

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



**Product User Manual (PUM)
for product H03B – P-IN-GRU-SEVIRI**

Precipitation rate at ground by GEO/IR supported by LEO/MW


Reference Number:	SAF/HSAF/PUM-03B
Issue/Revision Index:	1.1
Last Change:	08 September 2017

DOCUMENT CHANGE RECORD

Issue / Revision	Date	Description
1.0	02/05/2017	Baseline version prepared for ORR full disc
1.1	09/09/2017	RIDs acknowledgement from ORR full disc

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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 general information on H-SAF.

2 Introduction to product P-IN-GRU-SEVIRI

2.1 Principle of sensing

Product **H03B (P-IN-GRU-SEVIRI over the full disk area)** is based on the IR images from the SEVIRI instrument on board of Meteosat satellites.

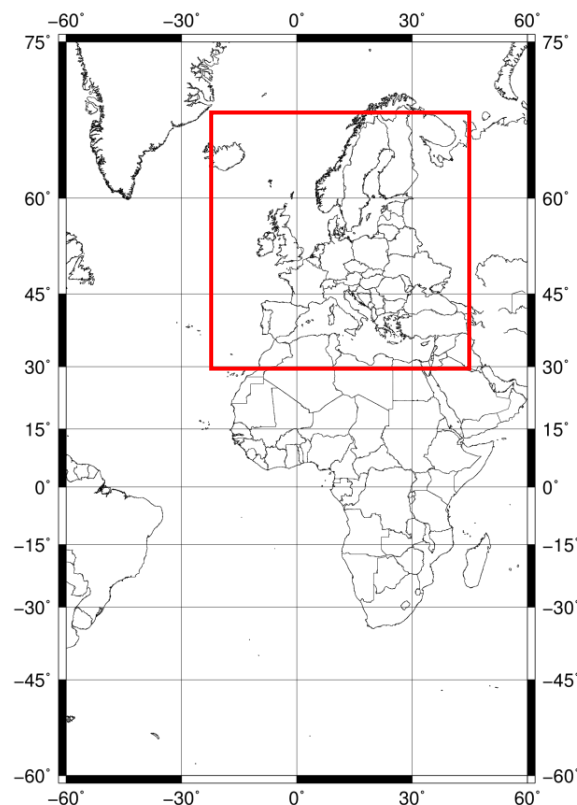



Figure 1: The P-IN-GRU-SEVIRI coverage 60°S-75°N , 60°W - 60°E. The HSAF area is indicated by the red square

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The product is generated at the 15-min imaging rate of SEVIRI, and the spatial resolution is consistent with the SEVIRI pixel. The processing method is called “Rapid Update”.

The SEVIRI channel utilised for P-IN-GRU-SEVIRI is 10.8 μm . The calibration of T_{BB} 's (equivalent blackbody temperatures) in term of precipitation rate by means of MW measurements (supposedly accurate) implies the existence of good correlation between T_{BB} and precipitation rate. This is fairly acceptable for convective precipitation, less for non-convective. Nevertheless, Rapid Update is currently the only operational algorithm enabling precipitation rate estimates with the time resolution required for nowcasting. In addition, frequent sampling is a prerequisite for computing accumulated precipitation (product P-AC-G-SEVIRI).

2.2 Status of satellites and instruments

P-IN-GRU-SEVIRI does not retrieve precipitation from MW sensors. MW-derived precipitation data come from SSMIS (utilised by P-IN-OBA-SSMIS), and AMSU-A and MHS (utilised by P-IN-ONN-AMSU); it is not excluded the use of precipitation estimations from other MW instruments.. The current status of the satellites possibly to be utilised for P-IN-GRU-SEVIRI is shown in Table 1.


Satellite	Launch	End of service	Height	LST	Status	Instruments for P-IN-GRU-SEVIRI
DMSP-F16	18 Oct 2003	expected \geq 2016	833 km	21:32 a	Secondary Operation	SSMIS
DMSP-F17	4 Nov 2006	expected \geq 2016	850 km	17:30 a	Primary Operation	SSMIS
DMSP-F18	18 Oct 2009	expected \geq 2016	850 km	17:31 a	Primary Operation	SSMIS
MetOpA	19 Oct 2006	expected \geq 2018	817 km	09:31 d	Operational	AMSU-A (defective), MHS
MetOpB	17 Sep 2012	expected \geq 2023	817 Km	09:30 d	Operational	AMSU-A, MHS
NOAA-18	20 May 2005	expected \geq 2016	870 km	14:00 a	Operational	AMSU-A, MHS
NOAA-19	6 Feb 2009	expected \geq 2016	870 km	14:00 a	Operational	AMSU-A, MHS (defective)
GCOM-W	18 May 2012	expected \geq 2016	700 km	13:30 a	Operational	AMSR-2
NPP	28 Oct 2011	expected \geq 2020	824 Km	13:30 a	Operational	ATMS
Meteosat-10	5 Jul 2012	expected \geq 2022	GEO: 0°		Operational	SEVIRI

