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



**Product User Manual (PUM)  
for product H42B (P-AC-FCI)**



**Accumulated precipitation at ground by blended MW+MTG FCI-IR**

Reference Number: SAF/HSAF/PUM-H42B  
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<b>DOCUMENT CHANGE RECORD</b>
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Issue / Revision	Date	Description
1.0	08 oct 2021	First release for ORR
1.1	15 Feb. 23	Update for MTG ORR1
1.2	17 Mar 25	Update for MTG ORR2 <ul style="list-style-type: none"> <li>- Paragraph "Status of satellites and instruments" deleted</li> <li>- Figures updated</li> <li>- Paragraph "Description of the files" modified</li> </ul>
1.3	27 Maj 25	Revised as required by ORR2: <ul style="list-style-type: none"> <li>- quality flag description added</li> <li>- ftp path corrected</li> </ul>

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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.

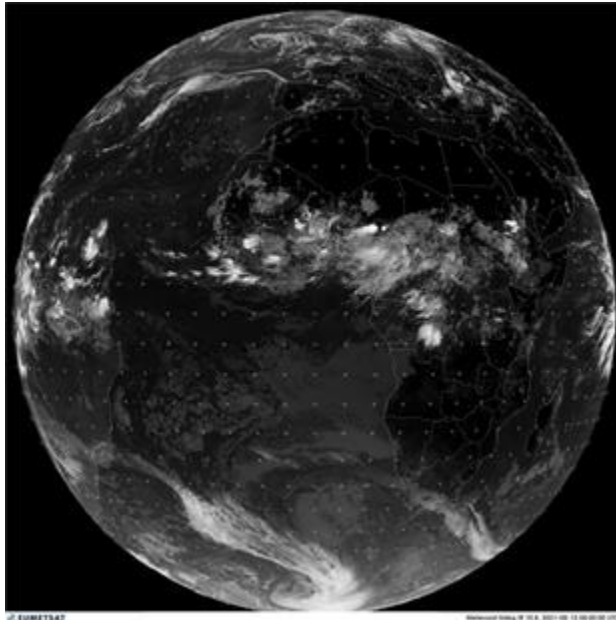
## 2 Introduction to product H42B (P-AC-FCI)

### 2.1 Principle of sensing

H42B (P-AC-FCI) product is based on 10 minutes time frequency rainfall measurements as retrieved by blending LEO MW-derived precipitation rate measurements and GEO IR imagery. Input data come from H40B (P-IN-FCI), which means that the algorithm provides a Level 3 accumulated precipitation product based on the exploitation of all available cross-track and conically scanning passive microwave radiometers, equipped with precipitation sensing channels, on board Low Earth Orbit (LEO) satellites orbiting around the globe.

Covered areas are the same as P-IN-FCI instantaneous product (*Figure 1*).

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**Figure 1 P-AC-FCI coverage.**

## 2.2 Highlights of the algorithm

P-AC-FCI product has been proposed as a Level 3 precipitation product, providing hourly the 1 hour accumulated precipitation and every six hours (at 00, 06, 12 and 18 UTC) the 24 hours accumulated precipitation. The accumulated precipitation rate is obtained from the H-SAF product P-IN-FCI instantaneous precipitation rate based on inter-calibrated Level 2 PMW instantaneous precipitation rate estimates blended with 10.5  $\mu\text{m}$  channel from FCI instrument.

P-AC-FCI product is the upgrade version of H61B (P-AC-SEVIRI-PMW) product. The main difference stands in the input data used. The pixels matrix of P-AC-FCI data input is 5568 rows x 5568 columns.



For its characteristics, the product can be well exploited for hydrological applications and for data assimilation in hydrological models and it can be easily compared to global rainfall gridded datasets (i.e., GPCC).

The P-AC-FCI algorithm mainly consists of one module:

- integration module.

