THE QUALITY OF H-SAF ATOVS BASED PRECIPITATION PRODUCTS OVER POLAND

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The EUMETSAT Network of Satellite Application Facilities — H SAF — Support to Operational Hydrology and Water Management

INTRODUCTION

The main goal of EUMETSAT Satellite Application Facility in Support to Operational Hydrology and Water Management (H-SAF) is to provide satellite products for operational hydrology. Products of H-SAF concerns precipitation, soil moisture and snow cover parameters. Among them, the H-SAF precipitation products based on both passive microwave sensors (AMSU and MSH) and IR sensors calibrated by MW have been operationally available for meteorological and hydrological users.

In the poster, the quality of mentioned above H-SAF precipitation products in precipitation detection and estimation is analysed. The analysis was performed using data from both rain gauges and radar data from Polish ground measurement networks. The quality of the satellite products was studied using continuous and categorical statistical parameters within appropriate precipitation classes.

H-SAF CONSORTIUM

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; 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 new 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.

More information at H-SAF web page: **www.hsaf.meteoam.it**

COMPOSITION OF THE H-SAF CONSORTIUM

No.	Country	Units in the Country (responsible unit in bold)	Role in the Project
01	Austria	**- Zentral Anstalt für Meteorologie und Geodynamik** - Technische Univ. Wien, Inst. Photogrammetrie & Fernerkundung	Leader for soil moisture
02	Belgium	**- Institut Royal Météorologique**	
03	Bulgary	**- National Institute of Meteorology and Hydrology**	
04	ECMWF	**- European Centre for Medium-range Weather Forecasts**	Contributor for "core" soil moisture
05	Finland	**- Finnish Meteorological Institute**	Leader for snow parameters
06	France	**- Météo-France** - CNRS Centre d'Etudes Spatiales de la BIOsphere - CNRS Centre d'études des Environnem. Terrestres et Planétaires	
07	Germany	**- Bundesanstalt für Gewässerkunde**	
08	Hungary	**- Hungarian Meteorological Service**	
09	Italy	**- Servizio Meteorologico dell'Aeronautica** - Dipartimento Protezione Civile, Presidenza Consiglio Ministri - CNR Istituto di Scienze dell'Atmosfera e del Clima - Ferrara University, Department of Physics	**Host + Leader for precipitation**
10	Poland	**- Institute of Meteorology and Water Management**	Leader for Hydrology
11	Romania	**- National Meteorological Administration**	
11	Slovakia	**- Slovenský Hydrometeorologický Ústav**	
13	Turkey	**- Turkish State Meteorological Service** - Middle East Technical University, Civil Engineering Department - Istanbul Technical University, Meteorological Department - Anadolu University	Contributor for "core" snow parameters

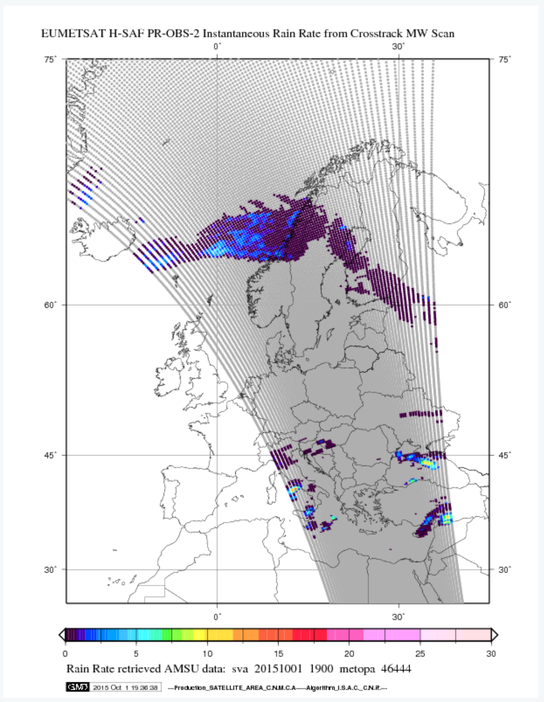
H-SAF ATOVS BASED PRECIPITATION PRODUCT

H-02 - Precipitation rate at ground by MW cross-track scanners (with indication of phase)

