

EUMETSAT Satellite Application Facility on
Support to Operational Hydrology and Water Management
<http://hsaf.meteoam.it/>



Product Validation Report (PVR)

H109

Revision History

Revision	Date	Author(s)	Description
0.1	2016/10/11	S. Hahn	First release of H109 SSM CDR validation.

Table of Contents

1. Introduction	7
2. Data	8
3. Methods	8
4. Results	8
4.1. Boxplot of metrics	8
4.2. Signal-to-Noise-Ratio (SNR)	9
4.3. Pearson correlation coefficient (R)	11
5. Discussion and Conclusion	13
6. References	13
Appendices	15
A. Introduction to H SAF	15
B. Purpose of the H SAF	15
C. Products / Deliveries of the H SAF	16
D. System Overview	17

List of Tables

List of Figures

1.1. Committed Metop ASCAT soil moisture area.	7
4.1. The boxplots indicate the distribution of the quality benchmarks globally and just for the committed area. A percentage of locations exceeding each of the three thresholds is indicated as well.	9
4.2. SNR of the test data set.	10
4.3. SNR of the test data set for the committed area only.	11
4.4. Pearson R between the test data set and ERA-Interim.	12
4.5. Pearson R between the test data set and ERA-Interim for the committed area only.	13
A.1. Conceptual scheme of the EUMETSAT Application Ground Segment.	15
A.2. Current composition of the EUMETSAT SAF Network.	16

List of Acronyms

ASAR	Advanced Synthetic Aperture Radar (on Envisat)
ASAR GM	ASAR Global Monitoring
ASCAT	Advanced Scatterometer
ATBD	Algorithm Theoretical Baseline Document
BUFR	Binary Universal Form for the Representation of meteorological data
DORIS	Doppler Orbitography and Radiopositioning Integrated by Satellite (on Envisat)
ECMWF	European Centre for Medium-range Weather Forecasts
Envisat	Environmental Satellite
ERS	European Remote-sensing Satellite (1 and 2)
ESA	European Space Agency
EUM	Short for EUMETSAT
EUMETCast	EUMETSAT's Broadcast System for Environment Data
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FTP	File Transfer Protocol
H SAF	SAF on Support to Operational Hydrology and Water Management
Météo France	National Meteorological Service of France
Metop	Meteorological Operational Platform
NRT	Near Real-Time
NWP	Near Weather Prediction
PRD	Product Requirements Document
PUM	Product User Manual
PVR	Product Validation Report
SAF	Satellite Application Facility
SAR	Synthetic Aperture Radar
SRTM	Shuttle Radar Topography Mission
SZF	Sigma Zero Full resolution
SZO	Sigma Zero Operational (25 km spatial sampling)

SZR Sigma Zero Research (12.5 km spatial sampling)

TU Wien Technische Universität Wien (Vienna University of Technology)

WARP Soil Water Retrieval Package

WARP H WARP Hydrology

WARP NRT WARP Near Real-Time

ZAMG Zentralanstalt für Meteorologie und Geodynamik (National Meteorological Service of Austria)

1. Introduction

The validation of the H109 Metop ASCAT DR2015 SSM time series 12.5 km sampling** product (hereafter referred to test data set) is summarized in this online Product Validation Document (PVR). The online PVR gives an overview of the data sets and methods used to validate the test data set. The analysis of the test data set follows the guidelines described in the Metop ASCAT Product Validation Report [1]. The committed area and quality benchmarks are defined in the Product Requirements Document (PRD) [2]. The committed area represents a restricted geographical region with high confidence in the successful retrieval of surface soil moisture information from Metop ASCAT. The area is limited to low and moderate vegetation regimes, unfrozen and no snow cover, low to moderate topographic variations, as well as no wetlands and coastal areas (see Figure 1.1).

All quality benchmarks were computed on a global basis and are presented either globally (i.e. all valid results) or masked to the committed product area. The validation framework of the Python Toolbox for the Evaluation of Soil Moisture Observations (pytesmo¹ v0.6.0) has been used to perform the validation.

More information on the soil moisture data records can be found in the Product User Manual (PUM) [3] and Algorithm Theoretical Baseline Document (ATBD) [4].

