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 H10 – SN-OBS-1

Snow detection (snow mask) by VIS/IR radiometry

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1.0	16/05/2011	Baseline version prepared for ORR1 Part 2. Obtained by PUM-10 delivered during the Development Phase.
1.1	30/09/2011	Updates, acknowledging ORR1 Part 2 review board recommendation
1.2	06/04/2018	Minor adjustments: • Document reference number as "PUM-10" instead of "PUM" • Annex 2 updated

INDEX

1 Introduction ... 5
1.1 Purpose of the document ... 5
1.2 Introduction to product SN-OBS-1 ... 5
1.2.1 Principle of sensing ... 5
1.2.2 Status of satellites and instruments ... 6
1.2.3 Highlights of the algorithm ... 6
1.2.4 Architecture of the products generation chain ... 8
1.2.5 Product coverage and appearance ... 10
1.3 Comparison between H10 (SN-OBS-1) and H11 (SN-OBS-2) ... 10
2 Product operational characteristics ... 11
2.1 Horizontal resolution and sampling ... 11
2.2 Vertical resolution if applicable ... 11
2.3 Observing cycle and time sampling ... 12
2.4 Timeliness ... 12
3 Product validation ... 13
3.1 Validation strategy ... 13
3.2 Summary of results ... 13
4 Product availability ... 14
4.1 Sites ... 14
4.2 Formats and codes ... 14
4.3 Description of the files ... 14
Annex 1. SN-OBS-1 Output description ... 16
Annex 2. Introduction to H-SAF ... 17
Annex 3. Acronyms ... 20

List of Tables

Table 1 Current status of Meteosat Second Generation satellites (as of March 2010) 6
Table 2 Main features of the SEVIRI instrument 6
Table 3 Comparison between H10 and H11: summary table... 11
Table 4 Statistical scores for SN-OBS-1 - Winter 2009-2010 - Threshold snow/no-snow for flat/forested areas: 1 cm depth 14
Table 5 Summary instructions for accessing SN-OBS-1 data at the CNMCA site 15
Table 6 Summary instructions for accessing SN-OBS-1 data at the FMI site 15
Table 7 Summary instructions for accessing SN-OBS-1 data at the TSMS site.. 15
Table 8 H-SAF Product List..**Errore. Il segnalibro non è definito.**
Table 9 Definition of the development status of a product according to EUMETSAT .**Errore. Il segnalibro non è definito.**

List of Figures

Figure 1 Mask flat/forested versus mountainous regions 6
Figure 2 Flow chart of the Snow Recognition processing chain in flat and forested areas 7
Figure 3 Flow chart of the Snow Recognition processing chain in mountainous regions................................ 8
Figure 4 Conceptual architecture of the SN-OBS-1 chain.. 9
Figure 5 Snow mask from SEVIRI - Time-composite maps from all observations in 24 hours from Meteosat-9, 9 March 2010... 10
Figure 6 Structure of the Snow products validation team 13
Figure 8 Current composition of the EUMETSAT SAF Network (in order of establishment) .... **Errore. Il segnalibro non è definito.**
Figure 7 Conceptual scheme of the EUMETSAT Application Ground Segment ....**Errore. Il segnalibro non è definito.**
Figure 9 Logic of the incremental development scheme ....**Errore. Il segnalibro non è definito.**
Figure 10 Required H-SAF coverage: 25-75°N lat, 25°W - 45°E.................**Errore. Il segnalibro non è definito.**
Figure 11 H-SAF central archive and distribution facilities.........................**Errore. Il segnalibro non è definito.**

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-1

1.2.1 Principle of sensing

Product SN-OBS-1 (*Snow detection (snow mask) by VIS/IR radiometry*) is based on multi-channel analysis of the SEVIRI instrument onboard Meteosat satellites.

The SEVIRI IFOV at nadir is 4.8 km and sampling is performed at 3 km intervals. These figures degrade over Europe to ~ 8 km IFOV and ~ 5 km sampling. The observing cycle (15 min) enables continuous monitoring of the cloud situation, searching for time instants of cloud-free conditions in a given time interval (e.g., 24 h). However, since short-wave channels play an essential role in the retrieval algorithm, the useful range of hours (i.e. day light time) depends on the time of year and location of observation.

The SN-OBS-1 product for flat/forested areas has been developed and integrated in the operational environment of FMI. It has a long-standing heritage over Scandinavia, where it was extensively validated. Over other European areas, validation has started in late 2007. The product for mountainous areas has been developed by METU and thereafter transferred on the operational environment of TSMS in late 2007. Products have been available for validation starting from mid-November 2007.

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/forest areas from the FMI product and that one on mountainous areas from the TSMS product, according to the mask shown in next figure:

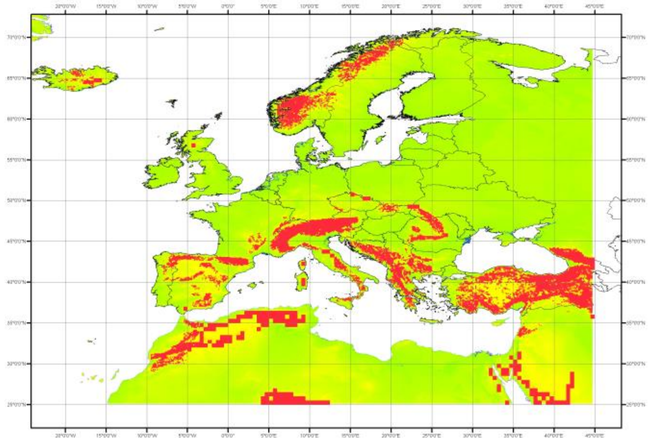


Figure 1 Mask flat/forested versus mountainous regions

1.2.2 Status of satellites and instruments

The current status of Meteosat Second Generation satellites is shown in next table:

