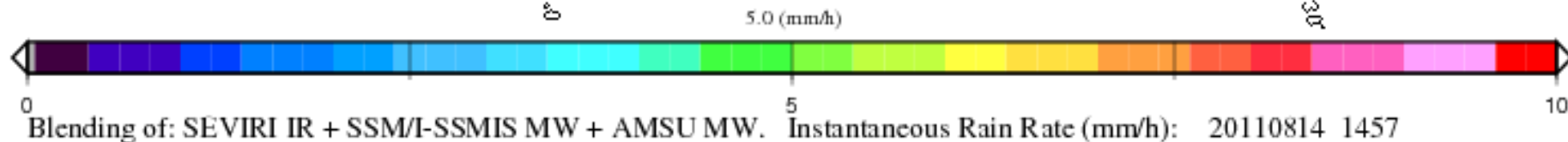


CWG Workshop 2012  
Prague  
27-30 march 2012

# Satellite Rainfall Estimation

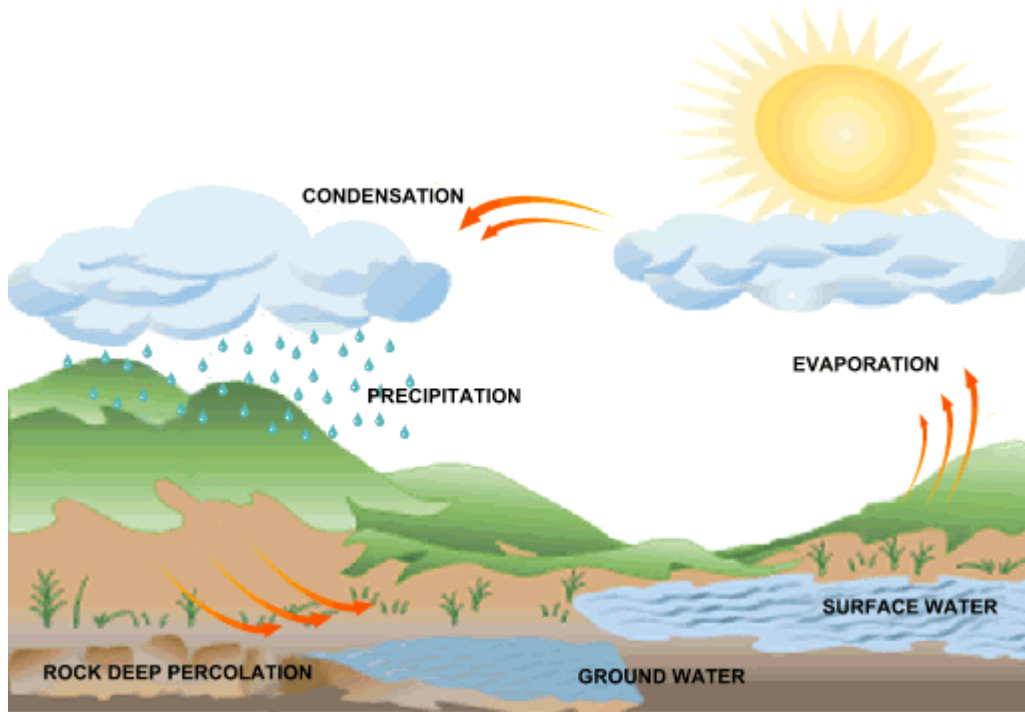
Cap. Davide MELFI  
Italian Air Force Met Service



# Satellite Rainfall Estimation Outline

- Why?
- From infrared and/or visible channels
- From Microwave instruments
- Satellite Rainfall Estimation multi-platform algorithm
- Outlooks