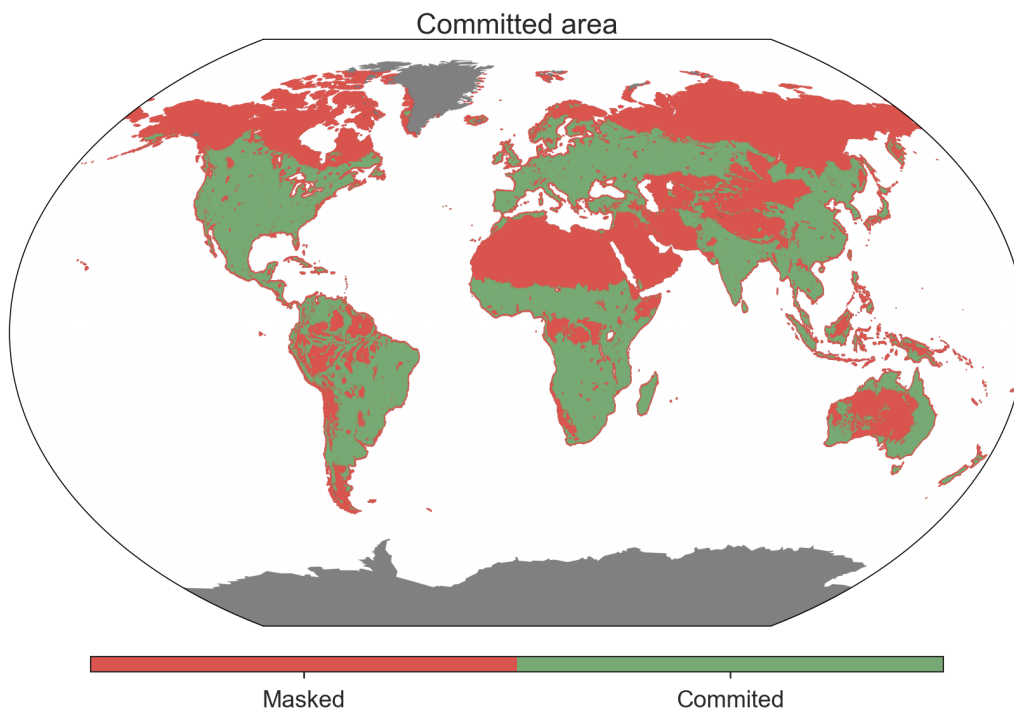


Figure 1.1: Committed Metop ASCAT soil moisture area.

¹<https://github.com/TUW-GEO/pytesmo>

2. Data

The validation has been performed globally for the time period 2007-01-01 until 2015-12-31 on the WARP 5 grid. As reference data set the ERA-Interim land surface model and the passive CCI soil moisture product (v2.3) were used. The first soil moisture layer (0.00-0.07 m) of ERA-Interim was used for the validation. The soil temperature and snow depth information was used for filtering for non-frozen (soil temperature $>4^{\circ}$) and snow-free (snow depth = 0) time periods.

3. Methods

The standard quality benchmark Signal-to-Noise Ratio (SNR) [5] and, in addition, the Pearson correlation coefficient (R) have been computed on a global basis. Triple Collocation (TC) has been performed between the test data set, ERA-Interim and the passive CCI soil moisture product, whereas R was only computed between the test data set and ERA-Interim.

4. Results

The quality benchmarks have been computed on a global basis, but under certain circumstances (e.g. no valid measurements) no results have been obtained. In addition, locations with a p-value >0.05 have been discarded.

4.1. Boxplot of metrics

The following Boxplot in Figure 4.1 summarizes the distribution of the quality benchmarks. The whisker indicate the 5th and 95th percentile, whereas the size of the box represents the Inter Quartile Range (IQR). A percentage indicating the number of locations exceeding the threshold/target/optimal requirements is given as well.

