

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



## **Product User Manual (PUM) for product H68 (P-IN-PMW)**

**Gridded MW instantaneous precipitation rate based on inter-calibrated  
PMW instantaneous precipitation rate estimates**

**DOCUMENT CHANGE RECORD**

Issue / Revision	Date	Authors	Description
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## 1. Introduction

### 1.1 Purpose of the document

Product User Manuals (PUMs) are available for operational, (pre)-operational and for demonstrational H SAF product.

The 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.

This document describes the H SAF H68 product (acronym P-IN-PMW: <Precipitation product> - <INstantaneous precipitation rate> – <Passive MicroWave sensors>) providing precipitation rate estimates over the H SAF extended area (LAT 60°S – 75°N, LON 60°W – 60°E). P-IN-PMW is a Level 3 microwave-based (MW-based) precipitation rate 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. It is based on instantaneous precipitation rate estimates available from the Level 2 operational products H01 (P-IN-SSMIS), H02B (P-IN-MHS), H18 (P-IN-ATMS), and auxiliary modules H-AUX-17 (P-IN-AMSR2) and H-AUX-20 (P-IN-GMI), merged and inter-calibrated.

The algorithm provides the surface precipitation rate (mm/h), the phase of the precipitation, a pixel-based quality index for the evaluation of the reliability of the retrieval, and the number and type of conical and cross-track satellites overpassing each grid-box, and their total number.

### 1.2 Introduction to product P-IN-PMW

H68 (P-IN-PMW) is a Level 3 (gridded) MW-based product providing the instantaneous precipitation rate estimate, exploiting the combination of passive microwave (PMW) Level 2 instantaneous precipitation rate products. H68 is provided every half hour (from 00:00 UTC to 23:30 UTC), on a 0.25°x0.25° regular grid over the extended H SAF area (LAT 60°S – 75°N, LON 60°W – 60°E). All the available overpasses at a given grid-box every 30 minutes by DMSP (SSMIS), MetOp/NOAA (AMSU/MHS), GCOM-W1 (AMSR2), SNPP and NOAA-20 (ATMS) and GPM-Core Observatory (GMI) satellites are considered. The precipitation rate estimates from the corresponding Level 2 operational products H01 (P-IN-SSMIS, based on CDRD algorithm for SSMIS radiometers, Casella et al., 2013, Sanò et al., 2013, Mugnai et al., 2013 a,b), H02B (P-IN-MHS, based on PNPR algorithm for AMSU/MHS radiometers, Sanò et al., 2015), and H18 (P-IN-ATMS, based on PNPR-V2 algorithm for ATMS radiometer, Sanò et al., 2016), and on the auxiliary modules H-AUX-17 (P-IN-AMSR2, CDRD-V2 algorithm for AMSR2 radiometer, Casella et al., 2017), and H-AUX-20 (P-IN-GMI, PNPR-V3 algorithm for GMI radiometer, Sanò et al., 2018) are matched in order to provide the best instantaneous precipitation rate estimate at each grid point every half hour.

## **2. Product operational characteristics**

### **2.1 Spatial and temporal resolution**

The P-IN-PMW product, being a Level 3 product, is provided over a regular grid at  $0.25^{\circ} \times 0.25^{\circ}$  on the H SAF extended area (LAT  $60^{\circ}\text{S} - 75^{\circ}\text{N}$ , LON  $60^{\circ}\text{W} - 60^{\circ}\text{E}$ ). It is provided every 30 minutes (from 00:00 to 23:30 UTC) in Nera Real Time (NRT), but because of the latency of some of the input products (e.g., as high as 3 hours for H01), the timeliness is set at 4 hours. This means that the product will be made available in the worst case (at the latest) 4 hours after the latest data acquisition time.

### 3. Product accuracy

P-IN-PMW has been validated, over European H SAF and H SAF extended areas.