Table 1: Current status of satellites potentially utilised for P-IN-GRU-SEVIRI

Table 2 collects the main features of SEVIRI. As mentioned, SSMIS, AMSU-A and MHS are not directly entered in the P-IN-GRU-SEVIRI generation chain, thus are not described here. Descriptions of SSMIS, and of AMSU-A and MHS can be found in the Product User Manuals PUM-01B (for P-IN-OBA-SSMIS) and PUM-02B (for P-IN-ONN-AMSU) [Note: AMSU-B is no longer used for P-IN-ONN-AMSU].

Table 2 - Main features of SEVIRI

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

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Central wavelength	Spectral interval (99 % encircled energy)	Radiometric accuracy (SNR or NE Δ T)
N/A (broad bandwidth channel)	0.6 - 0.9 μ m	4.3 @ 1 % albedo
0.635 μ m	0.56 - 0.71 μ m	10.1 @ 1 % albedo
0.81 μ m	0.74 - 0.88 μ m	7.28 @ 1 % albedo
1.64 μ m	1.50 - 1.78 μ m	3 @ 1 % albedo
3.92 μ m	3.48 - 4.36 μ m	0.35 K @ 300 K
6.25 μ m	5.35 - 7.15 μ m	0.75 K @ 250 K
7.35 μ m	6.85 - 7.85 μ m	0.75 K @ 250 K
8.70 μ m	8.30 - 9.10 μ m	0.28 K @ 300 K
9.66 μ m	9.38 - 9.94 μ m	1.50 K @ 255 K
10.8 μ m	9.80 - 11.8 μ m	0.25 K @ 300 K
12.0 μ m	11.0 - 13.0 μ m	0.37 K @ 300 K
13.4 μ m	12.4 - 14.4 μ m	1.80 K @ 270 K

2.3 Highlights of the algorithm

The baseline algorithm for P-IN-GRU-SEVIRI processing is described in ATBD-03. Only essential elements are highlighted here.

The blending technique adopted for P-IN-GRU-SEVIRI is called “Rapid Update (RU)”¹; see, for instance, Turk et al. 2000¹. Key to the RU blended satellite technique is a real time, underlying collection of time and space-intersecting pixels from operational geostationary IR imagers and LEO MW sensors. Rain intensity maps derived from MW measurements are used to create global, geo-located rain rate (RR) and T_{BB} (equivalent blackbody temperature) relationships that are renewed as soon as new co-located data are available from both geostationary and MW instruments. In the software package these relationships are called *histograms*. To the end of geo-locating histogram relationships, the globe (or the study area) is subdivided in equally spaced lat-lon boxes (2.5°×2.5°). As new input datasets (MW and IR) are available in the processing chain, the MW-derived rain rate pixels are paired with their time and space-coincident geostationary 10.8- μ m IR T_{BB} data, using a 15-minute maximum allowed time offset between the pixel observation times.

The main inputs to the RU procedure are:

- geo-located equivalent blackbody temperatures (T_{BB}) observed by the GEO platform;
- rain-rate maps that, in principle, can arise from any satellite-based MW data and algorithm;
- observation geometry (satellite zenith angle).

The package can be subdivided into four main parts, namely:

- 1) pre-processing: preparation and pre-processing of GEO data; ingest of rain rate maps at the LEO space-time resolution. To allow the proper initialization of the statistical relationships the input data must be collected for a time window that start several hours before the study period. According to the present constellation of MW-equipped satellites, the parameter MAXHOURS is currently set to 24 h;
- 2) co-location: co-located GEO and LEO observations are collected for the selected study area and accumulated from newest to oldest;
- 3) set-up of geo-located statistical relationships applying the probability matching technique;

¹ Turk J.F., G. Rohaly, J. Hawkins, E.A. Smith, F.S. Marzano, A. Mugnai and V. Levizzani, 2000: “Analysis and assimilation of rainfall from blended SSMI, TRMM and geostationary satellite data”. *Proc. 10th AMS Conf. Sat. Meteor. and Ocean.*, 9, 66-69.