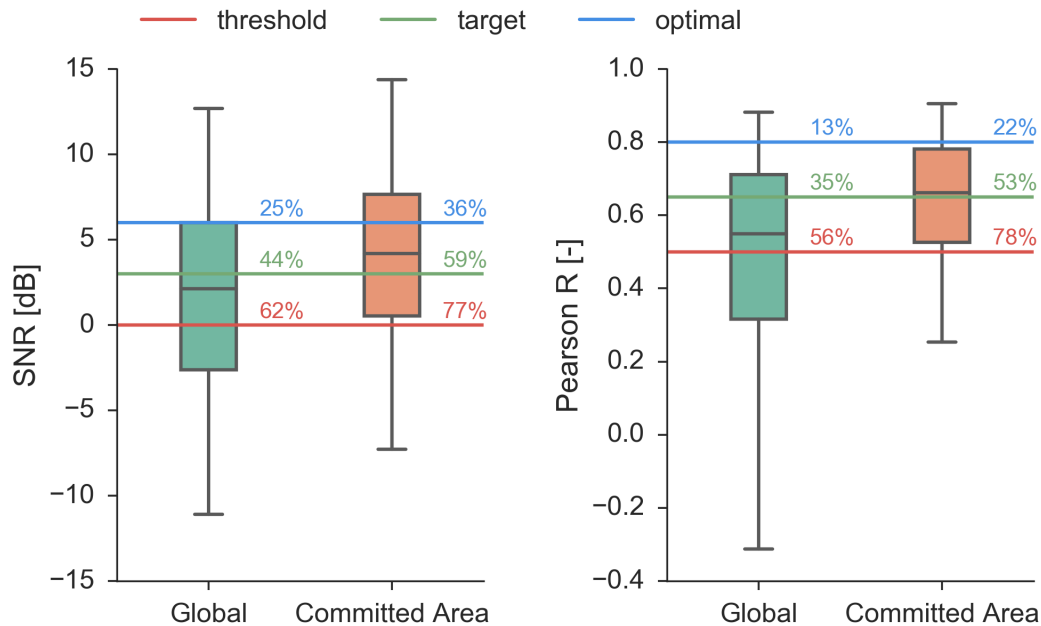


Figure 4.1: The boxplots indicate the distribution of the quality benchmarks globally and just for the committed area. A percentage of locations exceeding each of the three thresholds is indicated as well.

4.2. Signal-to-Noise-Ratio (SNR)

The Signal-to-Noise-Ratio (SNR) is shown in Figure 4.2 and in Figure 4.3 for the committed area.

