H SAF Precipitation Products Quality Assessment

H SAF Precipitation Products Quality Assessment Cluster

Italian Civil Protection Department - DPC

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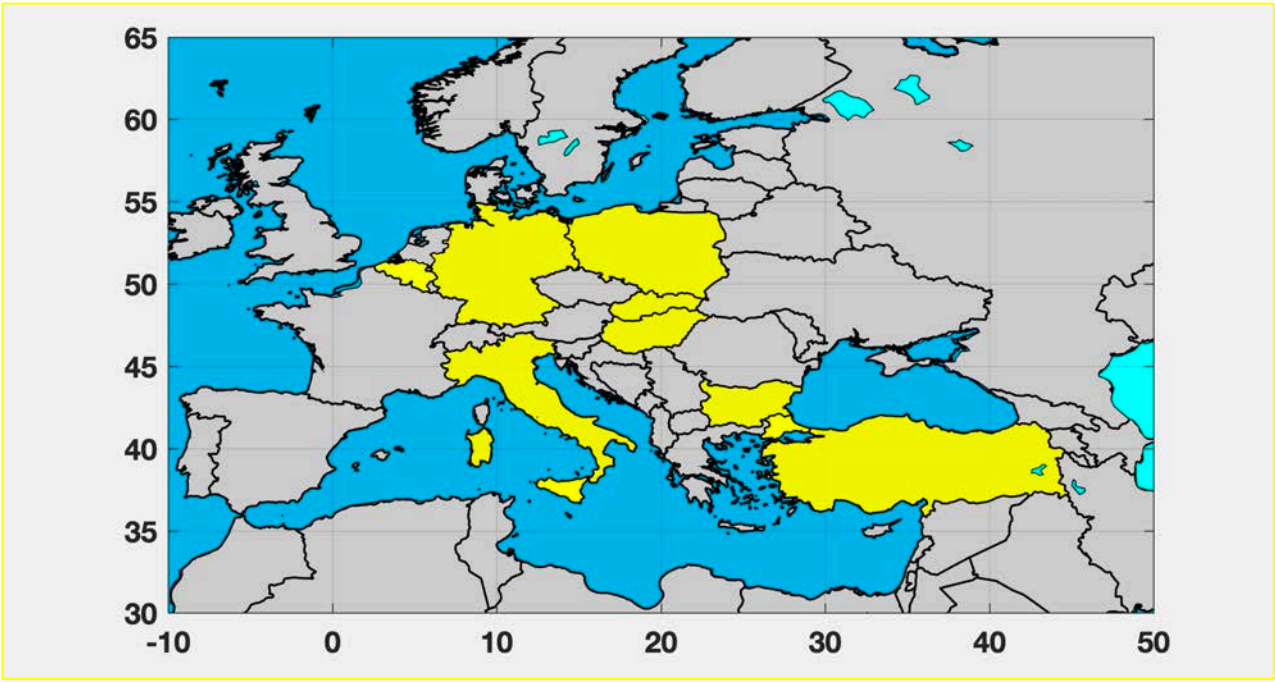
Outline

- Precipitation Product Validation Group (PPVG)
- Methodologies & Reference precipitation data
- Case studies

Precipitation Product Validation Group (PPVG)

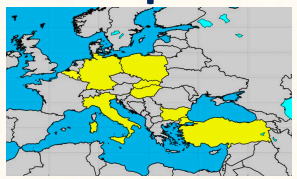
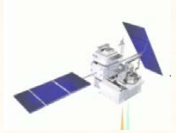
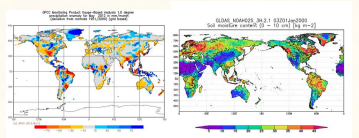
The *Precipitation Product Validation Group* (**PPVG**) is composed of experts from the National Meteorological and Hydrological Institutes of **8 European countries**. The PPVG uses ground data for quality assessment of precipitation products, following the same methodology.

Country	Institutes
Belgium	RMI
Bulgaria	NIMH
Germany	BfG
Hungary	OMSZ
Italy	DPC, UniBo
Poland	IMWM
Slovakia	SHMU
Turkey	ITU, METU,TSMS



QA Methodologies and Reference data

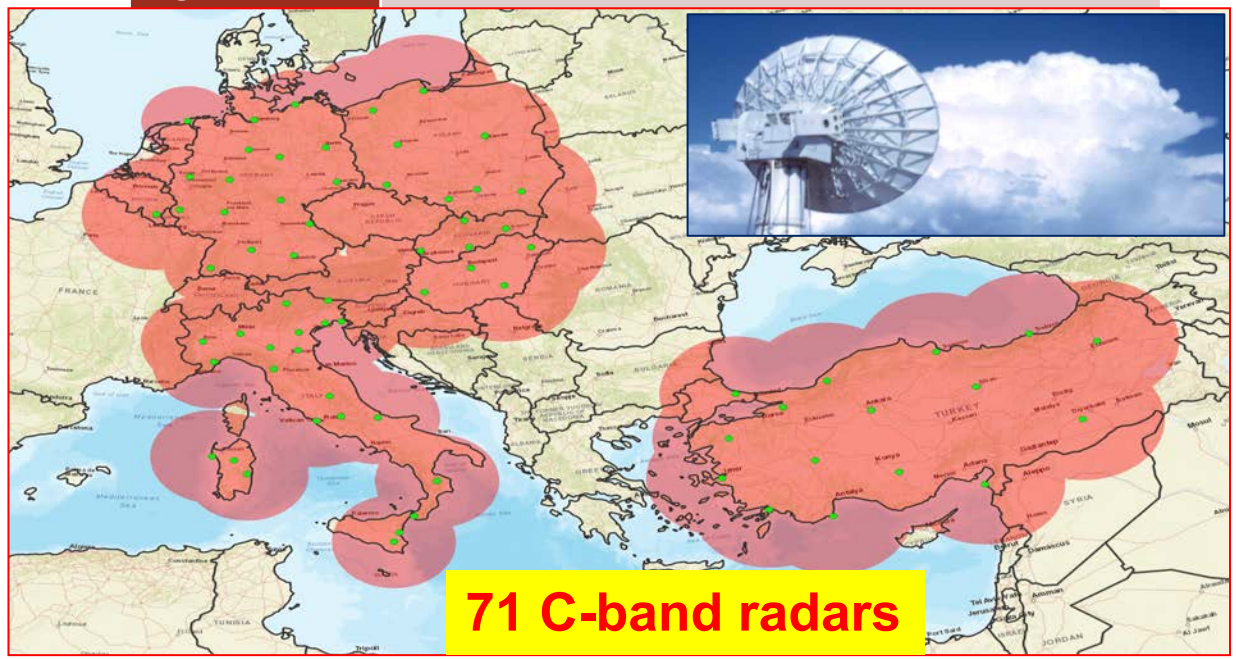
Precipitation Products

Area	Instantaneous	Accumulated
		
European 	Unique Common Code *Ground (Radars and Raingauges)*  	
Full Disk or Global 	Comparison Code *DPR – GPM-CO* 	Triple Collocation *GPCC & GLDAS* 

European ground data

Country	Total number of gauges	Average minimum distance (km)
Belgium	92	15.2
Bulgaria	123	25.2
Germany	2299	12.9
Hungary	270	17.0
Italy	2934	11.3
Poland	540	24.0
Slovakia	911	13.6
Turkey	1235	26.5
TOTAL	**8404**	

Country	Total number of radar	Average minimum distance (km)
Belgium	1	-
Bulgaria	-	-
Germany	16	163
Hungary	4	190
Italy	22	141
Poland	8	186
Slovakia	4	137
Turkey	16	253
TOTAL	**71**	



