The EUMETSAT Network of Satellite Application Facilities

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

SMHI

User Workshop, April 2010, Madrid

Precipitation Products I MSG and PPS

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Outline

- General thoughts on precipitation retrieval
- MW and AVHRR algorithm
- SEVIRI algorithm
- Planned visiting scientist activities

- CDOP2: general thoughts once more…

Probabilities / Rain rates

Which information do we have available on operational meteorological satellites received at NMS in real time to estimate precipitation?

High spatial resolution VIS/IR, including channels carrying microphysical information on cloud top (GEO/LEO).

LEO: MW sounding on relatively high spatial resolution (15km) for high frequency channels (89GHz and 150/157GHZ window channels, 183GHz bands for WV sounding). Information content: scattering signature of precipitation size ice particals

➡ That means only information indirectly related to precipitation especially for cases not involving strong convection!

For general instantaneous estimates:

probabilities or rain rates with large error bars?

Precipitating Cloud products (GEO/LEO): probabilities of precipitation for intensity classes

LEO: Likelihood supplied for classes

- **no precip (< 0.1mm/h)**
- **Light/chance of precip (0.1mm/h - 0.5mm/h)**
- **Moderate precip (>0.5mm/h – 5mm/h)**
- **Heavy precip (>5mm/h)**

GEO initial attempts to stratify intensity classes given up after validation:

- **no precip (< 0.1mm/h)**
- **precip (0.1mm/h - >5mm/h)**

Statistically very few cases with heavy precipitation!

CRR product calculating rain rate for convective precipitation is complementing MSG PC product, but there is no direct link between PC/CRR production so far.

before CDOP2: reassess status and options!

GEO/LEO: many users still ask for rain rates!

- **Supply both rain rates with error estimates and likelihood in same product?**

GEO/LEO: microphysical property retrieval has evolved/matured over recent years

- **precipitation retrieval based on explicit cloud microphysics should be re-evaluated!**
- **Day time only!**

LEO: Precipitation imaging on the horizon, but not committed yet

- **Leave to HSAF to supply MW algorithm expertise for these satellites?**
- **However requirements on product availability/ easy integration for NWC users must be fully met!**
- **Meetings planned…**

LEO:For NPP a vital channel (89GHz) will only be available att reduced horizontal resolution

- **i.e. current PPS PC product will have degraded performance for NPP/JPSS!**
- **Exploit 183GHz channels?**

GEO:

- **combined LEO (MW)/GEO precipitation products?**
- **Better integrate GEO-only precipitation information (convective/stratiform)?**
- **Lightning Imager on the horizon….**

NWCSAF PPS Precipitating Clouds algorithm outline

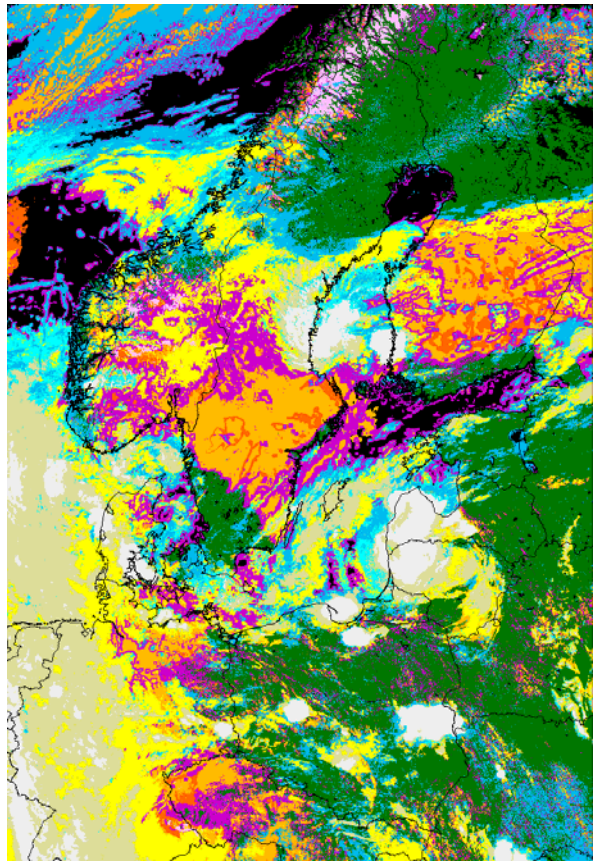
- Using AVHRR and NWCSAF Cloud type product to screen out non-precipitating areas (statistically verified with BALTRAD/NORDRAD data)
- AMSU-B/MHS estimate of precipitation likelihood based on scattering signature
- SI=Tb89 - Tb150 – corrections(θ)
- For MHS (NOAA18 and METOP) the 157GHZ channel is corrected to simulate 150GHZ behaviour with help of RTM calculations. Correction factor applied: corr (Tb89,Tb183, θ)
- Separate estimates over land and sea, in coastal areas blended estimate according to land/sea fraction
- Likelihood of precipitation estimated in intensity classes is mapped to SI based on histograms of scattering index versus NORDRAD data.