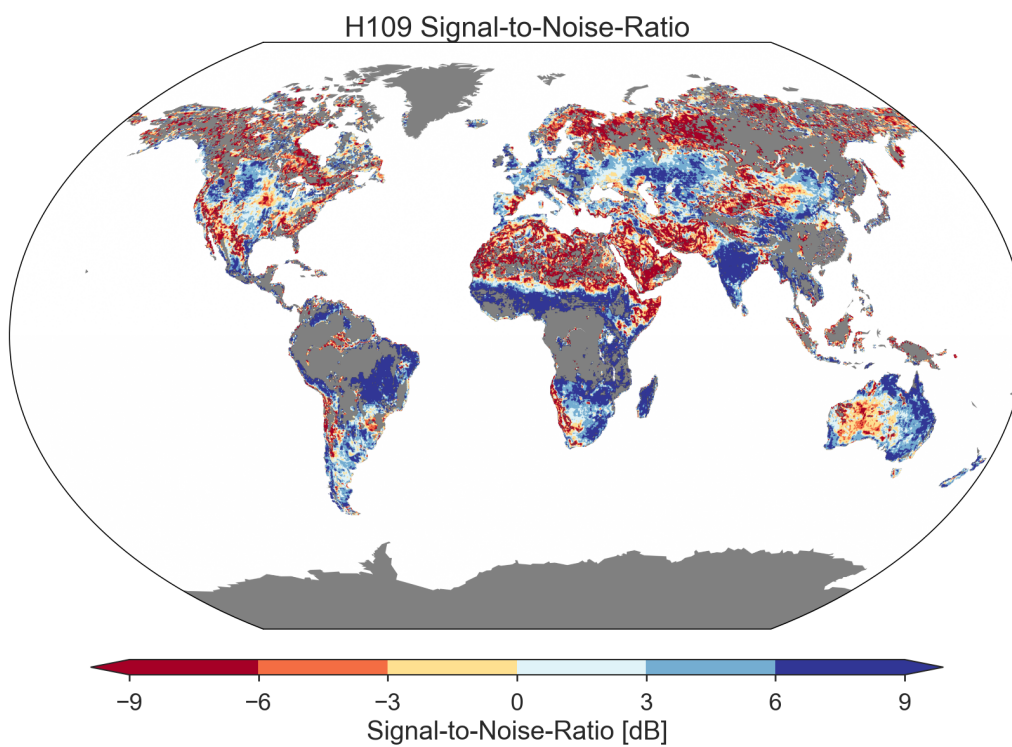


Figure 4.2: SNR of the test data set.

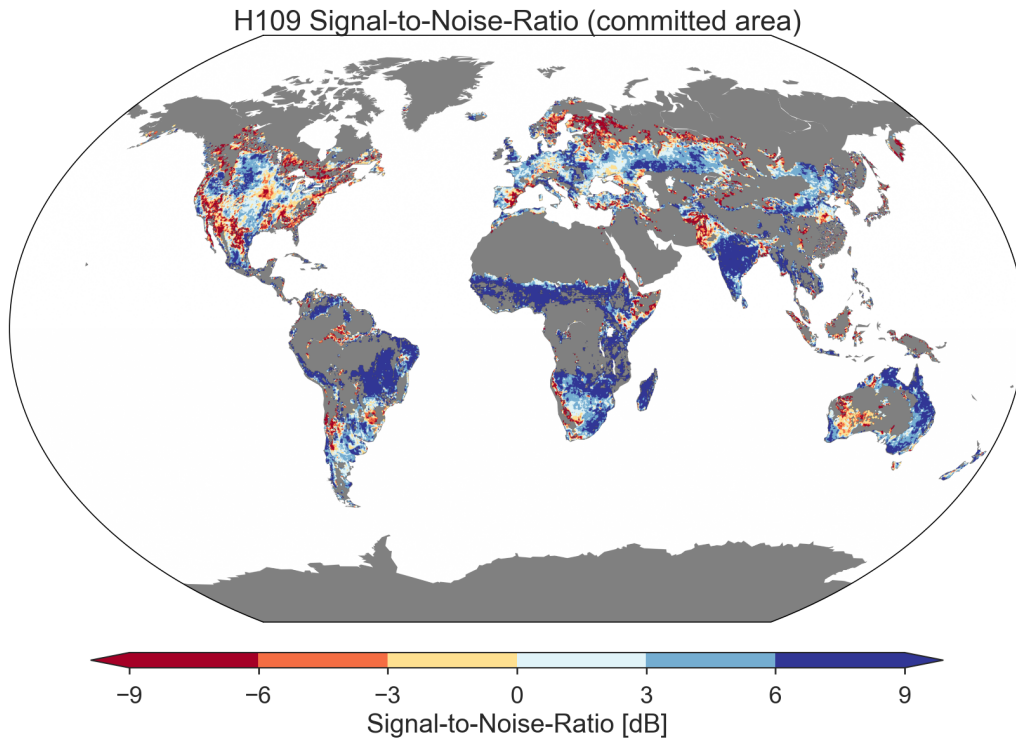


Figure 4.3: SNR of the test data set for the committed area only.

4.3. Pearson correlation coefficient (R)

The Pearson correlation coefficient (R) is illustrated in Figure 4.4 and in Figure 4.5 for the committed area.