Validation methodology over Europe

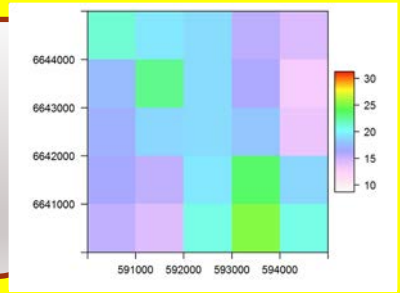
1. GROUND DATA

Quality check and filtering

Spatial interpolation (GRISO)

2. TEMPORAL-SPATIAL MATCHING

Upscaling to the product grid



3. STATISTICAL (CONTINUOUS AND MULTI-CATEGORICAL) SCORES

Precipitation

- Light [0.25≤R
- Moderate [1.0≤ R
- Heavy [R
- All [R

Surface types:

- Sea
- Land
- Coast
- Overall

Time intervals:

- Monthly
- Seasonal
- Yearly

Precipitation phases:

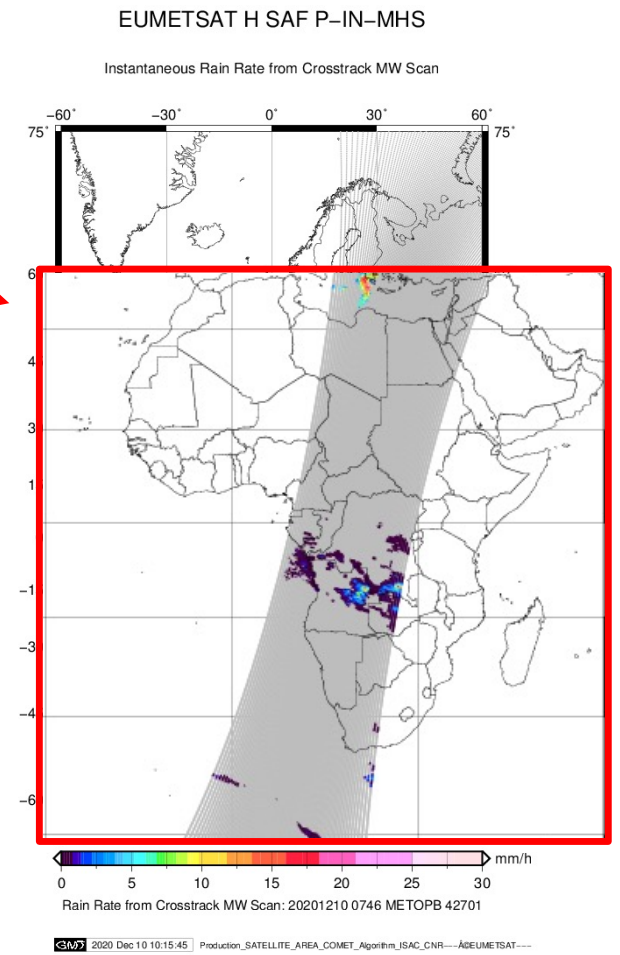
- Liquid
- Solid
- Mixed
- All

This comparison methodology is performed by the **Unique Common Code (UCC)** for all (8) participating countries (PPVG)

<- the validation is performed over the satellite grid. Only the reference data is degraded and not the satellite data. This is to evaluate the product at the same resolution as the data released.

Comparison over extended area

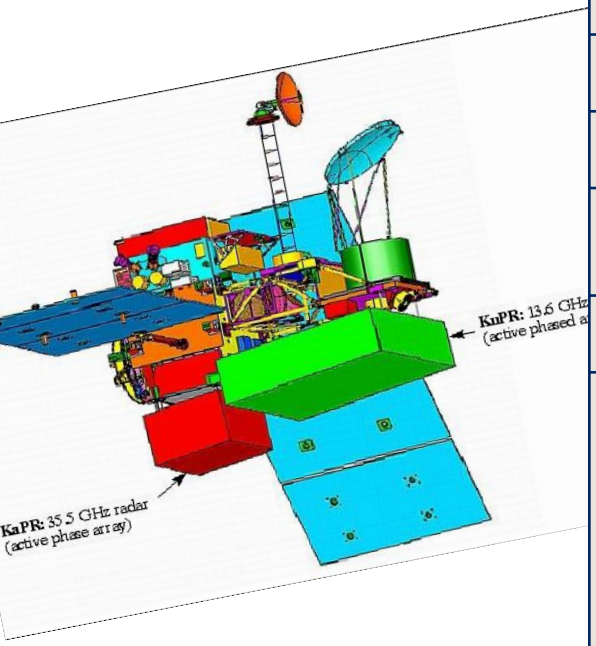
African area



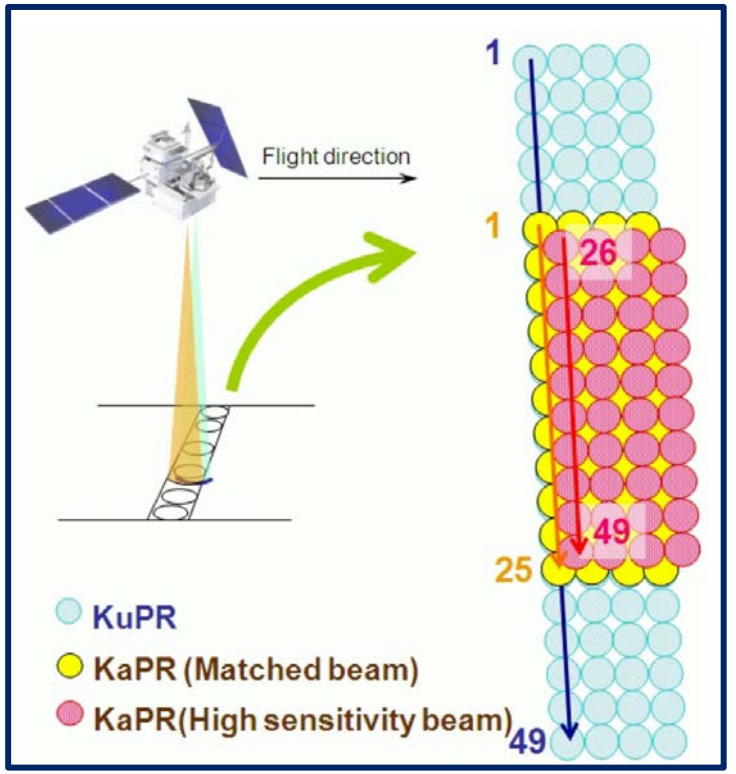
Satellites

Reference ground data:
radars and/or **raingauges**

Dual-frequency Precipitation Radar (DPR)



Features	KuPR	KaPR
Frequency	13.6 GHz	35.5 GHz
Swath Width	245 km	120 km
Spatial Resolution	5.2 km (Nadir @ 407 km)	
Beam Width	0.71° (Center Beam)	
Beam Number	49 Normal Scan, NS	49: 25 in matched beams (MS) + 24 in interlaced scans (HS)
Min. measur. RR	0.5 mm/h	0.2 mm/h
Cross T. Scan Angle	±17°	±8.5°



3 Scan modes (NS, MS and HS)

2 product types (K-band only / Combined [DPR] Product)

prEs
Precipitation Estimated on Surface

Comparison methodology (for inst. products)

