The EUMETSAT Network of Satellite Application Facilities

NWC SAF
Support to Nowcasting and Very Short Range Forecasting

SMHI

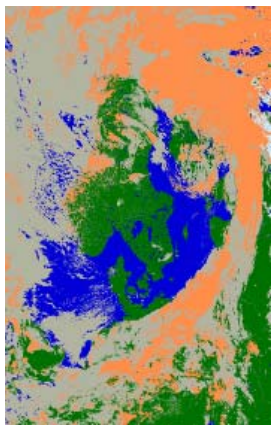
User Workshop, April 2010, Madrid

Cloud Products (PPS)

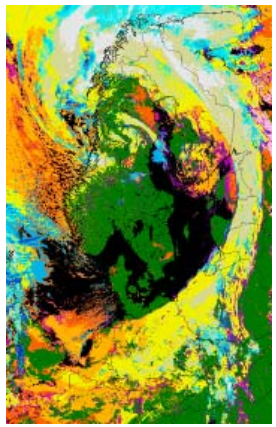
Anna Eronn, SMHI

Outline

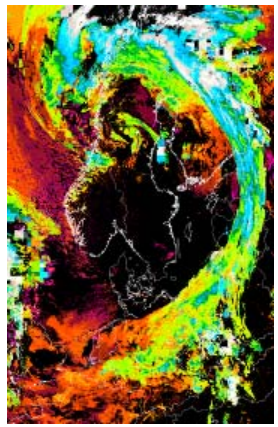
- Status
  - News and updates
  - Validation
- Future
  - CDOP
  - CDOP2



Cloud Mask



Cloud Type



CTTH

New for PPS version 2010

- Radiative transfer calculations now done by RTTOV9

Offline Threshold Calculations

v. 2009

RTTOV7
2311 TIGR profiles (focus on mid-latitude atmosphere)

v. 2010

RTTOV9
10 000 ECMWF profiles (focus on maximum diversity)

Cloud Top Temperature/height calculation

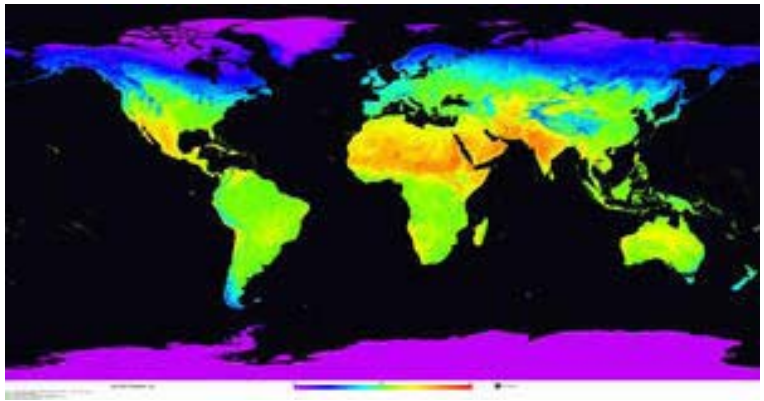
v. 2009

RTTOV7

v. 2010
RTTOV9 (new interface to allow new features)

