



LIFE Project Number  
**ENV/FIN/000133**

### **Documentation of the data exchange method**

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Action  
**Action 9 – Demonstration and validation of EO services (SYKE)**

LIFE+ PROJECT NAME or Acronym  
**SNOWCARBO**

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## List of key-words and abbreviations

ENVIMON	Processing software for satellite images
FMI	Finnish Meteorological Institute
MODIS	Moderate Resolution Imaging Spectroradiometer
NAPS	Near Autonomous Processing System
NDVI	Normalized Difference Vegetation Index
SYKE	Finnish Environment Institute
TB	Terabyte

## 1 Summary

The SnowCarbo project uses and produces vast amount of data from different sources. Analyzed and implemented datasets include: large quantities of satellite images, with different stages of processing, in-situ observations made by the participating institutes operationally and datasets from dedicated field campaigns; and finally data from external sources.

Although the processing of each dataset is specifically assigned to one of the participating institutes, the work and development done in each action may at some point require access to other datasets for viewing and testing. Therefore, the final products and related documentation need to be efficiently delivered among the project participants.

Large (>1TB, terabyte) datasets are stored on duplicated on external hard drives and are available for project partners upon request, through the delivery of the hard drives. Smaller datasets are transferred to the project partners through an ftp-server. Internal network is used for local data delivery.

Metadata is created during the processing steps of satellite images. The metadata informs the user of the procedures and their parameterizations the data has gone through previously. This data is saved together with the images and can be provided to the user. The metadata also becomes useful if some of the satellite data needs to be reprocessed.

This document describes the data exchange within the project, but also describes the metadata created during satellite image processing at SYKE, due to foreseen re-processing of selected images or subsets of the full dataset in conjunction with method development.

## 2 Methods of data delivery

Three main methods are used for data delivery within the project.

- 1) FTP- server
- 2) External hard drives
- 3) Internal data delivery at

Following sections describe the delivery method for each dataset:

### *Satellite image data*

The satellite data consists of years 2001-2011, with hundreds of images/year making the dataset very large. As the satellite image data needs pre-processing, processing for extracting the desired information and re-formatting it for further use as an input in the climate models or for product validation, the satellite data processing has been assigned to Finnish Meteorological Institute (FMI) and Finnish Environment Institute (SYKE) as described in the project plan. This minimizes the need to deliver the large satellite image datasets between the institutions. Selected images can be delivered between the institutions through

the ftp- server, but if large quantities of satellite images (> 1 TB) are required to be transferred this is done through delivering external hard drives, used also for archiving the data. Duplicates of the datasets are on another set of external hard drives for backup. Within SYKE, the data is shared via network folders, where all the project members have access to.

#### *Time-series from satellite data*

The time-series extracted from the satellite data are smaller in size and the format is designed together with the data users for easy access and further implementation, e.g. for input in the climate-vegetation models (applied in Action 6). These products are delivered through the ftp-server and internally through local networks.

#### *In-situ data*

The in-situ data are even smaller in size than the time-series data. The data is mainly used for validation of the environmental information extracted from the satellite images, but can also be used as an input to the climate models. This data is also delivered through ftp-server.

### **3 Logs for satellite image processing at SYKE**

The in-house software for sequencing the data processing for satellite images, NAPS (NAPS, Near Autonomous Processing System), used at SYKE for satellite image data, produces metadata that gives the user information on the applied settings during the processing of products, mainly the spatial reference and the treatment of no-data. Metadata is produced in *.xml*- format and is named as

xxx\_NAPS.xml

where *xxx* is the *image name*. Table 1 lists the information stored in the NAPS process metadata. An example of a metadata from an NDVI (Normalized Difference Vegetation Index) estimate process is given in Annex 1.

