EUMETSAT Satellite Application Facility on
Support to Operational Hydrology and Water Management

Product User Manual (PUM) for product H25 – SM-OBS-4

Metop ASCAT Soil Moisture Time Series

DOCUMENT CHANGE RECORD

Issue / Revision	Date	Description	Prepared by
0.1	2013/07/25	Document created.	S. Hahn
0.2	2013/09/23	Major revision of the document.	S. Hahn
0.3	2013/10/01	Updated section 3.	S. Hahn
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0.5	2013/10/07	Revised document format	S. Hahn, S. Hasenauer
0.6	2013/10/16	Updated product introduction and characteristics.	S. Hasenauer
0.7	2013/10/21	Version prepared for delivery of product in demonstrational status	Project Management Team
0.8	2014/02/07	Minor updates in section product availability	S. Hasenauer
0.9	2014/02/13	Minor changes in headlines, page breaks, links	S. Hasenauer

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1 Introduction

1.1 Purpose of the document

Product User Manuals are available for each (pre)-operational H-SAF product, for open users, and also for demonstrational products, as necessary for *beta-users*.

Each PUM contains:

- Product introduction: principle of sensing, Satellites utilized, Instrument(s) description, Highlights of the algorithm, Architecture of the products generation chain, Product coverage and appearance;
- Main product operational characteristics: Horizontal resolution and sampling, Observing cycle and time sampling, Timeliness;
- Overview of the product validation activity: Validation strategy, Global statistics, Product characterisation
- Basic information on product availability: Access modes, Description of the code, Description of the file structure

An annex also provides common information on Objectives and products, Evolution of H-SAF products, User service and Guide to the Products User Manual.

Although reasonably self-standing, the PUM's rely on other documents for further details. Specifically:

- ATDD (*Algorithms Theoretical Definition Document*), for extensive details on the algorithms, only highlighted here;
- PVR (*Product Validation Report*), for full recount of the validation activity, both the evolution and the latest results.

These documents are structured as this PUM, i.e. one document for each product. They can be retrieved from the CNMCA site on HSAF web page at User Documents session.

On the same site, to obtain user and password please contact the Help Desk) it is interesting to consult, although not closely connected to this PUM, the full reporting on hydrological validation experiments (*impact studies*):

- HVR (*Hydrological Validation Report*), spread in 10 Parts, first one on requirements, tools and models, then 8, each one for one participating country, and a last Part with overall statements on the impact of H-SAF products in Hydrology.

1.2 Relevant staff associated to the User Service and the product

Table 1 records the names of the persons associated to the development and operation of the User service and of product SM-OBS-4.

Table 1: Relevant persons associated to the User service and to product SM-OBS-4

Product Development Team			
Wolfgang Wagner (Leader)	Technische Universität Wien (TU-Wien), Department of Geodesy and Geoinformation	Austria	wolfgang.wagner@geo.tuwien.ac.at
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2 Product description

The surface soil moisture data (SSM) are retrieved from the radar backscattering coefficients measured by the ASCAT (Advanced Scatterometer) onboard the Metop satellite (Figa-Saldaña et al. 2002) using a change detection method, developed at the Research Group Remote Sensing, Department for Geodesy and Geoinformation (GEO), Vienna University of Technology (TU-Wien). In the TU-Wien model, long-term Scatterometer data are used to model the incidence angle dependency of the radar backscattering signal. Knowing the incidence angle dependency, the backscattering coefficients are normalised to a reference incidence angle. Finally, the relative soil moisture data ranging between 0% and 100% are derived by scaling the normalised backscattering coefficients between the lowest/highest values corresponding to the driest/wettest soil conditions. The derived soil moisture product represents the content in the first 5 cm of the soil in relative units between totally dry conditions and total water capacity. The unit is degree of saturation [%], but can be converted into volumetric units [m^3m^{-3}] with the help of soil porosity information.

More information on the retrieval algorithm can be found in the Algorithmic Theoretical Baseline Document (ATBD) [RD-2] and in Wagner et al. (1999) and Naeimi et al. (2009).

2.1 Product parameters

The product is composed of several parameters (geophysical parameters, flags, geo-location information, etc.), which are described in the following Table 2.

Parameter	Description
Grid point index	The grid point index (GPI) is a unique identifier for each single grid point.
Latitude	Latitude position of the GPI in degrees.
Longitude	Longitude position of the GPI in degrees.
Row size	The number of observations per GPI is indicated by the row size or in other words the length of the time series per GPI. A detailed description on how this is important for reading the time series data is given in section 2.3.2.1.
Time	The time parameter represents the time stamp for the measurements. It is defined as the days since 1970-01-01 00:00:00.
Soil moisture	Soil moisture represents the water content in the first 0-5 cm of the soil in relative units between totally dry conditions and total water capacity. The unit is degree of saturation [%]. A conversion from degree of saturation (%) to absolute units (m^3 m^{-3}) is possible by using the porosity values (see equation below).
Soil moisture noise	An estimate of the uncertainty of soil moisture is given in the parameter soil moisture noise. The unit is degree of saturation [%].
Porosity (LDAS)	The porosity is a measure of the void spaces in the soil and defined as the fraction of the volume of voids over the total volume. The parameter is given in m^3 m^{-3} and can be used to transform the relative soil moisture % into absolute units m^3 m^{-3}.