- 4) assign rain rate to each GEO pixel: production of rain-rate maps at the GEO space-time resolution.

2.4 Architecture of the products generation chain

The architecture of the P-IN-GRU-SEVIRI product generation chain is shown in Figure 2

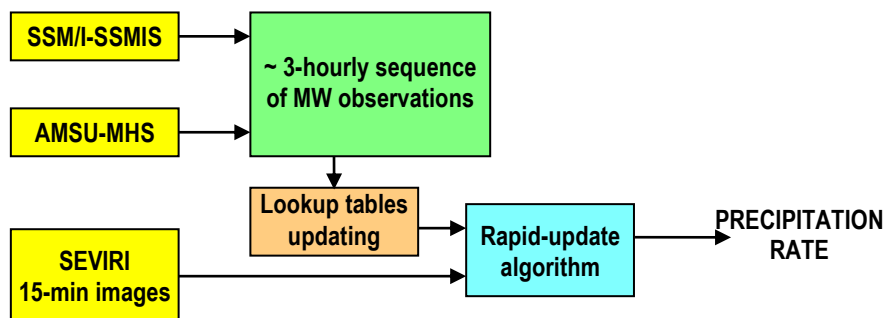


Figure 2 Flow chart of the LEO/MW-GEO/IR-blending precipitation rate processing chain

The architecture of the product P-IN-GRU-SEVIRI that includes:

- the Rapid Update process based on (frequent) SEVIRI IR images “calibrated” by the (infrequent) MW-derived precipitation data as retrieved from SSMIS (P-IN-OBA-SSMIS) or from AMSU-A and MHS (P-IN-ONN-AMSU);

2.5 Product coverage and appearance

Figure 3 shows a SEVIRI image, in its native projection, and the processing area of product P-IN-GRU-SEVIRI. The input area includes 3712 lines x 3712 columns.

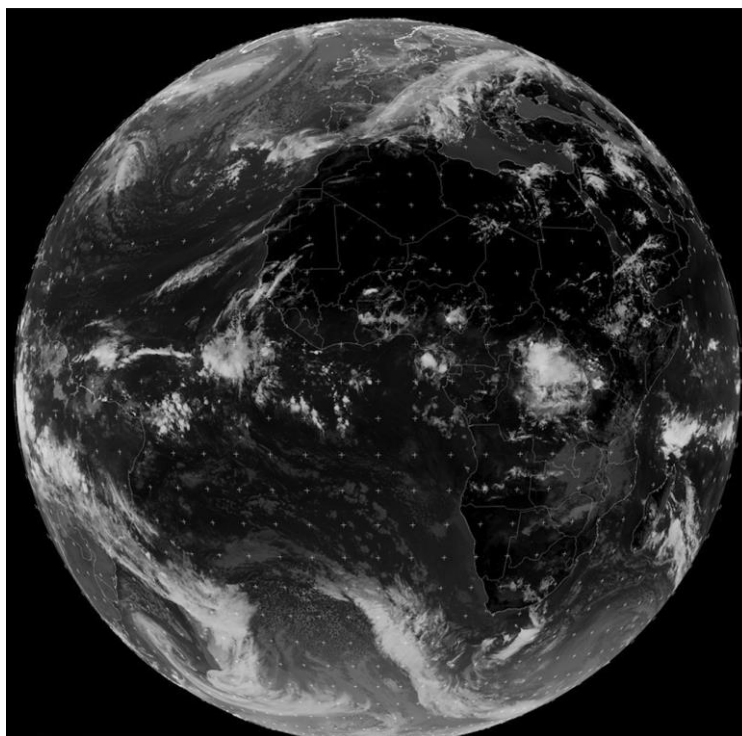


Figure 3 SEVIRI image in the 10.8 μ m channel - Meteosat-10, day 27 Apr 2017, time 09:00 UTC

Since data are delivered coded (in GRIB2) as values in grid points of known coordinates (those of the SEVIRI pixels), the product can be plotted in any projection of user's choice. The example of product shown in Figure 4 is in the projection actually used in the .png files on the web site, *rectangular stereography centred on 0°N, 0°E*. The represented area is a fraction of the total processed area. Obviously, the map sequences are generally visualised as animations at 15-min intervals.