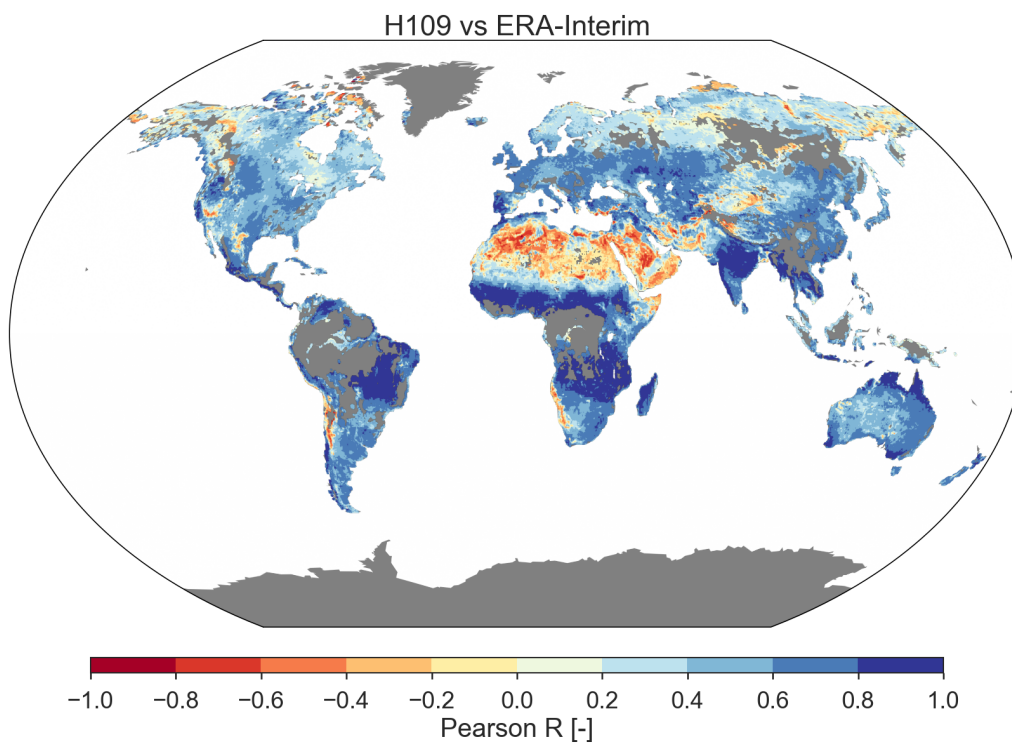


Figure 4.4: Pearson R between the test data set and ERA-Interim.

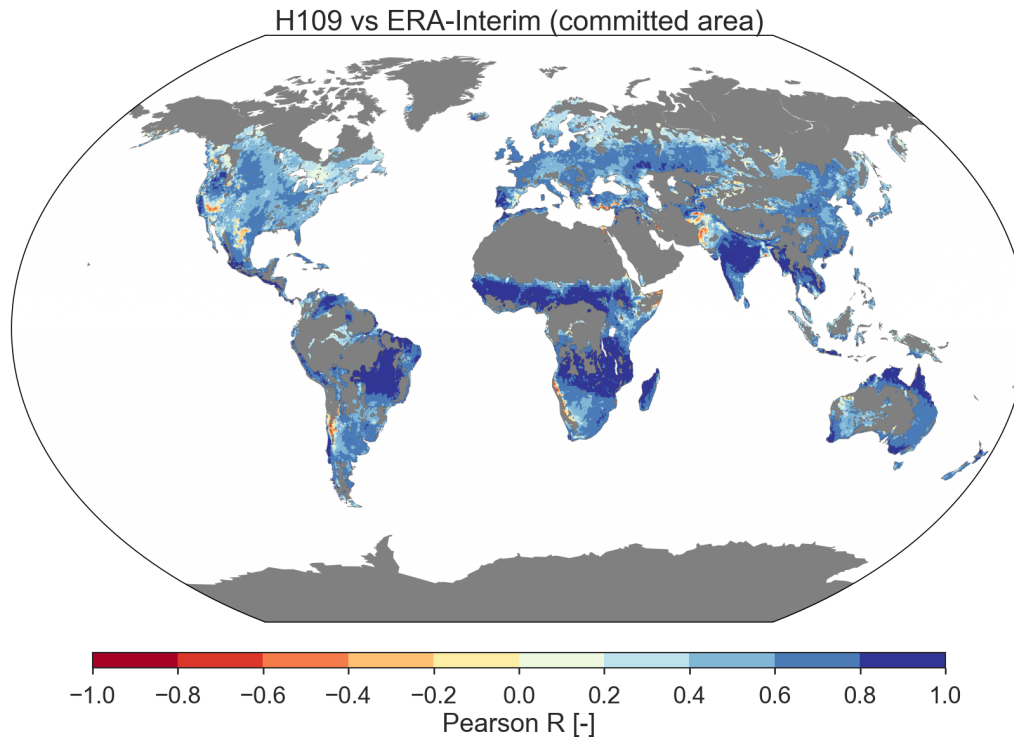


Figure 4.5: Pearson R between the test data set and ERA-Interim for the committed area only..