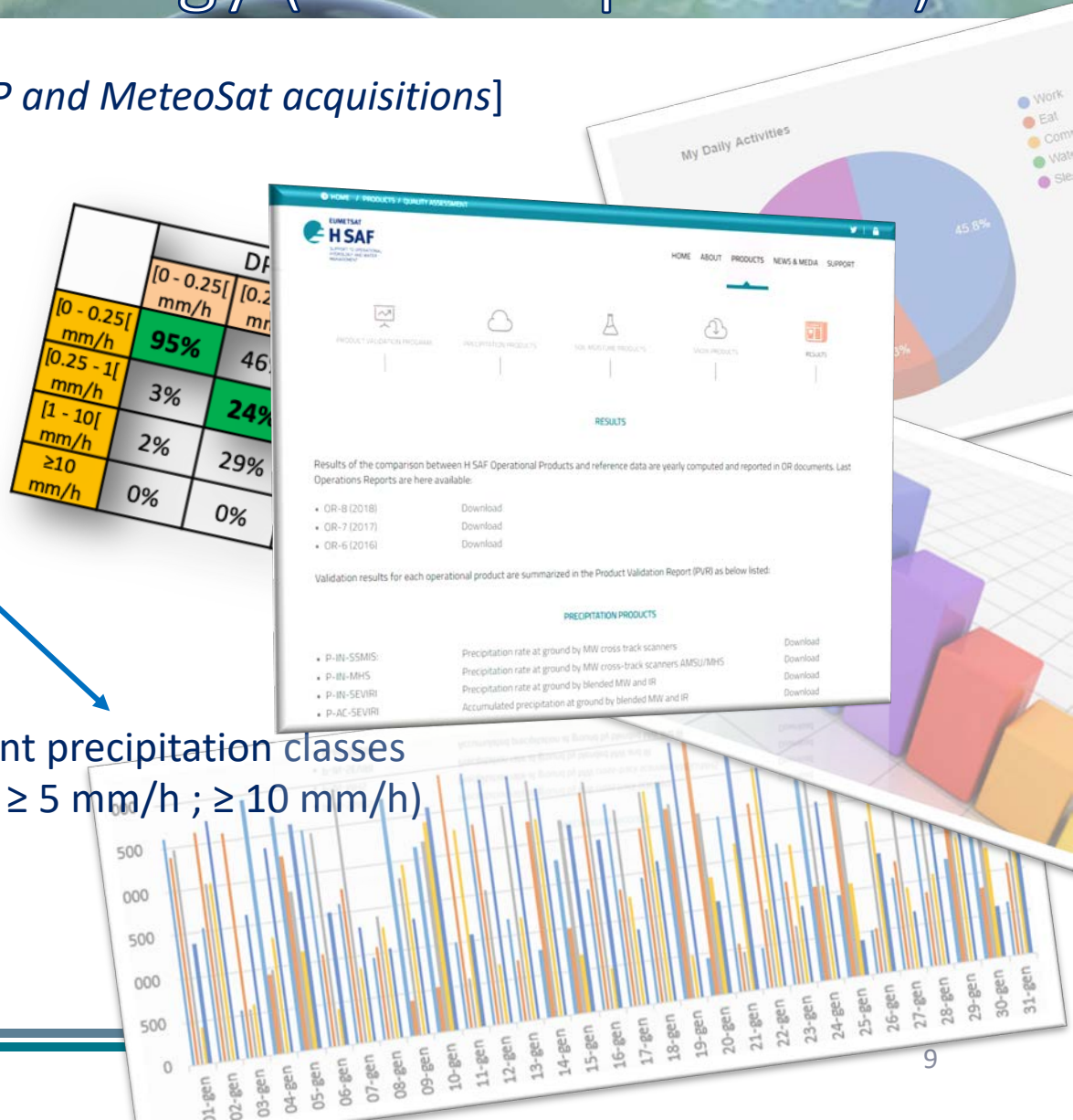
- ✓ Intersection [*temporal and spatial GPM vs NOAA/METOP and MeteoSat acquisitions*]
- ✓ Downscaling [*regular grid 0.5°*]
- ✓ Comparison [*pixel-based*]
- ✓ Results

Statistical scores
(events, monthly, seasonal, yearly)

For different geographical areas
(Africa, Europe, Ocean)

For different surface types
(sea, land, coast)

For different precipitation classes
(≥ 1 mm/h; ≥ 5 mm/h ; ≥ 10 mm/h)



TC methodology (for acc. products)

Underlying the triple collocation technique is the linear additive error model between the measurement systems and the unknown truth:

$$X = \alpha + \beta T + \varepsilon \quad (1)$$

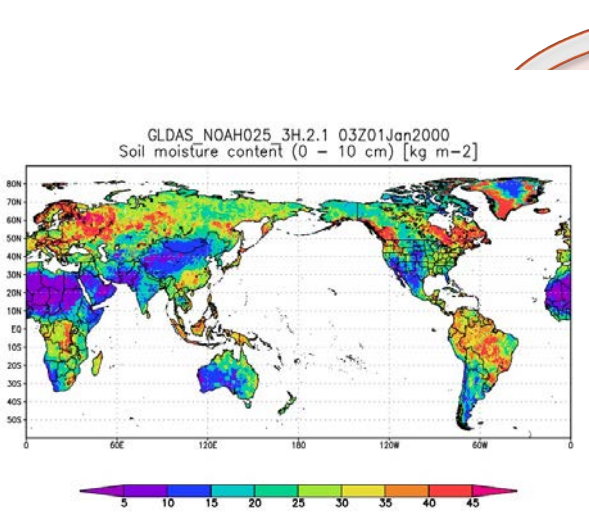
where X is a daily accumulated rainfall product, T is the true rainfall, α and β are additive and multiplicative biases, respectively, and ε is the zero-mean random error.

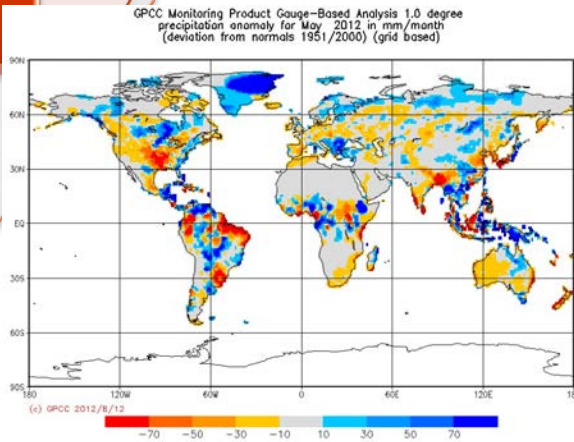
The extended triple collocation (hereafter referred to as TC) approach (McColl et al., 2014) can be applied to estimate the correlation (R) of a measurement system to the unknown truth. Given three gridded daily rainfall products (X, Y and Z) that linearly relate to the true daily rainfall intensity as described in (1), the correlation between X and the unknown truth T can be estimated as

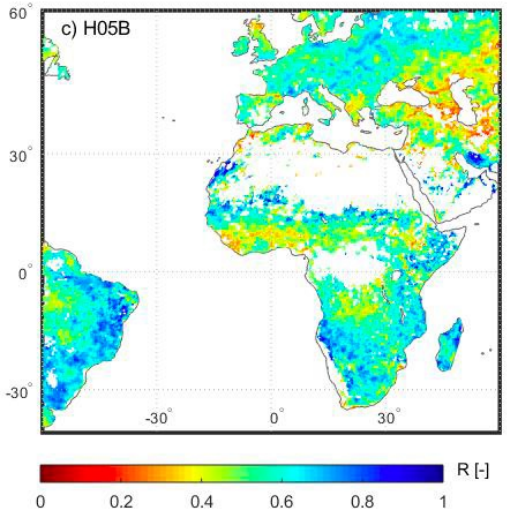
$$R_X = \sqrt{\frac{\sigma_{XY}\sigma_{XZ}}{\sigma_X^2\sigma_{YZ}}} \quad (2)$$

