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Validation of SAFNWC/MSG cloud products

27th April 2010

Madrid

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Météo-France / CMS lannion

Introduction

-This presentation summarizes the validation results of **CMa CT CTTH** implemented in version **V2010** (available to users in spring 2010; presented in a poster at the 2009 Eumetsat users conference)).

-This **V2010** version includes:

- ✓ use of HRV for cloud masking (**CMa**)
- ✓ improved low cloud classification in case thermal inversion (**CT**)
- ✓ cloud phase implemented (**CT**)
- ✓ use of RTTOV9 (**CTTH**)

-An extensive validation has been performed:

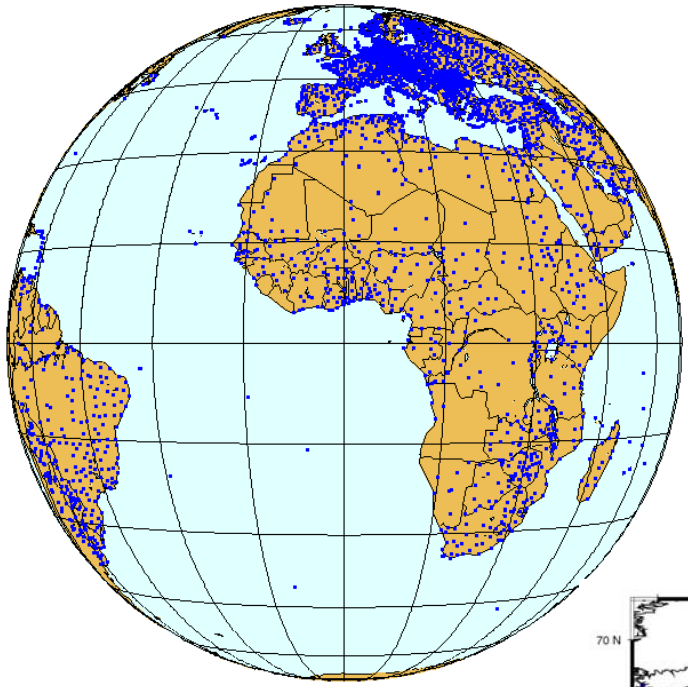
- ✓ spatial extension to the full disk
- ✓ new validation data (space-born lidar, aeronet dataset).