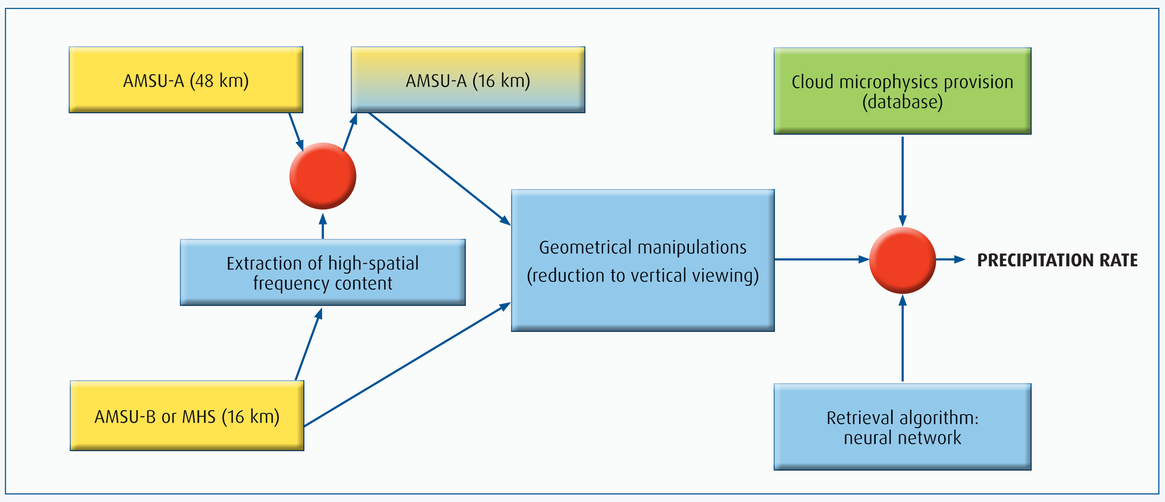
Product H-02 is based on the instruments AMSU-A and AMSU-B or MHS flown on NOAA and MetOp satellites. The algorithm has been devoloped in CNR-ISAC.

Algorithm:

The algorithm uses data from MW absorption bands exploited for temperature sounding (the 54 GHz band of AMSU-A) or for water vapour sounding (the 183 GHz band of AMSU-B and MHS), in which the effect of surface emissivity is minimized. Precipitation is retrieved by exploiting the differential effect of liquid drops or ice particles at different frequencies associated to weighting functions peaking in different atmospheric layers. It is a highly indirect principle that implies that only part of the retrieval process is physically-based, whereas substantial part of the retrieval is currently relying on the use of neural networks trained with the use of Cloud Resolving Model (CRM).



Flow chart of the AMSU-MHS (H-02) precipitation rate processing chain.



All 15-km pixels with brightness temperatures at 183±7 GHz that are below a threshold T_7 are flagged as potentially precipitating, where

$$T_7 = 0.667\,(T_{53.6} - 248) + 252 + 6\cos\theta$$

and where ϑ is the satellite zenith angle and $T_{53.6}$ is the spatially filtered limb-corrected 53.6 GHz brightness temperature obtained by selecting the warmest brightness temperature within a 7×7 array of AMSU-B pixels. This T_7 threshold was determined empirically and can vary with atmospheric temperature.

The 183±7 GHz channel can become sensitive to surface variations in very cold, dry atmospheric conditions. When $T_{53.6}$ is less than 248 K, the 183±3 GHz brightness temperature is compared to a threshold T_3.

$$T_3 = 242.5 + 5\cos\theta$$

The thresholds T_7 and T_3 are slightly colder than a saturated atmosphere would be, implying the presence of a microwave absorbing or scattering cloud. It is possible for the 183±3 GHz and the 183±1 GHz channels to be sensitive to surface variations. If $T_{53.6}$ is less than 242 K, then the pixel is assumed not to be precipitating.