The basic operational algorithms for computing the cumulated precipitation relies on the assumption that:

- instantaneous derivative (the retrieved rain rate) is constant along the integration period;

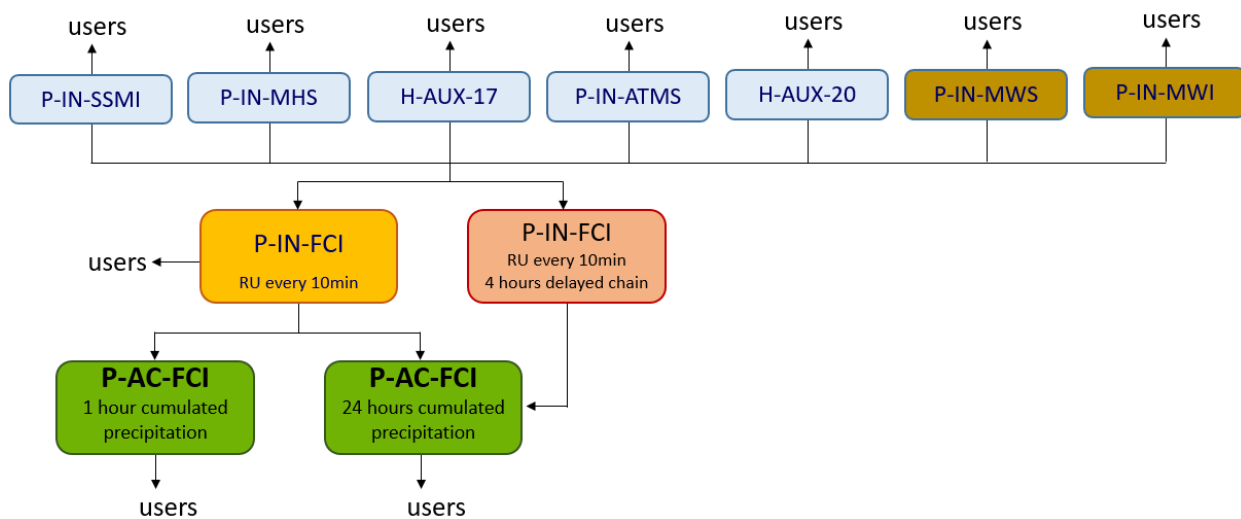
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- spatial resolution will be kept constant, no upscaling is performed along time integration of highest space time resolution rain rate products (IR+MW);

Algorithm details are described in ATBD-H42B.

### 2.3 Architecture of the products generation chain

The architecture of the P-AC-FCI product generation chain is shown in *Figure 2*.





**Figure 2** Flow chart of generation chain.

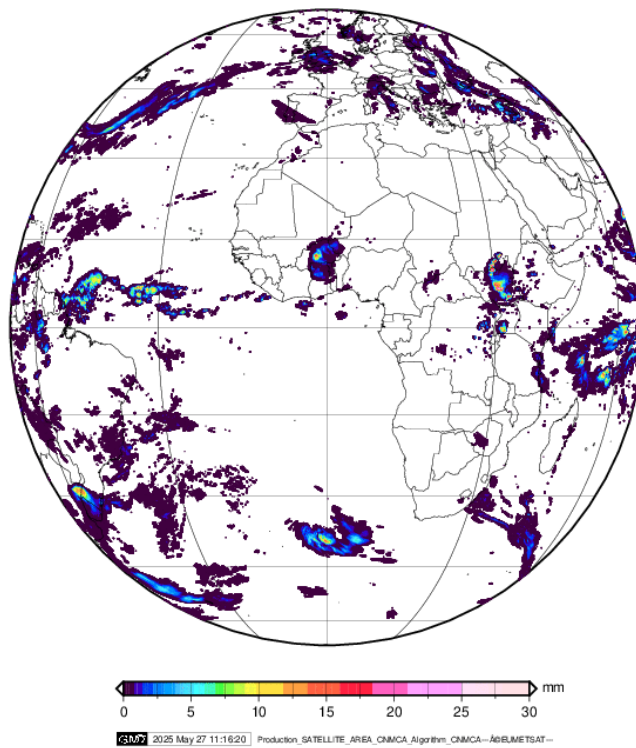
The final product is parallax corrected (because the used inputs are too) and is subjected to an integrity check. The integrity check algorithm's tasks concern a series of checks performed on the output (i.e. size control of output file, identification of how many zero-value, NaN-value and rainy pixels, statistical comparison, etc). If the output doesn't pass all the checks it is moved into a failure folder. Integrity check algorithm produces a warning, recorded on log file.

### 2.4 Product coverage and appearance

Since data in NetCDF format, as values in grid points of known coordinates (those of the FCI pixels), the product can be plotted in any projection of user's choice. Products examples are shown in *Figure 3*.