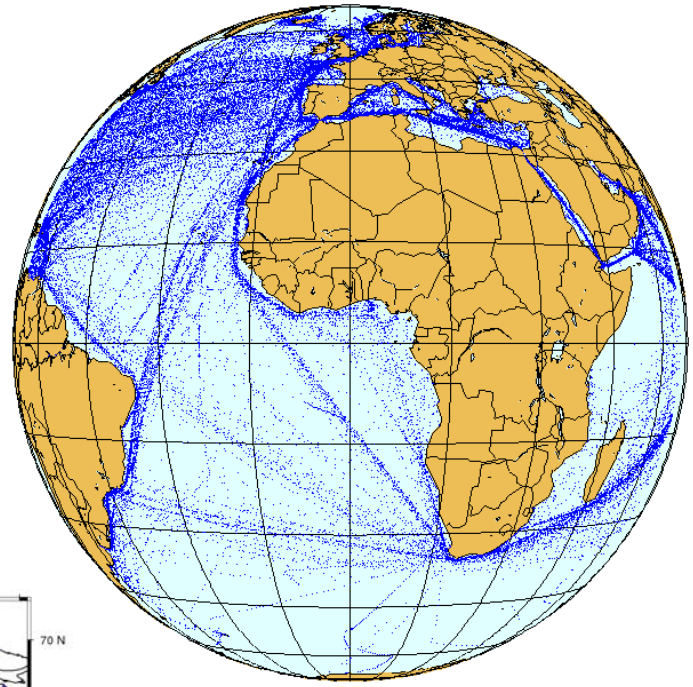
Validation of CMa with SYNOP and SHIP

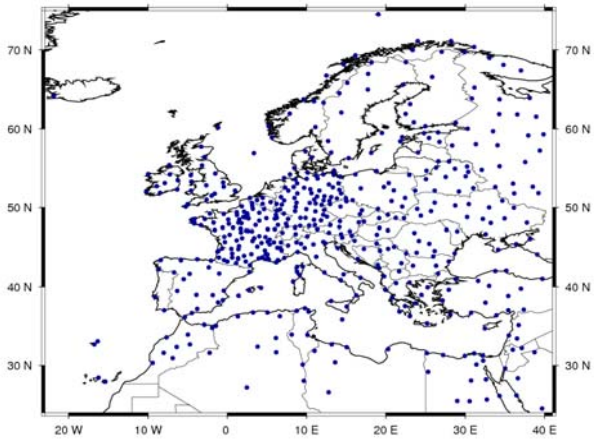
Comparison of cloudiness observed in SYNOP and computed from SEVIRI (CMa):

- Following cloudiness are compared:
  - SEVIRI: average cloudiness in a 5x5 target (no account of fractional cloudiness in pixel)
  - SYNOP: total observed cloudiness
- Two datasets (October 2009-December 2009):
  - Over European continental areas
  - Over MSG full disk (synop/ship data provided by CM-SAF)

Validation of CMa with SYNOP and SHIP







Validation of CMa with SYNOP and SHIP

Cloudy event		Detected		
		yes	no	
Observed	yes	h	m	h+m
	no	fa	cr	fa+cr
		h+fa	m+cr	Total

Cloudy event:
yes if total cloudiness > 5 octas
no if total cloudiness < 3 octas

POD: h/(h+m) rate of correctly detected cloud observation

FAR: fa/(fa+h) fraction of cloud detection observed to be clear

Validation of CMa with SYNOP

Over Europe with SYNOP measurements

	POD (%)	FAR (%)
All illumination :244700	96.7	4.5
Daytime : 76013	98.4	1.6
Night-time : 131496	95.7	7.1
Twilight : 37191	96.1	1.7