	This parameter was resampled from the soil porosity used in the Land Data Assimilation System (LDAS) dataset (Reynolds 2000) by NASA.
Porosity (HWSD)	See porosity description above. This parameter was derived using soil information from the Harmonized World Soil Database (HWSD) (FAO/IIASA/ISRIC/ISSCAS/JRC 2012) by applying the formulas of Saxton and Rawls (2006)
Orbit direction	The orbit direction indicates the movement of the spacecraft through the plane of reference. The ascending direction represents a movement north through the plane of reference, and the descending south through the plane of reference.
Processing flag	The processing flags comprise information about internal quality checks and specific processing details.
Surface state flag	The Surface State Flag (SSF) indicates the surface conditions: unknown, unfrozen, frozen, temporary melting/water on the surface or permanent ice.
Frozen probability	This frozen probability flag is built on a historic analysis of modelled climate data (ERA-40, Uppala et al. (2005)) and gives the probability for the frozen soil/canopy conditions for each day of the year.
Snow probability	This snow probability flag is built on a historic analysis of SSM/I snow cover data and gives the probability for the occurrence of snow for any day of the year.
Inundation and wetland fraction	The fraction coverage of inundated and wetland areas are derived from a combined analysis of the Global Lakes and Wetlands Database (GLWD) Level 3 product (2004) and the Global Self-consistent, Hierarchical, High-resolution Shoreline database GSHHS (v1.5, 2004) which includes several wetland and inundation types.
Topographic complexity	The topographic complexity flag is derived from the GTOPO30 data. The standard deviation of elevation is calculated and globally normalized between 0 and 100.

Table 2 Overview of product parameters.

A conversion from degree of saturation (%) to absolute units (m^3 m^{-3}) is possible by multiplying with porosity:

$$\theta = p \cdot \frac{s}{100}$$

where θ is absolute soil moisture in m^3 m^{-3}, p is porosity in m^3 m^{-3} and s is degree of saturation (%). As it can be seen in this equation, the accuracy of soil porosity is as import as the relative soil moisture content.

2.2 Product resolution and grid

The spatial resolution of the product is 25x25 km and based on the WARP 5 grid [RD-1]. The WARP 5 grid represents a discrete global grid (DGG) with a grid spacing of 12.5 km. In total, there are 3264391 grid points, where 839826 are land points. The location of the points can be viewed interactively with the internet browser tool "DGG Point Locator" (Figure 1) at the following location:

http://www.ipf.tuwien.ac.at/radar/dv/dgg

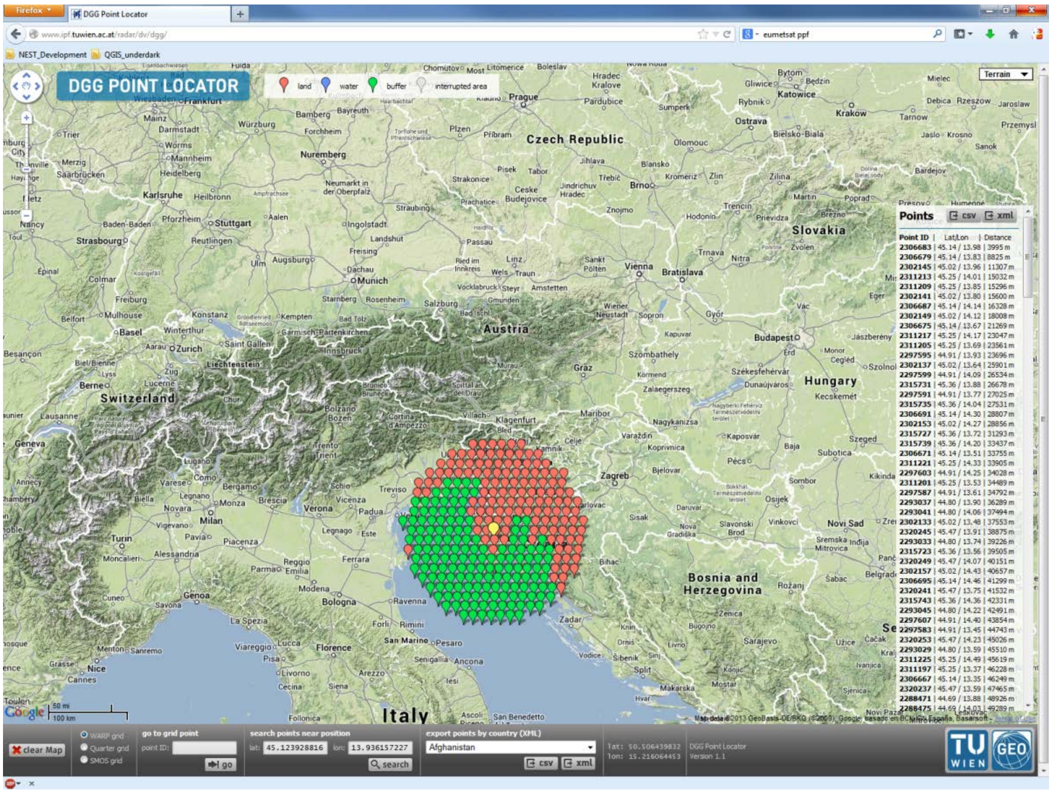

Figure 1: Screenshot of the DGG point locator.

2.3 Structure and format of the product

2.3.1 Data file format and file naming

The product is provided as time series on a global discrete grid (DGG) stored in NetCDF-4. All files follow the NetCDF Climate and Forecast (CF) Metadata Conventions version 1.6 [RD-3]. The grid points are organised in cells, in order to reduce the number of files. The cell size is defined as 5 x 5 degree and does contain up to 2000 grid points, mainly depending on the latitude. The cell number and the number of grid points per cell are shown in Figure 2.