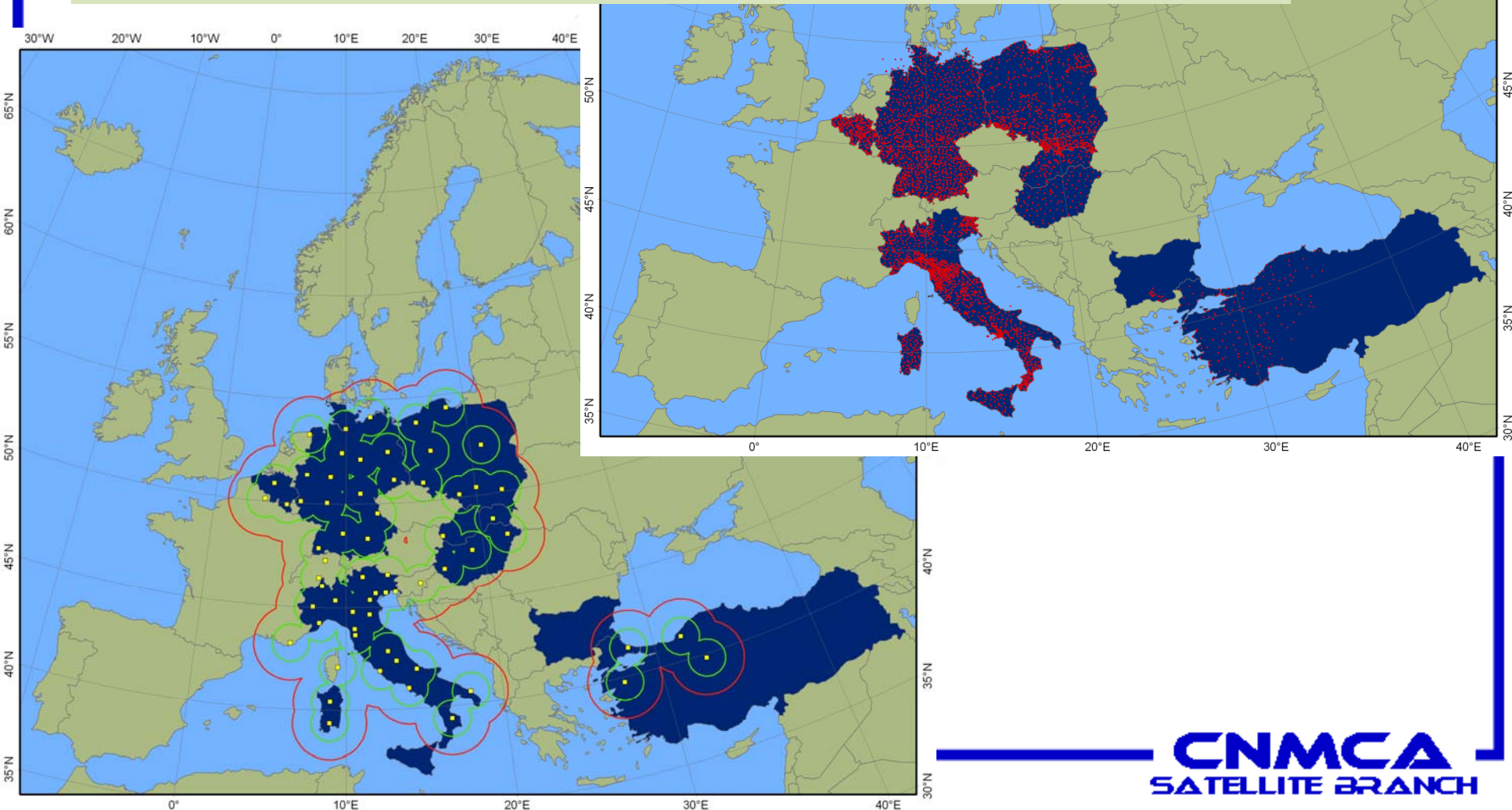
# Why?



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.

# Why?

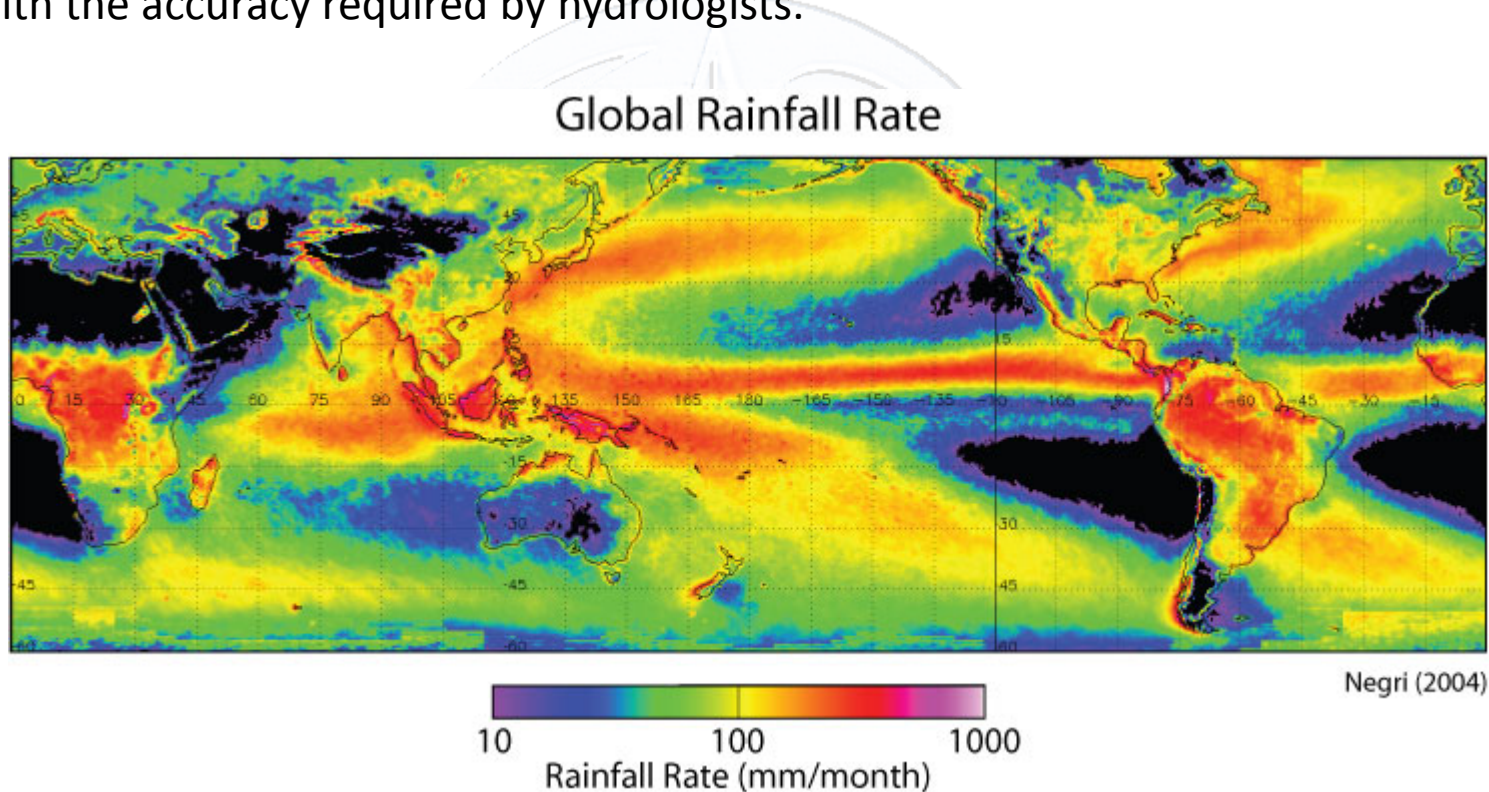
The inhomogeneity of temporal and spatial distribution of rainfall combined with the lack or the sparse presence of ground measurement makes it one of the most difficult parameter to quantify.



