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

EUMETSAT
H SAF
SUPPORT TO OPERATIONAL HYDROLOGY AND WATER MANAGEMENT

Product User Manual (PUM) for product H13 – SN-OBS-4

Snow water equivalent by MW radiometry

Reference Number:	SAF/HSAF/PUM-13
Issue/Revision Index:	1.1
Last Change:	06 April 2018

DOCUMENT CHANGE RECORD

Issue / Revision	Date	Description
1.0	20/01/2012	Baseline version prepared for ORR1 Part 3
1.1	06/04/2018	Annex 1 updated

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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 Introduction to product SN-OBS-4

1.2.1 Principle of sensing

Product SN-OBS-4 (*Snow water equivalent by MW radiometry*) is fundamentally based on the AMSR-E microwave radiometer being flown on EOS-Aqua. In case of failure of AMSR-E or of EOS-Aqua, SSM/I and SSMIS flown on the DMSP satellites will be used (with worse resolution). These conical scanners provide images with constant zenith angle, that implies constant optical path in the atmosphere and homogeneous impact of the polarisation effects (see next figure).

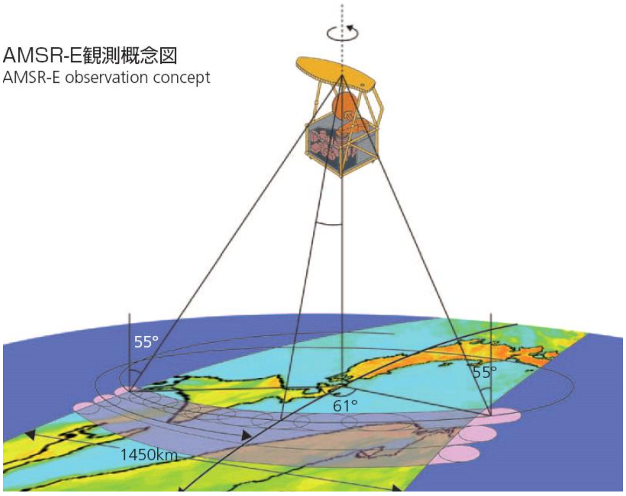


Figure 1 Geometry of conical scanning for AMSR-E

Also, conical scanning provides constant resolution across the image, though changing with frequency. It is noted that the IFOV is elliptical, with major axis elongated along the viewing direction and the minor axis along-scan, approximately 2/3 of the major. As for the 'pixel', i.e. the area subtended as a consequence of the bi-dimensional sampling rate, the sampling distance along the satellite motion, i.e. from scan line to scan line, is invariably 10 km, dictated by the satellite velocity on the ground and the scan rate. Along scan, the sampling rate is 10 km for all channels except 89 GHz where is 5 km.

The SN-OBS-4 product is actually the result of an assimilation process. The basic (very sparse) ground network of stations performing snow depth observation provides a first guess field that is converted into MW brightness temperatures by an emission model that also accounts for forests. The assimilation process forces the first guess field to optimally match the AMSR-E brightness temperatures.

The retrieval algorithm is somewhat different for flat or forested area and for mountainous regions. SN-OBS-4 is generated in Finland by FMI and in Turkey by TSMS. The products from FMI and from TSMS both cover the full H-SAF area, but thereafter are merged at FMI by blending the information on flat/forested areas from the FMI product and that one on mountainous areas from the TSMS product, according to the mask shown here below:

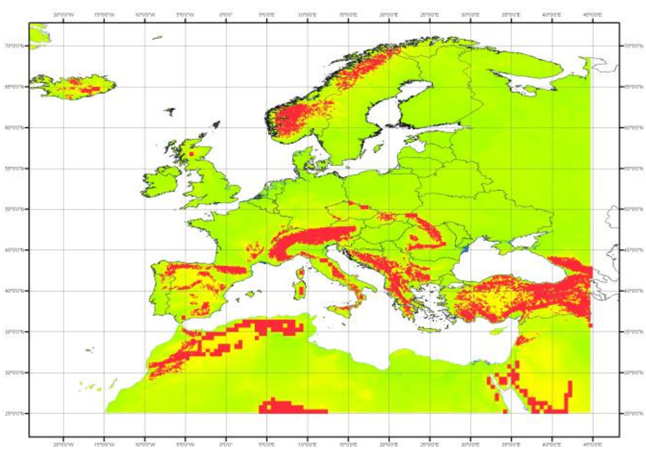


Figure 2 Mask flat/forested versus mountainous regions

1.2.2 Status of satellites and instruments

The current status of the EOS-Aqua satellite embarking AMSR-E is shown in the following table:

Satellite	Launch	End of service	Height	LST or inclin.	Status	Instrument used in H-SAF
EOS-Aqua	4 May 2002	expected ≥ 2010	705 km	13:30 a	AMSRE Defunctional	AMSR-E
DMSP-series F16, F17, F18	Oct 18 2009 (F18)	F18 expected ≥ 2014 F19 to be launched 2012	nominal 833 km	98.8°	Operational	SSMI/S

Table 1 Current status of the EOS-Aqua satellite and DMSP-satellites (as of January 2012)

Next table collects the main features of the AMSR-E:

AMSR-E	**Advanced Microwave Scanning Radiometer for EOS**
Satellite	**EOS-Aqua**
Status	**Operational** - Utilised in the period: 2002 to ~ 2010
Mission	Multi-purpose MW imager
Instrument type	Multi-purpose imaging MW radiometer - 6 frequencies / 12 channels
Scanning technique	Conical: 55° zenith angle; swath: 1450 km - Scan rate: 40 scan/min = 10 km/scan
Coverage/cycle	Global coverage once/day
Resolution (s.s.p.)	Changing with frequency, consistent with an antenna diameter of 1.6 m
Resources	Mass: 314 kg - Power: 350 W - Data rate: 87.4 kbps