The validation procedure over Europe has been carried out considering 1-year period (January to December 2019), using reference data (meteorological radar and rain gauges) provided by the members of the H SAF Precipitation Products Validation Group. The H SAF extended area validation procedure was based (for the same 1-year period) on the GPM DPR-NS product, as reference. The Fractional Standard Error (FSE) defines the accuracy of the product:

$$FSE = [RMSE / <obs>] * 100\%$$

where “<obs>” represents the mean value of the observations (surface rainfall evaluated using radar or rain gauges). In this document, only a summary of the main results is provided, mainly aiming at characterising the product quality. More details on the validation results are provided in the Product Validation report (PVR) for product H68 (P-IN-PMW).

Table 1 shows the performance of P-IN-PMW (over the European H SAF area) for precipitation rate  $\geq 1$  mm/h. The FSE for different surfaces (Land, Sea, Coast) is compared with the corresponding reference values (threshold, target and optimal). Almost all the FSE values are below the target requirement established at 150%, while the overall accuracy for P-IN-ATMS is equal to 134%

Table 1 - Summary of results from the validation of P-IN-PMW (January to December 2019) over the European H SAF area.

Between target and optimal		Between threshold and target		Threshold exceeded by < 50 %		Threshold exceeded by ≥ 50 %		
H68		Annual average of FSE (%)						
Precipitation Class	Requirement (FSE %)			Radar (Land)	Radar (Sea)	Radar (Coast)	Gauge (Land)	OVERALL
	thresh	target	optimal					
≥ 1 mm/h	200	150	100	117	145	162	146	134

Table 2 shows the performance of P-IN-PMW over H SAF extended area. FSE values are very close to the optimal requirement (100%). The mean annual overall accuracy for P-IN-PMW over the H SAF extended area equal to 158% is slightly higher than the target requirement.

Table 2 - Summary of results from the validation of P-IN-PMW (January to December 2019) over the H SAF extended area.

Between target and optimal		Between threshold and target		Threshold exceeded by < 50 %	Threshold exceeded by ≥ 50 %		
H68 vs DPR	Annual average of FSE (%)						
Precipitation Class	Requirement (FSE %)			Land	Sea	Coast	OVERALL
	thresh	target	optimal				
≥ 1 mm/h	200	150	100	154	158	148	157

## 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.

### 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 below.

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 multiservice 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. To place an order it is needed to select one or more products and set for each selected product an expected time range; the placed orders 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.

Here following the relevant web page is shown:



## H-SAF Products Download Centre

All H-SAF products are owned by EUMETSAT, and the EUMETSAT SAF Data Policy applies. They are available for all users free of charge. Users should recognise the respective roles of EUMETSAT, the H-SAF Leading Entity and the H-SAF Consortium when publishing results that are based on H-SAF products.



### Access to H-SAF on-line archive (last 60 days)

This function allows the direct access to the H-SAF FTP server by the web browser.

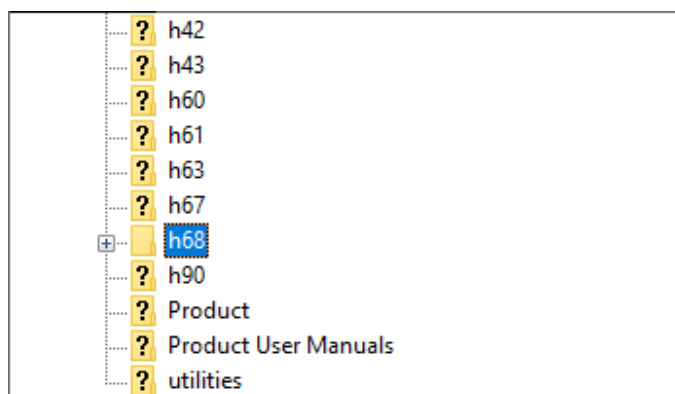


### Place an order to get the H-SAF archived data (basic)

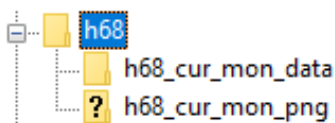
This function allows access to the H-SAF internal order centre. This service offers all basic functions to carry out orders on H-SAF historical archives (starting from the pre-operation/operational status of products). Orders placed will be submitted for approval and will be processed within three working days

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By choosing the first option the ftp download area is accessed:



By accessing the “H68” folder the data folders of both formats “png” and “NetCDF” are accessible:



## 4.3 Formats and codes

Two type of files are provided for P-IN-PMW:

- the digital data in Network Common Data Form (NetCDF);
- quicklooks (images) in PNG.