The actual data processing is done by Envimon satellite image processing software (developed by and Matlab- routines developed at SYKE. Envimon produces several processing logs, which are archived together with the images. This allows later to review the parameters used for different procedures: unpacking the raw data, radiometric correction and geo-correction of the images. These logs contain the following information (An example of logs from radiometric correction of the images is given in Annex 2):

- Version of the processing program
- Time stamp for processing
- Input and output files
  - o Envimon software also stores information about parameters used in different processes and this information is also stored for documentation, e.g. calibration coefficients of the radiometric correction.
- Possible errors in the data processing

**Table 1** Data given in a single metadata file (xxx\_NAPS.xml) with each processing run.

<b>Information</b>	<b>Description</b>
XML version and character encoding	File format version and character coding of the file.
<i>Spatial reference data</i>	
Process name	User given process name.
Date of creation	The creation date of the metadata file.
Coordinates of upper left corner pixel (input image)	Coordinate for the centre of the upper left pixel of the input image.
Pixel size	Given in decimal degrees
Reference corner coordinate	A transformation matrix for coordinates used by a Matlab routine.
Coordinates of lower right corner pixel (input image)	Coordinate for the centre of the upper left pixel of the input data.
Datum	Datum of the geographical coordinate system.
Bounding box	The area covered by the image
Input filename	Satellite image file(s) to be processed.
<i>Parameters</i>	Additional information on definition and treatment of missing data.

## Annexes

### Annex 1 Metadata file from NAPS- process sequencing software.

---

```
<?xml version="1.0" encoding="utf-8" ?>
<NDVIEstimate>
  <UpperLeft>[70.99875 19.00125]</UpperLeft>
  <PixelSize>[0.0025 0.0025]</PixelSize>
  <R>[0 -0.0025;0.0025 0;18.99875 71.00125]</R>
  <Datum>WGS84</Datum>
  <LowerRight>[58.00125 31.99875]</LowerRight>
  <BoundingBox>[71 19;58 32]</BoundingBox>
  <DataFile>Modis_qkm_02Apr01_0905_EV_250_RefSB_toa_rect.img</DataFile>
  <Parameters>
    <maskLessThanNoDataVal>true</maskLessThanNoDataVal>
    <maskNoDataVal>true</maskNoDataVal>
    <noDataVal>0.01</noDataVal>
    <replaceNansWithZeros>>false</replaceNansWithZeros>
  </Parameters>
</NDVIEstimate>
```

### Annex 2 Processing log from ENVIMON software for radiometric correction. The full log consists of 4 separate files.

---

-----em\_radio\_2009\_Oct143130.log-----

START LOG ..... 2009 Oct19 14:31:30

Program "em\_radio", version 1.48

Copyright by VTT, Apr 8 2009

reading instructions from:

Modis\_1KM\_08sep01\_1033\_EV\_1KM\_Emissive\_em\_radio.inst

reading inputs from file:

Modis\_1KM\_08sep01\_1033\_EV\_1KM\_Emissive\_em\_radio.inst

using all channels

processing file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_Emissive.img

reading calibration coefficients

carry out emissive data calibration

reading calibration coefficients

creating file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_Emissive\_kelvin.img

1354 cols, 2970 rows, 16 channels

compressing Imagine data

2970 rows processed

file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_Emissive\_kelvin.img written

thermal data written

program "em\_radio" (ver. 1.48) completed successfully

elapsed time 38 secs  
2009 Oct19 14:32:08

-----em\_radio\_2009\_Oct143208.log-----

START LOG ..... 2009 Oct19 14:32:08

Program "em\_radio", version 1.48  
Copyright by VTT, Apr 8 2009

reading instructions from:  
Modis\_1KM\_08sep01\_1033\_EV\_1KM\_RefSB\_em\_radio.inst  
reading inputs from file:  
Modis\_1KM\_08sep01\_1033\_EV\_1KM\_RefSB\_em\_radio.inst  
using all channels  
processing file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_RefSB.img

reading calibration coefficients  
combining angles and atmospheric data into an image file  
creating file: atmos\_tmp.img  
1354 cols, 2970 rows, 8 channels

compressing Imagine data

2970 rows processed

file: atmos\_tmp.img written  
angles and atm data written to temp file  
computing radiometric calibration  
reading calibration coefficients  
using viewing limit: 60 degrees  
using sun zenith limit: 71 degrees  
sun angle corrected TOA reflectance  
no atmospheric corrections  
no BRDF corrections  
process channels:  
band 8  
band 9  
band 10  
band 11  
band 12  
band 13lo  
band 13hi  
band 14lo  
band 14hi  
band 15  
band 16  
band 17  
band 18  
band 19  
band 26  
creating file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_RefSB\_toa.img  
1354 cols, 2970 rows, 15 channels

compressing Imagine data

2970 rows processed

file: Modis\_1KM\_08sep01\_1033\_EV\_1KM\_RefSB\_toa.img written  
file atmos\_tmp.img deleted

program "em\_radio" (ver. 1.48) completed successfully  
elapsed time 1 min 12 secs  
2009 Oct19 14:33:20

