H-SAF future developments on Convective Precipitation Retrieval

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THE EUMETSAT HYDROLOGICAL SATELLITE APPLICATION FACILITY (H-SAF)

The *"EUMETSAT Satellite Application Facility on support to Operational Hydrology and Water Management"* (H-SAF) was established by the EUMETSAT Council on July 3, 2005 and started activity at the official date of September 1, 2005 as part of the EUMETSAT SAF Network.

The H-SAF objectives are:

- 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 mean of the following 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);
- to perform independent validation of the usefulness of the new products for fighting against floods, landslides, avalanches, and evaluating water resources.

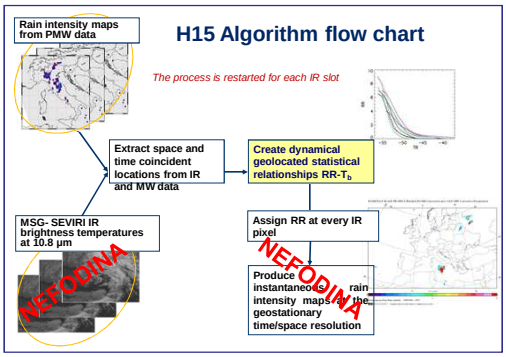
H SAF
Support to Operational Hydrology and Water Management

PRECIPITATION RETRIEVAL

Precipitation is the most important variable in the hydrological budget of the Earth. So the better understanding of the spatial and temporal distribution of precipitation is fundamental for any hydrologic and climatic applications and meteorological satellites provide a unique opportunity for monitoring the precipitation for regions where ground measurement is limited and consistent with the accuracy required by hydrologists.
The following table presents the list of the precipitation products in HSAF catalogue:

Product acronym	Product description
PR-OBS1	Precipitation rate at ground from MW conically scanning radiometers (SSM/I, SSMIS) on LEO satellites
PR-OBS2	Precipitation rate at ground by MW cross-track scanning radiometers (AMSU -MHS) on LEO satellites
PR-OBS3	Precipitation rate at ground by GEO/IR supported by LEO/MW (Rapid Update)
PR-OBS4	Precipitation rate at ground by LEO/MW supported by GEO/IR (CMORPH)
PR-OBS5	Accumulated precipitation at ground by blended MW+IR
PR-OBS6	Blended SEVIRI Convection area/ LEO MW - Convective Precipitation Rate

As shown by the Table on the left, the precipitation is retrieved from microwave instruments on account of their ability to "see" through cloud tops and detect directly the presence of actual precipitation particles within and below the clouds. But the most common approach is to combine geostationary and low orbital satellite data with several techniques to provide global precipitation estimation merging the high-quality, sparsely sampled data from polar-orbital satellites characterized by the more physically direct detection, with continuously sampled data from geostationary satellites.



PR-OBS6 ALGORITHM

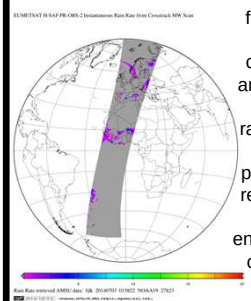
PR-OBS6 is a multisensory algorithm based on the rapid-update technique (RU) (Turk and Miller, 2005). RU is a blended passive microwave (MW) – infrared (IR) technique for the retrieval of instantaneous precipitation intensities in real-time by combining IR MSG-SEVIRI brightness temperatures (TB) at 10.8 mm with rain rates from MW measurements (PR-OBS1 and PR-OBS2). The SEVIRI data drive the identification of convective area. The microphysics information is retrieved from the short wave and a geometrical identification is performed by **NEFODINA**, the fully automatic tool of Italian Meteorological Service deputed to monitoring of strong convective clouds.

FUTURE DEVELOPMENTS

The future developments of PR-OBS6 are related to four different items:

The software itself:

One of the task of this CDOP2 phase of the project, is to deliver all the precipitation software over the full SEVIRI disk.
In this scenario the consortium will support EUMETSAT in the development of global precipitation product, and will sustain the subsequent integration with its product over Euro-African region.
The goal is to provide precipitation products optimized for Europe/Mediterranean areas and other regions in MSG full disk area (Africa and Southern Atlantic) and achieve accuracy and consistency of precipitation retrieval

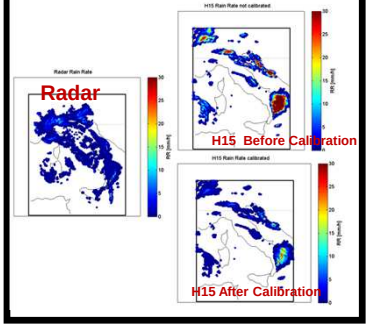


from all the available cross-track and conically scanning radiometers, for all precipitation regimes and surface/ environmental conditions.

The algorithm:

The use of the NEFODINA inside the algorithm solved the underestimation of the pick value in the reconstructed precipitation field but brought an overestimation of the precipitating area.
So a calibration campaign was performed by the University of Tor Vergata in Rome.
Using a Simulated Annealing Approach, a cost function based on the radar rain rate and our retrieval was minimized and the formula was corrected exponentially:

$$H15^{*} = e^{(H15 \cdot m + q)}$$



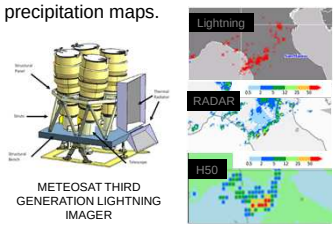
The inputs:

Global monitoring of the precipitation requires the full exploitation of all overpasses of present and future satellites carrying cross-track and conically scanning passive microwave (PMW) radiometers. In particular, the Blending techique strongly depends on three factors: 1) temporal frequency of PMW observations 2) accuracy of the PMW precipitation retrievals; 3) consistency among the precipitation estimates obtained from the different PMW sensors.
The recent advent of the Global Precipitation Measuring (GPM) mission has started a new era for precipitation monitoring and great advances in the accuracy and consistency. HSAF project proposed to develop products for the following radiometers in the GPM constellation:

- G-COMW1 AMSR-2
- Suomi NPP
- GPM Microwave Imager.

The convection mask:

The last development is related to the convection mask itself. An upcoming study will exploit the possibility to improve the convection detection using also the lightning data. The idea is, as for NEFODINA, to use the lightning information not only for a better location of the convection but also for the rain rate estimation.
A rainfall retrieval technique (**RELASE**-Rainfall Estimation from Lightning And SEviri data) that uses geostationary satellite Infrared (IR) observations and lightning information has been developed. During CDOP-2 a feasibility study will be conducted in the use of data provided by the Meteosat Third Generation Lightning Imager instrument for the production of convective precipitation maps.



METEOSAT THIRD GENERATION LIGHTNING IMAGER

References: http://www.eumetsat.int http://hsaf.meteoam.it http://www.meteoam.it/ http://nefodina.meteoam.it/

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