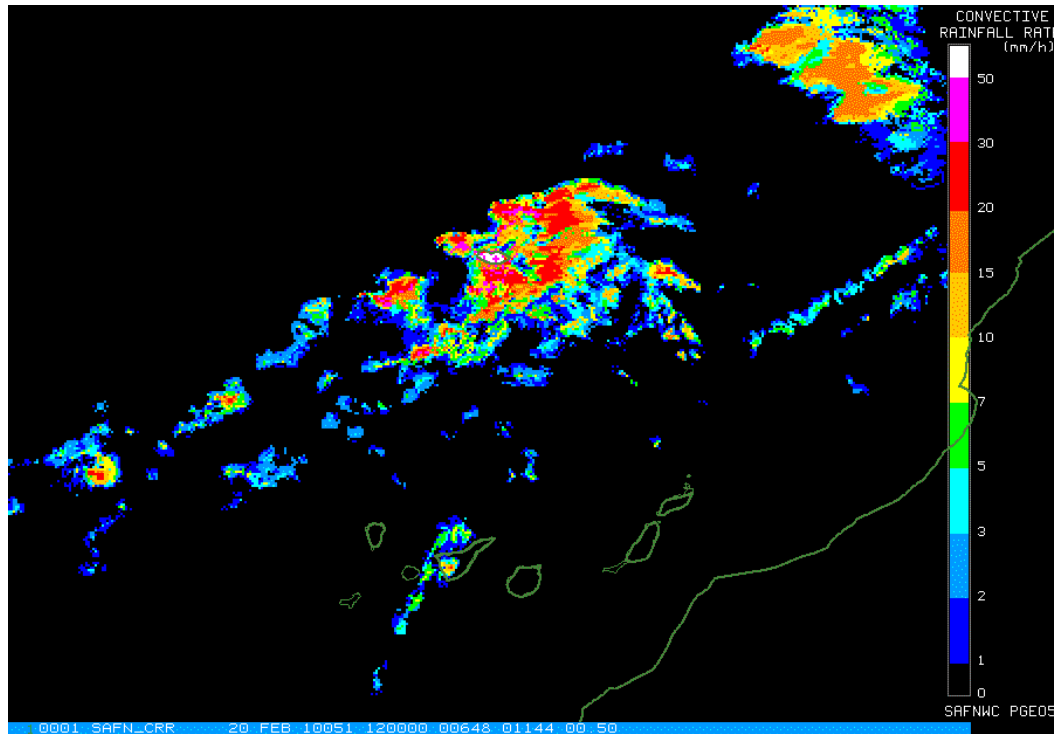


# Why?

Meteorological satellite provide a unique opportunity for monitoring the precipitation for regions where ground measurement is limited and consistent with the accuracy required by hydrologists.