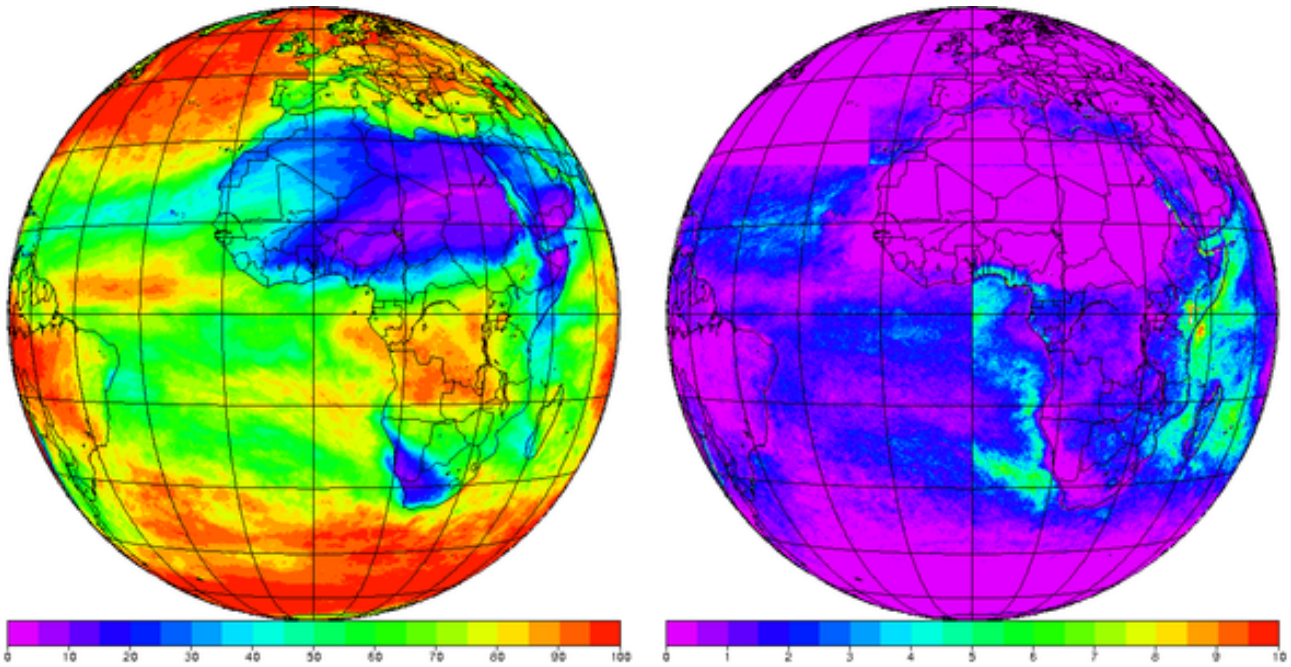
Validation of CMa with SYNOP and SHIP

Over MSG full disk with SYNOP and SHIP measurements

	LAND ZA <78°		SEA ZA <78°	
	POD (%)	**FAR (%)**	**POD (%)**	**FAR (%)**
All	94.3	6.5	96.3	14.9