-----em\_radio\_2009\_Oct143320.log-----

START LOG ..... 2009 Oct19 14:33:20

Program "em\_radio", version 1.48  
Copyright by VTT, Apr 8 2009

reading instructions from:  
Modis\_HKM\_08sep01\_1033\_EV\_500\_RefSB\_em\_radio.inst  
reading inputs from file:  
Modis\_HKM\_08sep01\_1033\_EV\_500\_RefSB\_em\_radio.inst  
using all channels  
processing file: Modis\_HKM\_08sep01\_1033\_EV\_500\_RefSB.img

reading calibration coefficients  
combining angles and atmospheric data into an image file  
Modis\_LL\_08sep01\_1033\_SensorZenith.img  
dimension scale col: 2.0 row: 2.0  
Modis\_LL\_08sep01\_1033\_SensorAzimuth.img  
dimension scale col: 2.0 row: 2.0  
Modis\_LL\_08sep01\_1033\_SolarZenith.img  
dimension scale col: 2.0 row: 2.0  
Modis\_LL\_08sep01\_1033\_SolarAzimuth.img  
dimension scale col: 2.0 row: 2.0  
creating file: atmos\_tmp.img  
2708 cols, 5940 rows, 8 channels

compressing Imagine data

5940 rows processed

file: atmos\_tmp.img written  
angles and atm data written to temp file  
computing radiometric calibration  
reading calibration coefficients  
using viewing limit: 60 degrees  
using sun zenith limit: 71 degrees  
sun angle corrected TOA reflectance  
no atmospheric corrections  
no BRDF corrections  
process channels:  
band 3  
band 4  
band 5  
band 6  
band 7  
creating file: Modis\_HKM\_08sep01\_1033\_EV\_500\_RefSB\_toa.img  
2708 cols, 5940 rows, 5 channels



compressing Imagine data

5940 rows processed

file: Modis\_HKM\_08sep01\_1033\_EV\_500\_RefSB\_toa.img written  
file atmos\_tmp.img deleted

program "em\_radio" (ver. 1.48) completed successfully  
elapsed time 2 min 19 secs  
2009 Oct19 14:35:39

-----em\_radio\_2009\_Oct143539.log-----

START LOG ..... 2009 Oct19 14:35:39

Program "em\_radio", version 1.48  
Copyright by VTT, Apr 8 2009

reading instructions from:  
Modis\_QKM\_08sep01\_1033\_EV\_250\_RefSB\_em\_radio.inst  
reading inputs from file:  
Modis\_QKM\_08sep01\_1033\_EV\_250\_RefSB\_em\_radio.inst  
using all channels  
processing file: Modis\_QKM\_08sep01\_1033\_EV\_250\_RefSB.img

reading calibration coefficients  
combining angles and atmospheric data into an image file  
Modis\_LL\_08sep01\_1033\_SensorZenith.img  
dimension scale col: 4.0 row: 4.0  
Modis\_LL\_08sep01\_1033\_SensorAzimuth.img  
dimension scale col: 4.0 row: 4.0  
Modis\_LL\_08sep01\_1033\_SolarZenith.img  
dimension scale col: 4.0 row: 4.0  
Modis\_LL\_08sep01\_1033\_SolarAzimuth.img  
dimension scale col: 4.0 row: 4.0  
creating file: atmos\_tmp.img  
5416 cols, 11880 rows, 8 channels

compressing Imagine data

11880 rows processed

file: atmos\_tmp.img written  
angles and atm data written to temp file  
computing radiometric calibration  
reading calibration coefficients  
using viewing limit: 60 degrees  
using sun zenith limit: 71 degrees  
sun angle corrected TOA reflectance  
no atmospheric corrections  
no BRDF corrections  
process channels:  
band 1  
band 2  
creating file: Modis\_QKM\_08sep01\_1033\_EV\_250\_RefSB\_toa.img

5416 cols, 11880 rows, 2 channels

compressing Imagine data

11880 rows processed

file: Modis\_QKM\_08sep01\_1033\_EV\_250\_RefSB\_toa.img written  
file atmos\_tmp.img deleted

program "em\_radio" (ver. 1.48) completed successfully  
elapsed time 7 min 35 secs  
2009 Oct19 14:43:14