NWCSAF PPS Precipitating Clouds algorithm

comparison of NWCSAF Cloud type classification (used in filtering of PC product) with BALTRAD data, statistics over 2 years of data, additionally IR only PC estimate is used to further screen out non-precipitating events (with less than 5% precipitatin likelyhood)

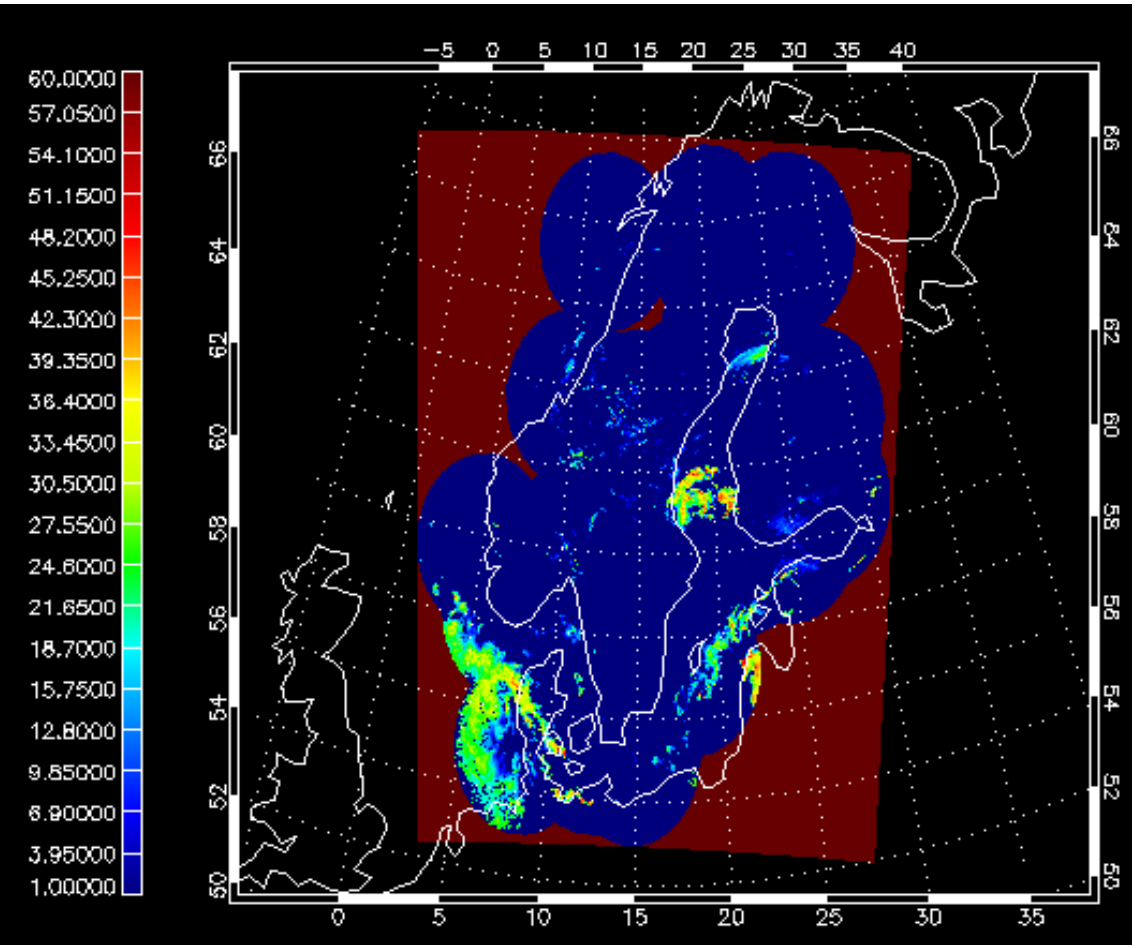
Cloud free	0.5%
Very low cloud	0.6%
Low cloud	2.1%
Medium level cloud	9.3%
High opaque cloud	19.5%
Very high opaque	28.1%
Very thin cirrus	2.0%
Thin cirrus	1.5%
Thick cirrus	5.7%
Cirrus over lower clouds	3.2%
Fractional clouds	0.9%