Daytime	96.1	4.4	96.8	10.3
Night-time	93.4	8.4	95.6	20.3
Twilight	93.5	4.0	96.9	8.3

Validation of Cma: illustration of HRV impact

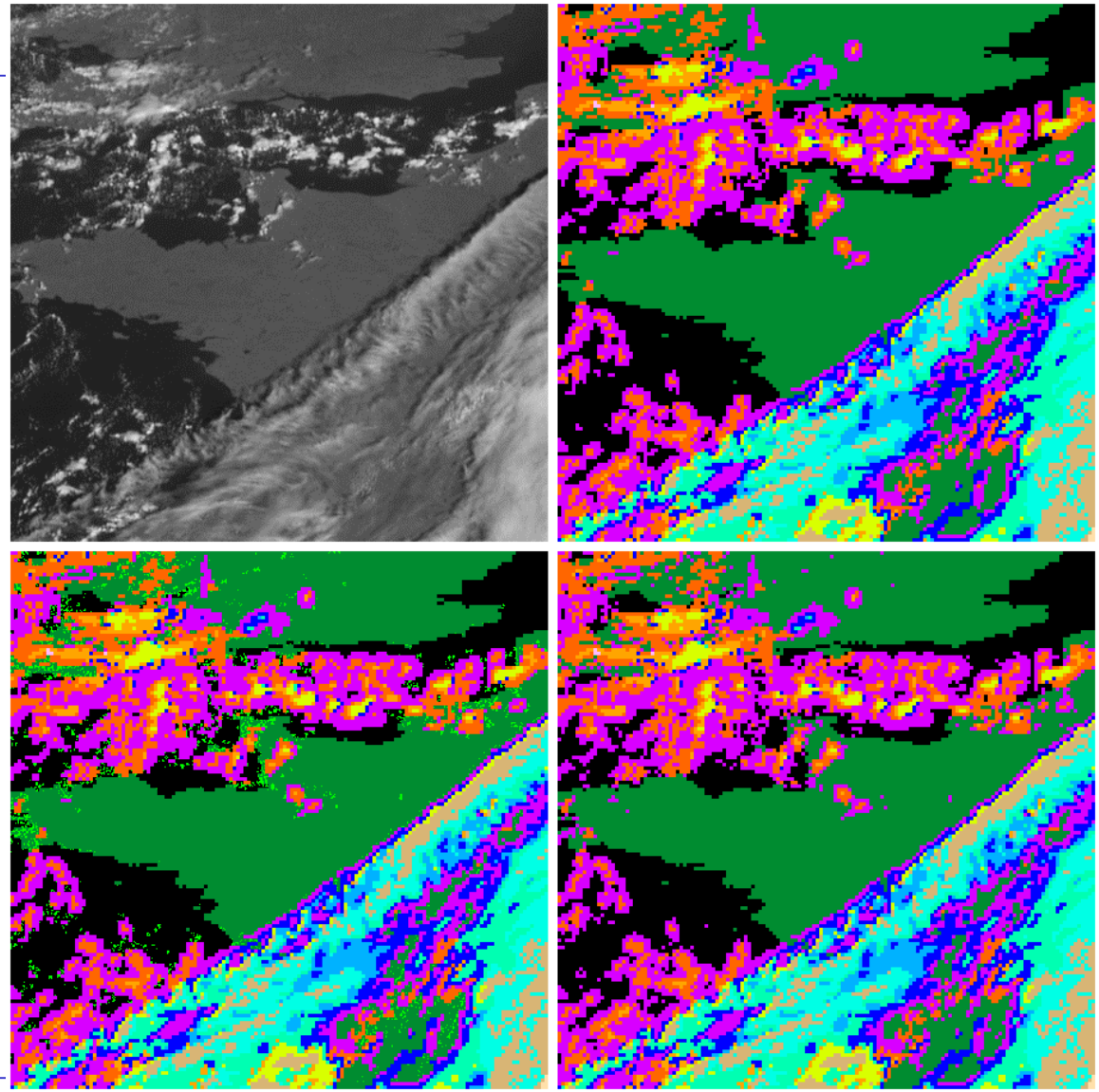
Impact of HRV (October-Decembre 2009)