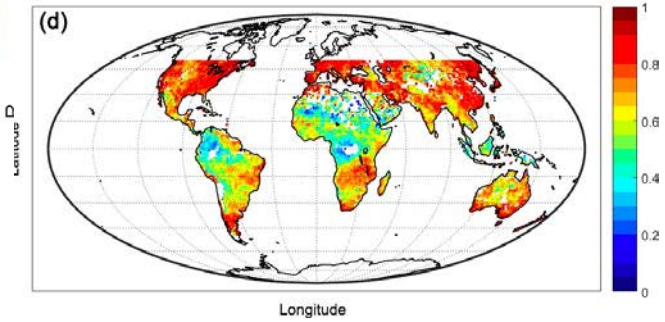
where $\sigma_{XY}$is the covariance of X and Y, etc., and σ_X^2 is the variance of X. For further details please refer to McColl et al. (2014). In addition to the linearity assumption, TC also requires: 1) mutually independent error impacting X, Y and Z; 2) errors that are uncorrelated to T (i.e. error orthogonality); and 3) the stationarity of signal and error statistics (i.e., homoscedasticity) (Gruber *et al*. 2016a; Draper *et al*. 2013; Zwieback *et al*. 2012).

Due to the linearity assumption expressed in (1), we applied TC only at pixels where significant (p = 0.05) levels of mutual correlation exist between the members of the triplet. To ensure the stationarity of signal and error statistics (see above), a common practice is to remove seasonal signals from the raw time-series prior to application of TC (e.g., Chen et al., 2017; Gruber *et al*. 2016a; Su and Ryu, 2015). However, because of the intermittent nature of precipitation, no-rain days are an important category of observation and should not be artificially altered into non-zero anomaly values. Therefore, raw daily rainfall time-series were used here in the TC and QC analyses.









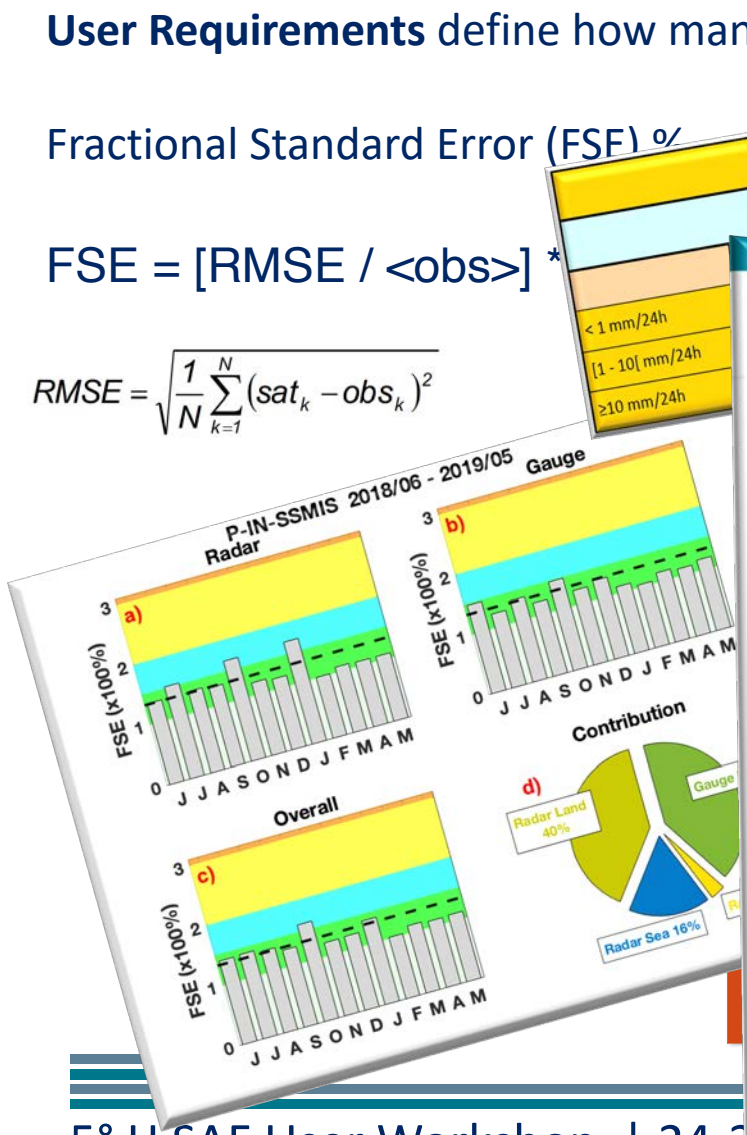
Results

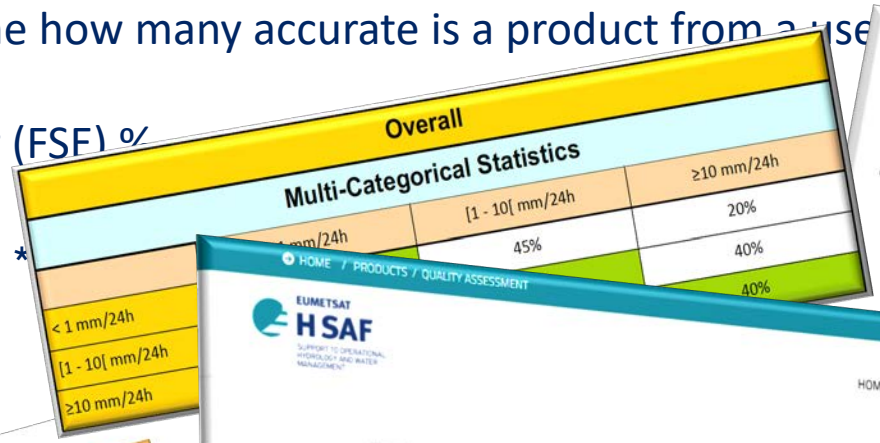
User Requirements define how many accurate is a product from a use[illegible] of view.