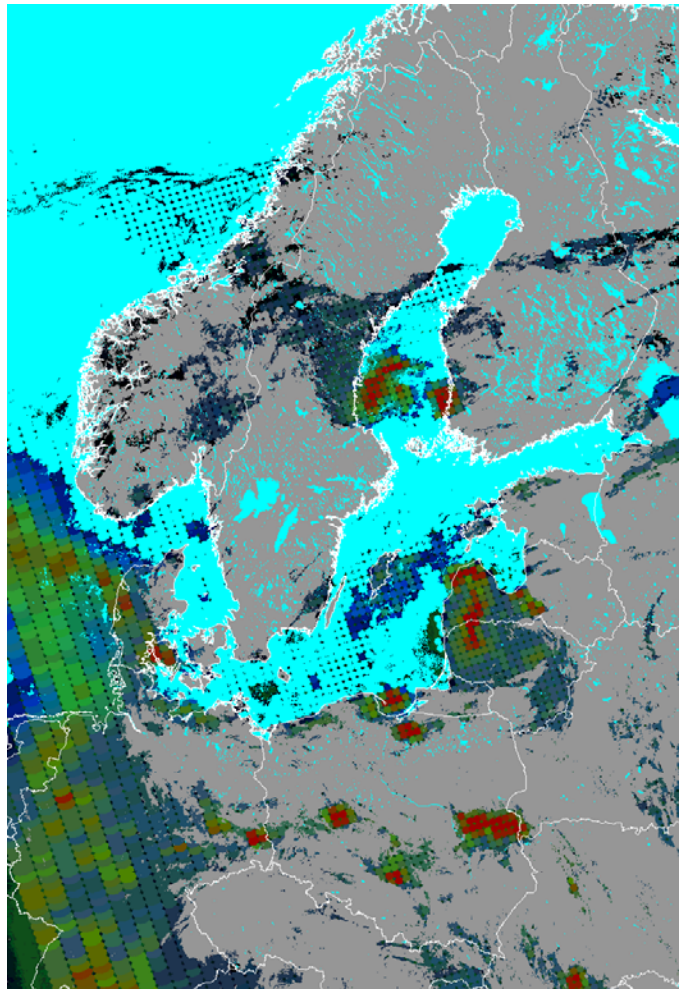
cloud classes treated as potentially precipitating in precipitating cloud algorithm marked green



Noaa18 20070529 1116Z

NWCSAF Precipitating Clouds algorithm example RGB of precipitation likelihood:
light moderate heavy