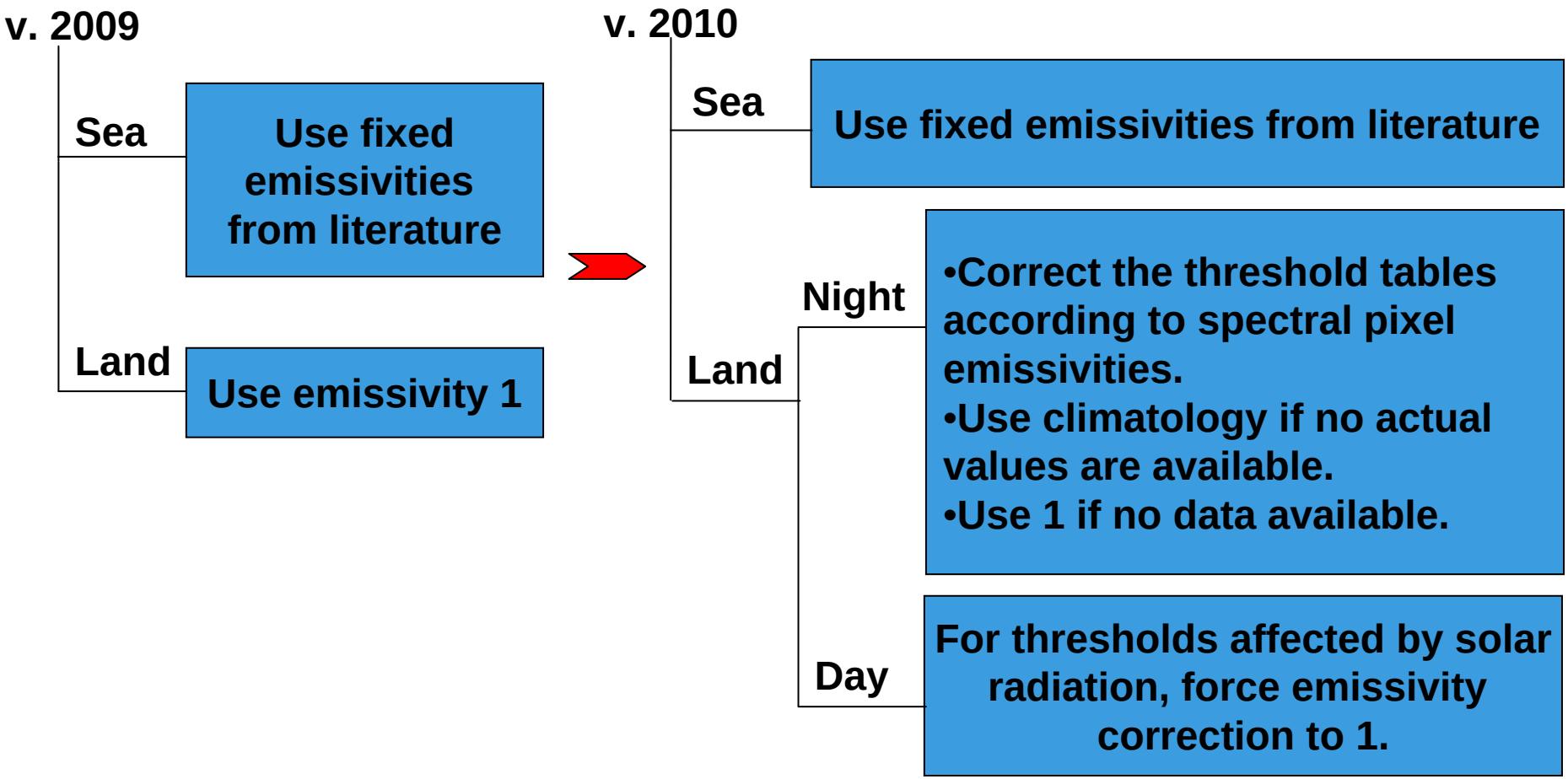
New for PPS version 2010

- **Use of IR emissivity maps over land**
  - 5 x 5 km global montly maps
  - Expect to increase performance over all land surfaces