Central frequency (GHz)	Bandwidth (MHz)	Polarisations	Accuracy (NEΔT)	IFOV	Pixel
6.925	350	V, H	0.3 K	43 x 75 km	10 x 10 km
10.65	100	V, H	0.6 K	29 x 51 km	10 x 10 km
18.7	200	V, H	0.6 K	16 x 27 km	10 x 10 km
23.8	400	V, H	0.6 K	14 x 21 km	10 x 10 km
36.5	1000	V, H	0.6 K	9 x 14 km	10 x 10 km
89.0	3000	V, H	1.1 K	4 x 6 km	5 x 5 km

SSMI/S	**Special Sensor Microwave Imager / Sounder**
Satellite	**DMSP F16, F17, F18**
Status	Operational – Utilised in the period: 2003 to ~ 2016
Mission	Multi-purpose MW imager with temperature/humidity sounding channels for improved precipitation
Instrument type	21-frequency, 24-channel MW radiometer
Scanning technique	Conical: 53.1° zenith angle, swath 1700 km – Scan rate: 31.9 scan/min = 12.5 km/scan
Coverage/cycle	Global coverage once/day / per satellite
Resolution (s.s.p.)	Changing with frequency, consistent with an antenna diameter of 61 x 66 cm
Resources	Mass: 96 kg - Power: 135 W - Data rate: 14.2 kbps

Central frequency (GHz)	Bandwidth (MHz)	Polarisations	Accuracy (NEΔT)	IFOV	Pixel
19.35	400	V, H	0.7 K	45 x 68 km	25.0 x 12.5 km
22.235	400	V	0.7 K	40 x 60 km	25.0 x 12.5 km
37.0	1500	V, H	0.5 K	24 x 36 km	25.0 x 12.5 km
50.3	400	H	0.4 K	18 x 27 km	37.5 x 12.5 km
52.8	400	H	0.4 K	18 x 27 km	37.5 x 12.5 km
53.596	400	H	0.4 K	18 x 27 km	37.5 x 12.5 km
54.4	400	H	0.4 K	18 x 27 km	37.5 x 12.5 km

55.5	400	H	0.4 K	18 x 27 km	37.5 x 12.5 km
57.29	350	-	0.5 K	18 x 27 km	37.5 x 12.5 km
59.4	250	-	0.6 K	18 x 27 km	37.5 x 12.5 km
60.792668 ± 0.357892 ± 0.050	120	V + H	0.7 K	18 x 27 km	37.5 x 12.5 km
60.792668 ± 0.357892 ± 0.016	32	V + H	0.6 K	18 x 27 km	75.0 x 12.5 km
60.792668 ± 0.357892 ± 0.006	12	V + H	1.0 K	18 x 27 km	75.0 x 12.5 km
60.792668 ± 0.357892 ± 0.002	6	V + H	1.8 K	18 x 27 km	75.0 x 12.5 km
60.792668 ± 0.357892	3	V + H	2.4 K	18 x 27 km	75.0 x 12.5 km
63.283248 ± 0.285271	3	V + H	2.4 K	18 x 27 km	75.0 x 12.5 km
91.655	3000	V, H	0.9 K	10 x 15 km	12.5 x 12.5 km
150	1500	H	0.9 K	.... x .... km	37.5 x 12.5 km
183.31 ± 6.6	1500	H	1.2 K	.... x .... km	37.5 x 12.5 km
183.31 ± 3.0	1000	H	1.0 K	.... x .... km	37.5 x 12.5 km
183.31 ± 1.0	500	H	1.2 K	.... x .... km	37.5 x 12.5 km

Table 2 Main features of AMSR-E and SSMI/S

1.2.3 Highlights of the algorithm

The baseline algorithm for SN-OBS-4 processing is described in ATDD-13. Only essential elements are highlighted here. Next figures illustrate the flow chart of the SN-OBS-4 processing chain, valid for flat/forested areas and for mountainous areas, respectively.