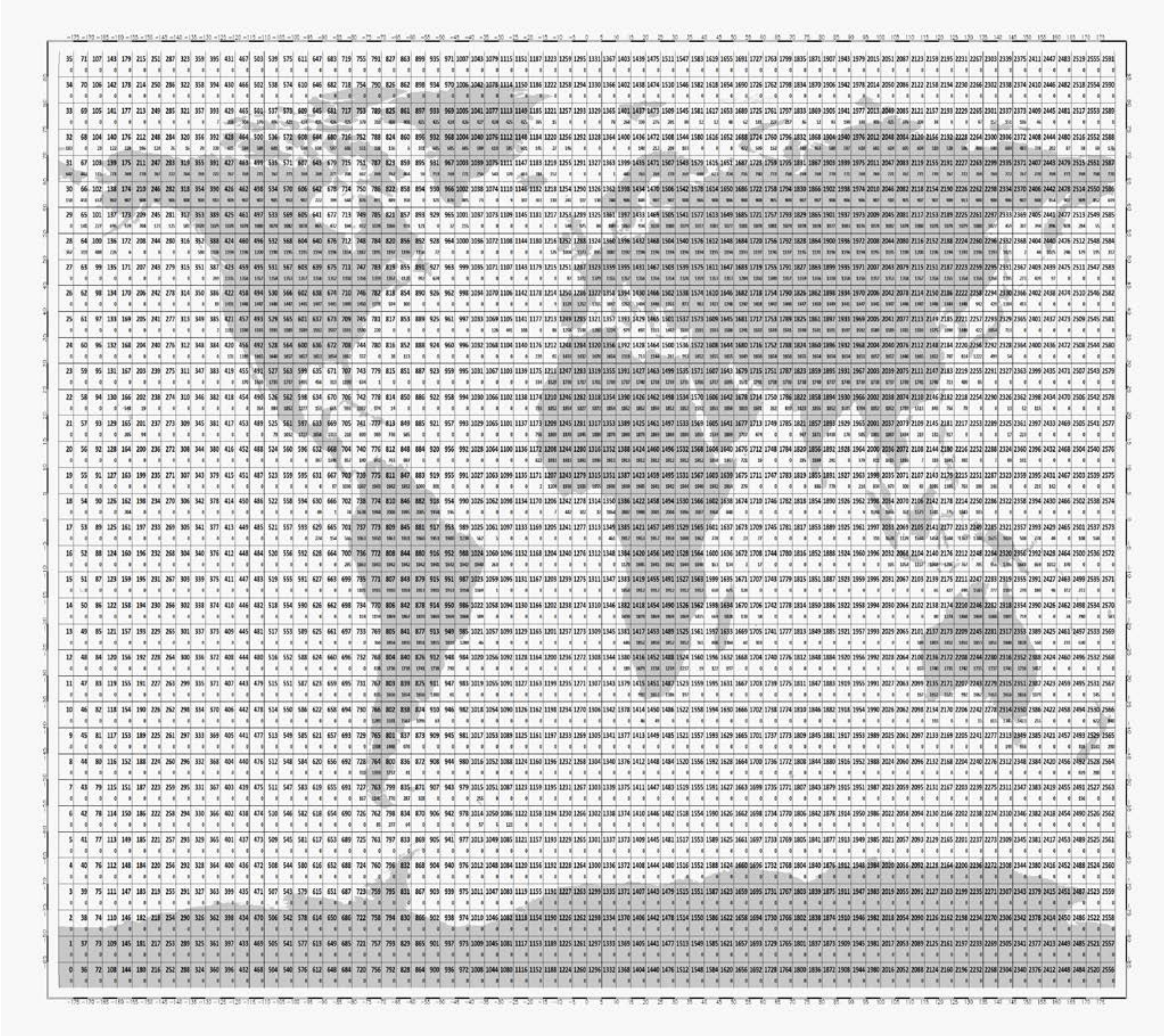

Figure 2: 5x5 degree cell partitioning of the grid points. The upper number in each cell represents the cell number and the lower number the number of grid points in this cell.

A look-up containing GPI cell number, longitude and latitude can be found in this file:

`TUW_WARP5_grid_info_<version>.nc`

The file naming is:

`TUW_METOP_ASCAT_<version><release>_<cell>.nc`

A NetCDF file for cell number 234 of product version WARP5.5 R1.2 looks like this:

`TUW_METOP_ASCAT_WARP55R12_0234.nc`

2.3.2 NetCDF file structure

2.3.2.1 Contiguous ragged array representation of time series

The time series are stored in the contiguous ragged array representation defined by the NetCDF Climate and Forecast (CF) Metadata Conventions version 1.6 [RD-3]. The time series parameters (like soil moisture, soil moisture noise) are associated with the coordinate values *time(obs), lat(i) and lon(i),* where *i* indicates which time series. The time series *i* comprises the following data elements:

```
rowStart(i) to rowStart(i) + row_size(i)-1
```

where

```
rowStart(i) = 0 if i = 0
rowStart(i) = rowStart(i-1) + row_size(i-1) if i > 0
```

The variable *row_size* is the count variable containing the length of each time series feature. It is identified by having an attribute with name *sample_dimension* whose value is name of the sample dimension (*obs* in this case). The auxiliary coordinate variables *lat* and *lon* are GPI variables.

2.3.2.2 **Global NetCDF attributes**

In general the global attributes will be static and do not vary between files for the same file version containing the same product version, with the exception of those attributes whose content is noted by a variable (denoted as <variable>). The Global NetCDF attributes are described in Table 3.