Cloud detection frequency

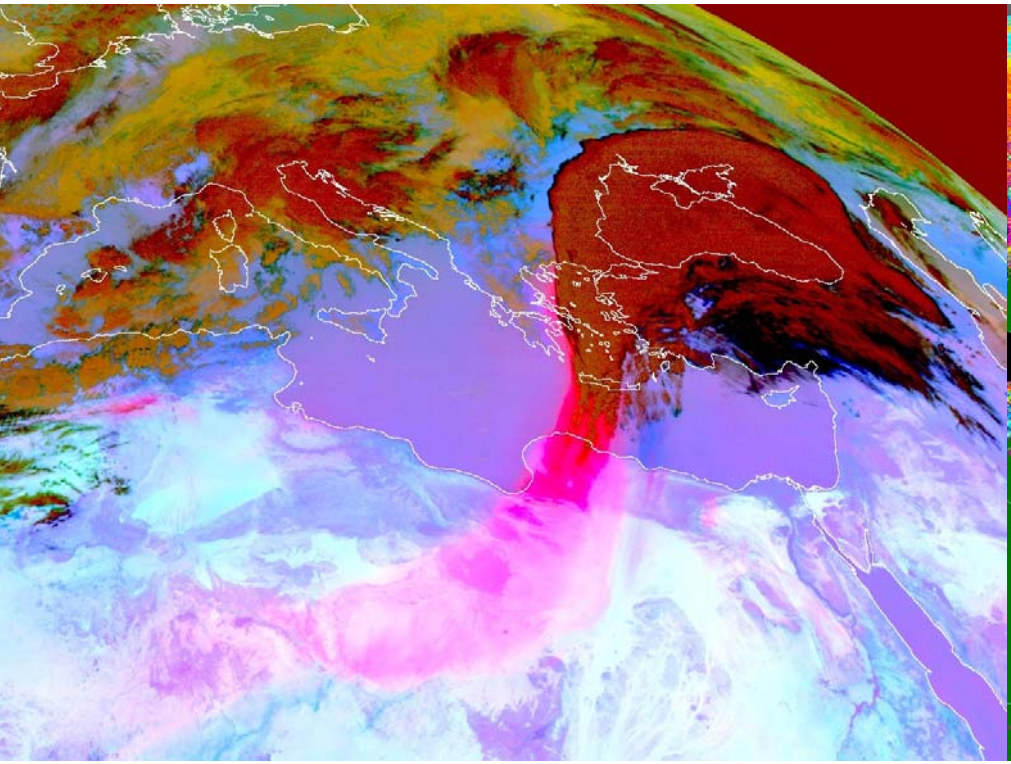
HRV-based detection frequency

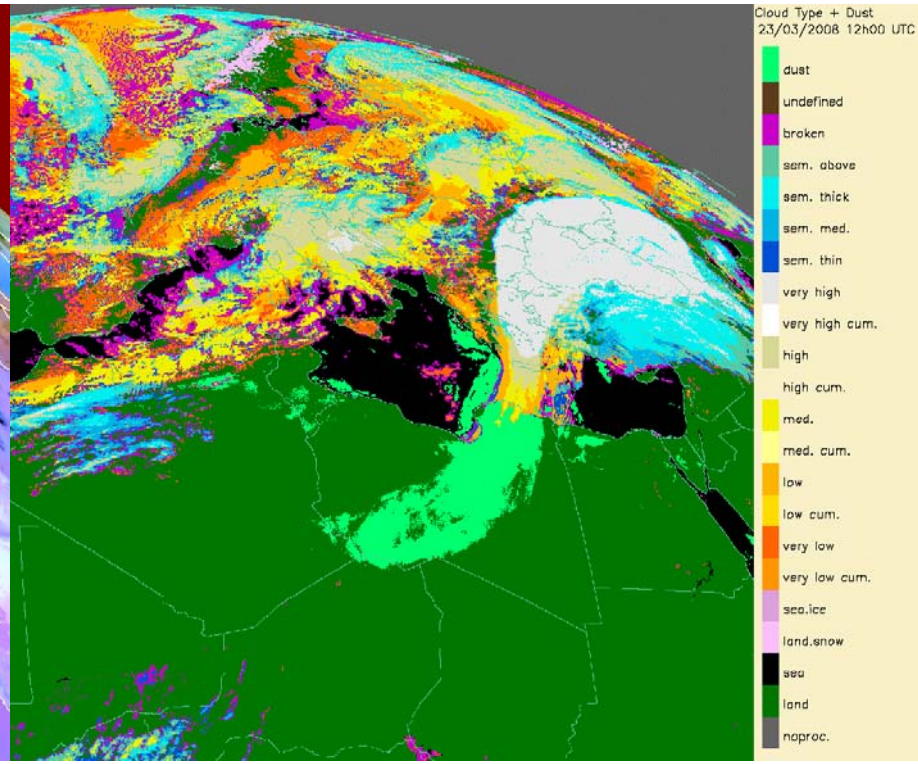
Validation of Cma: illustration of HRV impact