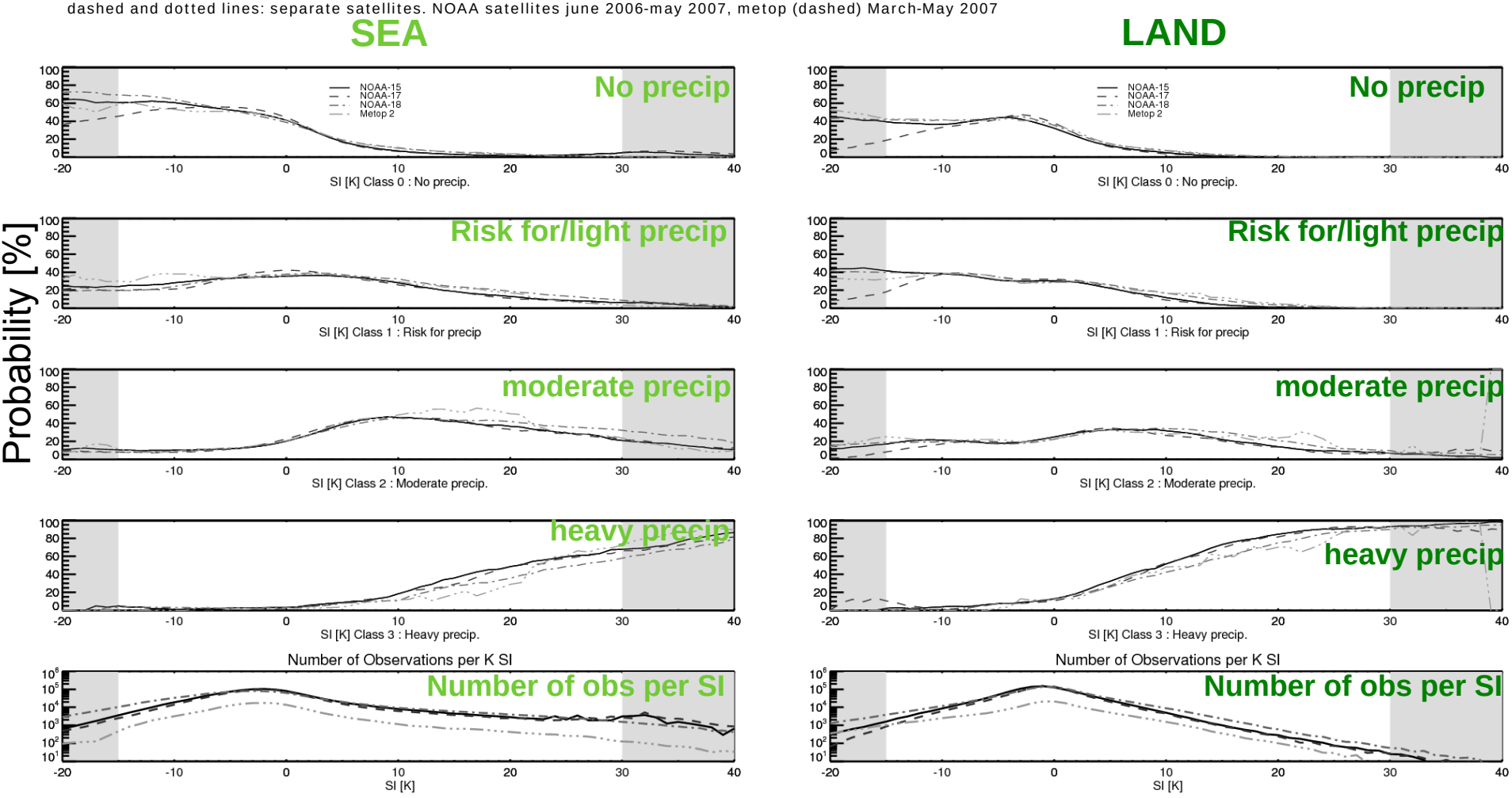




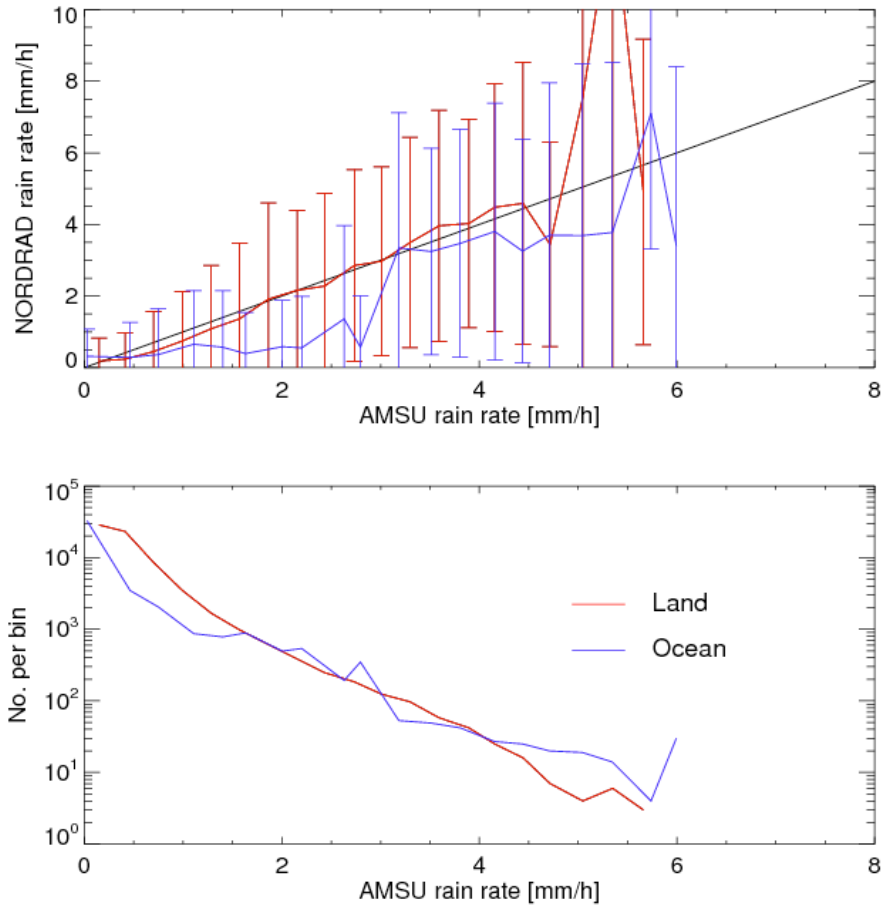
Noaa18 20070529 1116Z

NWCSAF Precipitating Clouds algorithm mapping of probability to scattering index

solid line: algorithm
dashed and dotted lines: separate satellites. NOAA satellites june 2006-may 2007, metop (dashed) March-May 2007