Global Attribute Name	Content
title	Metop ASCAT Soil Moisture Time Series
institution	Vienna University of Technology
source	Metop ASCAT Level 1b 25km backscatter
Conventions	CF-1.6
product_version	<product version>
id	<filename>
date_created	<file creation date>
creator_url	http://rs.geo.tuwien.ac.at/
project	H-SAF
geospatial_lat_min	<lat min>
geospatial_lat_max	<lat max>
geospatial_lon_min	<lon min>
geospatial_lon_max	<lon max>
time_coverage_start	20070101T000000Z
time_coverage_ed	20130712T000000Z
platform	Metop-A
sensor	ASCAT
geospatial_lon_resolution	12.5 km
geospatial_lat_resolution	12.5 km

Table 3 Global NetCDF Attributes

2.3.2.3 NetCDF variables and attributes

The rest of the file attributes is described in the following tables.

NetCDF Attribute	Description
long_name	Grid Point Index
cf_role	timeseries_id
coordinates	lat lon
valid_range	[0, 3264390]

Table 4 Attribute table for variable gpi

NetCDF Attribute	Description
standard_name	longitude
long_name	grid point longitude
units	degree_east
valid_range	[-180.0, 180.0]

Table 5 Attribute table for variable lon

NetCDF Attribute	Description
standard_name	latitude
long_name	grid point latitude
units	degree_north
valid_range	[-90.0, 90.0]

Table 6 attribute table for variable lat

NetCDF Attribute	Description
sample_dimension	obs
long_name	Number of observations for this grid point

Table 7 Attribute table for variable row_size

NetCDF Attribute	Description
standard_name	Time
long_name	Time of measurement
coordinates	time lat lon

Table 8 Attribute table for variable jd

NetCDF Attribute	Description
long_name	Soil Moisture
units	%
coordinates	time lat lon

valid_range	[0, 100]
missing_value	-1

Table 9 Attribute table for variable sm

NetCDF Attribute	Description
long_name	Soil Moisture Noise
units	%
coordinates	time lat lon
valid_range	[0, 100]
missing_value	-1

Table 10 Attribute table for variable sm_noise

NetCDF Attribute	Description
long_name	Orbit direction
coordinates	time lat lon

Table 11 Attribute table for variable orbit_dir

NetCDF Attribute	Description
long_name	Processing flag
flag_values	0, 1, 2, 4, 8, 16
coordinates	time lat lon
flag_meanings	• default • soil_moisture_set_to_0_since_it_was_between_0_and_-50 • soil_moisture_set_to_100_it_was_between_100_and_150 • soil_moisture_set_to_NaN_it_was_below_-50 • soil_moisture_set_to_NaN_it_was_above_150 • normalised_backscatter_is_out_of_limits_or_dry_wet_reference_is_NaN
valid_range	[0, 16]
missing_value	-1

Table 12 Attribute table for variable proc_flag

NetCDF Attribute	Description
long_name	Porosity resampled from NASA's LDAS
units	m^3 m^{-3}
coordinates	lat lon
valid_range	[0, 1]
missing_value	-1

Table 13 Attribute table for variable por_gldas

NetCDF Attribute	Description
long_name	Porosity derived from HWSD
units	m^3 m^{-3}
coordinates	lat lon
valid_range	[0, 1]
missing_value	-1

Table 14 Attribute table for variable por_hwsd

NetCDF Attribute	Description
long_name	Surface State Flag
flag_values	0, 1, 2, 3, 4
coordinates	time lat lon
flag_meanings	• unknown • unfrozen • frozen_temporary • melting_water_on_the_surface • permanent_ice
valid_range	[0, 4]
missing_value	-1

Table 15 Attribute table for variable ssf

NetCDF Attribute	Description
long_name	Frozen probability
units	%
coordinates	doy lat lon
valid_range	[0, 100]
missing_value	-1

Table 16 Attribute table for variable frozen

NetCDF Attribute	Description
long_name	Snow probability
units	%
coordinates	doy lat lon
valid_range	[0, 100]
missing_value	-1

Table 17 Attribute table for variable snow

NetCDF Attribute	Description
long_name	Inundation and wetland fraction

units	%
coordinates	lat lon
valid_range	[0, 100]
missing_value	-1

Table 18 Attribute table for variable wetland

NetCDF Attribute	Description
long_name	Topographic complexity
units	%
coordinates	lat lon
valid_range	[0, 100]
missing_value	-1

Table 19 Attribute table for variable topo

NetCDF Attribute	Description
long_name	Day of year
units	days

Table 20 Attribute table for variable doy

2.3.3 Example NetCDF file

An example of the NetCDF product is shown in the following Figure 3. The viewer used for this example is ncBrowse, available at:

http://www.epic.noaa.gov/java/ncBrowse/

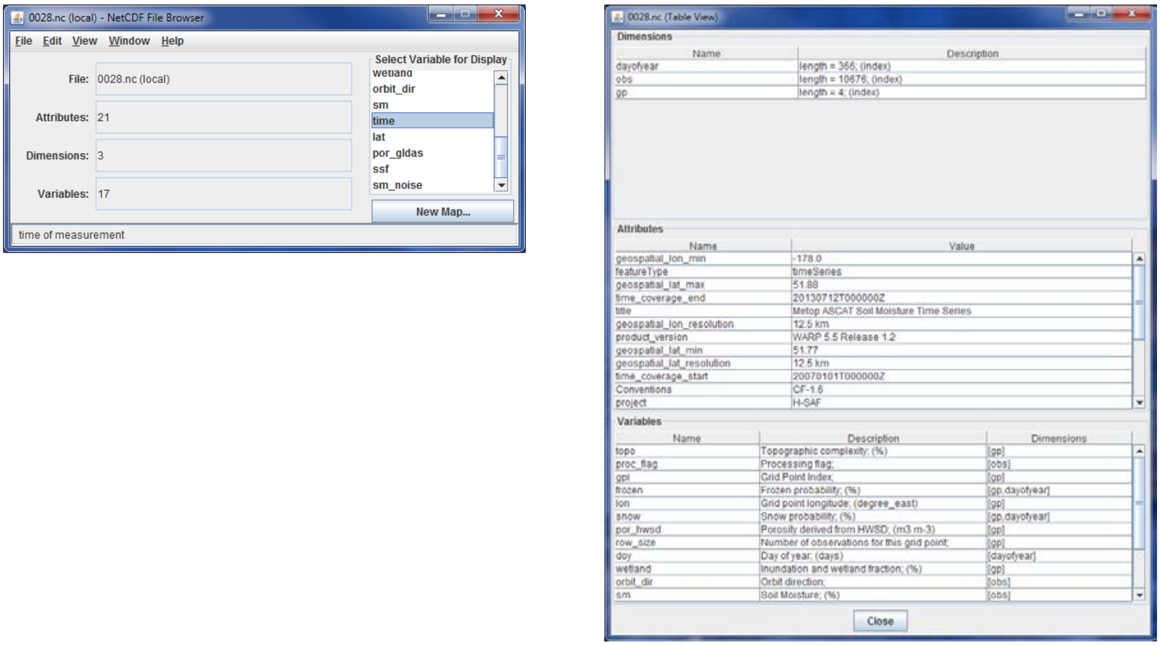

Figure 3 An example of a NetCDF file using the software ncBrowse. The left image shows ncBrowse after opening the NetCDF file and the right image shows all dimensions (top), attributes (middle) and variables (bottom) in a table view.

The netCDF files can also be easily read using the open source python package *pytesmo* (Toolbox for the Evaluation of Soil Moisture Observations). For more information (installation instructions, documentation, examples and links to the source code) please consult the pytesmo website at:

http://rs.geo.tuwien.ac.at/validation_tool/pytesmo/.

After Downloading the NetCDF files as well as the grid information NetCDF file to your computer the data can be read with pytesmo and plotted with the *matplotlib* library using the following example program. The output time series plot is shown in Figure 4.

```
import matplotlib.pyplot as plt
import pytesmo.io.sat.ascat as ascat
import os
ascat_folder = os.path.join('path','to','downloaded','NetCDF','files')
# path to which you downloaded the NetCDF files
ascat_grid_folder = os.path.join('path','to','grid','NetCDF','file')
#path to the grid file TUW_warp5_grid_info_<version>.nc

ascat_SSM_reader = ascat.AscatH25_SSM(ascat_folder, ascat_grid_folder)

gpi = 2329253
result = ascat_SSM_reader.read_ssm(gpi)

#alternative way using lon, lat
#lon = 14.284
#lat = 45.698
#result = ascat_SSM_reader.read_ssm(lon, lat)

result.plot()
plt.show()
```

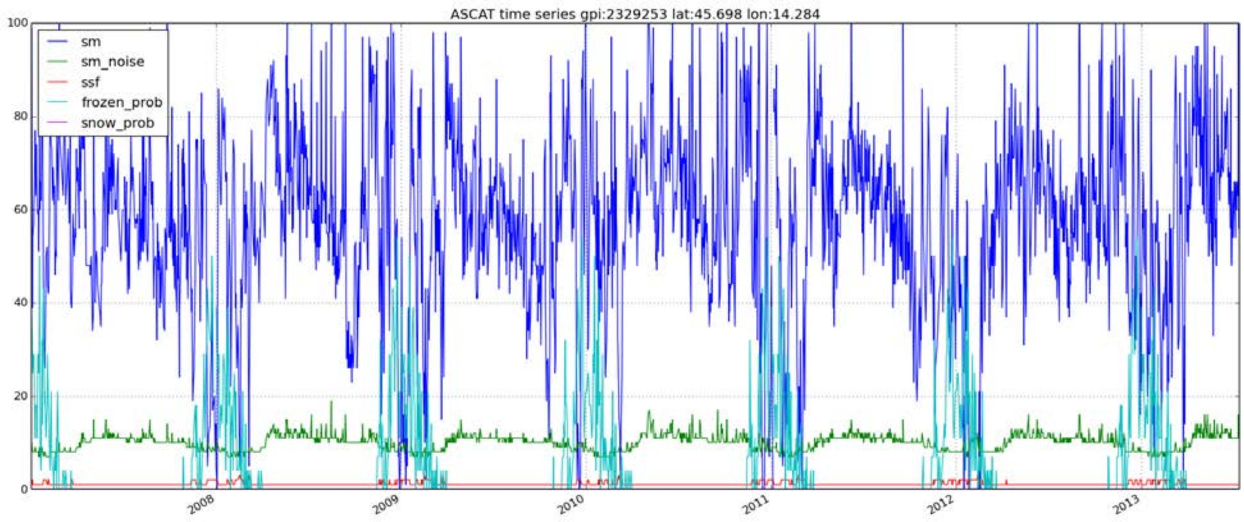

Figure 4: Time series plot of all available variables at a grid point in Slovenia, plotted with the pytesmo software

2.4 Product change log

The following Table 21 lists the product changes with the most recent version on top.