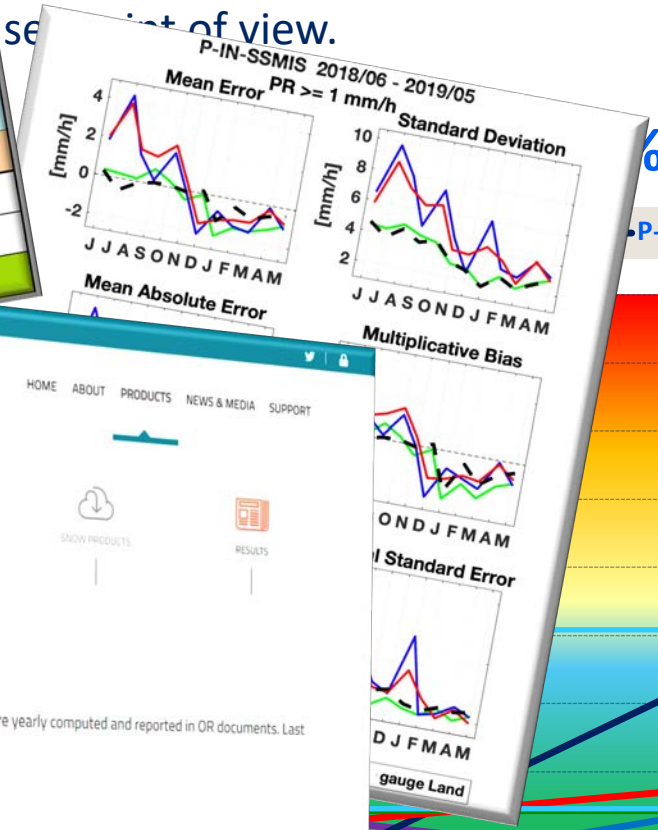
Fractional Standard Error (FSE) %

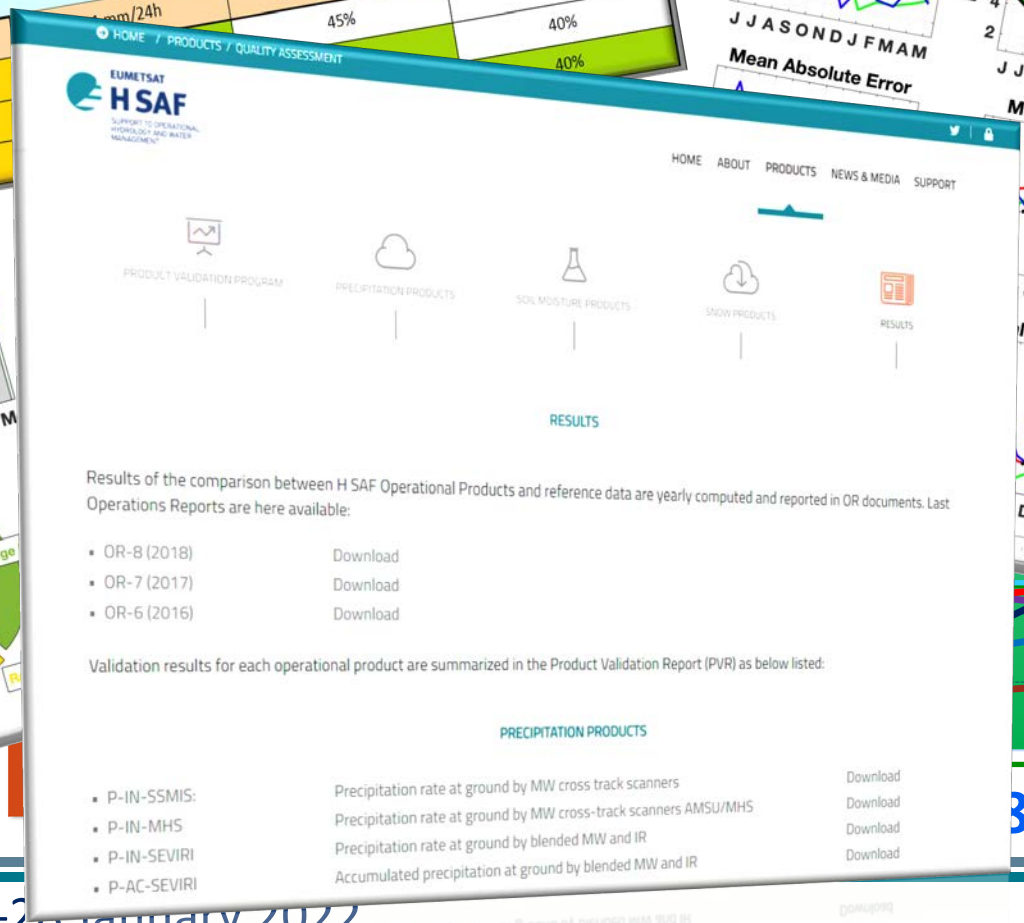
FSE = [RMSE / <obs>] *

$$RMSE = \sqrt{\frac{1}{N}\sum_{k=1}^{N}(sat_k - obs_k)^2}$$



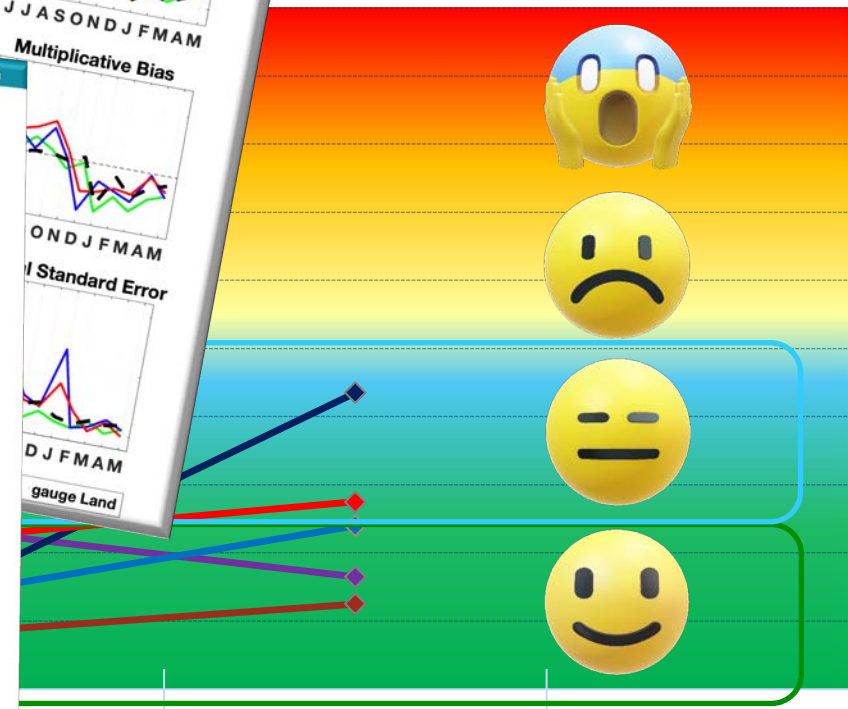






% annual trend

P-AC-SEVIRI P-IN-SEVIRI-CO



2019 2020

QA conclusions

- Quality assessment service monitors the progress in product quality
- Products successfully reviewed are available to end-users (EUMETcast, FTP, HTTPS)
- Various independent reference datasets (EU ground, GPM-DPR and Global data)
- Product's accuracy is defined by User Requirements (FSE for inst and CC for acc)
- All operational precipitation products fully satisfy the User Requirements

Case studies

Precipitation, Soil moisture and Snow Clusters
Quality Assessment and Hydro validation Clusters

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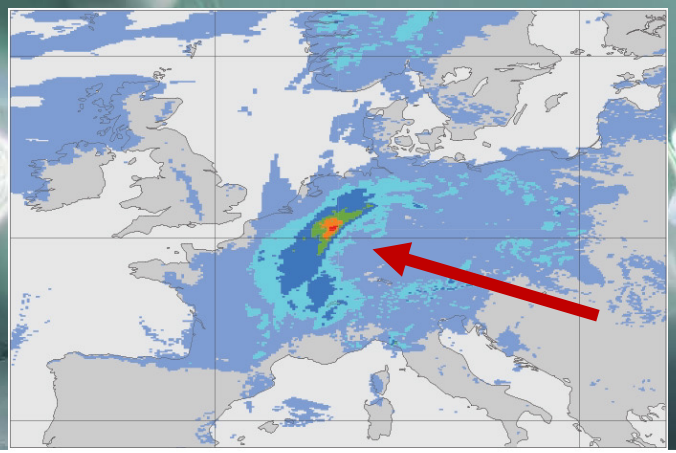
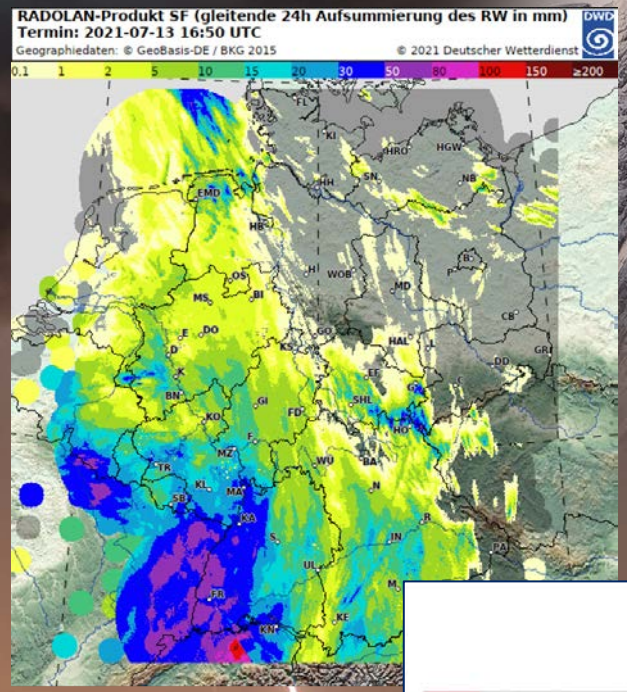
Central Europe flooding – July 2021