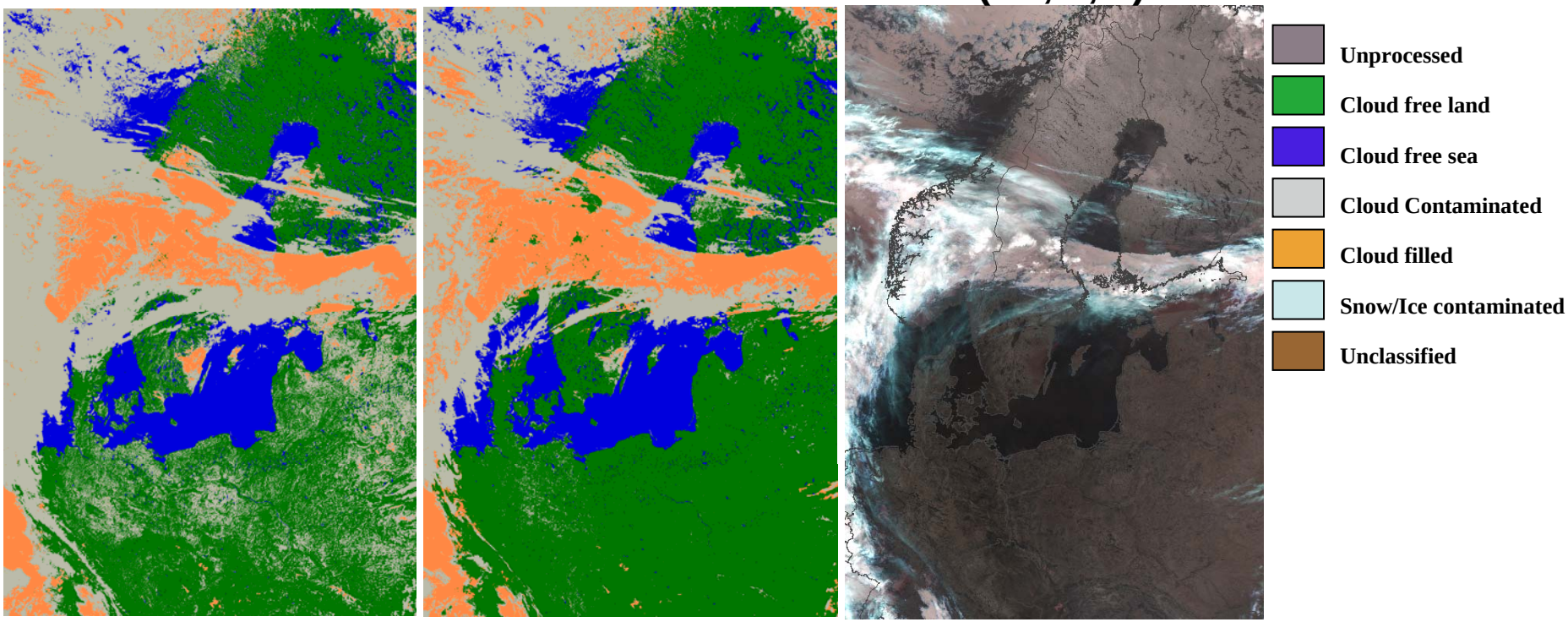
New for PPS version 2010

- **Threshold table on pixel basis**



Improvement: less noisy

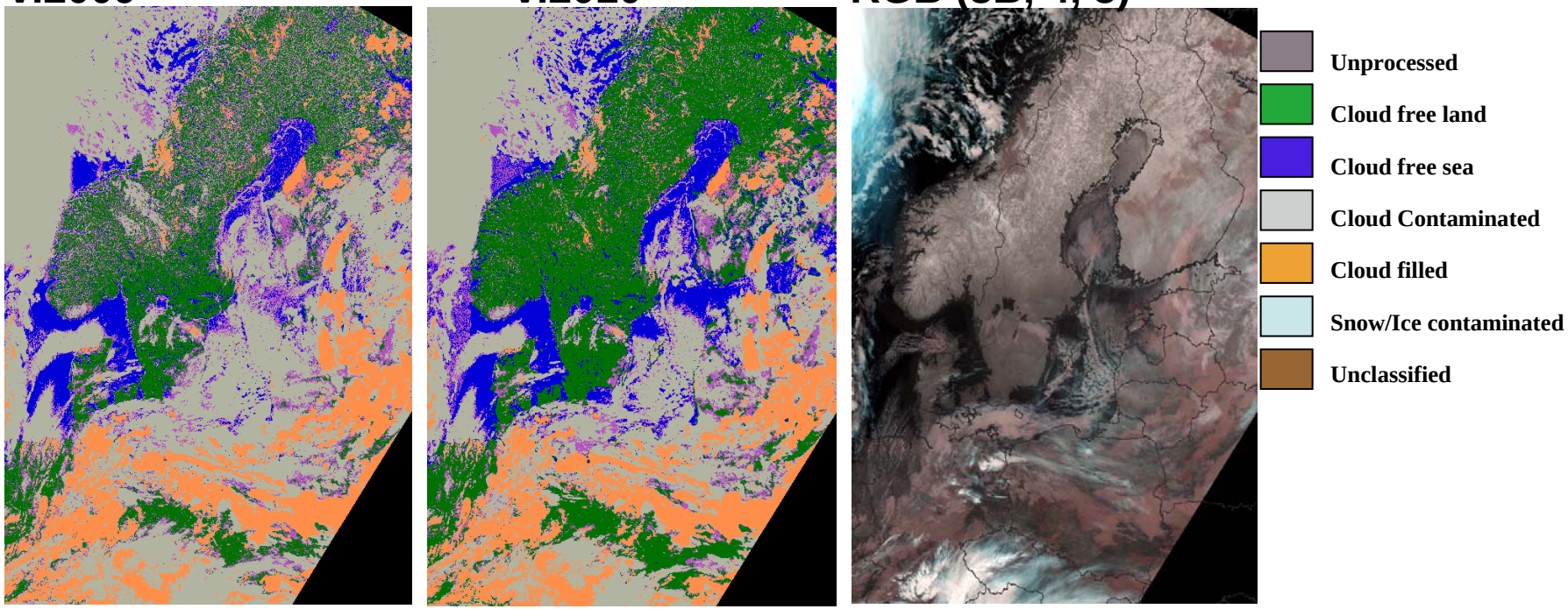
v.2009 **v.2010** **RGB (3B, 4, 5)**



NOAA18 20060925 0141utc

Improvement: less noisy

v.2009 **v.2010** **RGB (3B, 4, 5)**



NOAA16 20030131 0233utc

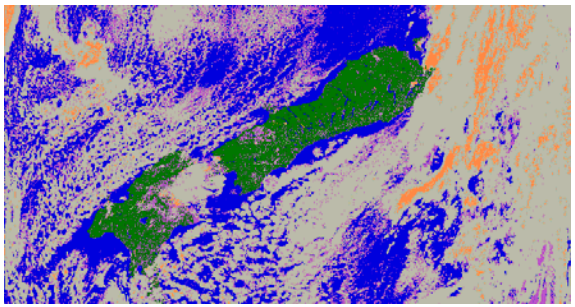
More changes for thresholds

- New threshold tables using land emissivity maps
- RTTOV7 with TIGR profiles =>
  RTTOV9 with ECMWF91 profiles
- **Humidity and temperature range of threshold expanded:**
  - **Water vapor from 0.25-4.75 g/cm^3 to 0.25-7.75 g/cm^3**
  - **Surface temperature from 220-320K to 190-340K**

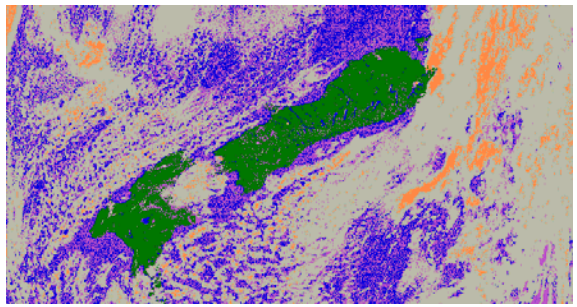
More changes for Cloud Mask

- **Added spatial coherence test over sea**
  - **Find the warmest pixel in a 5x5 neighbourhood**
  - **Day and night**

v.2009



v.2010



RGB (3B, 4, 5)

Metop 20080630 1034utc

Improvement but cloud contaminated pixel still left undetected.