Product version/release	Description	Algorithm changes
WARP5.5 R1.2	Extension of time-series 2013-03-01 to 2013-07-12 Processed: Sep 2013	

WARP5.5 R1.1	Reprocessing 2007-01-01 to 2013-02-28 Processed: Mar 2013	Inter-beam calibration of Level 1 backscatter data applied.
WARP5.5 R0.1	Reprocessing 2007-01-01 to 2012-11-30 Processed: Dec 2012 – Jan 2013	
WARP5.4 R2.2	Extension of time-series 2011-12-31 to 2012-05-31 Processed: Jun 2012	
WARP5.4 R2.1	Reprocessing 2007-01-01 to 2011-12-31 Processed: Feb 2012	The criterion for a successful fit to the logistic function during freeze-thaw computation turned out to be too strict, resulting in many invalid SSFs, particularly in the northern regions. The criterion has been relaxed.
WARP5.4 R1.4	Extension of time-series (2007-01-01 to 2011-12-31) Processed: Jan 2012	
WARP5.4 R1.3	Extension of time-series 2011-06-11 to 2011-08-17 Processed: Nov 2011	
WARP5.4 R1.2	Extension of time-series 2010-12-31 to 2011-06-11 Processed: Nov 2011	
WARP5.4 R1.1	Reprocessing 2007-01-01 to 2010-12-31 Processed: Nov 2011	Correction of SSF computation.
WARP5.4 R0.1	Reprocessing 2007-01-01 to 2010-12-31 Processed: May – Jun 2011	

Table 21 Product change log.

2.5 Data Citation

The data set should be cited using the complete references as follows:

[1] W. Wagner, G. Lemoine, and H. Rott, “A method for estimating soil moisture from ERS scatterometer and soil data,” Remote Sensing of Environment, vol. 70, no. 2, pp. 191–207, 1999.

[2] V. Naeimi, K. Scipal, Z. Bartalis, S. Hasenauer, and W. Wagner, “An Improved Soil Moisture Retrieval Algorithm for ERS and METOP Scatterometer Observations,” IEEE Trans. Geosci. Remote Sensing, vol. 47, no. 7, pp. 1999–2013, 2009.

[3] V. Naeimi, C. Paulik, A. Bartsch, W. Wagner, R. Kidd, S.-E. Park, K. Elger, and J. Boike, “ASCAT Surface State Flag (SSF): Extracting Information on Surface Freeze/Thaw Conditions From Backscatter Data Using an Empirical Threshold-Analysis Algorithm,” IEEE Transactions on Geoscience and Remote Sensing, 2012.

[4] Naeimi, V., Paulik, C., Bartsch, A., Wagner, W., Kidd, R., Park, S.-E., Elger, K., Boike, J. (2012). ASCAT Surface State Flag (SSF): Extracting Information on Surface Freeze/Thaw Conditions From Backscatter Data Using an Empirical Threshold-Analysis Algorithm. IEEE Transactions on Geoscience and Remote Sensing, 50(7), 2566–2582. doi:10.1109/TGRS.2011.2177667

3 Product validation

Detailed information about product validation can be found in the corresponding Algorithmic Theoretical Baseline Document (ATBD) [RD-2].

4 Product availability

4.1 Site

The product is available via FTP. Login details are available after contacting the user help desk at http://hsaf.meteoam.it/

4.2 Conditions for use

All H-SAF products are owned by EUMETSAT, and the EUMETSAT SAF Data Policy applies. They are available for all users free of charge.

Users should recognise the respective roles of EUMETSAT, the H-SAF Leading Entity and the H-SAF Consortium when publishing results that are based on H-SAF products. EUMETSAT's ownership and intellectual property rights into the SAF data and products is best safeguarded by simply displaying the words "**© EUMETSAT**" under each of the SAF data and products shown in a publication or website.

5 Reference documents

[RD-1] WARP 5 grid document, version 0.3, 4 October 2013, Vienna University of Technology, Austria

[RD-2] Algorithm Theoretical Baseline Document (ATBD) for product H25/SM-OBS-4 METOP ASCAT Soil Moisture Time Series, version 0.3, 16 October 2013

[RD-3] NetCDF Climate and Forecast (CF) Metadata Conventions: Version 1.6, 5 December, 2011, Brian Eaton, Jonathan Gregory, Bob Drach, Karl Taylor, and Steve Hankin

6 References

FAO/IIASA/ISRIC/ISSCAS/JRC (2012). Harmonized World Soil Database (version 1.2)

Figa-Saldaña, J., Wilson, J.J.W., Attema, E., Gelsthorpe, R., Drinkwater, M.R., & Stoffelen, A. (2002). The advanced scatterometer (ASCAT) on the meteorological operational (MetOp) platform: A follow on for European wind scatterometers. Canadian Journal of Remote Sensing, 28, 404-412

Naeimi, V., Scipal, K., Bartalis, Z., Hasenauer, S., & Wagner, W. (2009). An improved soil moisture retrieval algorithm for ERS and METOP scatterometer observations. IEEE Transaction on Geoscience and Remote Sensing, 47, 1999-2013

Reynolds, C.A., T. J. Jackson, and W. J. Rawls (2000). Estimating soil water-holding capacities by linking the Food and Agriculture Organization soil map of the world with global pedon databases and continuous pedotransfer functions. Water Resour. Res., 36, 9