Satellite	Launch	End of service	Position	Status	Instrument used in H-SAF
Meteosat-8 (MSG-1)	28 Aug 2002	expected ≥ 2015	9.5°E	Rapid scan	SEVIRI (not used for SN-OBS-1)
Meteosat-9 (MSG-2)	21 Dec 2005	expected ≥ 2019	0°	Operational	SEVIRI

Table 1 Current status of Meteosat Second Generation satellites (as of March 2010)

Next figure collects the main features of the SEVIRI instrument:

SEVIRI	Spinning Enhanced Visible Infra-Red Imager
Satellites	Meteosat-8, Meteosat-9, Meteosat-10, Meteosat-11 (i.e., Meteosat Second Generation)
Status	Operational - Utilised in the period: 2002 to ~ 2021
Mission	Multi-purpose imagery and wind derivation by tracking clouds and water vapour features
Instrument type	Multi-purpose imaging VIS/IR radiometer - 12 channels (11 narrow-bandwidth, 1 high-resolution broad-bandwidth VIS)
Scanning technique	N/A (GEO)
Coverage/cycle	Full disk every 15 min. Limited areas in correspondingly shorter time intervals
Resolution (s.s.p.)	4.8 km IFOV, 3 km sampling for narrow channels; 1.4 km IFOV, 1 km sampling for broad VIS channel
Resources	Mass: 260 kg - Power: 150 W - Data rate: 3.26 Mbps

Table 2 Main features of the SEVIRI instrument

1.2.3 Highlights of the algorithm

The baseline algorithm for SN-OBS-1 processing is described in ATDD-10. Only essential elements are highlighted here.

Next figure shows the flowchart of Land-SAF snow cover product generation at the Portuguese Meteorological Institute. Unit 1 refers to production of instantaneous snow cover maps from 15-minutely imagery. Unit 2 combines these 96 images from latest 24 hours to a single daily product, which is available for use via EUMETCast the day after of the nominal date (LSA-SAF 2009a):

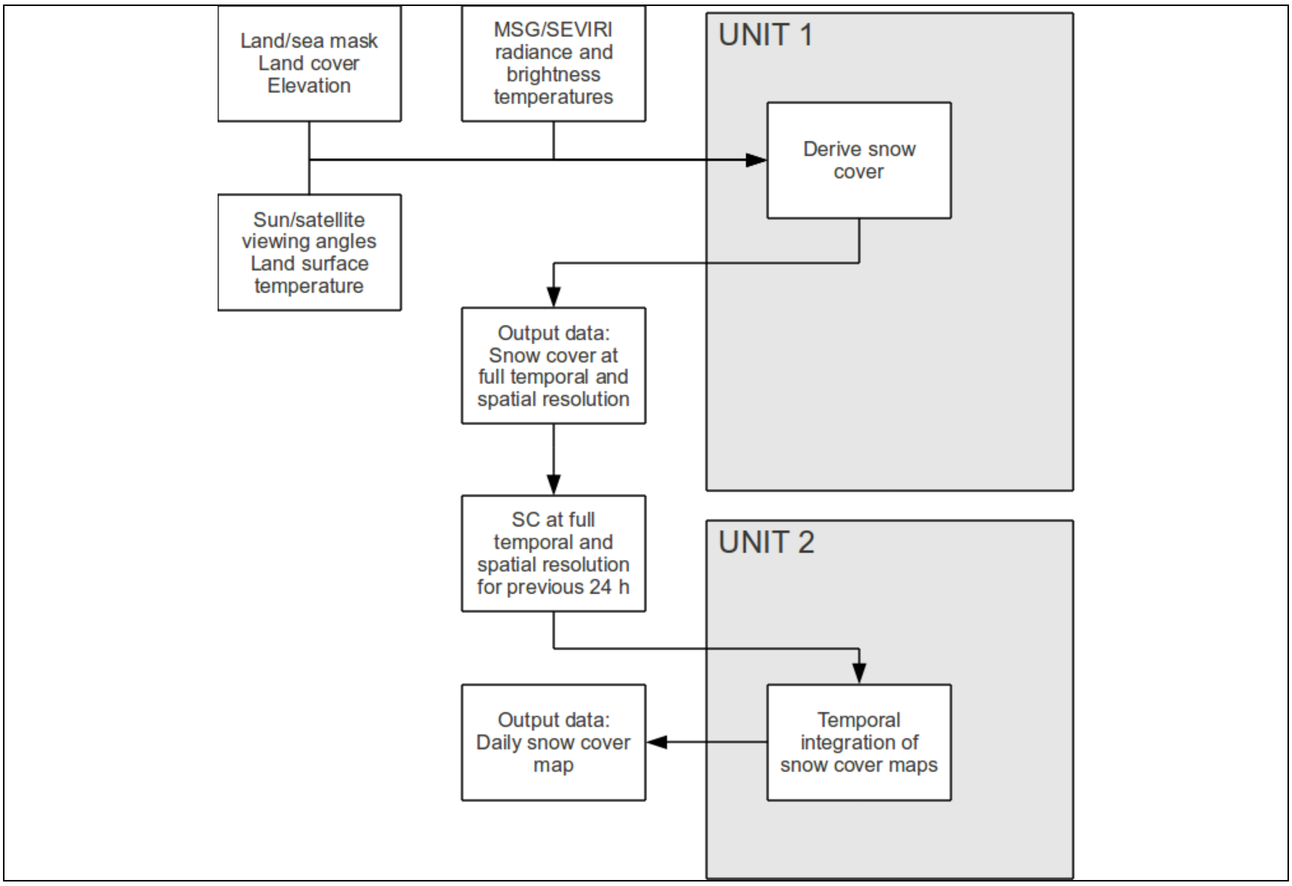


Figure 2 Flow chart of the Snow Recognition processing chain in flat and forested areas