# Satellite Rainfall Estimation from infrared and/or visible channels



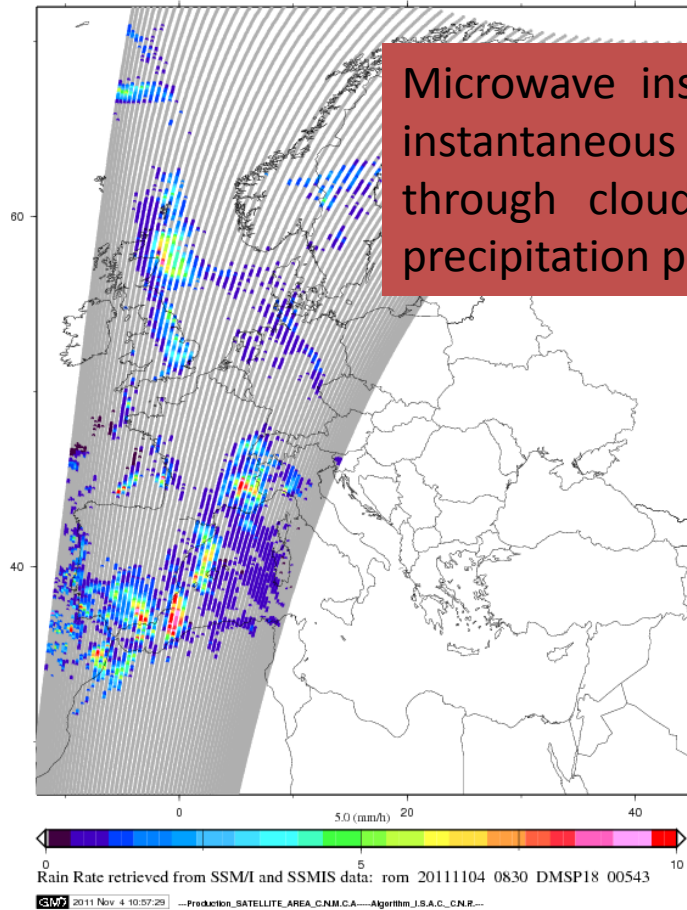
**NWCSAF Convective Rainfall Rate**

Rainfall rates are generally derived from cloud-top infrared (IR) brightness temperature, which is related to cloud-top height for optically thick clouds below the tropopause.

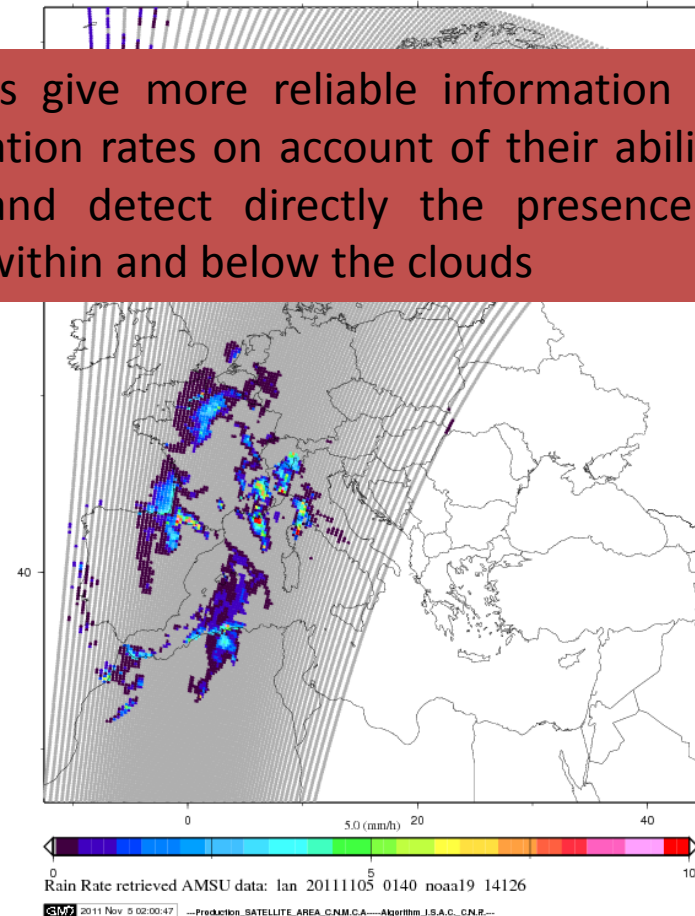
Visible cloud albedos are generally used, as supplemental information to discriminate cold clouds which are optically thin and presumably non-precipitating from those which are optically thick and therefore possibly precipitating