Saxton, K.E., & Rawls, W.J. (2006). Soil Water Characteristic Estimates by Texture and Organic Matter for Hydrologic Solutions. Soil Science Society of America Journal, 70, 1569

Uppala, S.M., Kallberg, P.W., Simmons, A.J., Andrae, U., Bechtold, V.D., Fiorino, M., Gibson, J.K., Haseler, J., Hernandez, A., Kelly, G.A., Li, X., Onogi, K., Saarinen, S., Sokka, N., Allan, R.P., Andersson, E., Arpe, K., Balmaseda, M.A., Beljaars, A.C.M., Van De Berg, L., Bidlot, J., Bormann, N., Caires, S., Chevallier, F., Dethof, A., Dragosavac, M., Fisher, M., Fuentes, M., Hagemann, S., Holm, E., Hoskins, B.J., Isaksen, L., Janssen, P., Jenne, R., McNally, A.P., Mahfouf, J.F., Morcrette, J.J., Rayner, N.A., Saunders, R.W., Simon, P., Sterl, A., Trenberth, K.E., Untch, A., Vasiljevic, D., Viterbo, P., & Woollen, J. (2005). The ERA-40 re-analysis. Quarterly Journal of the Royal Meteorological Society, 131, 2961-3012

Wagner, W., Lemoine, G., & Rott, H. (1999). A Method for Estimating Soil Moisture from ERS Scatterometer and Soil Data. Remote Sensing of Environment, 70, 191-207

Annex 1 - Introduction to H-SAF

The EUMETSAT Satellite Application Facilities

H-SAF is part of the distributed application ground segment of the "*European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)*". The application ground segment consists of a "*Central Application Facility (CAF)*" and a network of eight "*Satellite Application Facilities (SAFs*)" dedicated to development and operational activities to provide satellite-derived data to support specific user communities. See next figure:

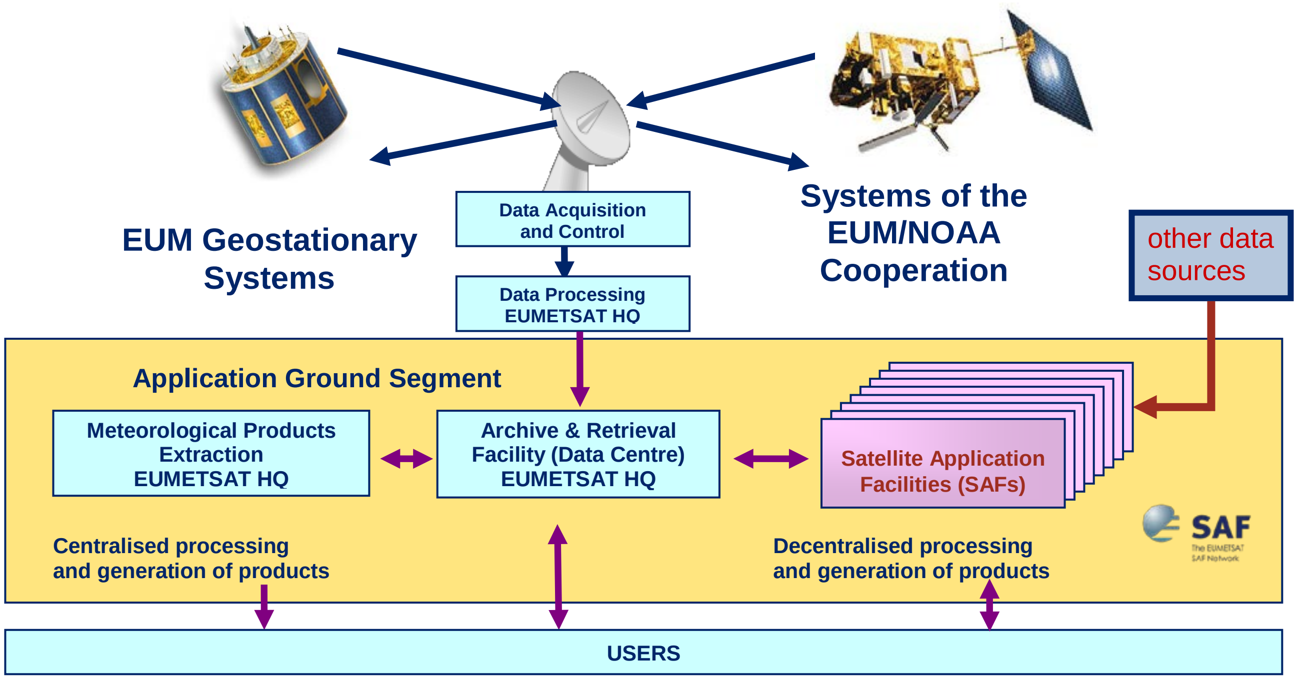

Figure 5 Conceptual scheme of the EUMETSAT Application Ground Segment

Next figure reminds the current composition of the EUMETSAT SAF network (in order of establishment).