24h accumulated precipitation by calibrated weather radar data

Up to 100 mm CH, F, DE



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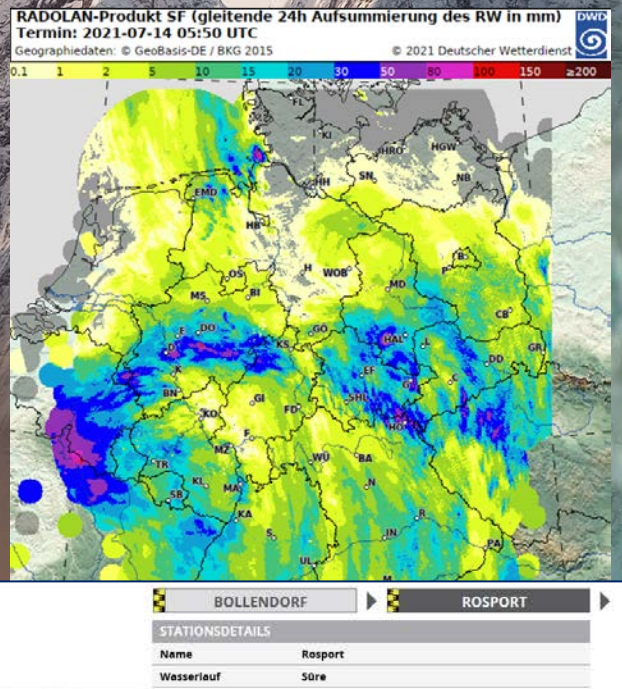
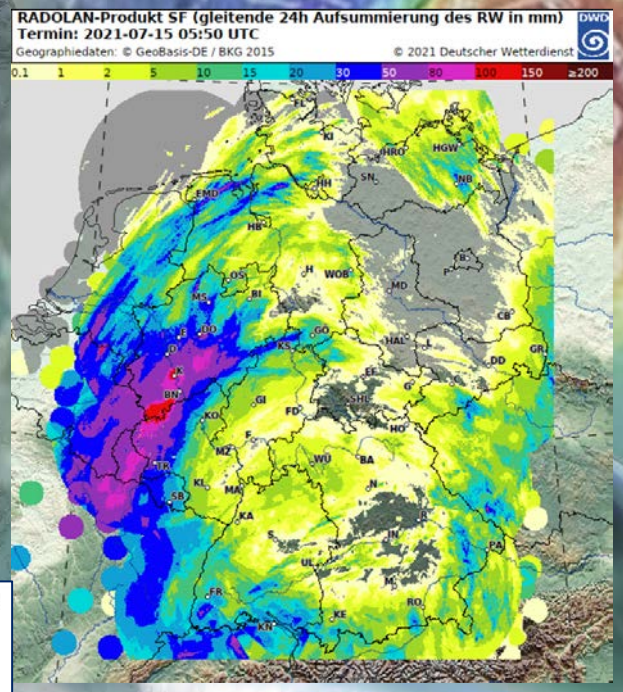
100 mm CH, F, DE



150 mm F, L, B, NL, DE



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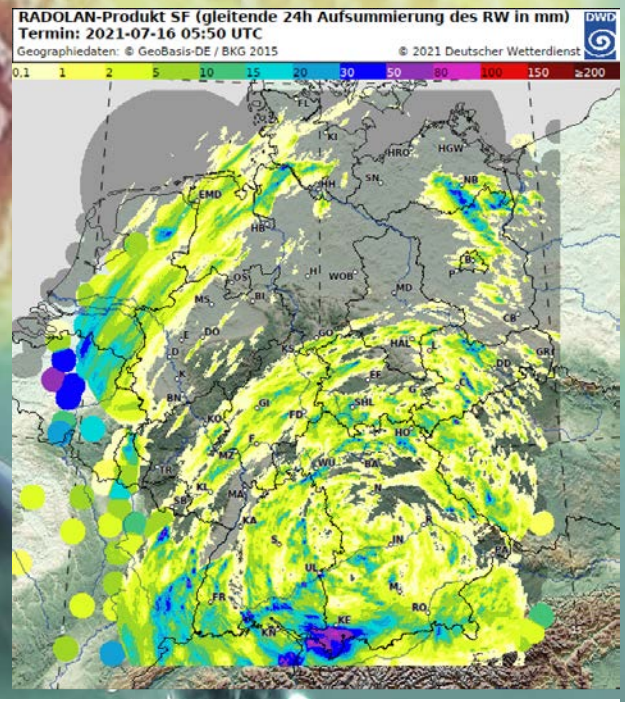
80 mm F, CH, DE



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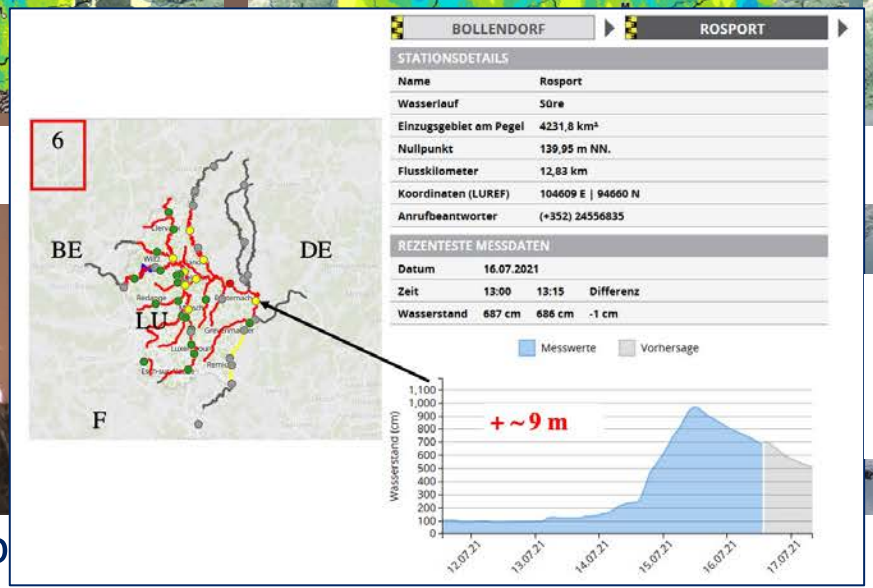