# Satellite Rainfall Estimation from MicroWave instruments

EUMETSAT H-SAF PR-OBS-1 Instantaneous Rain Rate from Conical MW Scan



EUMETSAT H-SAF PR-OBS-2 Instantaneous Rain Rate from Crosstrack MW Scan

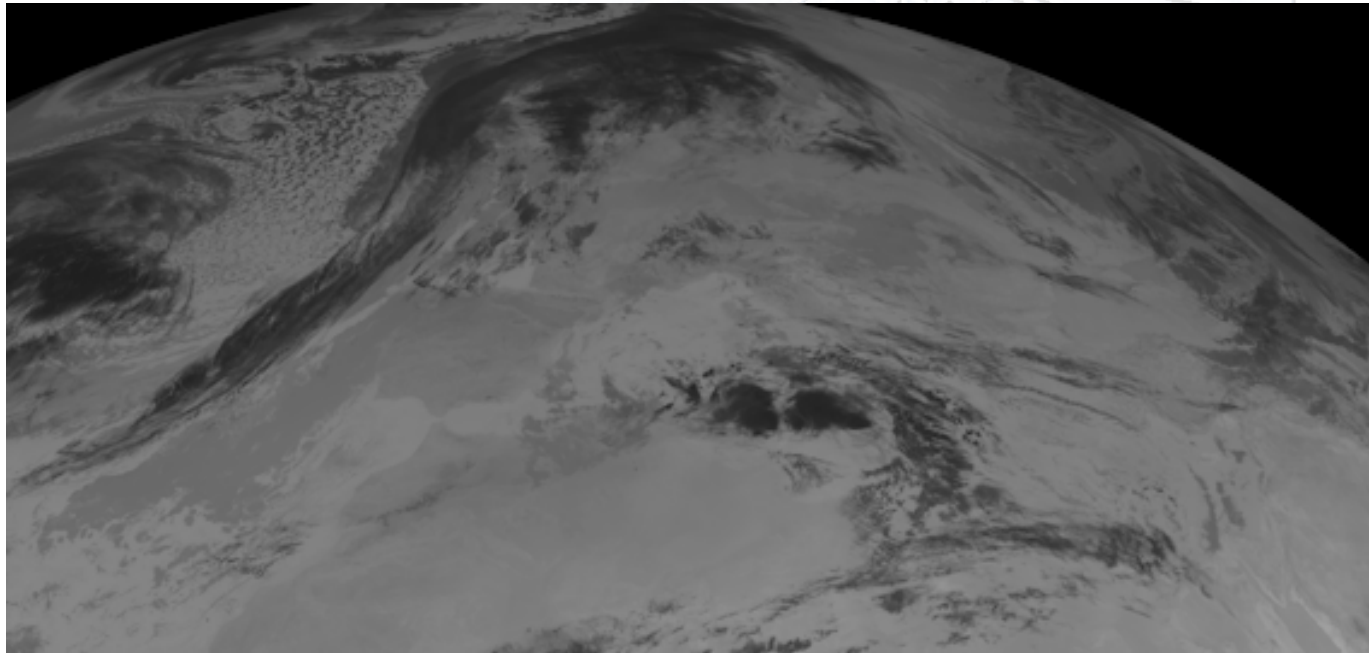


Microwave instruments give more reliable information concerning instantaneous precipitation rates on account of their ability to "see" through cloud tops and detect directly the presence of actual precipitation particles within and below the clouds

- ✓ CNR-ISAC Italy, 2010: Algorithm Theoretical Basic Document for "PR-OBS1 Precipitation rate at ground by MW conical scanners" .
- ✓ CNR-ISAC Italy, 2010: Algorithm Theoretical Basic Document for "PR-OBS2 Precipitation rate at ground by MW cross-track scanners"

# Satellite Rainfall Estimation multi-platform algorithm

So the most common approach is to combine geostationary and low orbital satellite imagery and sounder. This kind of multi-platform algorithm provides global precipitation estimation merging high-quality, sparsely sampled data from METOP, NOAA and DMSP low altitude polar-orbital satellites with the more physically direct detection with continuously sampled data from geostationary satellites