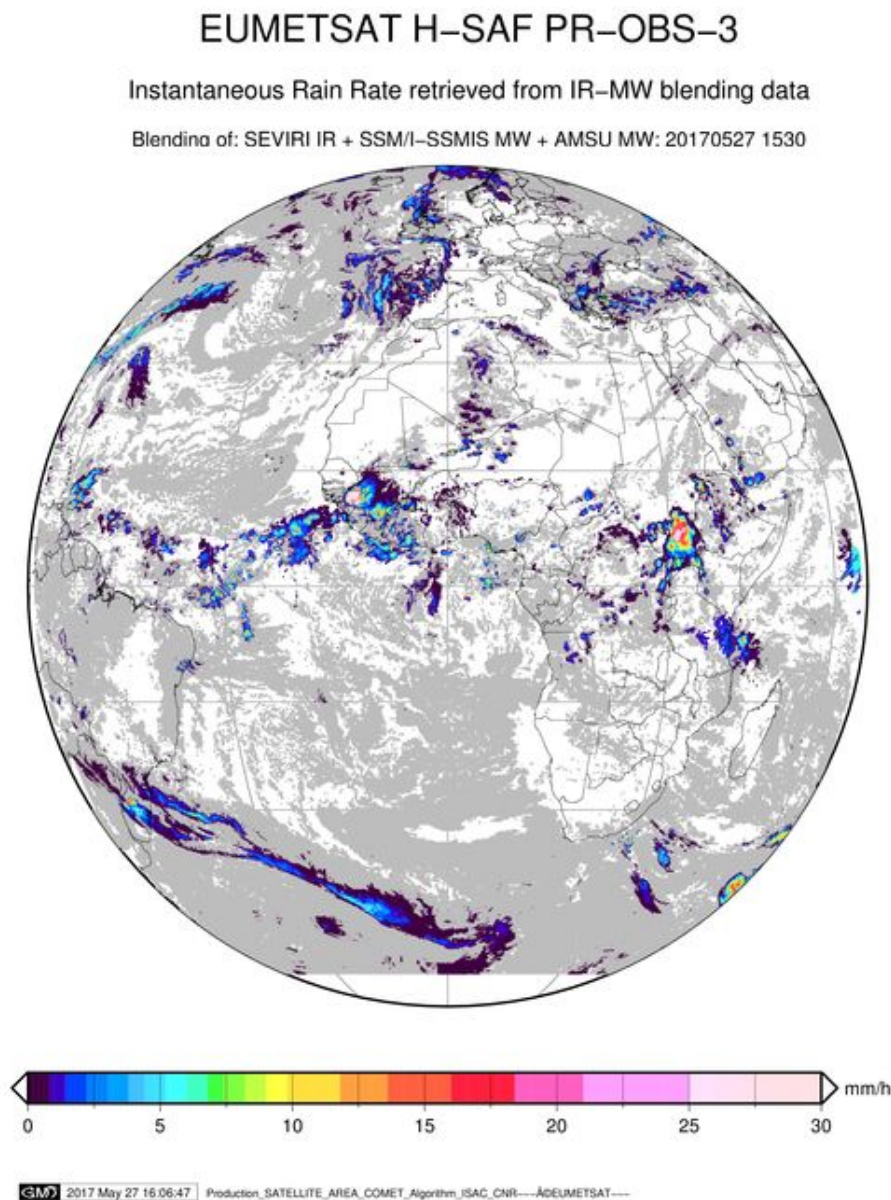



Figure 4: 2017-05-27 15:30 UTC: Example of product H03B – P-IN-GRU-SEVIRI. Grey colour means ZERO RAIN, white colour means NOT PROCESSED.

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3 Product operational characteristics

3.1 Horizontal resolution and sampling

The horizontal resolution (Δx). 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. The IFOV of SEVIRI images is 4.8 km at nadir, and degrades moving away from nadir.

3.2 Observing cycle and time sampling

The observing cycle (Δt) is defined as the average time interval between two measurements over the same area. In the case of P-IN-GRU-SEVIRI the product is generated soon after each SEVIRI new acquisition, Thus the observing cycle is $\Delta t = 15 \text{ min}$ and the sampling time also is **15 min**.

3.3 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. For P-IN-GRU-SEVIRI, the time of observations is 1-5 min before each quarter of an hour, ending at the full hour. To this, $\sim 5 \text{ min}$ have to be added for acquisition through EUMETCast and $\sim 5 \text{ min}$ for processing at COMET, thus: timeliness $\delta \sim 15 \text{ min}$.