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EUMETSAT H SAF P-AC-FCI (H42)  
Accumulated precipitation at ground  
by blended MW and IR and MTG FCI h42\_20250527\_1100\_01\_fdk





**Figure 3 P-AC\_FCI product example day 27 May 2025 11:00 UTC.**

## 2.5 Quality flag

A quality flag is conceived and associated to the accumulated precipitation output with the aim to provide to the end-users a simple and immediate criterion for the assessment of the reliability of the accumulated precipitation products.

At general level, the **file quality level** is given within the metadata. It is the percentage of P-IN-FCI used to compute the total values, being 100%=6 out of 6 for hourly period and 144 out of 144 for daily period.

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At pixel level, the **quality index** is given by the average of the quality indexes coming from the P-IN-FCI source files.

Quality flag is a dimensionless parameter, expressing the percentage of confidence, ranging from -1 (undefined) to 100 (%). A 5568x5568 size matrix showing the pixel quality flag is contained in the NetCDF output files in addition to the accumulated rain rate (mm/h).

### 3 Product operational characteristics

#### 3.1 Spatial resolution

The *horizontal resolution* ( $\Delta x$ ). In P-AC-FCI product the resolution is the resolution of used inputs the same of FCI IR 10.5  $\mu\text{m}$  channel: its instantaneous field of view (IFOV) is 2 km at nadir, and it degrades moving away from nadir.

- Resolution:  $\Delta x \sim 2 \text{ km}$

#### 3.2 Generation frequency

The *generation frequency* is the reference time interval for calculating the cumulated precipitation. Two generation frequencies are provided: an hourly frequency for the 1 hour accumulated precipitation product, and a six hour frequency for the 24 hours accumulated precipitation.



#### 3.3 Timeliness

The *timeliness* is usually defined as the time difference between end of image acquisition at satellite level and output data reception time at the end-user. Within H-SAF this definition has been adopted once the specification of EUMETCast as the main dissemination; it includes the time needed by the SAF to process the data, generate a Level 2 product, disseminate it to the EUMETSAT and time for final dissemination to the end users.

- Timeliness:  $\delta \sim 30 \text{ min}$

#### 3.4 Accuracy

The *accuracy*, is evaluated *a-posteriori* by means of the *validation activities cluster*.

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## 4 Product availability

### 4.1 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.

### 4.2 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](mailto: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) Request for data older than 60 days can be done using the form request in the web site <https://hsaf.meteoam.it/>. The orders placed will be submitted for approval and will be delivered within three working days.

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



### 4.3 Formats and codes

Two type of files are provided for P-AC-FCI:

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

### 4.4 Description of the files

P-AC-FCI product is also identified as H42B. *Table 3* below shows the detailed information to access the product using the H-SAF FTP server (<ftp://ftphsaf.meteoam.it>).

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<b>P-AC-FCI Data</b>	
Repository root directory	<a href="ftp://ftphsaf.meteoam.it/products/h42B">ftp://ftphsaf.meteoam.it/products/h42B</a>
Sub-repository	<a href="#">/h42_cur_mon_data</a> (data of last 60 days)
File name	<b>h42_yyyymmdd_hhMM_TT_fdk.nc.gz</b> Namespace description <ul style="list-style-type: none"> <li>• yyyyymmdd: year, month, day</li> <li>• hhMM: hour and minute</li> <li>• TT: time span (01 or 24 hours)</li> </ul> Suffix for Digital Data: “.nc.gz” (compressed NetCDF file)
Examples	<a href="ftp://ftphsaf.meteoam.it/products/h42B/h42_cur_mon_data/h42_20200413_0000_01_fdk.nc.gz">ftp://ftphsaf.meteoam.it/products/h42B/h42_cur_mon_data/h42_20200413_0000_01_fdk.nc.gz</a>
<b>P-AC-FCI Image Data</b>	
Repository root directory	<a href="ftp://ftphsaf.meteoam.it/products/h42B">ftp://ftphsaf.meteoam.it/products/h42B</a>
Sub-repository	<a href="#">/h42_cur_mon_png/</a> (data of last 60 days)
File name	<b>h42_yyyymmdd_hhMM_TT_fdk.png</b> Namespace description: same as for nc.gz files Suffix for Image Data: “.png” (image data file)
Examples	<a href="ftp://ftphsaf.meteoam.it/products/h42B/h42_cur_mon_png/h42_20200413_0000_01_fdk.png">ftp://ftphsaf.meteoam.it/products/h42B/h42_cur_mon_png/h42_20200413_0000_01_fdk.png</a>
EUMETCast dissemination filename	W_IT-HSAF-ROME,SATELLITE,h42B_C_LIIB_202011230000_PACFCI.nc.gz