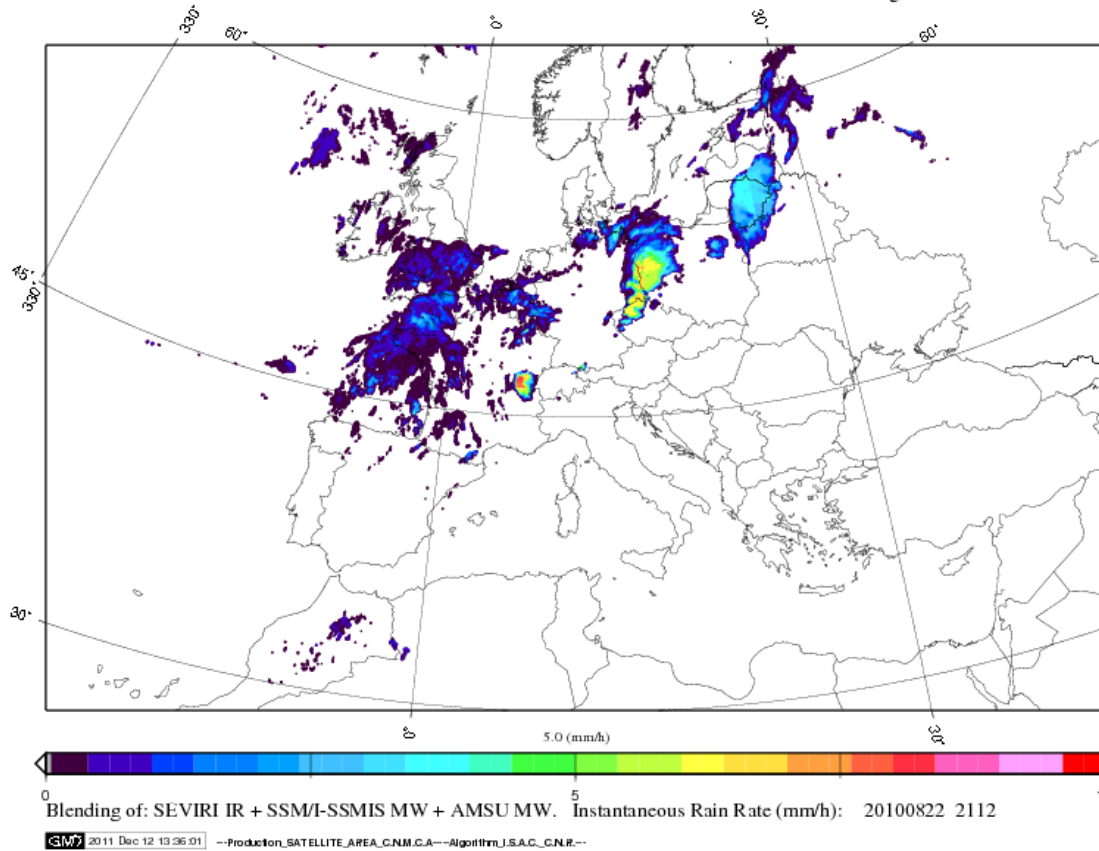




# Satellite Rainfall Estimation multi-platform algorithm

## HSAF PR-OBS3: **BLENDING** Technique

EUMETSAT H-SAF PR-OBS-3 Instantaneous Rain Rate retrieved from IR-MW blending data