4 Product quality assessment

4.1 Quality assessment

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”. P-IN-GRU-SEVIRI, as any other H-SAF product, is submitted to continuous quality assessment and validation activity entrusted to a number of institutes (see Figure 5).

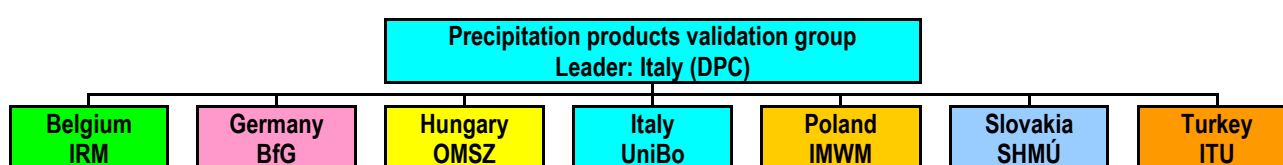



Figure 5: Structure of the Precipitation products validation team

Precipitation data are compared with rain gauges and meteorological radar. Before undertaking comparison, ground data and satellite data have been submitted to scaling and filtering procedures. Two streams of activities are carried out:

- evaluation of general statistics (multi-categorical and continuous), to help in identifying existence of pathological behaviour
- selected case studies, useful in identifying the roots of such behaviour.

Detailed report of the product validation activity for product P-IN-GRU-SEVIRI is provided as following document:

- PVR-03B: Product Validation Report for P-IN-GRU-SEVIRI.

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4.2 Product Accuracy

User requirements for precipitation observation have been stated by authoritative entities such as WMO, EUMETSAT and the GPM planning group. Those requirements are based on the Fractional Standard Error (FSE%) or Adjusted Fractional Standard Error AFSE as statistical score evaluated on open classes of precipitation as expressed by the table below:

Threshold	Target	Optimal
Changing with precipitation type: <ul style="list-style-type: none"> 90 % for > 10 mm/h, 120 % for 1-10 mm/h, 240 % for < 1 mm/h 	Changing with precipitation type: <ul style="list-style-type: none"> 80% for > 10 mm/h, 105% for 1-10 mm/h, 145% for < 1 mm/h 	Changing with precipitation type: <ul style="list-style-type: none"> 25% for > 10 mm/h, 50% for 1-10 mm/h, 90% for < 1 mm/h

Table 3 H-SAF Accuracy requirements for H03B (Overall Accuracy)

5 Product availability

5.1 Terms of Use

All H-SAF products are owned by EUMETSAT, and the EUMETSAT SAF Data Policy applies.

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.

5.2 General Information

To access the H-SAF products the user must register at the H-SAF Official Web Portal <http://hsaf.meteoam.it/> from which it is possible to access to the "H-SAF Product Download Centre", which allows users to access data as described here following.

- 1) Access to data produced in the last 60 days must be made by the Official H-SAF FTP server <ftp://ftphsaf.meteoam.it> (to obtain user and password, please submit registration form on H-SAF Official Web Portal or contact the help desk at us_hsaf@meteoam.it) and via EUMETCAST, a multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology (for more information <http://www.eumetsat.int/>).
- 2) The access to the archived data must be performed through an order process. There are two ways to place an order:
 - a. the first (link) is a basic function provided directly from the H-SAF Web Portal. It provides all basic functions to carry out orders by selecting one or more products and setting for each selected product an expected time range;
 - b. The second function <https://eoportal.eumetsat.int/> allows access to EUMETSAT Data Centre. A registration to EUMETSAT portal is required. The EUMETSAT Data Center offers advanced functions of management and control of orders, among which the possibility to make geographical selection of products, to make the cloning of orders, and to monitor the status of the orders.

In Both cases the orders placed will be submitted for approval and will be delivered within three working days.

Finally, quick-looks of the latest 20 maps can be viewed as PNG images or as an animated slideshow on the H-SAF Web Portal.

5.3 Formats and codes

Two type of files are provided for P-IN-GRU-SEVIRI:

- the digital data, coded in GRIB2
- the image-like maps, coded in PNG

On the ftp server, in the directory “*utilities*”, the folder *Grib_decode* provides the instructions for reading the digital data.