Next figure illustrates the flow chart of the SN-OBS-1 processing chain at TSMS:

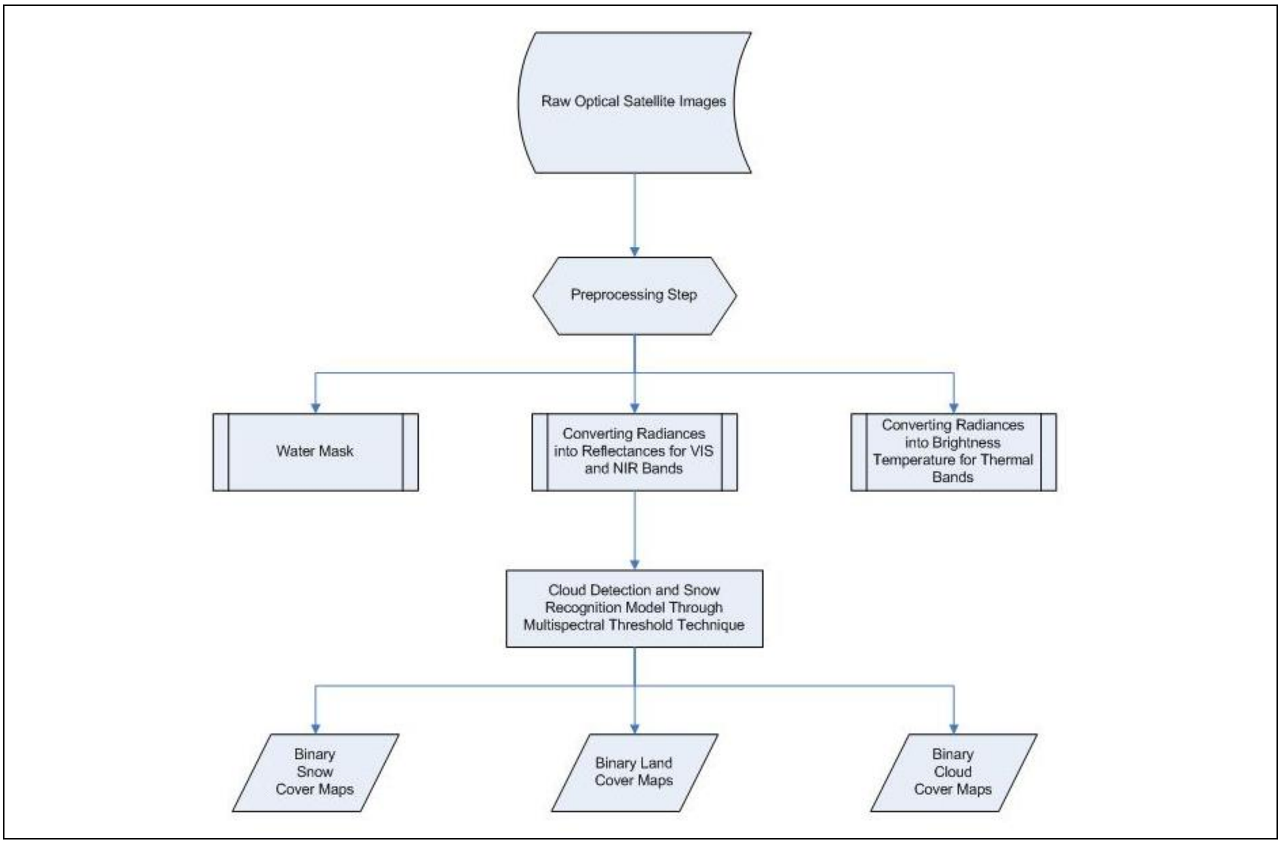


Figure 3 Flow chart of the Snow Recognition processing chain in mountainous regions

The SEVIRI channels at 0.64, 1.6, 3.9 and 10.8 μm were selected for the snow recognition algorithm and most important, cloud discrimination. The 0.64 μm channel is most suitable to detect clouds because of their high reflectance. Channels in this spectral region are commonly used for cloud detection (e.g. Rossow and Garder 1993[1]). Compared to the reflectivity of snow, the reflectivity of clouds is substantially higher at 1.6 μm. The 10.8 μm channel is suitable for detecting clouds due to their temperature which is generally lower than the temperature of the surface beneath. Distinguishing low clouds from cold surfaces with the same temperature is very difficult when using only thermal information around 10.8 μm (Ernst 1975[2]). For this task, IR 3.9 provides an important additional information at daytime as well as at night-time.

Comparing the algorithms for flat/forested and mountainous areas it is noted that the second better exploits multispectral features. Corrections for sun zenith angle are applied. Atmospheric corrections are not applied.

1.2.4 Architecture of the products generation chain

The architecture of the SN-OBS-1 product generation chain is shown in next figure:

[1] Rossow W.B. and L.C. Garder, 1993: “Cloud Detection Using Satellite Measurements of Infrared and Visible Radiances, for ISCCP”. *Journal of Climate*, vol. 6 (12), p. 2341-2369.

[2] Ernst J.A., 1975: “Fog and Stratus Invisible in Meteorological Satellite Infrared (Ir) Imagery”. *Monthly Weather Review*, vol. 103 (11), p. 1024-1026.