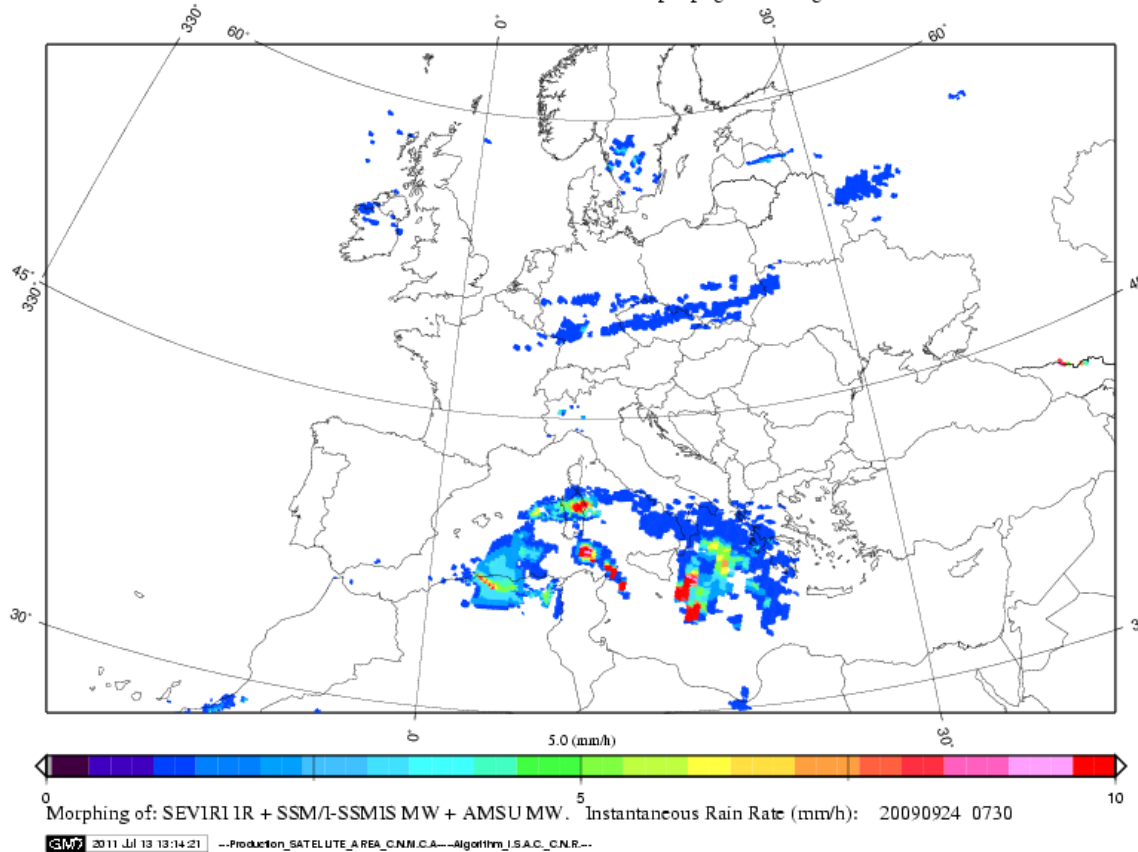


The PR-OBS3 algorithm is based on a collection of time and space overlapping SEVIRI IR images and Low Earth Orbit (LEO) MW radiometers. As a new MW swath is available, the MW-derived pixels are paired with the time and space coincident geostationary (GEO) TB at 10.8  $\mu\text{m}$ . Coincident data are subsequently located in a geographical latitude-longitude grid ( $2.5^\circ \times 2.5^\circ$ ), and for each grid box the histogram of the IR TBs and that of the corresponding MW rain rates is built.

# Satellite Rainfall Estimation multi-platform algorithm

## HSAF PR-OBS4: MORPHING Technique

EUMETSAT H-SAF PR-OBS-4 Microwave-derived Rain Rate propagated using GEO-IR information

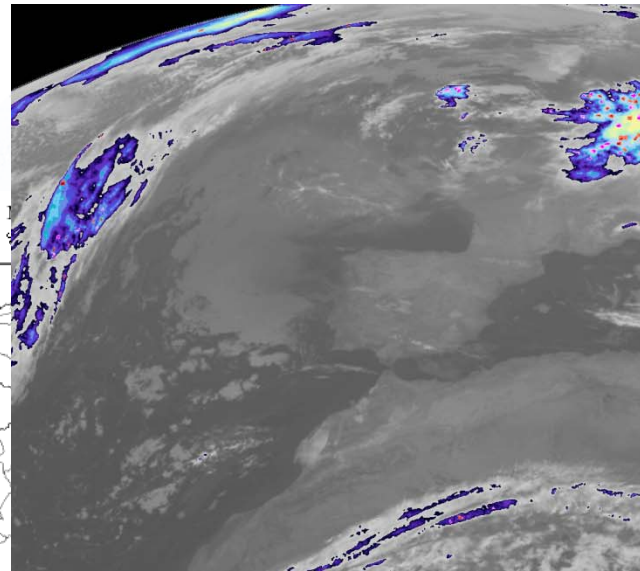
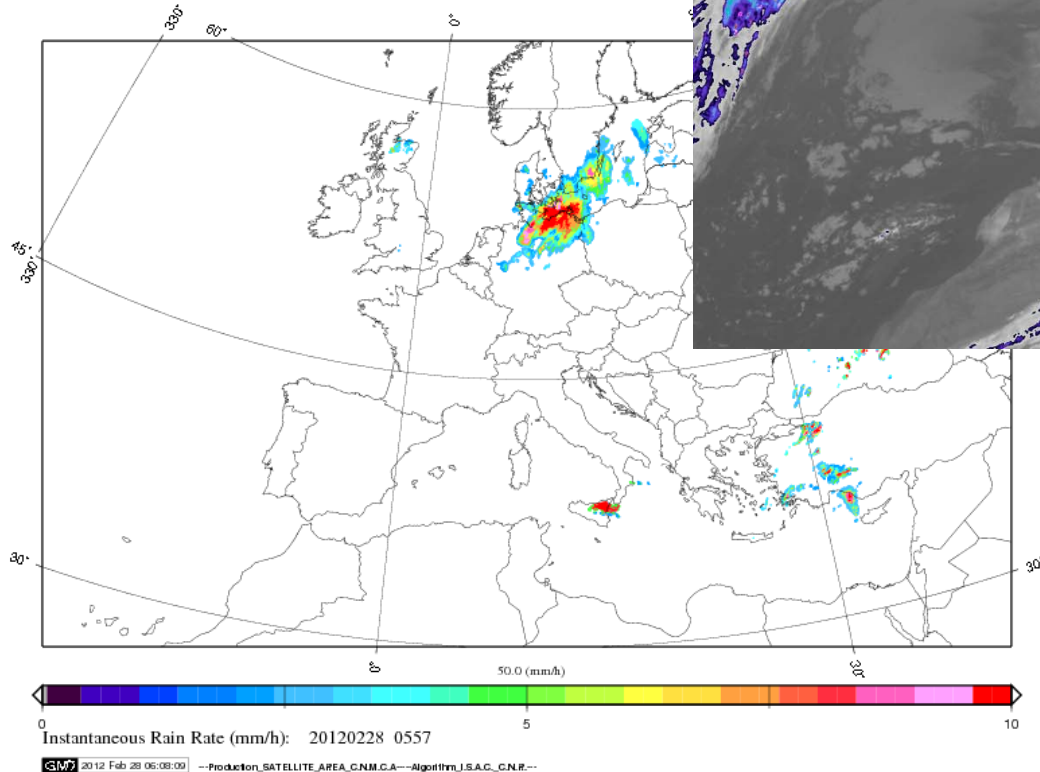


Propagation vector matrices are produced by computing spatial lag correlations over successive images of GEO/IR and then used to propagate the MW-derived precipitation estimates in time and space when updated MW data are unavailable.