5.4 Description of the files

Product P-IN-GRU-SEVIRI is the Precipitation rate at ground by GEO/IR supported by LEO/MW, also identified as H03B. The table below shows the detailed information to access the product using the H-SAF FTP server (<ftp://ftphsaf.meteoam.it>)

P-IN-GRU-SEVIRI Data	
Description	
Content: Precipitation rate at ground by GEO/IR supported by LEO/MW	
Repository root directory: ftp://ftphsaf.meteoam.it/products/h03B	
h03B_yyyymmdd_hhMM_fdk.grb.gz	
Namespace description	
<ul style="list-style-type: none"> • yyyymmdd: year, month, day • hhMM: hour and minute 	
Suffix for Digital Data: “.grb.gz” (compressed GRIB file)	
Suffix for Image Data: “.png” (image data file)	
P-IN-GRU-SEVIRI Digital Data	
Sub-repository	/h03_cur_mon_data (data of last 60 days)
File name	h03B_yyyymmdd_hhMM_fdk.grb.gz Example: ftp://ftphsaf.meteoam.it/products/h03B/h03_cur_mon_data/h03B_20150210_1512_fdk.grb.gz
P-IN-GRU-SEVIRI Image Data	
Sub-repository	/h03_cur_mon_png (data of last 60 days)
File name	h03B_yyyymmdd_hhMM_fdk.png Example: ftp://ftphsaf.meteoam.it/products/h03B/h03_cur_mon_png/h03B_20150210_1512_fdk.png

Table 4: Summary instructions for accessing P-IN-GRU-SEVIRI data

5.5 Output description

The P-IN-GRU-SEVIRI output is encoded as a GRIB2 (please refer to WMO GRIB2 format documentation available at www.wmo.int), with the following keys:

GRIB2

```

/* gribSection0 */
/* 3 = Space products (grib2/0.0.table) */
discipline,3
editionNumber,2
/* section 1 */
/* 80 = Rome (RSMC) (grib1/0.table) */
identificationOfOriginatingGeneratingCentre,80
identificationOfOriginatingGeneratingSubCentre,0
/* 3 = Current operational version number implemented on 2 November 2005 (grib2/1.0.table) */
gribMasterTablesVersionNumber,3
/* 0 = Local tables not used (grib2/1.1.table) */
versionNumberOfGribLocalTables,0
/* 3 = Observation time (grib2/1.2.table) */
significanceOfReferenceTime,3
/* 3 = Observation time (grib2/1.2.table) */
significanceOfReferenceTime,3
year,
month,
day,
hour,
minute,
second,
/* 1 = Operational test products (grib2/1.3.table) */
productionStatusOfProcessedData,1
/* 6 = Processed satellite observations (grib2/1.4.table) */
typeOfProcessedData,6
/* 0 = Specified in Code table 3.1 (grib2/3.0.table) */
sourceOfGridDefinition",
numberOfDataPoints, 13778944
numberOfOctetsForOptionalListOfNumbersDefiningNumberOfPoints,0
/* 0 = There is no appended list (grib2/3.11.table) */
interpretationOfListOfNumbersDefiningNumberOfPoints,0
/* 90 = Space view perspective orthographic (grib2/3.1.table) */
gridDefinitionTemplateNumber,90
/* 3 = Earth assumed oblate spheroid with major and minor axes specified by data producer (grib2/3.2.table) */
shapeOfTheEarth,3
scaleFactorOfRadiusOfSphericalEarth,0
scaledValueOfRadiusOfSphericalEarth,0
scaleFactorOfMajorAxisOfOblateSpheroidEarth,4
scaledValueOfMajorAxisOfOblateSpheroidEarth,63781400
scaleFactorOfMinorAxisOfOblateSpheroidEarth,4
scaledValueOfMinorAxisOfOblateSpheroidEarth,63567550
numberOfPointsAlongXAxis,3712
numberOfPointsAlongYAxis,3712
latitudeOfSubSatellitePoint,0
longitudeOfSubSatellitePoint,0
/* 0 = 00000000
(3=0) i direction increments not given