Purple = low quality

New changes in other PGE:s

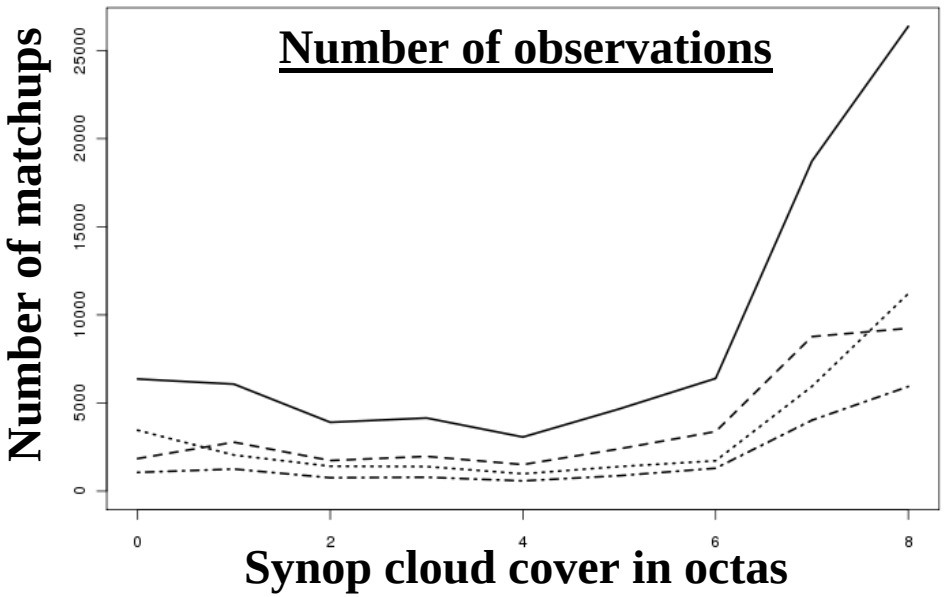
- PGE02 – Cloud Type
  - New thresholds and changed from RTTOV7 to RTTOV 9
- PGE03 – Cloud Top Temperature and Height
  - Changed from RTTOV7 to RTTOV9

MODIS/NPP

- MODIS updated for Cloud Mask and Cloud Type
  - New test with 8.5 micron (water cloud test and high cloud test)

Validation

- **Cloud Mask validation using Synop**
- **January to December 2008**
- **European land areas only**



- **Solid line: total**
- **Dashed: day time**
- **Dotted: night time**
- **Dash-dotted: twilight**

- **NOAA15**
- **NOAA17**
- **NOAA18**
- **Metop**

Cloud Mask validation using Synop

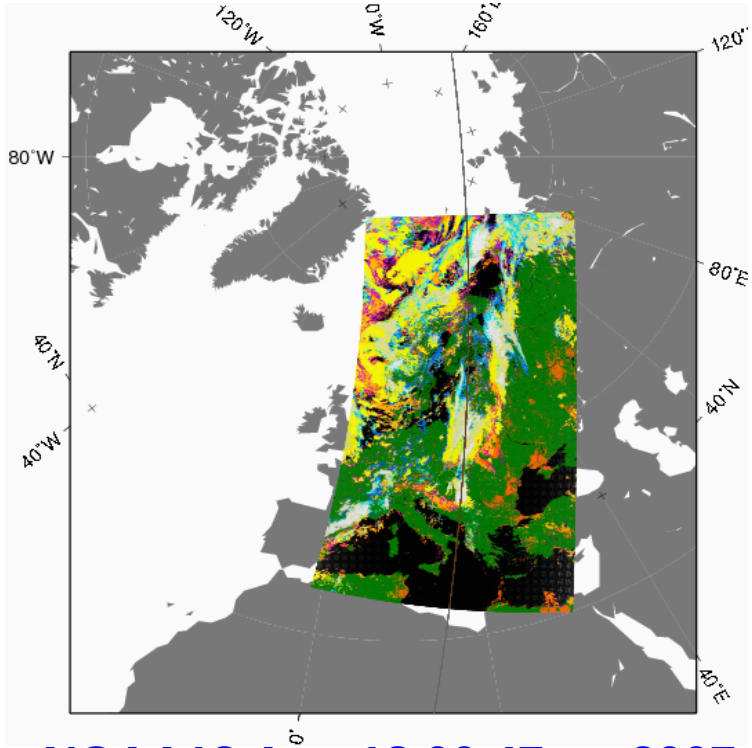
Version 2010 compared with version 2009.
All stations, January to December 2008.