**Table 1 Summary instructions for accessing P-AC-FCI data.**



An example of NetCDF file metadata is shown; there are 2 integer variables, accumulated rain and pixel quality index. Please note that the rain value is saved as 10 times the estimated value in order to pack the file. The scale factor (0.1) allows for auto adjustment of the values for many softwares, like Panoply or Matlab. The missing values are saved as –99. In parallax correction section “mode\_on” indicates that correction occurred and data were sufficient for operating the correction. Sometimes it happens that the CTHH data is unavailable, in that case “mode\_off” will be in parallax\_correction section.

The file is CF 1.7 compliant.

```

dimensions:
  nx = 5568;
  ny = 5568;
variables:

```

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```

float nx(nx=5568);
:units = "m";
:standard_name = "projection_x_coordinate";
:long_name = "X Georeferenced Coordinate for each pixel count";
:_ChunkSizes = 5568U; // uint

byte geostationary_projection;
:grid_mapping_name = "geostationary";
:latitude_of_projection_origin = 0.0; // double
:longitude_of_projection_origin = 0.0; // double
:perspective_point_height = 35785831; // int
:semi_major_axis = 6378169; // int
:semi_minor_axis = 6356584; // int
:sweep_angle_axis = "y";
:long_name = "satellite view parameters";



byte qind(ny=5568, nx=5568);
:valid_min = 0B; // byte
:valid_max = 100B; // byte
:long_name = "pixel quality index";
:units = "percent";
:missing_value = -99B; // byte
:grid_mapping = "geostationary_projection";
:_ChunkSizes = 1856U, 1856U; // uint

short acc_rr(ny=5568, nx=5568);
:valid_min = 0S; // short
:valid_max = 10000S; // short
:long_name = "Hourly accumulated rain amount";
:units = "mm";
:add_offset = 0.0; // double
:scale_factor = 0.1; // double
:missing_value = -990S; // short
:grid_mapping = "geostationary_projection";
:_ChunkSizes = 1392U, 1392U; // uint

float ny(ny=5568);
:units = "m";
:standard_name = "projection_y_coordinate";
:long_name = "Y Georeferenced Coordinate for each pixel count";
:_ChunkSizes = 5568U; // uint

// global attributes:
:title = "Hourly accumulated rain amount";
:license = "All intellectual property rights of the Hydrology and Water
Management SAF products belong to EUMETSAT. The use of these products is
granted to every user, free of charge. If users wish to use these products,
EUMETSAT\'s copyright credit must be shown by displaying the words

```

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\'Copyright EUMETSAT\' under each of the products shown. EUMETSAT offers no warranty and accepts no liability in respect of the H SAF products. EUMETSAT neither commits to nor guarantees the continuity, availability, or quality or suitability for any purpose of, the H SAF products.";

```
:creator_name = "H SAF";
:creator_email = "us_hsaf@meteoam.it";
:creator_url = "http://hsaf.meteoam.it";
:platform = "MTG1";
:date_created = "16-May-2025 16:19:07";
:original_run_time = "ven 16 mag 2025, 16.18.00, UTC";
:algorithm_version = "1.0";
:parallax_correction = "Mode_on";
:satellite_identifier = "MTG1";
:resolution = 5568S; // short
:sub_satellite_longitude = "0.0f";
:satellite_altitude = "35785831";
:satellite_altitude_unit = "m";
:r_eq = "6378.169000";
:r_eq_unit = "Km";
:r_pol = "6356.583800";
:r_pol_unit = "Km";
:gdal_projection = "+proj=geos +a=6378169.000000 +b=6356583.800000
+lon_0=0.000000 +h=35785831.000000 +sweep=y";
:Conventions = "CF-1.7";
```

## 4.5 Latitude and Longitude generation

Geographic latitude and longitude coordinates are not present within the NetCDF files, but the metadata contain all parameters to calculate them.

In [ftp://ftphsaf.meteoam.it/products/utilities/matlab\\_code/](ftp://ftphsaf.meteoam.it/products/utilities/matlab_code/) files and code are available to simplify and speed up the calculation.

The files `latlon_mtg_zero.nc` include latitude and longitude in float variables, to be appended to the `.nc` files using `ncks` utility.

The shell `add_latlon.sh` can be used to accomplish this task. Please use it as a template.