```

(4=0) j direction increments not given
(5=0) Resolved u- and v- components of vector quantities relative to easterly and northerly directions
See grib2/3.3.table */
resolutionAndComponentFlags,0
apparentDiameterOfEarthInGridLengthsInXDirection",3622
apparentDiameterOfEarthInGridLengthsInYDirection",3568
xCoordinateOfSubSatellitePoint",764000
yCoordinateOfSubSatellitePoint",1774000
/* 0 = 00000000
(1=0) Points of first row or column scan in the +i (+x) direction
(2=0) Points of first row or column scan in the -j (-y) direction
(3=0) Adjacent points in i (x) direction are consecutive
(4=0) All rows scan in the same direction
See grib2/3.4.table */
scanningMode,0
orientationOfTheGrid,0
altitudeOfTheCameraFromTheEarthSCenterMeasuredInUnitsOfTheEarth,6610700
xCoordinateOfOriginOfSectorImage,0
yCoordinateOfOriginOfSectorImage,0
/* grib 2 Section 4 PRODUCT DEFINITION SECTION */
numberOfCoordinatesValues,0
/* 30 = Satellite product (grib2/4.0.table) */
productDefinitionTemplateName,30
/* 1 = Quantitative products (grib2/4.1.3.table) */
parameterCategory,1
/* 0 = Estimated precipitation (kg m-2) (grib2/4.2.3.1.table) */
parameterNumber,0
/* 8 = Observation (grib2/4.3.table) */
typeOfGeneratingProcess,8
observationGeneratingProcessIdentifier,3
numberOfContributingSpectralBands,1
/* grib 2 Section 5 DATA REPRESENTATION SECTION */
numberOfValues, 13778944
/* 0 = Grid point data - simple packing (grib2/5.0.table) */
dataRepresentationTemplateName,0
decimalScaleFactor,0
numberOfBitsContainingEachPackedValue,16
/* 0 = Floating point (grib2/5.1.table) */
typeOfOriginalFieldValues,0
/* grib 2 Section 6 BIT-MAP SECTION */
/* 0 = Bit map is present in this product (grib2/6.0.table) */
bitMapIndicator,0
missingValue,0.0
/* grib 2 Section 7 data */
/* grib 2 Section 8 END */

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):