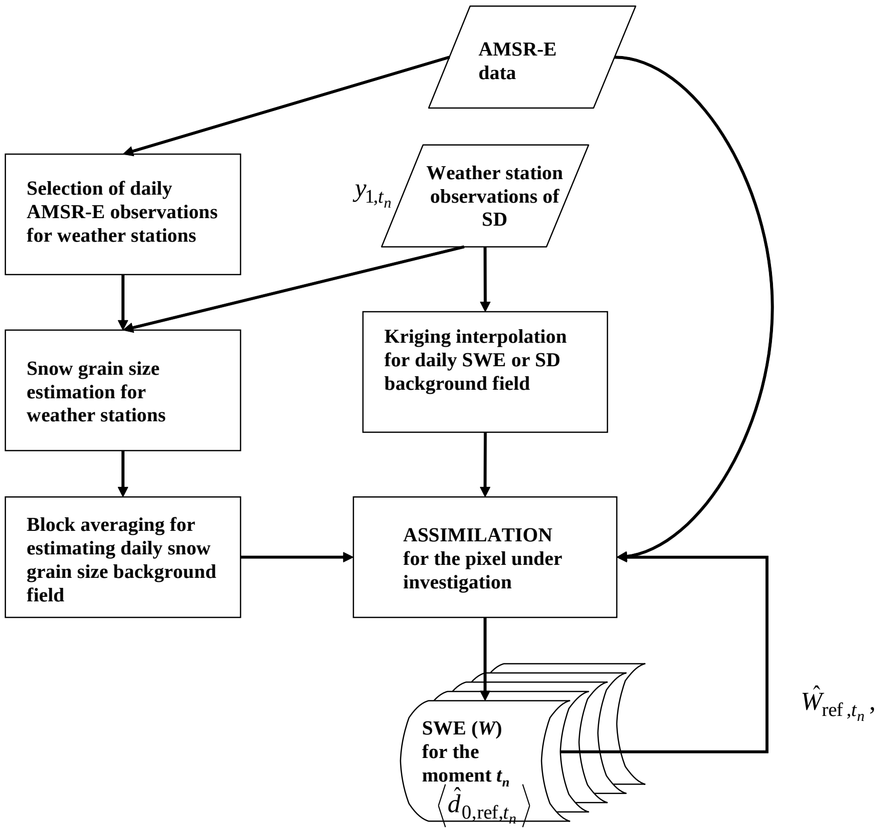


Figure 3 Flow diagram of the assimilation method in the case of AMSR-E observations in flat/forested areas (also significant for mountainous areas)

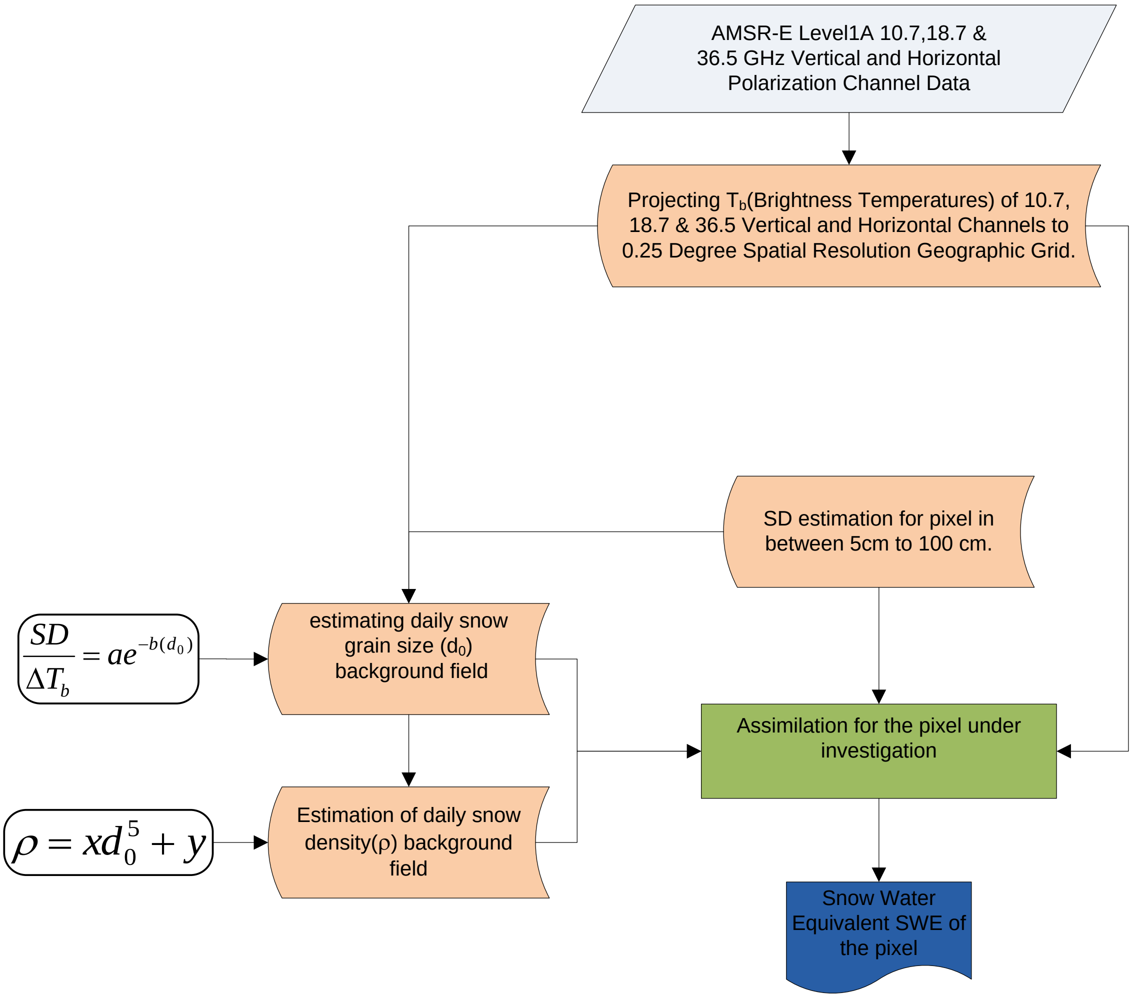


Figure 4 Flow diagram of the assimilation method in the case of AMSR-E observations in mountainous areas

The snow emission model describes the space-borne observed microwave brightness temperature as a function of snow pack characteristics and by considering the effects of atmosphere, forest canopy and land cover category (fractions of open and forested areas). A detailed description of the model and its performance is given by Pulliainen et al. 1999[1]. The emission from a snow pack is modeled by applying the Delta-Eddington-approximation to the radiative transfer equation (considering the magnitude of forward scatter by an empirical coefficient). The multiple reflections from snow-ground and snow-air boundaries are included using a non-coherent approach and the effect of forest canopy (transmissivity and emission) is included by employing an empirical model (Kruopis et al. 1999[2]). Finally, the transmissivity and emission contributions of the atmosphere are included using a statistical atmospheric model (Pulliainen et al. 1993[3]).