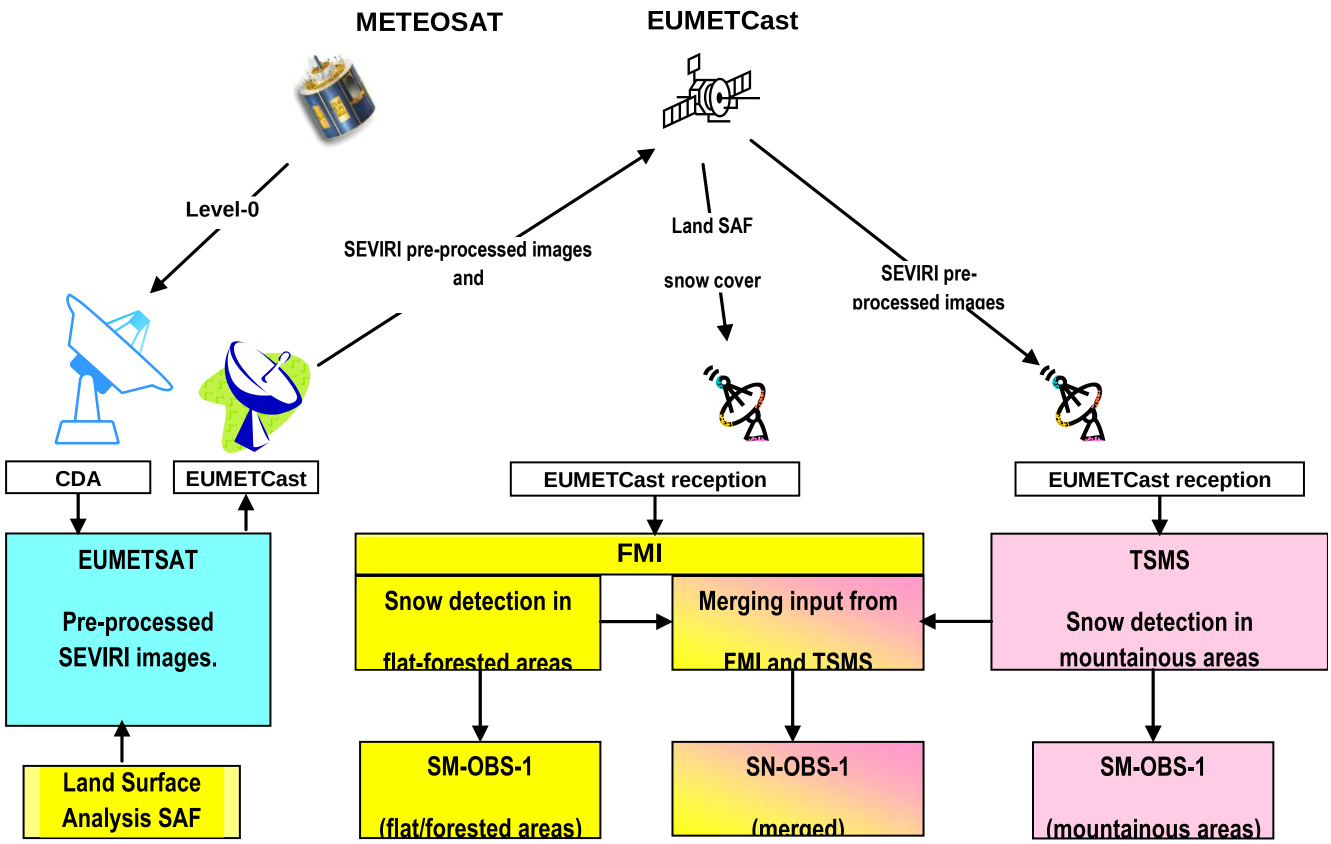


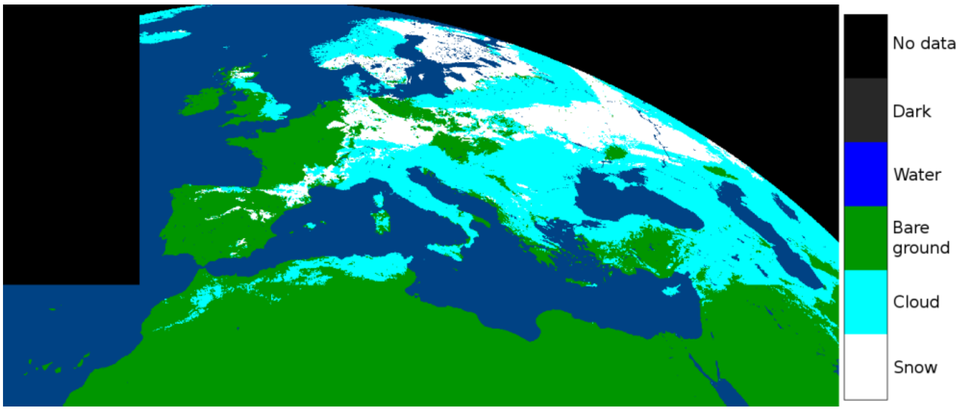
Figure 4 Conceptual architecture of the SN-OBS-1 chain.

It is noted that the generation chain for flat/forested areas, developed and tested by FMI, is actually run at the SAF for Land Surface Analysis (LSA-SAF), in Portugal, and data are disseminated by EUMETCast. TSMS, instead, receives the SEVIRI image data via EUMETCast and performs the processing tuned to mountainous areas. The TSMS data are delivered to FMI, that implements the merging of the product according to the mask shown in Figure 5.