	Mean Abs. Error	Hit rate	Bias (%)	POD cloudy	FAR cloudy	POD clear	FAR clear	N
All	1.43 (1.38)	0.910 (0.921)	-0.12 (1.37)	0.952 (0.952)	0.071 (0.055)	0.784 (0.820)	0.151 (0.157)	79712 (79712)
Day	1.26 (1.22)	0.946 (0.954)	3.09 (3.03)	0.964 (0.971)	0.033 (0.030)	0.878 (0.890)	0.136 (0.106)	33610 (33610)
Night	1.53 (1.44)	0.890 (0.905)	-1.31 (1.54)	0.940 (0.934)	0.092 (0.062)	0.766 (0.823)	0.161 (0.188)	29544 (29544)
Twilight	1.62 (1.57)	0.878 (0.885)	-4.53 (-2.31)	0.953 (0.947)	0.111 (0.094)	0.672 (0.694)	0.162 (0.192)	16558 (16558)

- Slightly lower overall skill
- Missing more clouds on average during twilight and night (negative bias)
- Offsets must be retuned for new RTM threshold

Validation: AVHRR with Calipso and CloudSat

Two co-located AVHRR-Calipso cases over Europe:



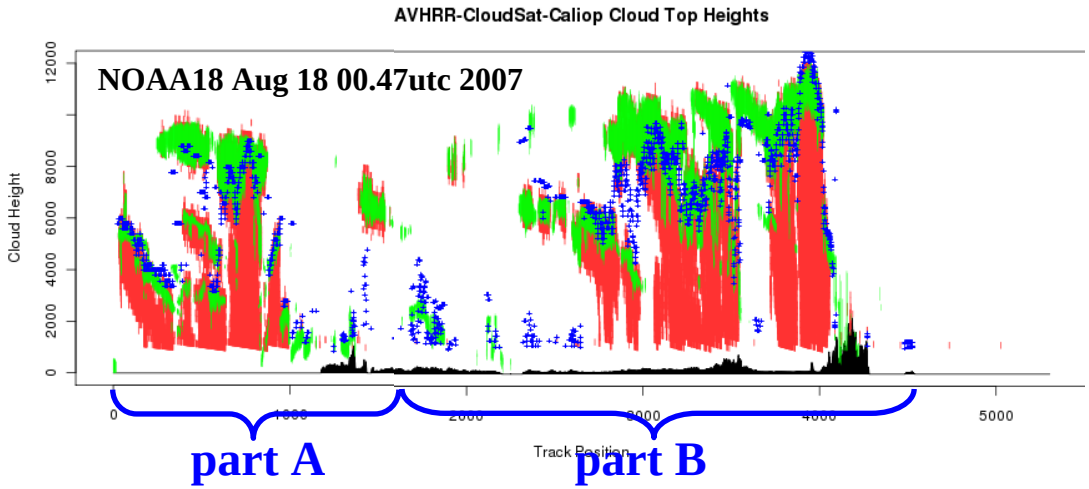
NOAA18 June 22 10.46utc 2008

Daytime

NOAA18 Aug 18 00.47utc 2007

Nighttime

Validation: Result Calipso - CloudSat - AVHRR



PPS CTTH in blue

Calipso in green

CloudSat in red

Cloud Height	Correlation	Bias (m)	RMS (m)	N
Calipso – PPS-v2008 (part A)	71.2%	-1288	2381	1010
Calipso – PPS-v2009 (part A)	71.4%	-1308	2389	1000
Calipso – PPS-v2010 (part A)	68.5%	-1451	2467	982
Calipso – PPS-v2008 (part B)	67.7%	-1768	2845	1793
Calipso – PPS-v2009 (part B)	67.4%	-1742	2842	1795
Calipso – PPS-v2010 (part B)	67.5%	-1870	2907	1770

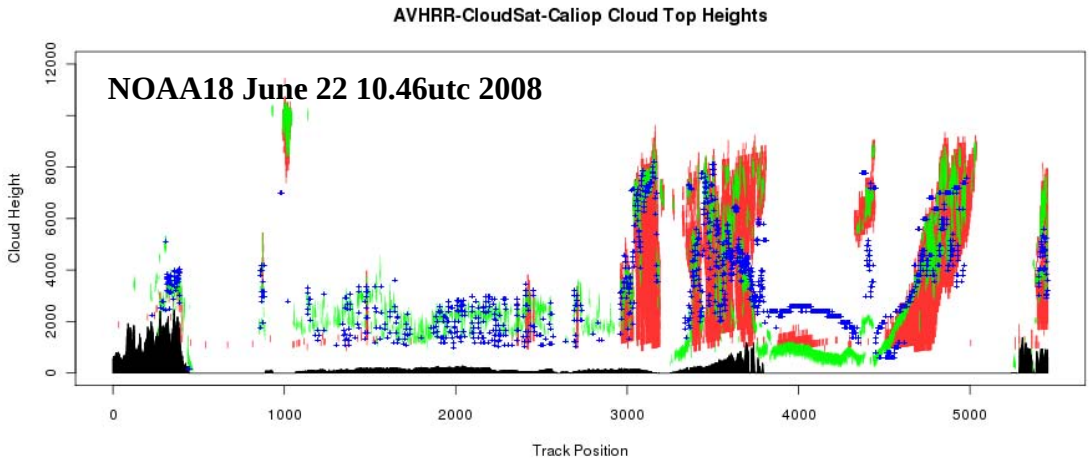
Requirements bias (opaque)

Threshold: 1000 m

Target: 500 m

Optimal: 200 m

Validation: Result Calipso - CloudSat - AVHRR



Cloud Height	Correlation	Bias (m)	RMS (m)	N
Calipso – PPS-v2008	74.9%	-89	1884	2140
Calipso – PPS-v2009	75.0%	-114	1889	2141
Calipso – PPS-v2010	75.1%	-196	1873	2167