[1] Pulliainen J., J. Grandell and M. Hallikainen, 1999: "HUT snow emission model and its applicability to snow water equivalent retrieval". *IEEE Trans. Geosci. Remote Sensing*, 37, 1378–1390.

[2] Kruopis N., J. Praks, A.N. Arslan, H. Alasalmi, J. Koskinen and M. Hallikainen, 1999: "Passive microwave measurements of snow-covered forest areas in EMAC'95". *IEEE Trans. Geosci. Remote Sensing* 37:2699-2705.

[3] Pulliainen J., J.-P. Kärnä and M. Hallikainen, 1993: "Development of geophysical retrieval algorithms for the MIMR". *IEEE Trans. Geosci. Remote Sensing*, 31:268-277.

1.2.4 Architecture of the products generation chain

The architecture of the SN-OBS-4 product generation chain is shown here below in the figure:

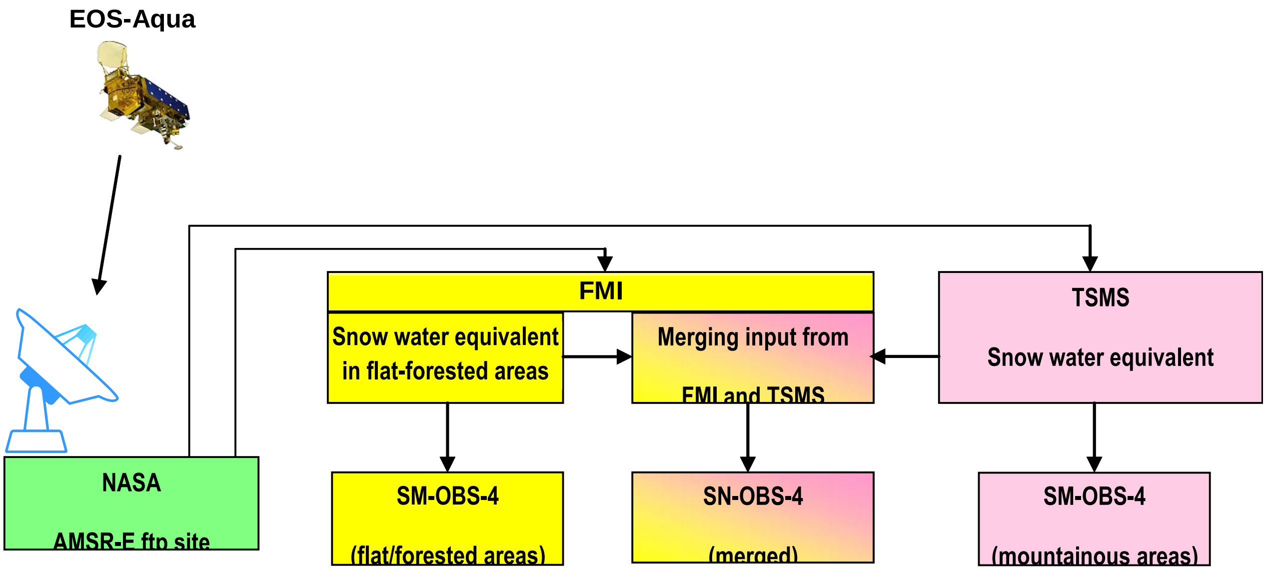
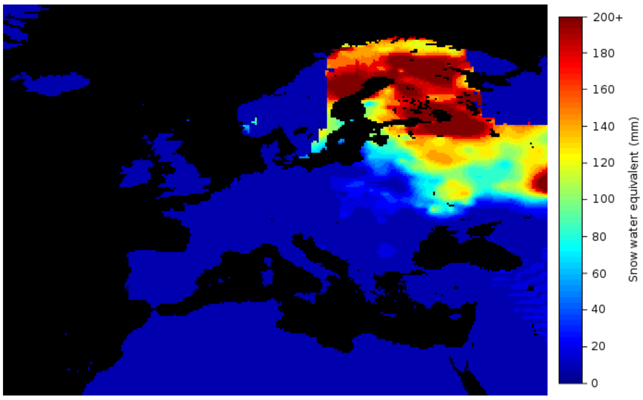


Figure 5 Conceptual architecture of the SN-OBS-4 chain

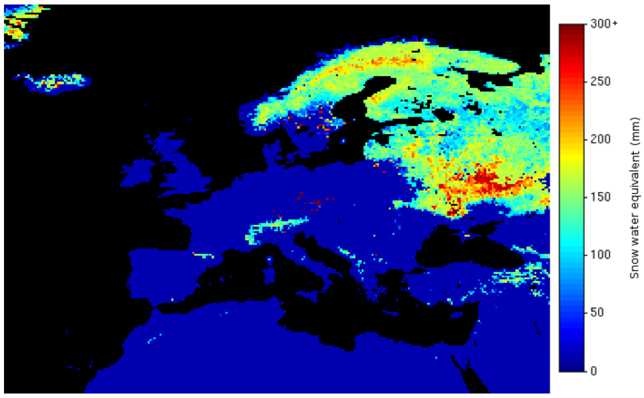
It is noted that the satellite data are acquired from the NASA EOS-Aqua AMSR-E FTP site. The product is generated both at FMI and at TSMS. The FMI product is tuned to flat/forested areas, that one from TSMS is tuned to mountainous areas. The TSMS data are delivered to FMI, that implements the merging of the two products.