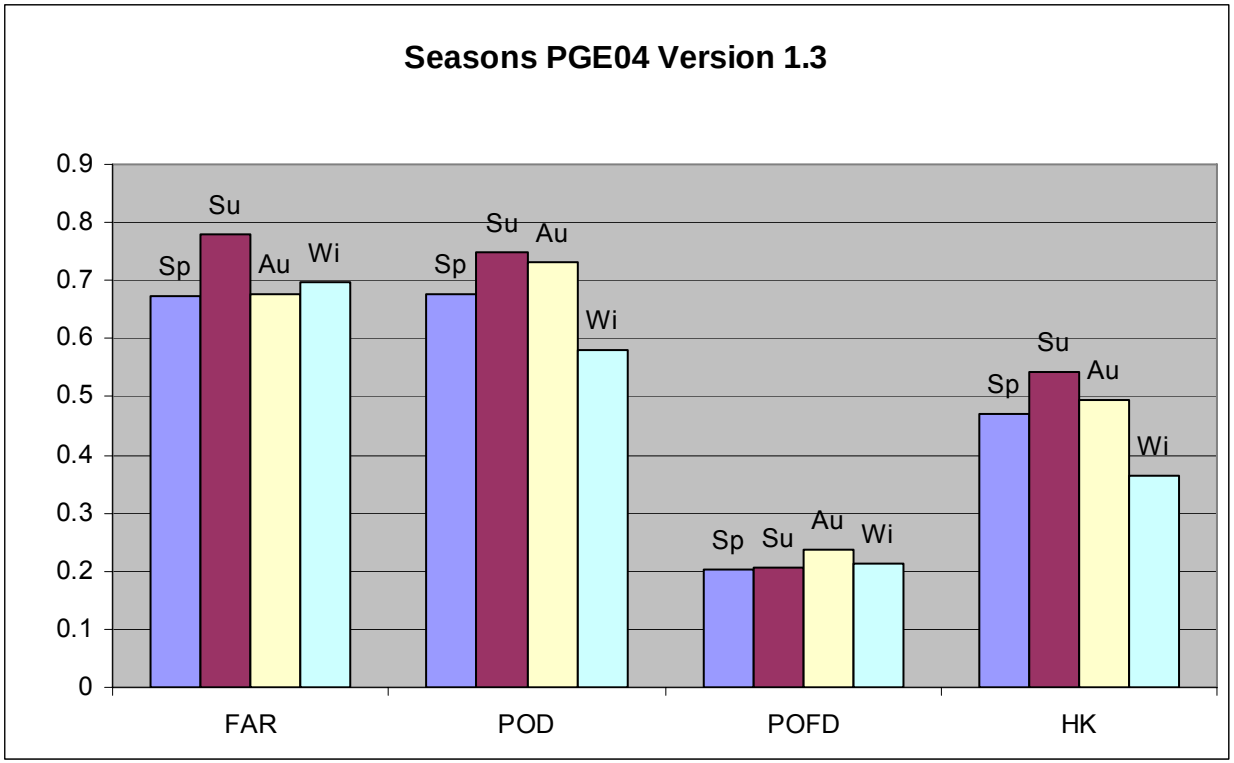
Precipitation rate from AMSU/MHS



Upper: Rain rate retrieval (not implemented) based on same dataset as likelihood retrieval for Land and Ocean
Comparison against NORDRAD data, error bars Denote standard deviation in intensity bin