Border Luxemburg/Germany

- River Sauer ~ 4200 km²

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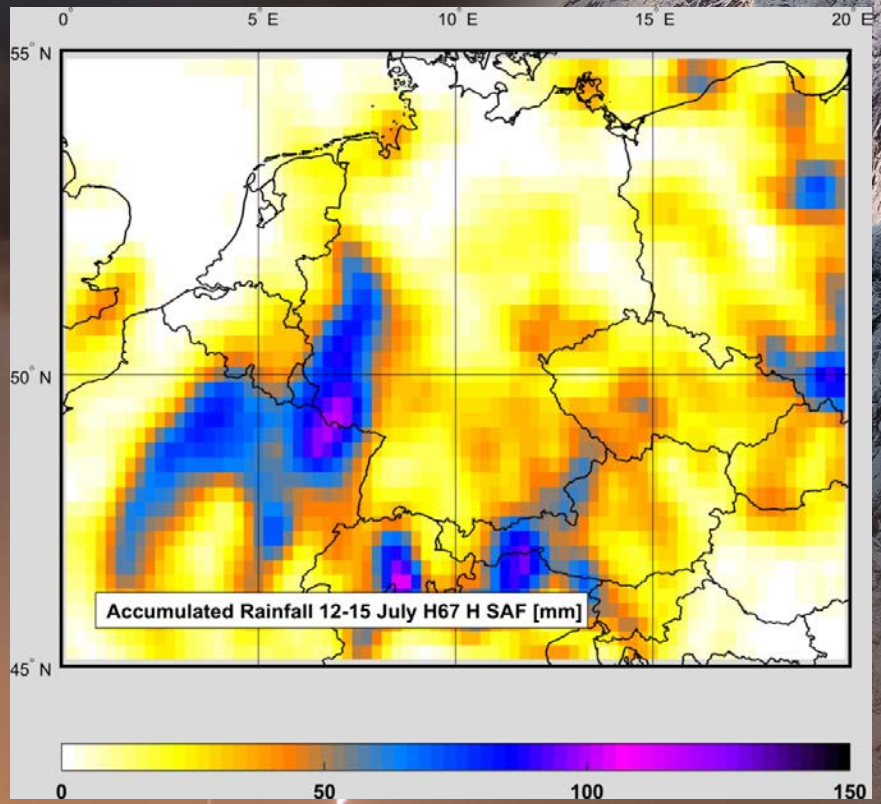
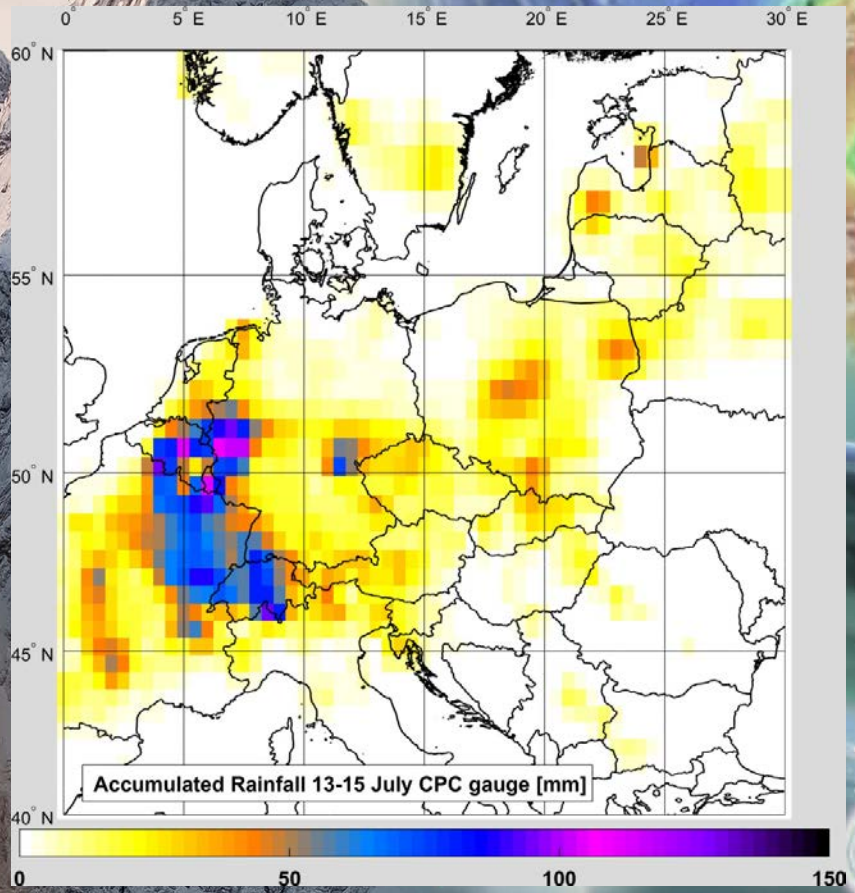
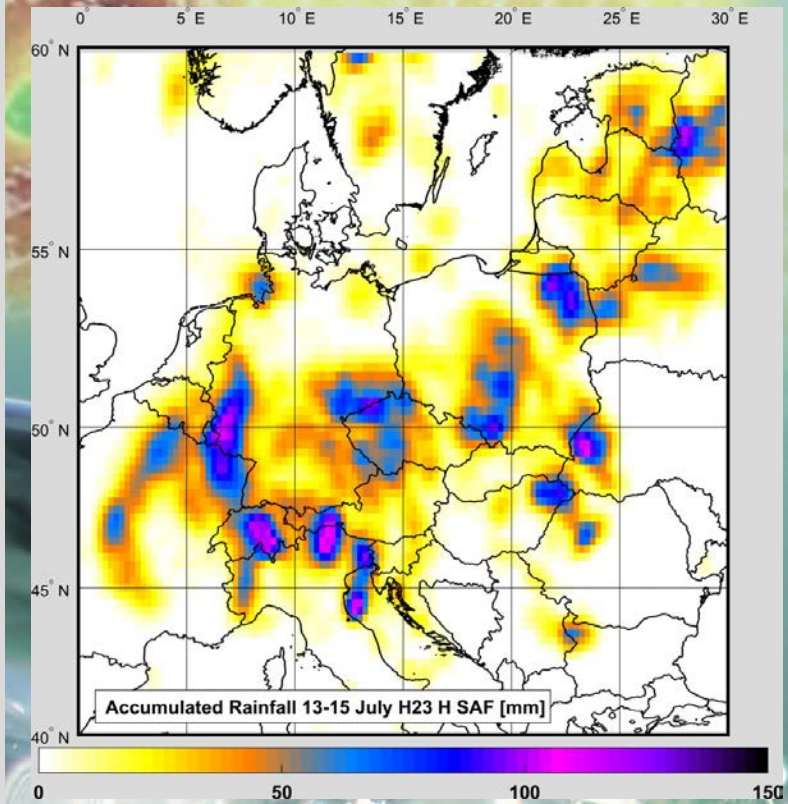
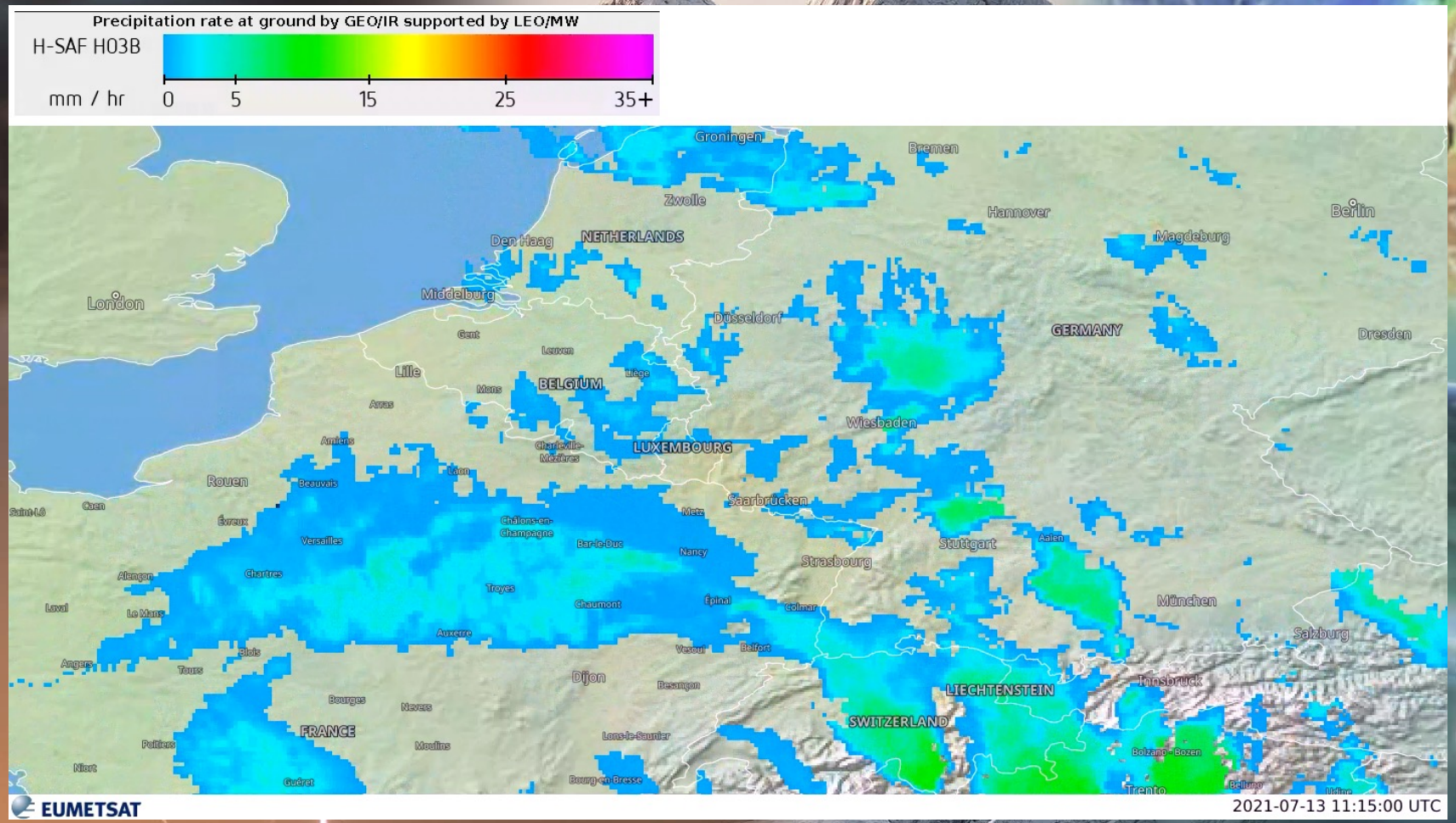
H67 – CPC gauge - H23