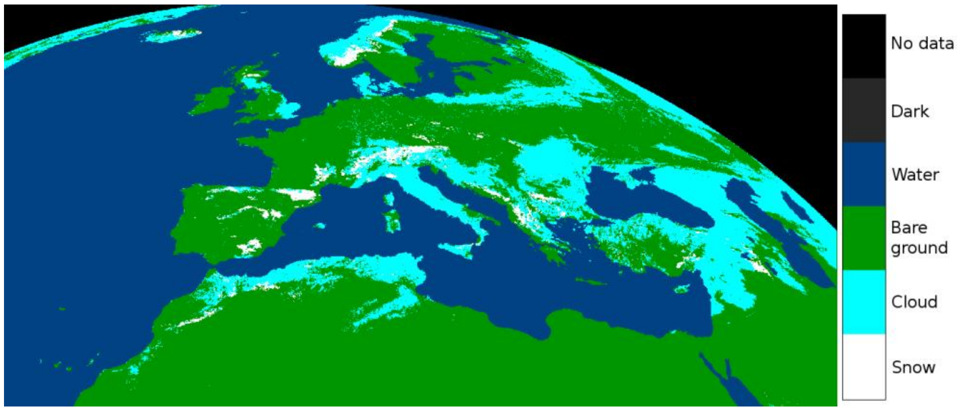
Currently, the products are held on the TSMS server (mountainous areas) and on the FMI and CNMCA servers (both flat/forested areas and merged). Eventually, only the merged product will be disseminated through EUMETCast.

1.2.5 Product coverage and appearance

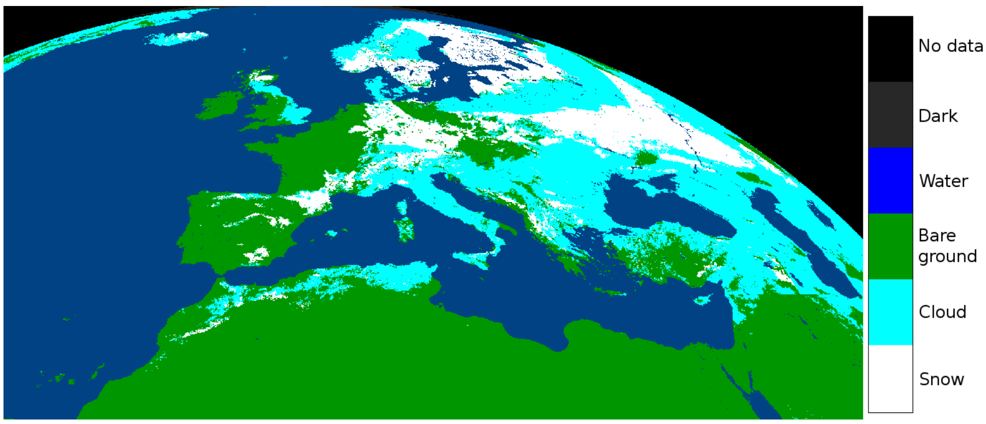
Examples of SN-OBS-1 products generated at FMI (flat and forested areas), at TSMS (mountainous area), and merged, for the same day, are here shown (Meteosat projection).



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 5 Snow mask from SEVIRI - Time-composite maps from all observations in 24 hours from Meteosat-9, 9 March 2010.

1.3 Comparison between H10 (SN-OBS-1) and H11 (SN-OBS-2)

This section present s a summary of accuracy and sampling limitations of H10 and H11, for short comparison between the two products.

The results here showed are obtained from the last validation cycle, winter 2009/2010 (i.e. 1st October 2009 - 31 March 2010).

The score are presented as follows:

- POD: Probability of Detection
- FAR: False Alarm Rate
- CSI: Critical Success Index (needed to compare different POD / FAR combinations)
- PODF: Probability Of False Detection
- ACC: Fraction correct Accuracy
- HSS: Heidke Skill Score.

Scores refer only to non-mountainous areas.

Score	H10 (SN-OBS-1)	H11 (SN-OBS-2)
N. samples	10437	220331
POD	0.50	0.75
FAR	0.10	0.03
CSI	0.48	0.74
POFD	0.24	0.02
ACC	0.55	0.86
HSS	0.15	0.72

Table 3 Comparison between H10 and H11: summary table

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).

In SEVIRI the IFOV at the s.s.p. is 4.8 km, that degrades moving away. At average European coordinates becomes ~ 8 km, and the 3 km sampling rate becomes ~ 5 km. To simplify matters, we quote as resolution ***Δx ~ 8 km***. Sampling is made at 0.05° intervals, i.e. ***~ 5 km***, close to the pixel size over Europe.

2.2 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*).

2.3 Observing cycle and time sampling

The <u>*observing cycle (Δt)*</u> 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 **Errore. L'origine riferimento non è stata trovata.**. In the case of LEO, the observing cycle depends on the instrument swath and the number of satellites carrying the addressed instrument.

For product SN-OBS-1, SEVIRI images are available at 15 min intervals. However, in order to collect as many cloud-free pixels as possible, multi-temporal analysis over 24 hours is performed. Thus the observing cycle is ***Δt = 24 h***.

2.4 Timeliness

The <u>*timeliness (δ)*</u> 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-1, that results from multi-temporal analysis disseminated at a fixed time of the day, the time of observation may change pixel by pixel (some pixel may have been cloud-free early in the time window, e.g. in the early morning, thus up to 12-h old at the time of dissemination; some very recently, just before product dissemination in the late afternoon). The average timeliness is therefore ***δ = 6 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-1, as any other H-SAF product, has been submitted to validation entrusted to a number of institutes (see next figure).