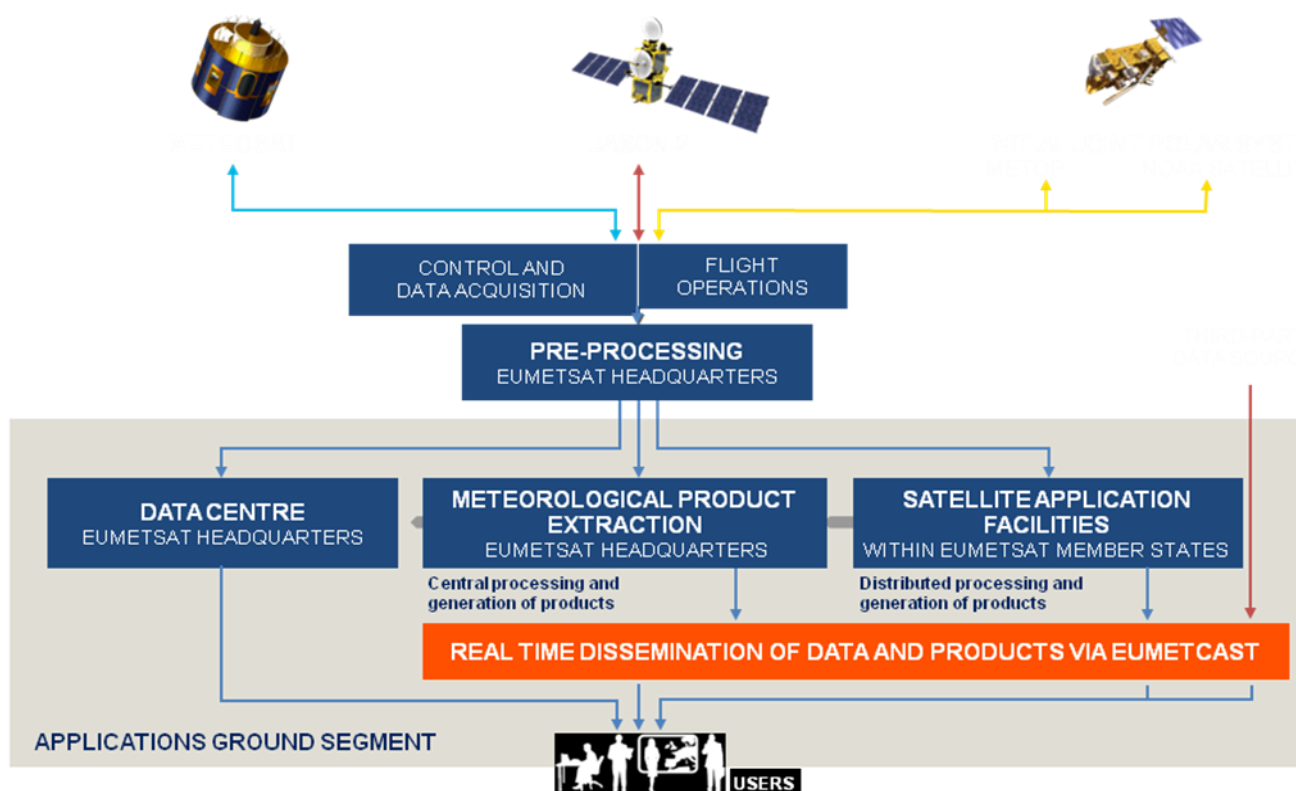


Figure 6: Conceptual scheme of the EUMETSAT Application Ground Segment

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

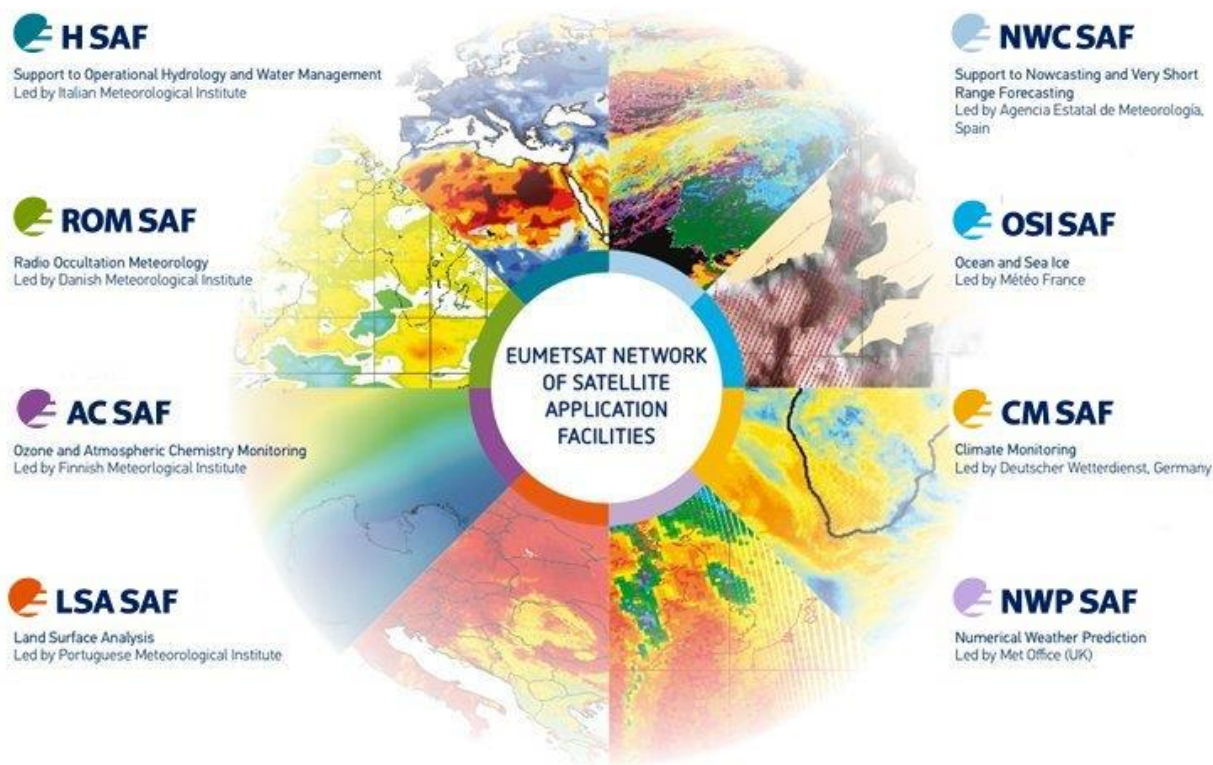


Figure 7: Current composition of the EUMETSAT SAF Network

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
COMET	Centro Operativo per la Meteorologia (in Italy)
CNR	Consiglio Nazionale delle Ricerche (of Italy)
CNRS	Centre Nationale de la Recherche Scientifique (of France)
DMSF	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	Istanbul 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
UniBo	University of Bologna (in Italy)
URD	User Requirements Document
UTC	Universal Coordinated Time
VIS	Visible
ZAMG	Zentralanstalt für Meteorologie und Geodynamik (of Austria)