1.2.5 Product coverage and appearance

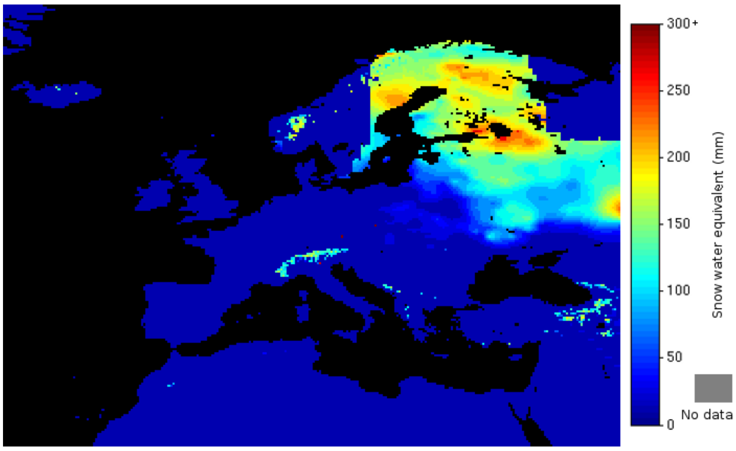
At the time of this writing, SN-OBS-4 is generated on a regular basis at FMI and TSMS. An example of map generated by FMI, TSMS, and merged, is provided in in the following figure:



Processed product from FMI, optimised for flat and forested areas



Processed product from TSMS, optimised for mountainous areas



Merged product from FMI and TSMS

Figure 6 Snow water equivalent from EOS-Aqua AMSR-E - Time-composite maps over 24 hours, 18 March 2010

2 Product operational characteristics

2.1 Horizontal resolution and sampling

The *horizontal resolution (Δx)* is the convolution of several features (sampling distance, degree of independence of the information relative to nearby samples, …). To simplify matters, it is generally agreed to refer to the sampling distance between two successive product values, assuming that they carry forward reasonably independent information. The horizontal resolution descends from the instrument Instantaneous Field of View (*IFOV*), sampling distance (*pixel*), Modulation Transfer Function (*MTF*) and number of pixels to co-process for filtering out disturbing factors (e.g. clouds) or improving accuracy. It may be appropriate to specify both the resolution Δx associated to independent information, and the *sampling distance*, useful to minimise aliasing problems when data have to undertake resampling (e.g., for co-registration with other data).

For MW conical scanners the IFOV is constant, but depends on the frequency channels utilised for building the product. The current algorithm utilises the two frequencies 18.7 and 36.5 GHz, thus the resolution is that one of AMSR-E at 18.7 GHz, i.e. ~ 20 km. Sampling is made at 0.25° intervals. To simplify matters, we quote as resolution ***Δx ~ 20 km***, and sampling distance ***~ 20 km***.

2.1.1 Vertical resolution if applicable

The *vertical resolution (Δz)* also is defined by referring to the vertical sampling distance between two successive product values, assuming that they carry forward reasonably independent information. The vertical resolution descends from the exploited remote sensing principle and the instrument number of channels, or spectral resolution. It is difficult to be estimated *a-priori*: it is generally evaluated *a-posteriori* by means of the validation activity.

The only product in H-SAF that provide profiles (below surface) is SM-ASS-1 (*Volumetric soil moisture (roots region) by scatterometer assimilation in NWP model*).

2.1.2 Observing cycle and time sampling

The *observing cycle (Δt)* is defined as the average time interval between two measurements over the same area. In general the area is, for GEO, the disk visible from the satellite, for LEO, the Globe. In the case of H-SAF we refer to the European area shown in Fig. 04. In the case of LEO, the observing cycle depends on the instrument swath and the number of satellites carrying the addressed instrument.

AMSR-E is available only on one satellite, and its swath is 1450 km, thus in principle provides global coverage every 24 h. Thus the observing cycle is ***Δt = 24 h***.

2.1.3 Timeliness

The *timeliness (δ)* is defined as the time between observation taking and product available at the user site assuming a defined dissemination mean. The timeliness depends on the satellite transmission facilities, the availability of acquisition stations, the processing time required to generate the product and the reference dissemination means. In the case of H-SAF the future dissemination tool is EUMETCast, but currently we refer to the availability on the FTP site.

For SN-OBS-4, that results from assembling data collected until a fixed time of the day, the time of observation may change across the scene (some area may have been observed early in the time window, thus up to 24-h old at the time of dissemination; some very recently, just before product dissemination). The average delay is therefore ***δ = 12 h***.

3 Product validation

3.1 Validation strategy

Whereas the previous operational characteristics have been evaluated on the base of system considerations (number of satellites, their orbits, access to the satellite) and instrument features (IFOV, swath, MTF and others), the evaluation of accuracy requires validation, i.e. comparison with the ground truth or with something assumed as "true". SN-OBS-4, as any other H-SAF product, has been submitted to validation entrusted to a number of institutes (see next figure).

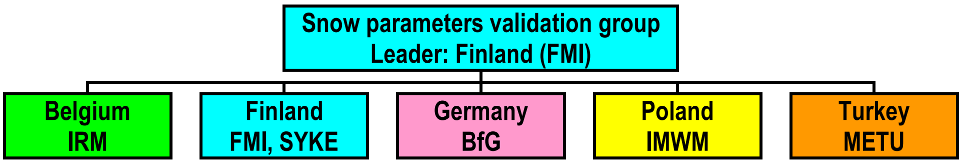


Figure 5 Structure of the Snow products validation team

The accuracy of the snow detection product has been assessed by comparison with meteorological bulletins and in-field measurements in properly equipped sites.