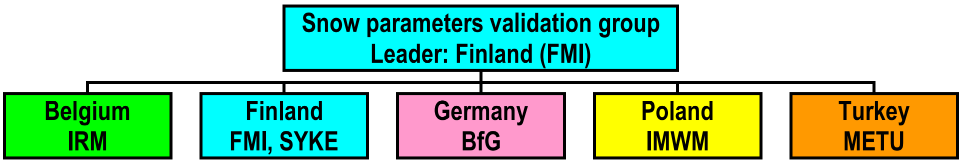


Figure 6 Structure of the Snow products validation team

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-1 is provided as document:

- PVR-10: Product Validation Report for SN-OBS-1.

In this PUM-10 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).

3.2 Summary of results

Prototypes of SN-OBS-1 have been available since winter 2006-2007, and validated by case studies. The product has been regularly distributed starting from end-2007 for systematic validation. The current release makes use of the Land-SAF product, available since April 2008. In next table the results from the last validation cycle, winter 2009/2010 (i.e. 1st October 2009 - 31 March 2010), are reported. Comparisons are recorded separately for flat/forested areas and mountainous areas. Combined statistics of results (averages weighed by the number of samples) are provided for both flat/forested and mountainous areas, although this information mixing inhomogeneous situation is of doubtful use

User requirements for snow detection have been stated in terms of POD and FAR. Other auxiliary scores also are reported. The total list is as follows (for more information, see PVR-10):

- POD: Probability of Detection
- FAR: False Alarm Rate
- CSI: Critical Success Index (needed to compare different POD / FAR combinations)
- PODF: Probability Of False Detection
- ACC: Fraction correct Accuracy
- HSS: Heidke Skill Score.

Score	Non-mountainous areas						Mountainous areas					
	IRM	FMI	BfG	IMWM	METU	Total	IRM	FMI	BfG	IMWM	METU	Total
N. samples	612	5803	207711	6205	0	220331	0	0	18760	2661	1221	22642
POD	0.91	0.89	0.75	0.80	-	0.75	-	-	0.60	0.55	0.93	0.60
FAR	0.29	0.05	0.03	0.07	-	0.03	-	-	0.00	0.07	0.16	0.01
CSI	0.67	0.85	0.73	0.76	-	0.74	-	-	0.60	0.52	0.79	0.60
POFD	0.03	0.08	0.02	0.14	-	0.02	-	-	0.05	0.20	0.10	0.12
ACC	0.97	0.90	0.86	0.82	-	0.86	-	-	0.61	0.59	0.91	0.62

HSS	**0.78**	**0.79**	**0.72**	**0.61**	**-**	**0.72**	**-**	**-**	**0.05**	**0.20**	**0.81**	**0.14**

Table 4 Statistical scores for SN-OBS-1 - Winter 2009-2010 - Threshold snow/no-snow for flat/forested areas: 1 cm depth

4 Product availability

4.1 Sites

SN-OBS-1 will be available via EUMETCast (when authorized) and via FTP (after log in).

Currently SN-OBS-1 is available on the following FTP sites (to obtain user and password please contact the Help Desk):

a. Product from FMI on flat/forested areas and merged product:

- URL: ftp://ftp.meteoam.it (to obtain user and password please contact the Help Desk).
- directory: *products*

only current data (at least two months, often more).

b. Product from FMI on flat/forested areas and merged product:

- URL: ftp://ftp.fmi.fi
- directory: *HSAF*
- folder: *products*

all data from April 2008 up to date.

c. Product from TSMS on mountainous areas:

- URL: ftp://hsaf.meteoroloji.gov.tr
- directory: *OUT*

all data from November 2007 up to date.

Quick-looks of the last 3 days of SN-OBS-1 maps can be viewed on the H-SAF web site.

4.2 Formats and codes

Two type of files are provided for SN-OBS-1:

- the digital data, coded in HDF5
- the image-like maps, coded in PNG

The information to read the HDF5 is provided in the FMI site, sub-directory "*products*", folder "*utilities*", file "*snobs1_hdf5_to_ascii.tar.gz*". In addition, the output description of SN-OBS-1 is provided in Appendix.

4.3 Description of the files

In the three ftp sites the structure of the records is identical, but the hierarchy is slightly different.

Next three tables, respectively:

- summarises the instructions for accessing the data in the CNMCA site;
- refers to the FMI site;
- refers to the TSMS site.

<table>
<tr><td>URL: ftp://ftp.meteoam.it</td><td>username: contact Help Desk</td><td>password: contact Help Desk</td><td>directory: products</td><td>folder: h10</td></tr>
<tr><td colspan="2" rowspan="2">Product identifier: h10.
Folders under h10:</td><td colspan="3">h10_cur_mon_data</td></tr>
<tr><td colspan="3">h10_cur_mon_png</td></tr>
<tr><td rowspan="2">Files description:</td><td>h10_cur_mon_data</td><td colspan="2">h10_yyyymmdd_day_FMI.H5
h10_yyyymmdd_day_merged.H5</td><td>digital data</td></tr>
<tr><td>h10_cur_mon_png</td><td colspan="2">h10_yyyymmdd_day_FMI.png
h10_yyyymmdd_day_merged.png</td><td>image data</td></tr>
<tr><td colspan="5">yyyymmdd: year, month, day
day: indicates that the product results from multi-temporal analysis over 24 hours (in daylight)</td></tr>
</table>