5. Discussion and Conclusion

The SNR and Pearson R indicate a good performance for the committed product area, except for parts of North America, Northern Europe and Western Australia. On a global scale, a lower performance of the test data set can be found in areas with low soil moisture dynamics (e.g. deserts) or at higher latitudes (see Figure 4.2 and Figure 4.4). In the latter case, frozen soil and snow cover make it difficult to retrieve reliable soil moisture information. Therefore, in these regions only summer months can be used for validation.

Looking at the distribution of the results and comparing them against the threshold/target/optimal requirement shows that more than 75% (SNR: 77%, Pearson R: 78%) of the locations are exceeding the minimal threshold and more than 50% (SNR: 59%, Pearson R: 53%) are above the target threshold for the committed area (see Figure 4.1). Only a small percentage of regions are below the threshold requirement.

In conclusion, the test data set under investigation has successfully been validated and can be reviewed for an official release.

6. References

- [1] "Product Validation Report (PVR) Soil Moisture, Metop ASCAT Soil Moisture," Tech. Rep. Doc. No: SAF/HSAF/CDOP2/PVR, v0.3, 2016.

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- [2] “Product Requirements Document (PRD),” Tech. Rep. Doc. No: SAF/HSAF/CDOP2/PRD, v1.4, 2016.
 - [3] “Product User Manual (PUM) Soil Moisture Data Records, Metop ASCAT Soil Moisture Time Series,” Tech. Rep. Doc. No: SAF/HSAF/CDOP2/PUM, v0.3, 2016.
 - [4] “Algorithm Theoretical Baseline Document (ATBD) Soil Moisture Data Records, Metop ASCAT Soil Moisture Time Series,” Tech. Rep. Doc. No: SAF/HSAF/CDOP2/ATBD, v0.3, 2016.
 - [5] A. Gruber, C.-H. Su, S. Zwieback, W. Crow, W. Dorigo, and W. Wagner, “Recent advances in (soil moisture) triple collocation analysis,” *International Journal of Applied Earth Observation and Geoinformation*, vol. 45, pp. 200–211, Mar. 2016.

Appendices

A. Introduction to H SAF

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 A.1):