## 4.4 Description of the output files

- Directory: products
- Sub-directory: h68
- Two folders:
  - h68\_cur\_mon\_data;
  - h68\_cur\_mon\_png.

Next table provides the information on the file structure, including the legenda:

Table 3 - Summary of the P-IN-PMW file structure.

URL: <a href="ftp://ftphsaf.meteoam.it">ftp://ftphsaf.meteoam.it</a>		Credentials: register to <a href="http://hsaf.meteoam.it">hsaf.meteoam.it</a>	
Directory: <i>products</i>			
Product identifier: <i>h68</i>			
h68_cur_mon_data		data of previous 60 days	
h68_cur_mon_png			
Files description (for both directories)	h68_yyyymmdd_hhmmssS_hhmmssF.nc.gz	digital data	
	h68_yyyymmdd_hhmmssl_hhmmssF.png	image data	
yyyymmdd: year, month, day			
hhmmssS: starting hour, minute and second of the considered half hour			
hhmmssF: final hour, minute and second of the considered half hour			

The P-IN-PMW output is an Instantaneous precipitation rate (level 3) product generated from all available level 2 products providing instantaneous precipitation rate. The P-IN-PME output is provided in NetCDF (V4.0) format and is CF convention compliant (<http://cfconventions.org/>).

A list of the variable and of the global attributes of P-IN-PMW NetCDF output files is reported, as an example, below:

```
netcdf file:/C:/Users/Leo/Desktop/h68_20210930_080000_082959_he.nc.gz {
  dimensions:
    xc = 540;
    yc = 480;
  variables:
    double lat(xc=540);
      :long_name = "latitude";
      :units = "degrees_north";
      :_ChunkSizes = 540U; // uint

    double lon(yc=480);
      :long_name = "longitude";
      :units = "degrees_east";
      :_ChunkSizes = 480U; // uint

    double rr(xc=540, yc=480);
      :long_name = "Precipitation rate estimation over 30 minutes";
      :short_name = "rr";
      :units = "mm/h";
      :coordinates = "lon lat";
```

```
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

double TotalCount(xc=540, yc=480);
:long_name = "Total sensors count";
:short_name = "TotalCount";
:units = "#";
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

double CrossTrackCount(xc=540, yc=480);
:long_name = "Cross-track sensors count";
:short_name = "CrossTrackCount";
:units = "#";
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

double ConicalCount(xc=540, yc=480);
:long_name = "Conical sensors count";
:short_name = "ConicalCount";
:units = "#";
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

double phase(xc=540, yc=480);
:long_name = "Precipitation Phase";
:short_name = "phase";
:units = ;
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

double qind(xc=540, yc=480);
:long_name = "Quality Index";
:short_name = "qind";
:units = ;
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

uint IdSensorBin(xc=540, yc=480);
:long_name = "conical/cross-track sensor id";
:short_name = "id sen";
:units = "#";
:coordinates = "lon lat";
:FillValue = "NaN";
:_ChunkSizes = 540U, 480U; // uint

// global attributes:
:Creation_Date = "30-Sep-2021 11:51:26";
:Version = "1.0";
:Conventions = "CF-1.5";
:Title = "Half Hour Gridded Mean Precipitation Rate";
```

:Institution = "Institute of Atmospheric Sciences and Climate - Italian  
National Research Council (CNR-ISAC) - Rome";  
:Source = "H01, H02B, H18, H-AUX-17 and H-AUX-20 precipitation rate  
products.";  
:Resolution = "The product is provided on a regular grid at 0.25x0.25  
resolution.";