PPS CTTH in blue

Calipso in green

CloudSat in red

Requirements bias (opaque)

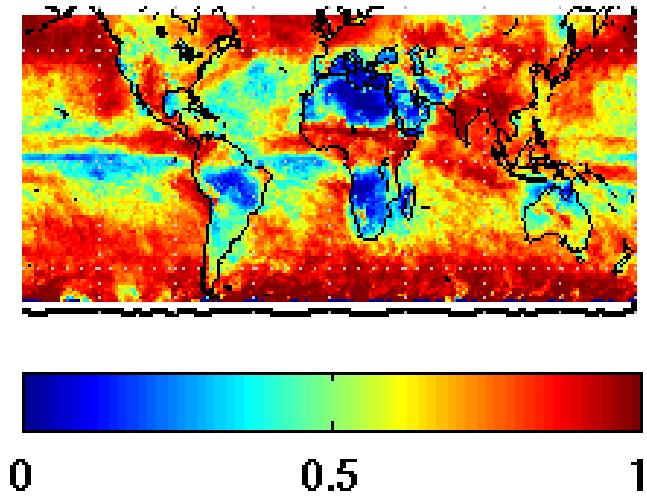
Threshold: 1000 m

Target: 500 m

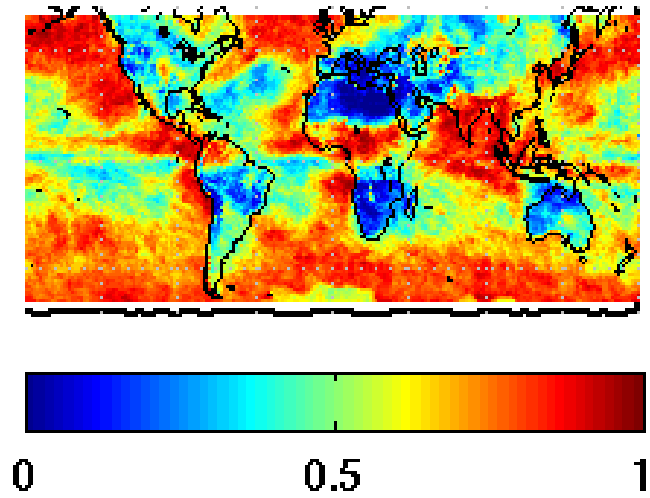
Optimal: 200 m

Global validation (by CMSAF)

Total, July 1998, Day



Total, July 1998, Night



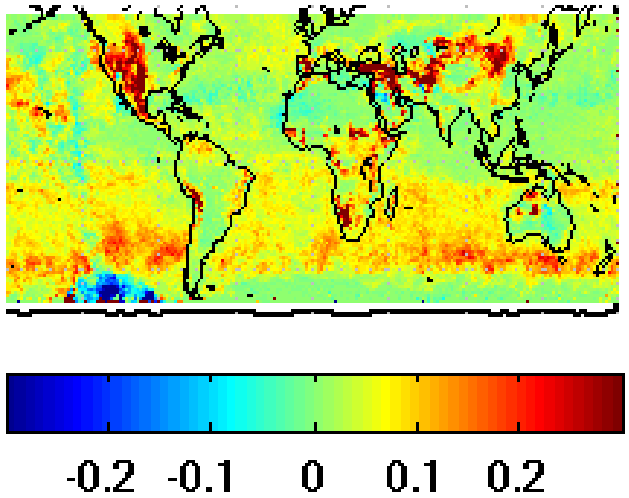
Total cloud fraction, PPS version 2010

Cloud amounts for monthly mean day: 67 %

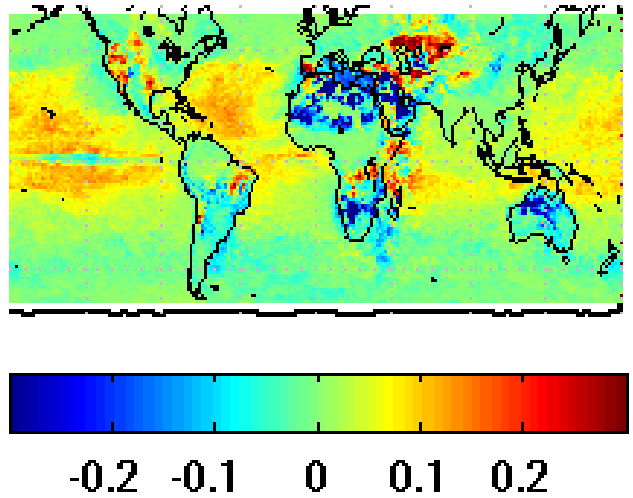
Cloud amounts for monthly mean night: 62 %

Global validation (by CMSAF)

July 1998, Day



July 1998, Night



Difference plots between PPS version 2010 and 2009

Validation - Conclusion

- **Cloud Mask skill slightly degraded during night and twilight.**

  NB! This applies to European land areas only and one year of Synop data.
- **Daytime Cloud Mask performance constant.**
- **Cloud Mask skill still above target accuracy.**
- **CTTH quality is nearly identical to v2009 – but only checked with two Calipso scenes.**
- **Offsets must be retuned for new RTM threshold.**
- **Major asset in global performance.**