Table 5 Summary instructions for accessing SN-OBS-1 data at the CNMCA site

<table>
<tr><td>URL: ftp://ftp.fmi.fi</td><td colspan="2">username: contact Help Desk</td><td>password: contact Help Desk</td><td>directory: HSAF</td><td>folder: products</td></tr>
<tr><td rowspan="4" colspan="2">Product identifier: h10.
Folders under h10:</td><td rowspan="2">h10</td><td>h10_yyyymm_data</td><td colspan="2">digital data monthly packages</td></tr>
<tr><td>h10_yyyymm_images</td><td colspan="2">image data monthly packages</td></tr>
<tr><td rowspan="2">h10_merged</td><td>h10_yyyymm_data</td><td colspan="2">digital data monthly packages</td></tr>
<tr><td>h10_yyyymm_images</td><td colspan="2">image data monthly packages</td></tr>
<tr><td rowspan="4">Files description:</td><td rowspan="2">h10</td><td>h10_yyyymm_data</td><td colspan="2">h10_yyyymmdd_day_FMI.H5</td><td>digital data</td></tr>
<tr><td>h10_yyyymm_images</td><td colspan="2">h10_yyyymmdd_day_FMI.png</td><td>image data</td></tr>
<tr><td rowspan="2">h10_merged</td><td>h10_yyyymm_data</td><td colspan="2">h10_yyyymmdd_day_merged.H5</td><td>digital data</td></tr>
<tr><td>h10_yyyymm_images</td><td colspan="2">h10_yyyymmdd_day_merged.png</td><td>image data</td></tr>
<tr><td colspan="6">yyyymm: year, month
yyyymmdd: year, month, day
day: indicates that the product results from multi-temporal analysis over 24 hours (in daylight)</td></tr>
</table>

Table 6 Summary instructions for accessing SN-OBS-1 data at the FMI site

<table>
<tr><td>URL: ftp://hsaf.meteoroloji.gov.tr</td><td colspan="2">username: contact Help Desk</td><td>password: contact Help Desk</td><td>directory: OUT</td></tr>
<tr><td colspan="2" rowspan="2">Product identifier: h10.
Folders under h10:</td><td>YYYY</td><td colspan="2">folders of files from previous years and months</td></tr>
<tr><td>files</td><td colspan="2">daily files of current month</td></tr>
<tr><td rowspan="2">Files description:</td><td colspan="3">h10_yyyymmdd_day_TSMS.H5</td><td>digital data</td></tr>
<tr><td colspan="3">h10_yyyymmdd_day_TSMS.png</td><td>image data</td></tr>
<tr><td colspan="5">YYYY: year (internally: months: JANUARY, FEBRUARY, etc.)
yyyymmdd: year, month, day
day: indicates that the product results from multi-temporal analysis over 24 hours (in daylight)</td></tr>
</table>

Table 7 Summary instructions for accessing SN-OBS-1 data at the TSMS site

Annex 1. SN-OBS-1 Output description

How to read H10_merged HDF5 files (based on Land-SAF and TSMS products) and to convert them to ASCII

1) You need HDF5 development libraries, freely available from http://hdf.ncsa.uiuc.edu/HDF5/
2) C-compiler (tested with gcc versions 3.2.3, 4.1.3 and 4.3.2)
3) Download snobs1_hdf5_to_ascii_FMI.tar.gz from ftp://ftp.fmi.fi
4) Uncompress the source code and compile the program with

```
tar -xzvf snobs1_hdf5_to_ascii_FMI.tar.gz
cd snobs1_hdf5_to_ascii_FMI
gcc -Wall -lhdf5 -o snobs1_hdf5_to_ascii_FMI *.c
```

5) Install by typing

```
./install.sh
```

and follow the instructions. The path where the program is installed has to be in, or added to, the users $PATH which tells where the operating system searches for executable programs.

Usage

Change to the directory with the data wanted to be converted to ASCII, and issue command:

```
cd $HSAF/h10/FMI/ snobs1_hdf5_to_ascii_FMI <file_in.H5> <file_out.txt>
```

where

file_in.H5: SN-OBS-1a or SN-OBS-1 HDF5 data file
file_out.txt: filename to output the ASCII data

For example: snobs1_hdf5_to_ascii_FMI h10_20080518_day_merged.H5 h10_20080518_day_merged.txt

Processing multiple files

Script is provided with the downloaded package for processing all the files in the current directory. This script is installed in step 5).

For example: cd $HSAF/H10/FMI/snobs1_hdf5_to_ascii_FMI_all.sh

Annex 2. 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 7):