Detailed report of the product validation activity for product SN-OBS-4 is provided as document:

- PVR-13: Product Validation Report for SN-OBS-4.

In this PUM-13 only summary results are provided, mainly aiming at characterising the product quality under different geographical/climatological conditions (those in the countries of the participating validation Units) and different seasons.

4 Product availability

4.1 Site

SN-OBS-4 will be available via EUMETCast (when authorized) and via FTP (after log in).

The current access is via FTP at the following site:

- URL: ftp://ftp.meteoam.it
- to obtain user a password please contact the Help Desk.

In the FTP site there are three relevant directories:

- *products*, for near-real-time dissemination;
- *from_archive*, for previous months;
- *utilities*, for providing decoding tools.

4.1.1 Directory "*products*"

In this directory the products appear shortly after generation, consistently with the "timeliness" requirement. They are kept available for nominally 1-2 months, often more.

Quick-looks of the latest 3-5 SN-OBS-4maps, covering some H-SAF areas, can be viewed on the H-SAF web site http://hsaf.meteoam.it

4.1.2 Directory "*from_archive*"

Currently "reprocessed_2010". This directory holds the data of the previous months.

4.1.3 Directory "*utilities*"

This directory provides tools to decode and manage the digital data.

4.2 Formats and codes

Three types of files are provided for SN-OBS-4:

- the digital data from FMI and merged, coded in GRIB2
- the digital data from TSMS, coded in HDF5
- the image-like maps, coded in PNG

4.3 Description of the files

Current data

- Directory: *products*
- Sub-directory: *h13*
- Two folders:
  - h13_cur_mon_data
  - h13_cur_mon_png

In both directories *products* and *reprocess* the files have identical structures. Next table summarises the situation and provides the information on the file structure, including the legenda.

URL: ftp://ftp.meteoam.it	username: *hsaf*	password: *00Hsaf*	directory: *products*	folder: *h13*

Product identifier: *h13*.	h13_cur_mon_data		
Folders under h13:	h13_cur_mon_png		
Files description:	h13_cur_mon_data	h13_yyyymmdd_day_FMI.grib2.gz h13_yyyymmdd_QC_day_FMI.grib2.gz h13_yyyymmdd_day_merged.grib2.gz h13_yyyymmdd_QC_day_merged.grib2.gz	digital data + quality flag
	h13_cur_mon_png	h13_yyyymmdd_day_FMI.png h13_yyyymmdd_day_merged.png	image data
yyyymmdd:	year, month, day		
day:	indicates that the product results from multi-temporal analysis over 24 hours (in daylight)		
QC:	Quality Control: combination of interpolation residual error and availability of data: 10*round(interpolation error / 2) + X, where - X = 0: all data available, dry snow, assimilation made - X = 1: all data available, no dry snow, assimilation not made - X = 2: no satellite data - X = 3: no interpolation data - X = 4: mountainous area (TSMS product used partly for the pixel) - X = 5: water		

Table 3 Summary instructions for accessing SN-OBS-4 data

Annex 1. Introduction to H-SAF

The EUMETSAT Satellite Application Facilities

H-SAF is part of the distributed application ground segment of the "*European Organization for the Exploitation of Meteorological Satellites (EUMETSAT)*". The application ground segment consists of a "*Central Application Facilities*" located at EUMETSAT Headquarters, and a network of eight "*Satellite Application Facilities (SAFs*)", located and managed by EUMETSAT Member States and dedicated to development and operational activities to provide satellite-derived data to support specific user communities (see Figure 6):

