when transforming points near equator for cylindrical	Both original EASE-Grid and EASE-Grid 2.0 are fully supported as of PROJ 4.8.0 (13 March 2012).

	EASE-Grid 2.0 data.	
GDAL Tools	Supported, with correct version of PROJ.4.	User must ensure correct PROJ.4 is installed; see PROJ.4 notes.
EPSG Codes	North: 3973 South: 3974 Global: 3975	PROJ 4.8.0 is required to obtain correct values for EASE-Grid 2.0 cylindrical.
ENVI	Azimuthal supported. Cylindrical equal-area requires user-defined projection information; simple modifications to support header information for EASE-Grid 2.0 data sets are forthcoming.	Simple modifications are required for cylindrical equal-area in both EASE-Grid versions; see respective column for current status.
Mapx	Supported	N/A
ArcGIS	Supported	N/A
ERDAS	Supported	N/A

6. ANNEX C - SE PRODUCTID

SnowPEx PRODID_VXX	SnowPEx PRODID_VXX	Product Name	Thematic Parameter	Pixel Sp.	Frequency	Period	Contact Organisation
M10C06	V01	MOD10_C6	Fractional Global	0.5 km	daily	2000 (Terra)	dorothy.k.hall@nasa.gov NASA
SCAG	V01	SCAG	Fractional NH	0.5 km	daily	2000 - 2013	thomas.painter@jpl.nasa.gov karl.rittger@nsidc.org JPL, NSIDC
GLSSE	V01	GlobSnow v2.1	Fractional NH	1 km	daily - monthly	1996 - 2012	sari.metsamaki@ymparisto.fi SYKE
ASNOW	V01	Autosnow	Fractional NH	4 km	daily	2006 - present	peter.romanov@noaa.gov NESDIS
IMS01	V01	IMS	NH	1 km	daily	2014 ->	sean.helfrich@noaa.gov NOAA
IMS04	V01	NOAA IMS	Binary NH	4 km	daily	2004 - present	sean.helfrich@noaa.gov NOAA
IMS24	V01	NOAA IMS	Binary NH	24 km	daily	1997 - 2004	sean.helfrich@noaa.gov NOAA
CRCLIM	V01	CryoClim	Binary Global	5km	daily	1982 - present	rune.solberg@nr.no NR,METNO
JXM10	V01	JASMES MDS10C	Binary NH	5 km	Daily weekly half-monthly	2000 – 2013	hori.masahiro@jaxa.jp JAXA
JXAM5	V01	JASMES GHRM5C	Binary NH	5 km	Daily weekly half-monthly	1979 – 2013	hori.masahiro@jaxa.jp JAXA

SnowPEx PRODID_VXX	SnowPEx PRODID_VXX	Product Name	Thematic Parameter	Pixel Sp.	Frequency	Period	Contact Organisation
PATHF	V01	AVHRR Pathfinder	Binary NH	5 km	daily	1985 - 2004	(Zhao, et al CCRS
MEASU	V01	MEaSUREs	Binary Global	25 km	daily	1999 - 2012	dorothy.k.hall@nasa.gov NASA
CRYOL	V01	CryoLand	Fractional (PanEur)	0.5 km	daily	2000 - present	thomas.nagler@enveo.at ENVEO
HSAF10	V01	HSAF H10	Binary (PanEur)	5 km	daily	2009-present	EUMETSAT
EURAC	V01	EURACSnow	Binary (Alps)	0.25 km	daily	2002 - present	claudia.notarnicola@eurac.edu EURAC

7. ANNEX D - SWE PRODUCTID

SnowPEx PRODID	SnowPEx Vxx	Product Name	Coverage	Thematic Parameter	Pixel Sp.	Frequency	Period	Contact Organisation
GLSWE	V01	ESA GlobSnow	Northern Hemis. (non Alpine)	SWE	25 km	Daily N	1979-present	kari.luojus@fmi.fi Finnish Met. Institute
NASSTD	V01	NASA AMSR-E (standard)	Northern Hemis.	SWE	25 km	daily	2002-2011	rejkelly@uwaterloo.ca University of Waterloo cryocity@gmail.com City College, New York
NASPR	V01	NASA AMSR-E (prototype)	Northern Hemis.	SWE	25 km	daily	2002-2011	cryocity@gmail.com City College, New York
JAXAA	V01	JAXA AMSR-E/2	Northern Hemis.	SWE	25 km	daily	2012-present	rejkelly@uwaterloo.ca University of Waterloo
HSAFSWE		FMI/ EUMETSAT	Europe	SWE	25 km	daily	2012-2014	Matias.Takala@fmi.fi FMI