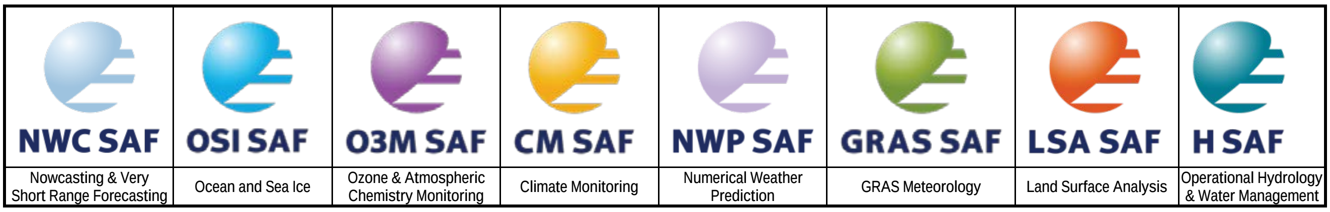

Figure 6 Current composition of the EUMETSAT SAF Network (in order of establishment)

H-SAF objectives and products

The H-SAF was established by the EUMETSAT Council on 3 July 2005; its Development Phase started on 1st September 2005 and ended on 31 August 2010. Its first Continuous Development and Operations Phase (CDOP) started on 28 September 2010 and ended on 28 February 2012. The SAF is now in its Second Continuous Development and Operations Phase (CDOP-2) started on 1 March 2012 and will end on 28 February 2017.

The H-SAF objectives are:

a. ***to provide new satellite-derived products*** from existing and future satellites with sufficient time and space resolution to satisfy the needs of operational hydrology; identified products:

- precipitation;
- soil moisture;
- snow parameters;

b. ***to perform independent validation of the usefulness of the new products*** for fighting against floods, landslides, avalanches, and evaluating water resources; the activity includes:

- downscaling/upscaling modelling from observed/predicted fields to basin level;
- fusion of satellite-derived measurements with data from radar and raingauge networks;
- assimilation of satellite-derived products in hydrological models;
- assessment of the impact of the new satellite-derived products on hydrological applications.

Annex 2 – Acronyms

ASAR	Advanced Synthetic Aperture Radar (on Envisat)
ASAR	GM ASAR Global Mode
ASCAT	Advanced Scatterometer (on MetOp)
ATDD	Algorithms Theoretical Definition Document
AU	Anadolu University (in Turkey)
BfG	Bundesanstalt für Gewässerkunde (in Germany)
BUFR	Binary Universal Form for the Representation of meteorological data
CAF	Central Application Facility (of EUMETSAT)
CC	Correlation Coefficient
CDA	Command and Data Acquisition station
CESBIO	Centre d'Etudes Spatiales de la BIOsphere (of CNRS, in France)
CM-SAF	SAF on Climate Monitoring
CNMCA	Centro Nazionale di Meteorologia e Climatologia Aeronautica (in Italy)
CNR	Consiglio Nazionale delle Ricerche (of Italy)
CNRS	Centre Nationale de la Recherche Scientifique (of France)
CORINE	COoRdination of INformation on the Environment
DPC	Dipartimento Protezione Civile (of Italy)
DWD	Deutscher Wetterdienst
EARS	EUMETSAT Advanced Retransmission Service
ECMWF	European Centre for Medium-range Weather Forecasts
Envisat	Environmental Satellite
ESA	European Space Agency
EUM	Short for EUMETSAT
EUMETCast	EUMETSAT's Broadcast System for Environmental Data
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FMI	Finnish Meteorological Institute
FTP	File Transfer Protocol
GEO	Geostationary Earth Orbit
GMES	Global Monitoring for Environment and Security
GRAS-SAF	SAF on GRAS Meteorology
H-SAF	SAF on Support to Operational Hydrology and Water Management
IFOV	Instantaneous Field Of View
IMWM	Institute of Meteorology and Water Management (in Poland)
IR	Infra Red
IRM	Institut Royal Météorologique (of Belgium) (alternative of RMI)
ISAC	Istituto di Scienze dell'Atmosfera e del Clima (of CNR, Italy)
ITU	İstanbul Technical University (in Turkey)
LATMOS	Laboratoire Atmosphères, Milieux, Observations Spatiales (of CNRS, in France)

LEO	Low Earth Orbit
LSA-SAF	SAF on Land Surface Analysis
LST	Local Solar Time (of a sunsynchronous orbit)
ME	Mean Error
Météo France	National Meteorological Service of France
MetOp	Meteorological Operational satellite
METU	Middle East Technical University (in Turkey)
MTF	Modulation Transfer Function
MW	Micro Wave
NMA	National Meteorological Administration (of Romania)
NOAA	National Oceanic and Atmospheric Administration (Agency and satellite)
NWC	Nowcasting
NWC-SAF	SAF in support to Nowcasting & Very Short Range Forecasting
NWP	Numerical Weather Prediction
NWP-SAF	SAF on Numerical Weather Prediction
O3M-SAF	SAF on Ozone and Atmospheric Chemistry Monitoring
OMSZ	Hungarian Meteorological Service
ORR	Operations Readiness Review
OSI-SAF	SAF on Ocean and Sea Ice
Pixel	Picture element
PNG	Portable Network Graphics
PUM	Product User Manual
PVR	Product Validation Report
REP-3	H-SAF Products Valiadation Report
RMI	Royal Meteorological Institute (of Belgium) (alternative of IRM)
RMSE	Root Mean Square Error
SAF	Satellite Application Facility
SAR	Synthetic Aperture Radar
SD	Standard Deviation
SHMÚ	Slovak Hydro-Meteorological Institute
SYKE	Suomen ympäristökeskus (Finnish Environment Institute)
TKK	Teknillinen korkeakoulu (Helsinki University of Technology)
TSMS	Turkish State Meteorological Service
TU-Wien	Technische Universität Wien (in Austria)
UniFe	University of Ferrara (in Italy)
URL	Uniform Resource Locator
UTC	Universal Coordinated Time
VIS	Visible
WARP-H	WAter Retrieval Package for hydrologic applications
ZAMG	Zentralanstalt für Meteorologie und Geodynamik (of Austria)