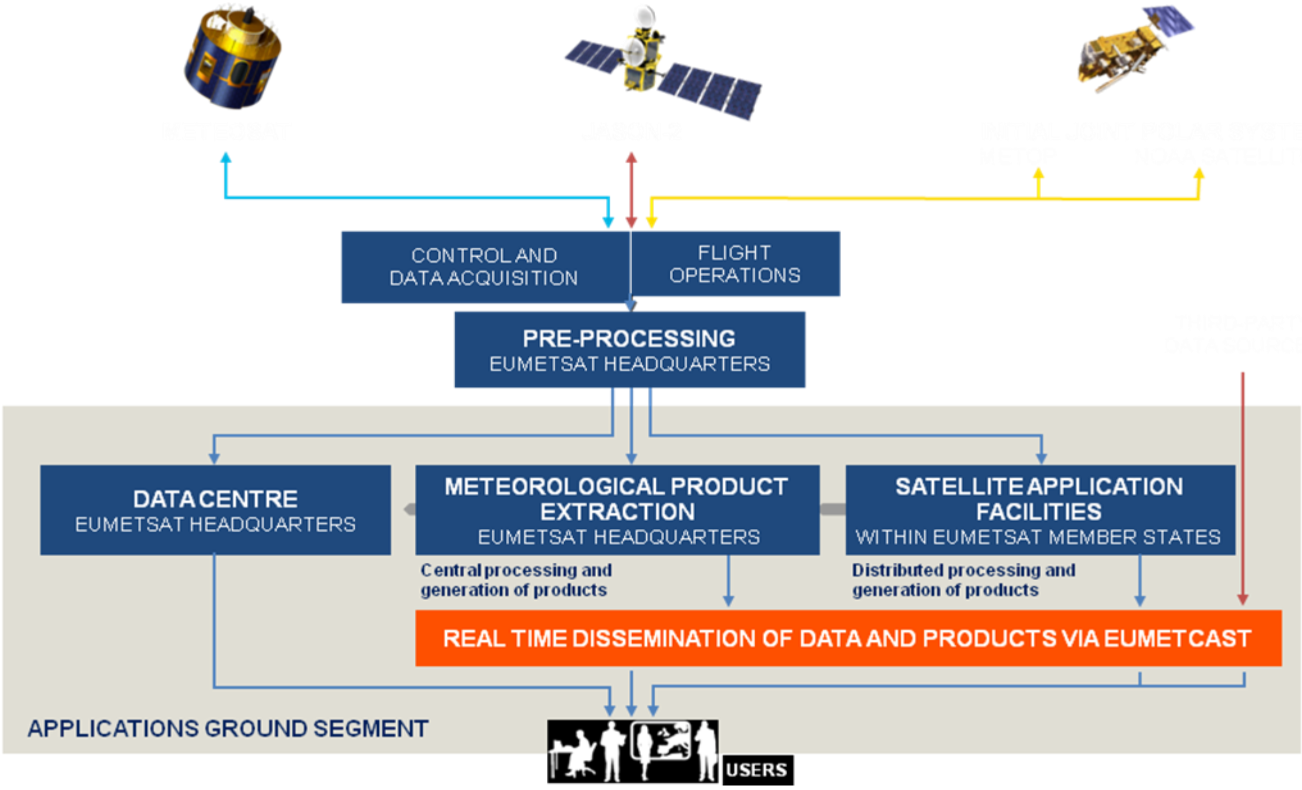


Figure 7: Conceptual scheme of the EUMETSAT Application Ground Segment

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

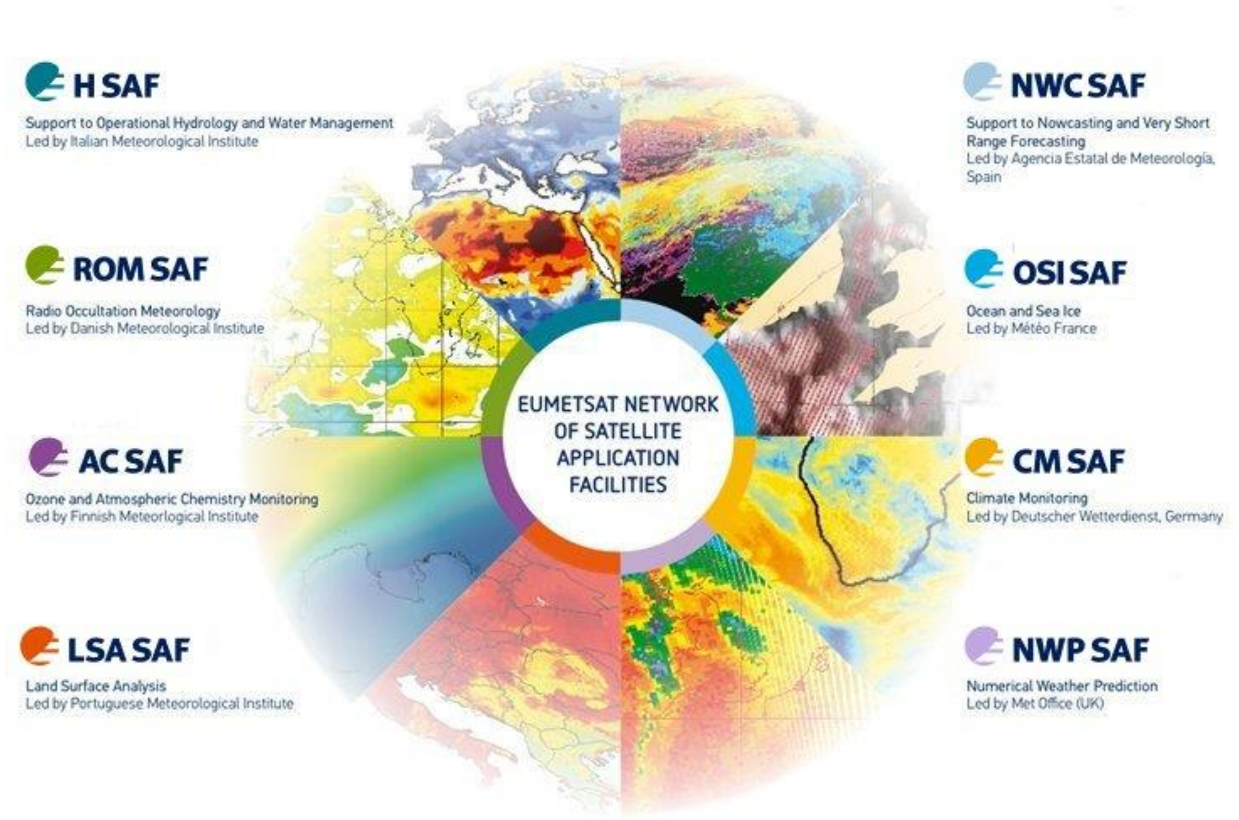


Figure 8: Current composition of the EUMETSAT SAF Network

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 3. 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)