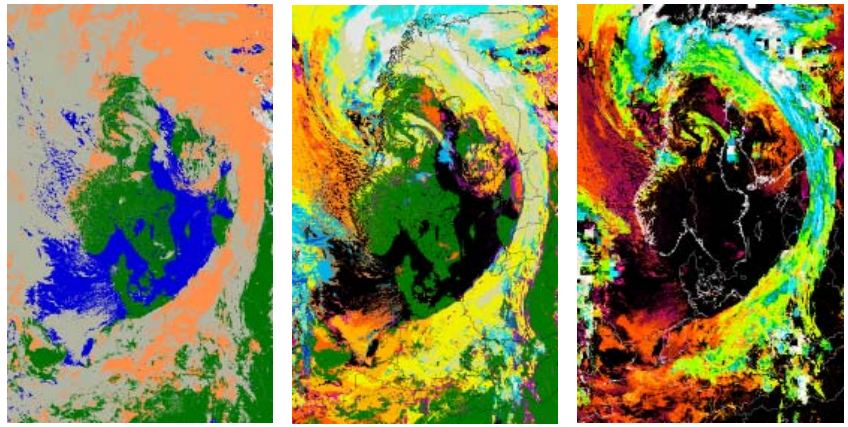
Accuracy of Cloud Mask version 2010 (in parenthesis 2009)

	v2010		Requirements		
	POD cloudy	POD clear	Threshold accuracy, POD	Target accuracy, POD	Optimal accuracy, POD
Accuracy	96.6% (96.2%)	83.9% (86.1%)	85%	95%	98%

Future

CDOP

- Retuning
- Prepare for new sensors (VIIRS as soon as specifications are available)
- Include cloud microphysical products
  - Cloud phase
  - Optical thickness
  - Effective radius
  - Condensed water path