Lower: number observations per intensity bin

Validation combined AMSU/IR on different Seasons



Validation for v2008 for year 2007, algorithm unchanged since than

MSG Precipitating clouds product

- Gives precipitation likelihood only, no stratification in intensity classes

- For potentially precipitating cloud types, a cloud type dependent precipitation index PI is calculated and statistically related to observed precipitation

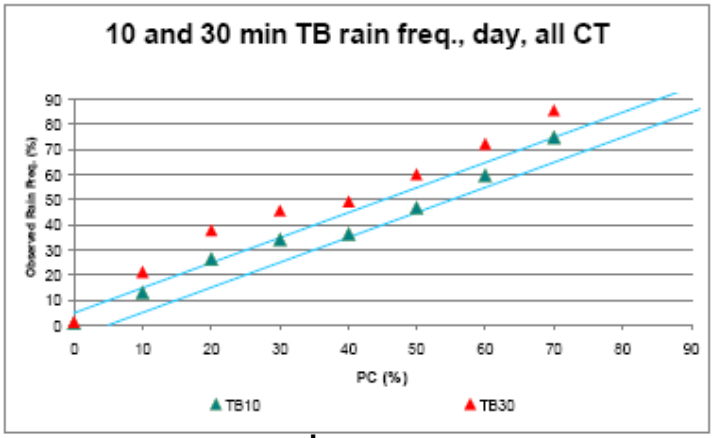
- PI is a linear combination of features most correlated with precipitation.
- Coefficients are tuned for groups of cloud types
- Different tuning for day (VIS/IR) and night (IR only, reduced performance)

PI = a0 + a1*Tsurf + a2*T108 + a3*(T108-T120) + a4*abs(a5-R06/R16)
+ a6*R06 + a7*R16 + a8*T062 + a9*T073 + a10*T039)

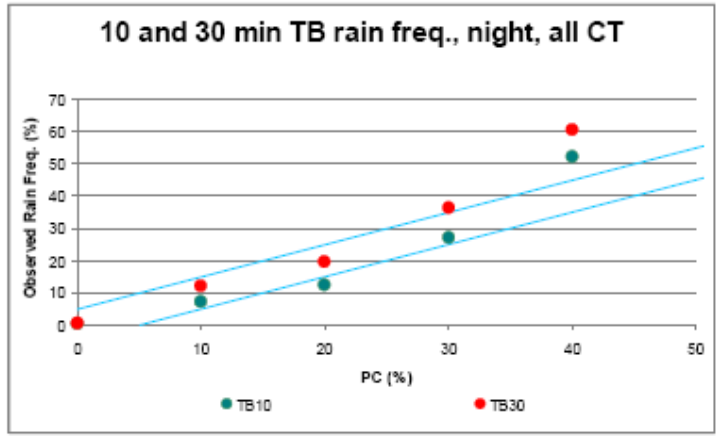
- Currently PI tuned on French rain gauge data