Summary H-02 performance:

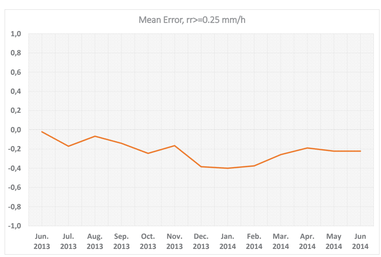
- **Status:** Operational.
- **Coverage:** Strips of ~ 2250 km swath crossing the H-SAF area [25-75°N lat, 25°W-45°E long] in direction approx. S-N or N-S
- **Cycle:** Up to six passes/day (if one Met-Op-A and two NOAA satellites are available) at approximately 09:30, 01:30, 03:00 ECT (descending mode) and 21:30, 13:30, 15:00 ECT (ascending mode)
- **Spatial Resolution:** Corresponds to the nominal resolution of MHS, varying with the viewing scan angle from 16 x 16 km2 / circular at nadir to 26 x 52 km2 / ovate at scan edge
- **Accuracy:**

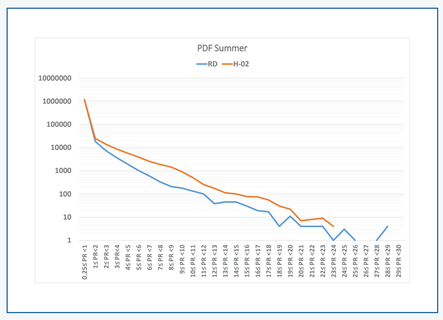
PRECIPITATION RANGE	THRESHOLD	TARGET	OPTIMAL
> 10 mm/h	90	80	25
1-10 mm/h	120	105	50
< 1 mm/h	240	145	90

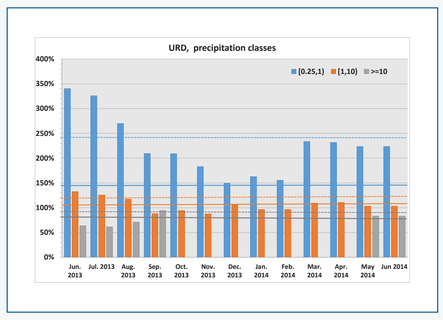
Accuracy requirements for product PR-OBS-2 [RMSE (%)]

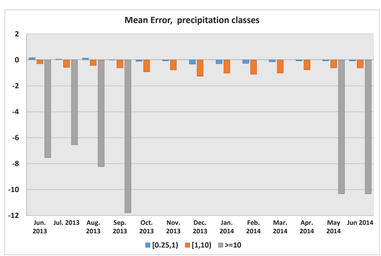
- **Timeliness:** 30 min from observing time
- **Dissemination:** By dedicated lines to centres connected by GTS - By EUMETCast to most other users, especially scientific
- **Formats:** BUFR with values on grid points corresponding to the MHS orbital projection. Also JPEG or similar for quick-look

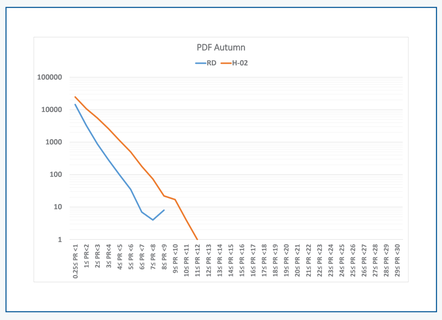
H-02 VALIDATION RESULTS: JUNE 2013-JUNE 2014

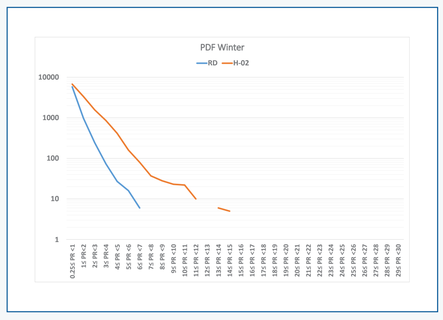












CONCLUSIONS

The H-SAF TOVS based precipitation product (H-02) was validated with the use of radar data for the period of June 2013-June 2014. On the basis of presented material it can be stated that:

- The H-02 precipitation products underestimates the measured rain rate for the whole period, however, the slight overestimation was found for light precipitation during summer 2013.
- The quality of H-02 rain rate products depends on the season – the best results were obtained for autumn and winter and worst – for spring and summer. This dependence is strongly pronounced for light precipitation class.
- Analysis performed for different precipitation classes showed that the quality of considered satellite precipitation product increases with increasing rain rate. The worst results were obtained for light precipitation – the URD reached 350% when compared with radar data, respectively.
- The ability of H-SAF rain rate products in precipitation recognition was found to be rather poor for winter and autumn and reasonably good for summer.

REFERENCES

Algorithms Theoretical Baseline Document for product H02 – PR-OBS-2, 2011, at www.hsaf.meteoam.it