Future – Microphysical products

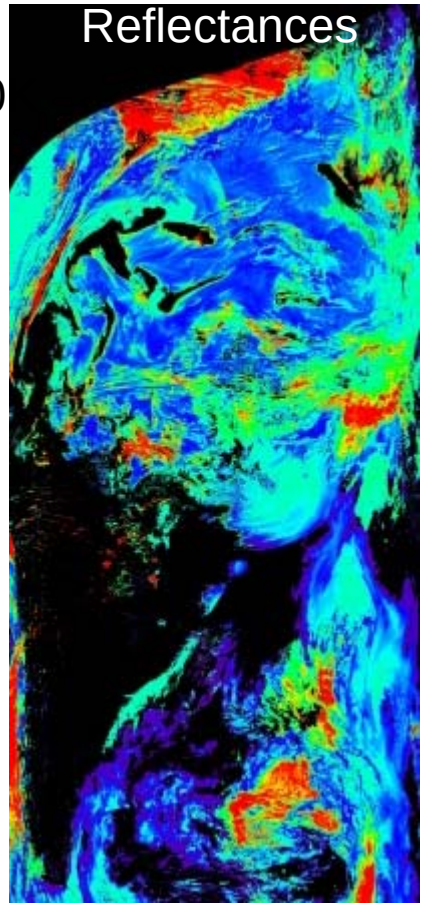
Cloud phase

Ice T11<233K

Water T11>260

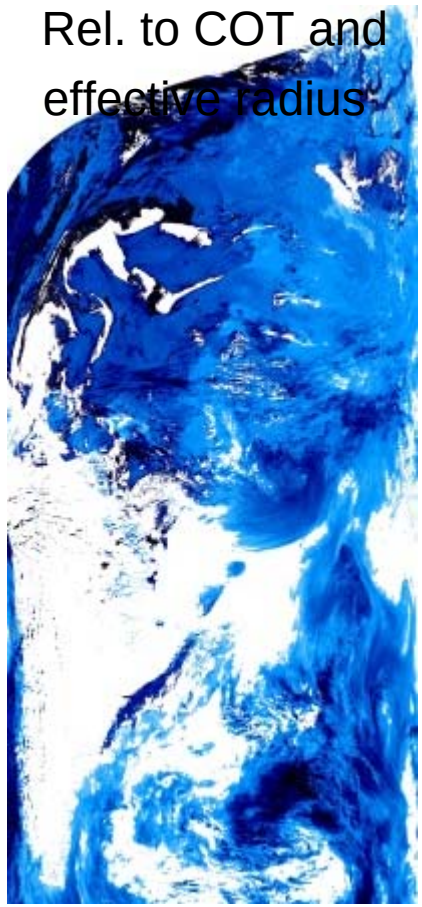
Effective radius

Reflectances



Condensed water path

Rel. to COT and effective radius

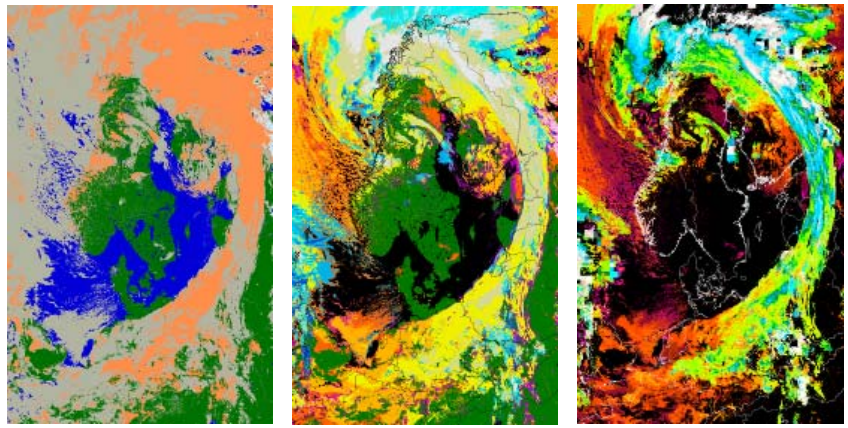


Frac of Land

Future

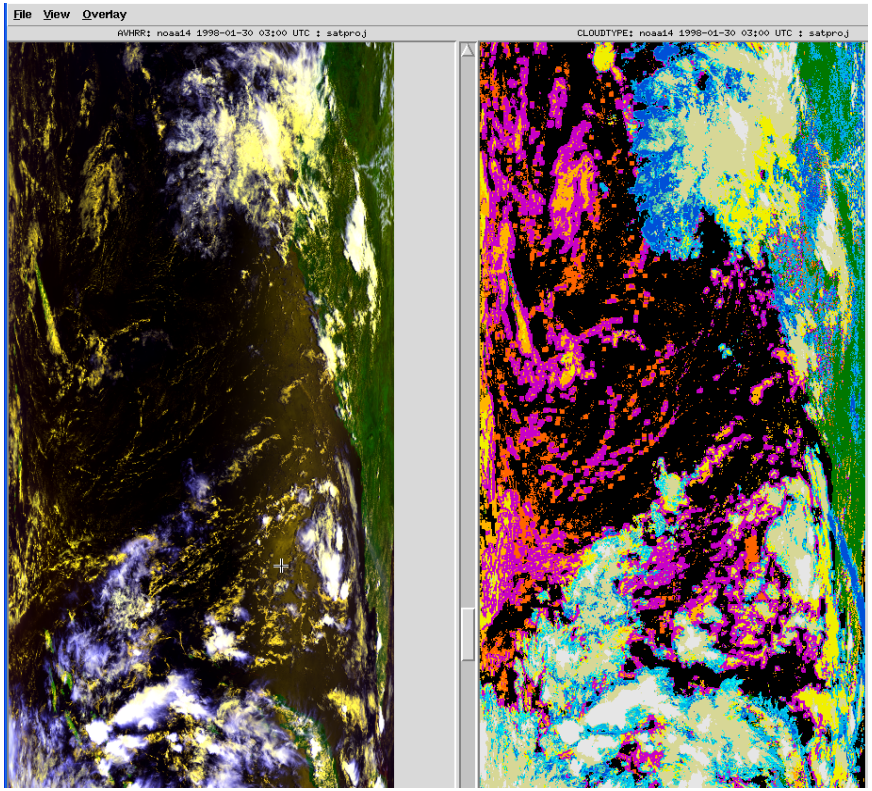
CDOP2

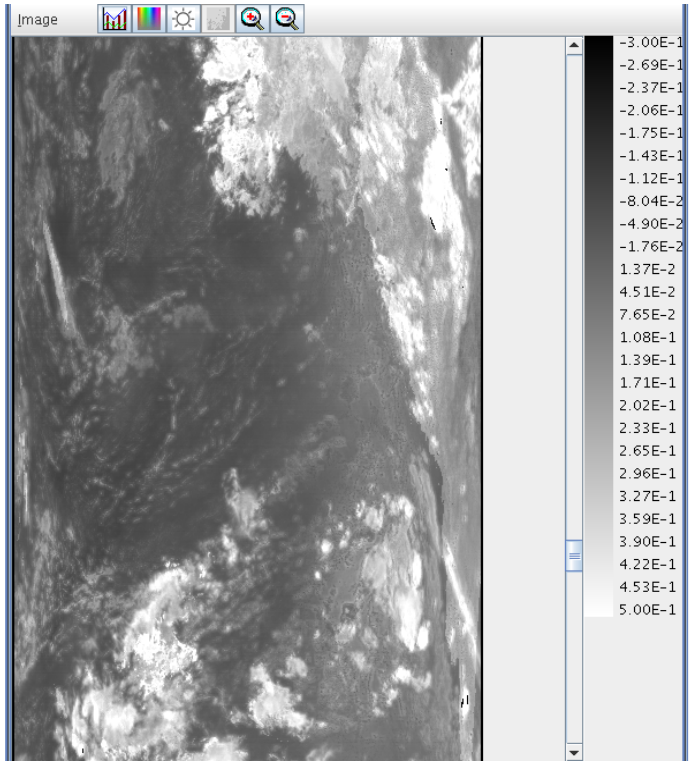
- Continue with improvements on existing products
- Improve aerosol detection
- More satellites / instruments
  - NPP/JPSS
  - Post-EPS
  - FY-3
  - PCW
- Probabilistic cloud masking



Future – Probabilistic Cloud Masking

Cloud indices between -1 (clear) and +1 (cloudy)





Error estimate

Minimise the risk for cloudy or clear.

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SMHI

Thanks!!!