- PC Validated against Hungarian rain gauge data

Validation of likelihood class against hungarian rain gauge data summer 2009



day

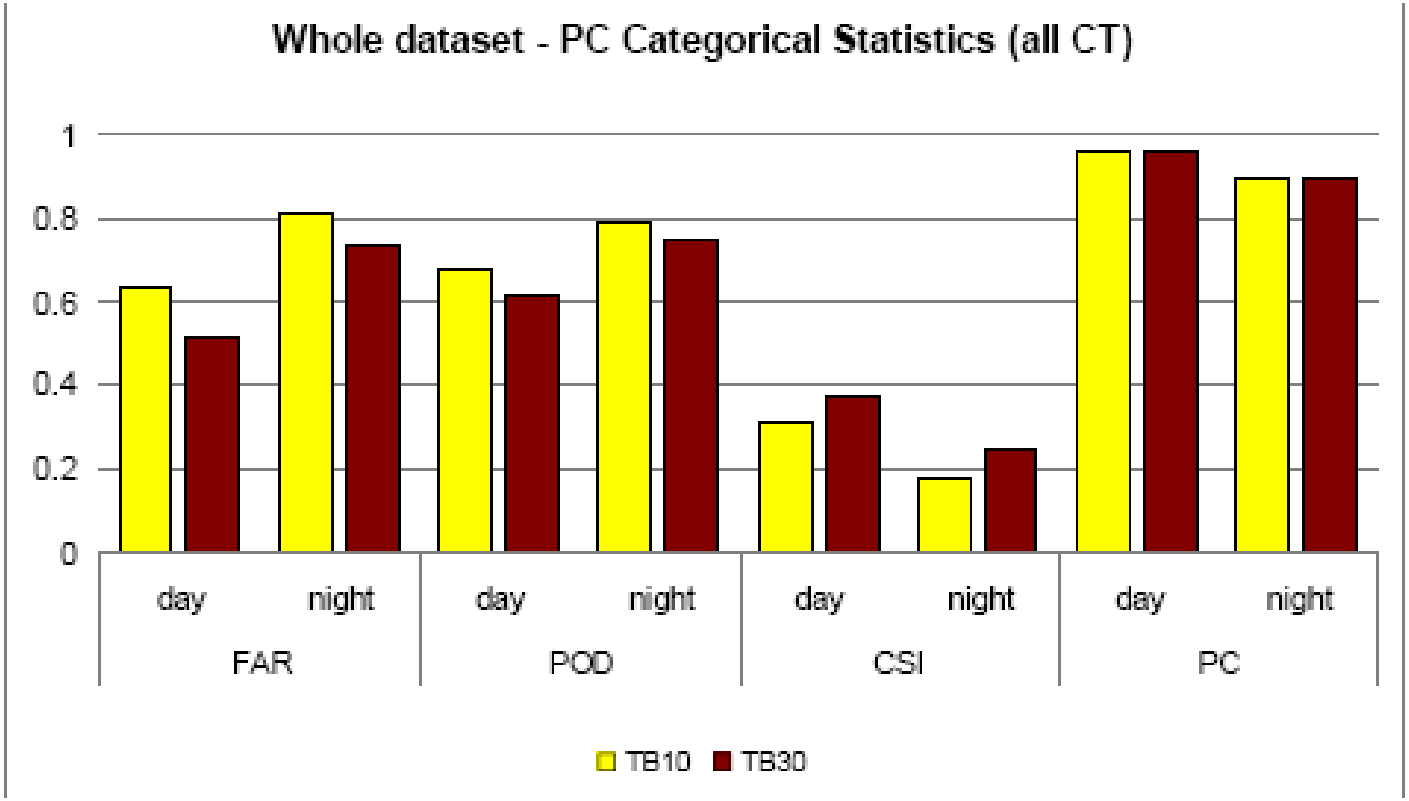


night

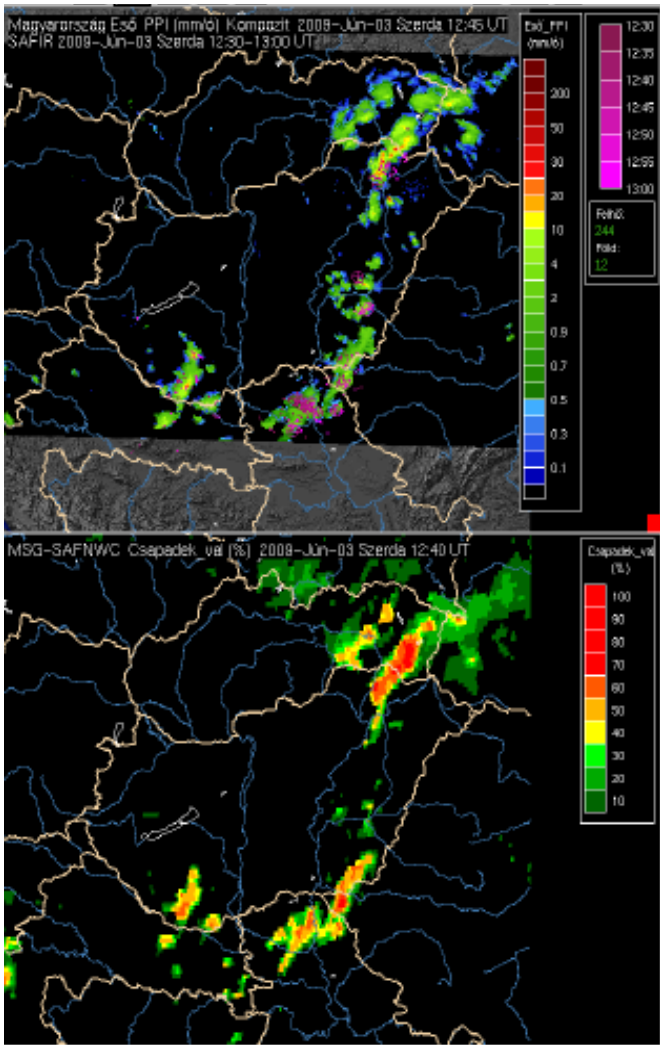
Day: PC underestimates precipitation likelihood for majority of cases by 10-20%, specially when indicating 20-30% precipitation likelihood (20% is recommended as threshold for identifying potential precipitating areas)