# Outlook 1 – Convective Precipitation

## HSAF PR-OBS15: **BLENDING** Technique + NEFODINA

EUMETSAT H-SAF PR-OBS-6 Blended SEVIRI Convection area / LEO



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# Outlook 2 – Convective Precipitation

## RELEASE Software: Rainfall Estimation from Lightning And Seviri data

A rainfall retrieval technique that uses geostationary satellite Infrared (IR) observations and lightning information retrieved from LAMPINET (lightning network of the Italian Air Force Meteorological Service)

A quantitative relationship for rainfall estimation using lightning and Seviri data has been developed using a bivariate linear regression for the cluster's rain volume :

$$RR = (b_0 + b_1S/N + b_2T)N$$

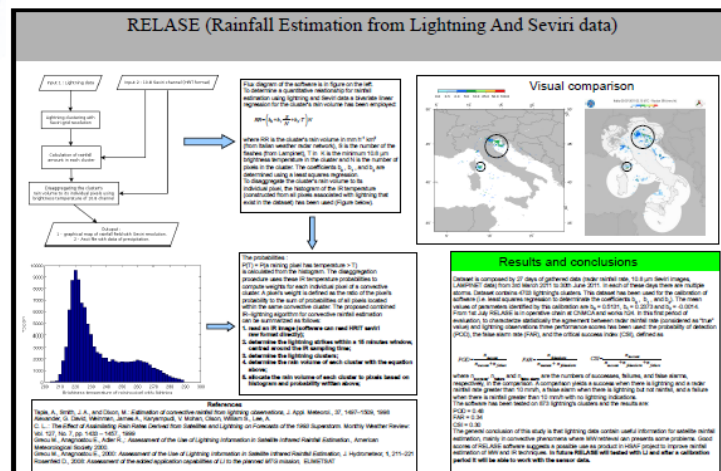
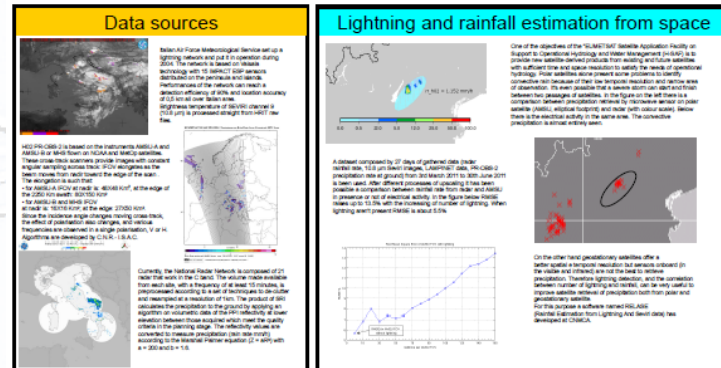
**ECSS 2011**  
**6<sup>th</sup> European Conference on Severe Storms**  
 Palma de Mallorca,  
 Balearic Islands, Spain  
 3—7 October 2011  
 Venue: L'Aljub, Museu Es Baluard

First operational results of RELEASE  
 (Rainfall Estimation from Lightning And Seviri data) software at CNMCA  
 Massimiliano SIST<sup>1</sup>, Francesco ZAULI<sup>1</sup>,  
 Daniele BIRON<sup>2</sup>, Davide MELFI<sup>1</sup>  
<sup>1</sup>Centro Nazionale di Meteorologia e Climatologia Aeronautica  
 2/Eser Galleo

**ABSTRACT**  
 For the first generation of geostationary meteorological satellites (Meteosat Third Generation - MTG) an optical Lightning Imager (LI) sensor is planned. Together with the CLM (Clouds and Moisture) sensor, it will be flown on the next generation of GOES (Geostationary Operational Environmental Satellite) series, there will be an almost global coverage for lightning detection from space. These continuous flow of lightning data will be crucial and critical in many applications as in forecasting, climatology and atmospheric research. The collaboration between CNMCA (Centro Nazionale di Meteorologia e Climatologia Aeronautica - Italy) and SILEX-GALILEO (a Transaspace company) aims to study a possible use of lightning data in hydrological field. A rainfall retrieval technique that use geostationary satellite infrared (IR) observations and lightning information retrieved from LAMPINET (lightning network of the Italian Air Force Meteorological Service) is presented in this paper. A comparison with products of ERSST (ERSSTv4) Satellite Applications Facility on Support to Operational Hydrology and Water Management is also presented.

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**KEYWORDS**  
 Lightning, Rainfall, Seviri, LAMPINET, RELEASE



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Thank you for your  
attention!

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