Near real time estimates - H03B

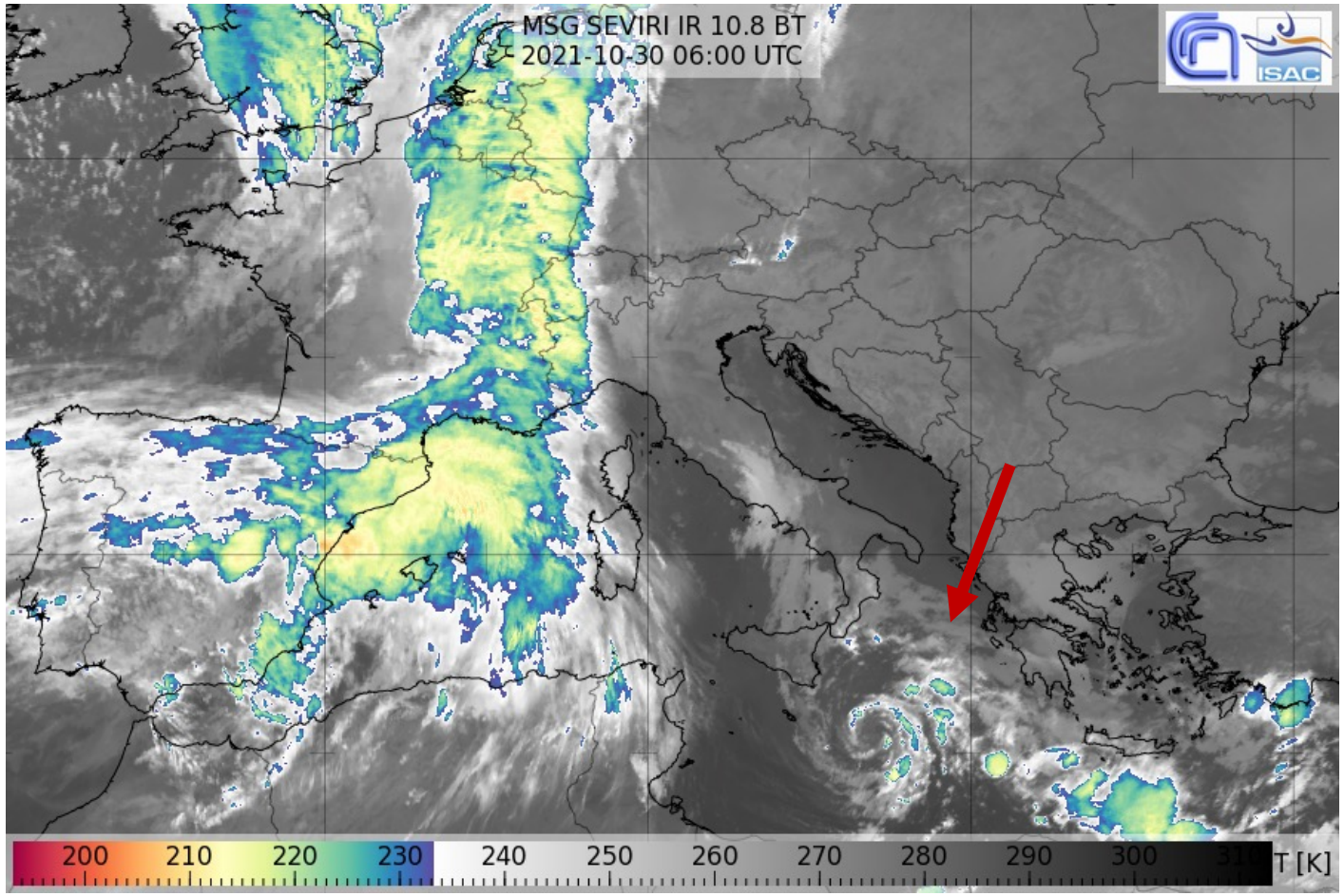


Animation of the rainfall affecting Central Europe (intense rainfall days, July 13-15) using MW/IR precipitation rate product (H03B) available on EUMETSAT viewer webtool to monitor precipitation events in near real time

https://view.eumetsat.int

detailed report on **https://www.eumetsat.int/devastating-floods-western-europe**

Mediterranean Cyclone – October 2021



Tuesday 25 January 2022

Session 2: The usage of satellite products for flood and drought monitoring

12:00 - 12:15 A complete meteo-hydrological chain to support early warning systems from weather scenarios to flooded areas: the Apollo medicane use case (Antonio Parodi)

Wednesday 26 January 2022

Session 4: Use cases of the H SAF products for hydrological applications

11:30 - 11:45: Analysis of H SAF precipitation products for the Mediterranean cyclone Apollo (Leo Pio D'Adderio)

Como Lake event – July 2021

Thursday 27 January 2022
Session 6: Use cases of satellite products for hydrological applications
10:30 - 10:45 Benchmark data analysis of the intense weather event around Como Lake occurred in July 2021 (Alessandra Mascitelli)

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Thank you for your attention !

http://h-saf.eumetsat.int/

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