Night: 40% class underestimates precipitation occurrence

MSG precipitation clouds: categorical statistics against hungarian rain gauge data

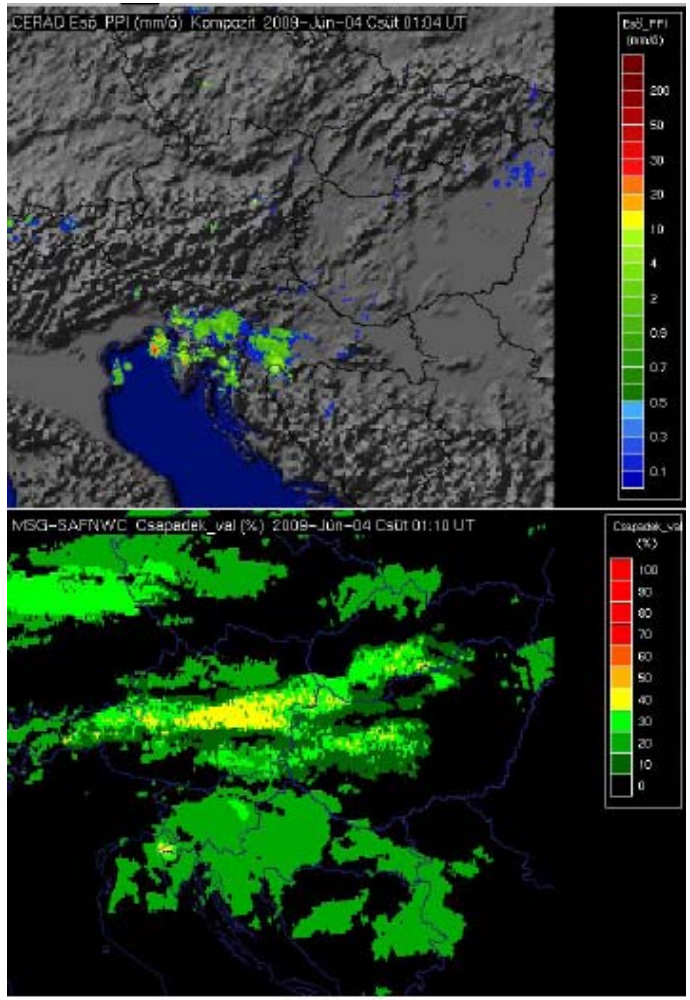


MSG PC: typical good and bad examples



Upper: radar

Lower: PC



3 juni 2009, 12:45/12:40

4 juni 2009, 01:04/01:10

Planned visiting scientist activities

- **Precipitation retrieval based on microphysics, MSG**:

  Promising results for validation of SEVIRI based precipitation estimates over Netherlands for precipitation algorithm developed by KNMI

  90%correlation of precipitation occurrence with radar, 68% correlation of rain rate estimates.

  VSA to perform validation of this algorithm over Hungary in comparison to PC and CRR (gauges and case studies against radar)

- **PPS: investigating both 183GHz potential and microphysically based precipitation retrieval for AVHRR in comparison with current PC algorithm**

  using an algorithm attempting stratiform/convective distinction from 183GHz channels

- **Statistics over periods necessary, since it is always possible to find nice cases!**

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- **Lightning Imager on the horizon….**
- **AEMET solely responsible for GEO precipitation retrieval in CDOP2**

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Thanks!

To our visiting scientists in previous VSA:

Ralf Bennartz, developer of MW part of algorithm and supporting algorithm adjustments over the years

Maria Putsay and Eszter Laban for validation of NWCSAF precipitation algorithms (more to come in Maria's presentation)