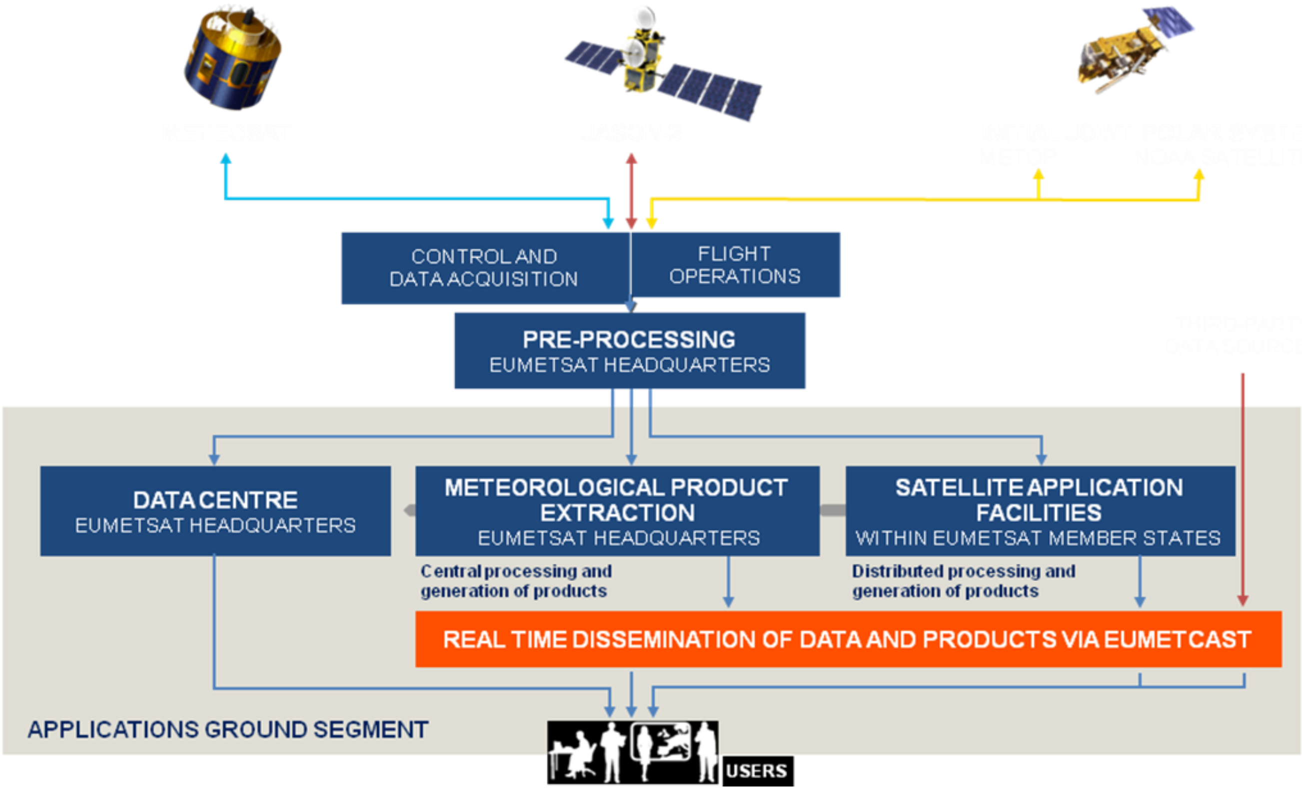


Figure 6: Conceptual scheme of the EUMETSAT Application Ground Segment

Figure here following depicts the composition of the EUMETSAT SAF network, with the indication of each SAF's specific theme and Leading Entity.

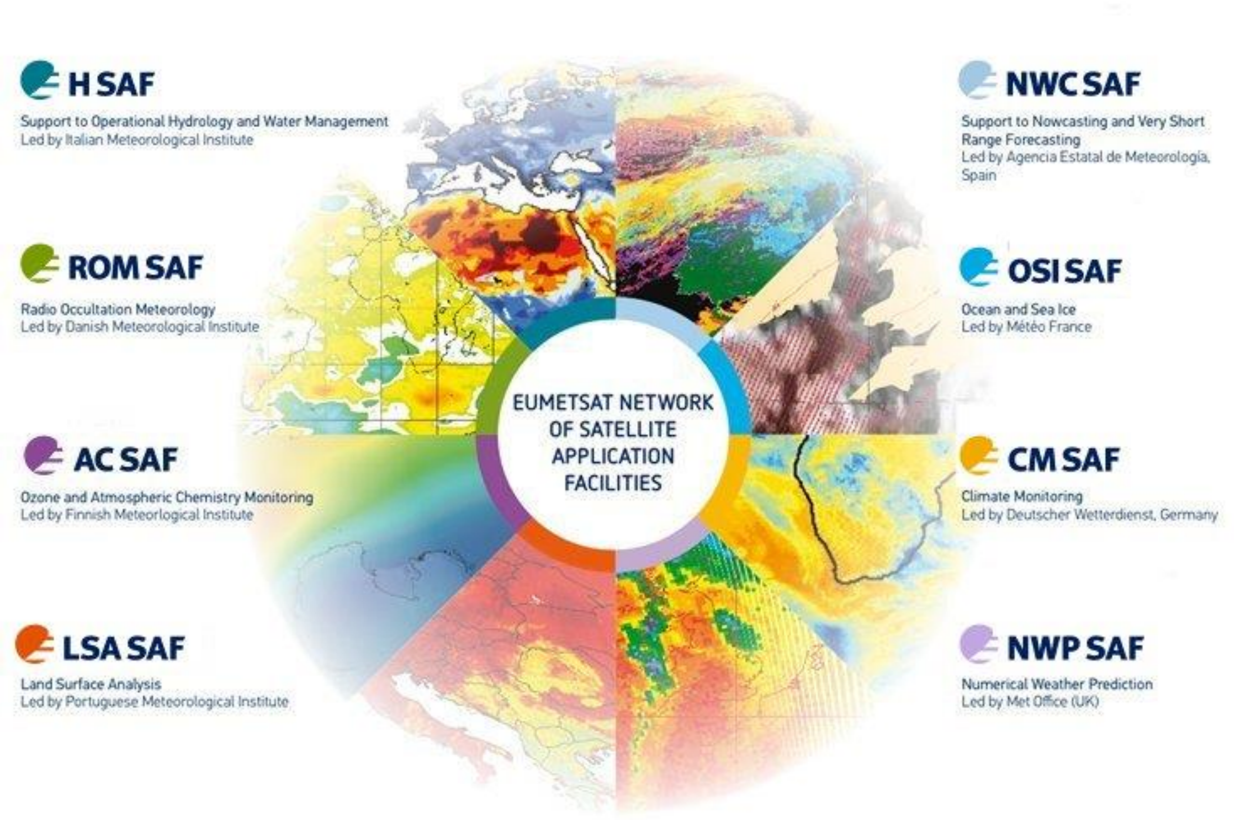


Figure 7: Current composition of the EUMETSAT SAF Network

Purpose of the H-SAF

The main objectives of H-SAF 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, by generating, centralizing, archiving and disseminating the identified products:
- precipitation (liquid, solid, rate, accumulated);
- soil moisture (at large-scale, at local-scale, at surface, in the roots region);
- snow parameters (detection, cover, melting conditions, water equivalent);

b. ***to perform independent validation of the usefulness of the 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.

Products / Deliveries of the H-SAF

For the full list of the Operational products delivered by H-SAF, and for details on their characteristics, please see H-SAF website hsaf.meteoam.it.