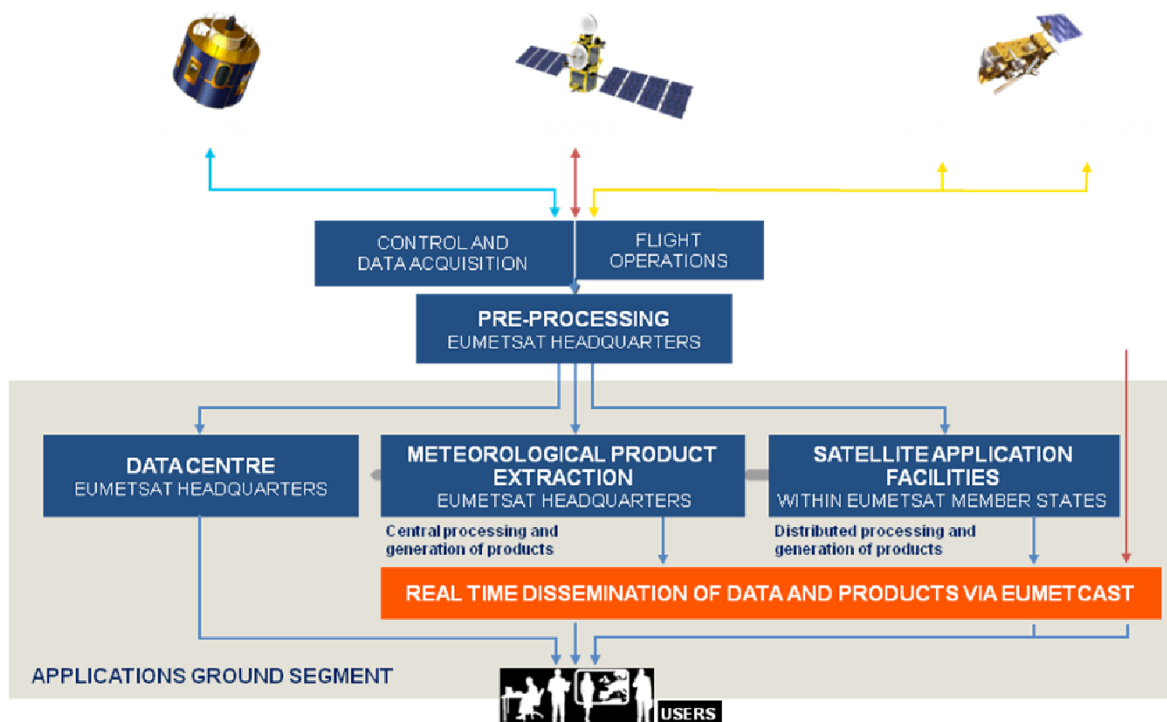


Figure A.1: Conceptual scheme of the EUMETSAT Application Ground Segment.

Figure A.2 here following depicts the composition of the EUMETSAT SAF network, with the indication of each SAF’s specific theme and Leading Entity.

B. 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);

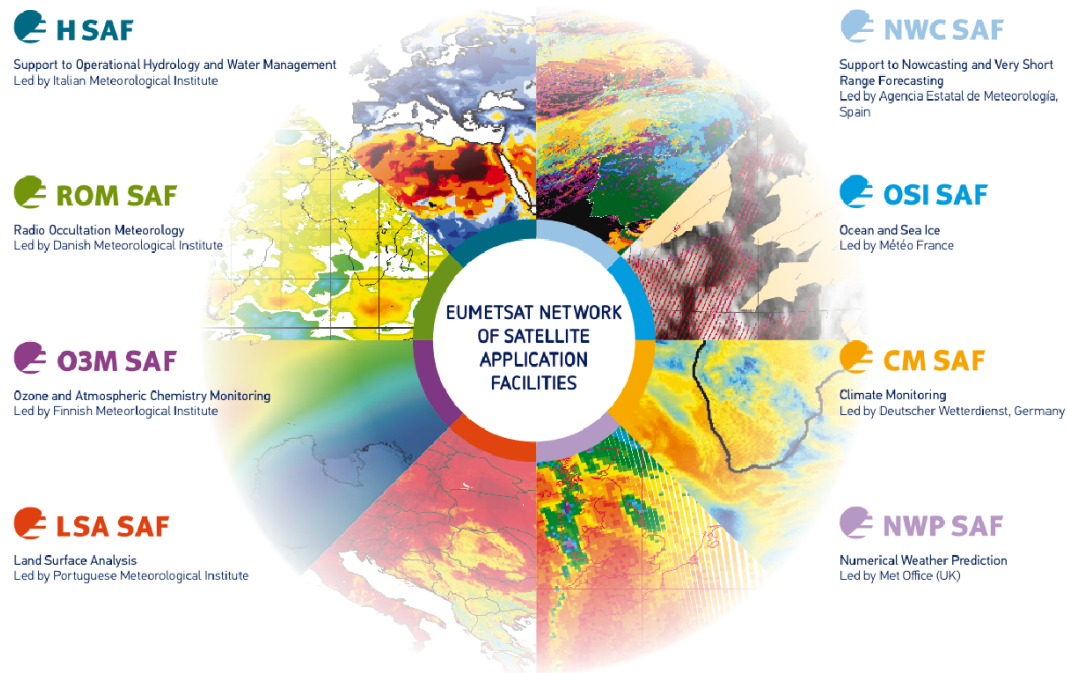


Figure A.2: Current composition of the EUMETSAT SAF Network.

- 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 rain gauge networks;
 - assimilation of satellite-derived products in hydrological models;
 - assessment of the impact of the new satellite-derived products on hydrological applications.

C. 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 (EUMETCast²), or via ftp download; they are also published in the H SAF website³.

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.

²<http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html>

³<http://hsaf.meteoam.it>

D. System Overview

H SAF is lead 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 CNMCA (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 CNMCA (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 CNMCA.

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.