All products are available via EUMETSAT data delivery service (EUMETCast, http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html), or via ftp download; they are also published in the H-SAF website hsaf.meteoam.it.

All intellectual property rights of the H-SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge. If you wish to use these products, EUMETSAT's copyright credit must be shown by displaying the words "copyright (year) EUMETSAT" on each of the products used.

System Overview

H-SAF is led by the Italian Air Force Meteorological Service (ITAF MET) and carried on by a consortium of 21 members from 11 countries (see website: hsaf.meteoam.it for details)

Following major areas can be distinguished within the H-SAF system context:

- Product generation area
- Central Services area (for data archiving, dissemination, catalogue and any other centralized services)
- Validation services area which includes Quality Monitoring/Assessment and Hydrological Impact Validation.

Products generation area is composed of 5 processing centres physically deployed in 5 different countries; these are:

- for precipitation products: ITAF COMET (Italy)
- for soil moisture products: ZAMG (Austria), ECMWF (UK)
- for snow products: TSMS (Turkey), FMI (Finland)

Central area provides systems for archiving and dissemination; located at ITAF COMET (Italy), it is interfaced with the production area through a front-end, in charge of product collecting.

A central archive is aimed to the maintenance of the H-SAF products; it is also located at ITAF COMET. Validation services provided by H-SAF consists of:

- Hydrovalidation of the products using models (hydrological impact assessment);
- Product validation (Quality Assessment and Monitoring).

Both services are based on country-specific activities such as impact studies (for hydrological study) or product validation and value assessment.

Hydrovalidation service is coordinated by IMWM (Poland), whilst Quality Assessment and Monitoring service is coordinated by DPC (Italy): The Services’ activities are performed by experts from the national meteorological and hydrological Institutes of Austria, Belgium, Bulgaria, Finland, France, Germany, Hungary, Italy, Poland, Slovakia, Turkey, and from ECMWF.

Annex 2. Acronyms

AMSU	Advanced Microwave Sounding Unit (on NOAA and MetOp)
AMSU-A	Advanced Microwave Sounding Unit - A (on NOAA and MetOp)
AMSU-B	Advanced Microwave Sounding Unit - B (on NOAA up to 17)
ATDD	Algorithms Theoretical Definition Document
AU	Anadolu University (in Turkey)
BfG	Bundesanstalt für Gewässerkunde (in Germany)
CAF	Central Application Facility (of EUMETSAT)
CDOP	Continuous Development-Operations Phase
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)
DMSP	Defense Meteorological Satellite Program
DPC	Dipartimento Protezione Civile (of Italy)
EARS	EUMETSAT Advanced Retransmission Service
ECMWF	European Centre for Medium-range Weather Forecasts
EDC	EUMETSAT Data Centre, previously known as U-MARF
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
GRAS-SAF	SAF on GRAS Meteorology
HDF	Hierarchical Data Format
HRV	High Resolution Visible (one SEVIRI channel)
H-SAF	SAF on Support to Operational Hydrology and Water Management
IDL©	Interactive Data Language
IFOV	Instantaneous Field Of View
IMWM	Institute of Meteorology and Water Management (in Poland)
IPF	Institut für Photogrammetrie und Fernerkundung (of TU-Wien, in Austria)
IPWG	International Precipitation Working Group
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 Satellite Time (if referred to time) or Land Surface Temperature (if referred to temperature)
Météo France	National Meteorological Service of France
METU	Middle East Technical University (in Turkey)
MHS	Microwave Humidity Sounder (on NOAA 18 and 19, and on MetOp)
MSG	Meteosat Second Generation (Meteosat 8, 9, 10, 11)
MVIRI	Meteosat Visible and Infra Red Imager (on Meteosat up to 7)
MW	Micro Wave
NEΔT	Net Radiation
NESDIS	National Environmental Satellite, Data and Information Services
NMA	National Meteorological Administration (of Romania)
NOAA	National Oceanic and Atmospheric Administration (Agency and satellite)
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
PDF	Probability Density Function
PEHRPP	Pilot Evaluation of High Resolution Precipitation Products
Pixel	Picture element
PMW	Passive Micro-Wave
PP	Project Plan
PR	Precipitation Radar (on TRMM)
PUM	Product User Manual
PVR	Product Validation Report
RMI	Royal Meteorological Institute (of Belgium) (alternative of IRM)
RR	Rain Rate
RU	Rapid Update
SAF	Satellite Application Facility
SEVIRI	Spinning Enhanced Visible and Infra-Red Imager (on Meteosat from 8 onwards)
SHMÚ	Slovak Hydro-Meteorological Institute
SSM/I	Special Sensor Microwave / Imager (on DMSP up to F-15)
SSMIS	Special Sensor Microwave Imager/Sounder (on DMSP starting with S-16)
SYKE	Suomen ympäristökeskus (Finnish Environment Institute)
T_{BB}	Equivalent Blackbody Temperature (used for IR)
TKK	Teknillinen korkeakoulu (Helsinki University of Technology)
TMI	TRMM Microwave Imager (on TRMM)
TRMM	Tropical Rainfall Measuring Mission UKMO
TSMS	Turkish State Meteorological Service
TU-Wien	Technische Universität Wien (in Austria)
U-MARF	Unified Meteorological Archive and Retrieval Facility
UniFe	University of Ferrara (in Italy)
URD	User Requirements Document
UTC	Universal Coordinated Time
VIS	Visible
ZAMG	Zentralanstalt für Meteorologie und Geodynamik (of Austria)