Dust flag (CMa): example

Illustration of coloured rain in Bulgaria
23 March 2008 12h00UTC

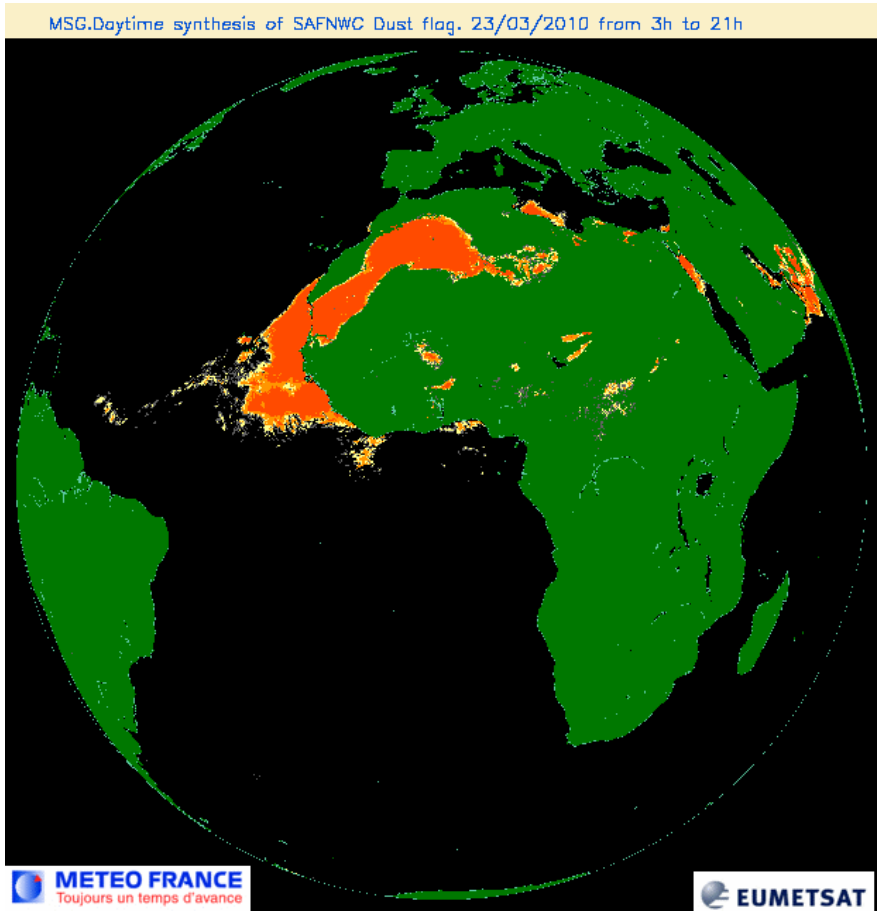




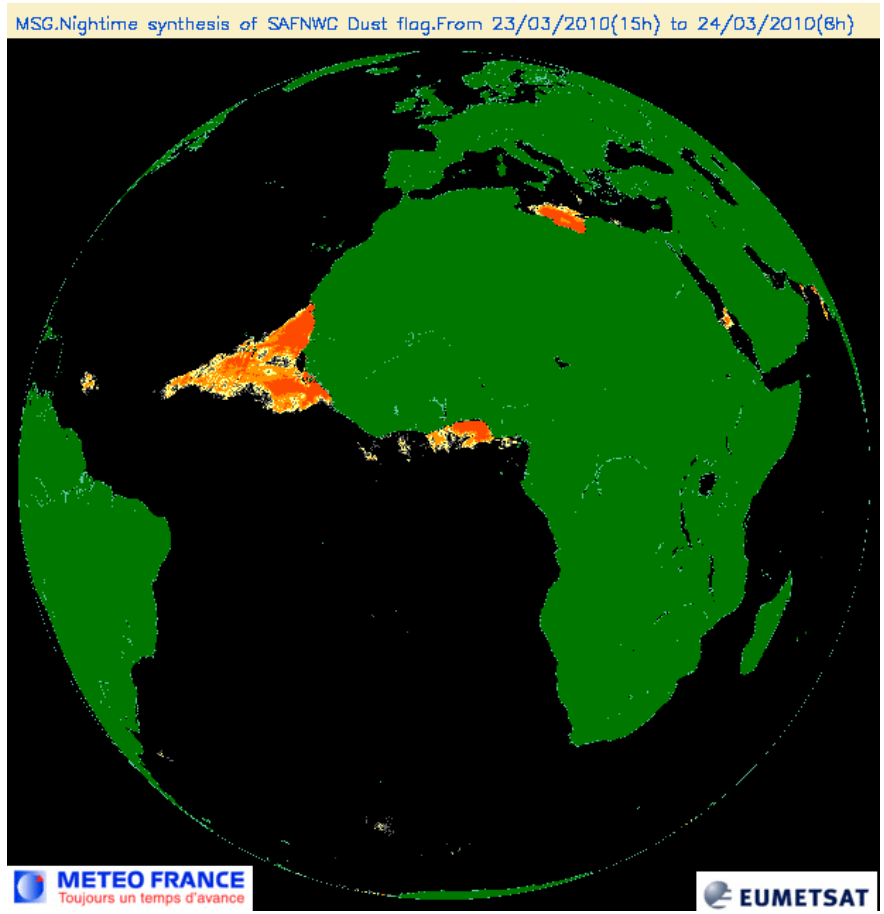
Eumetsat Dust RGB

SEVIRI dust flag (in green) included in SEVIRI CT (usual colours)

Dust flag (CMa) : example of daily synthesis

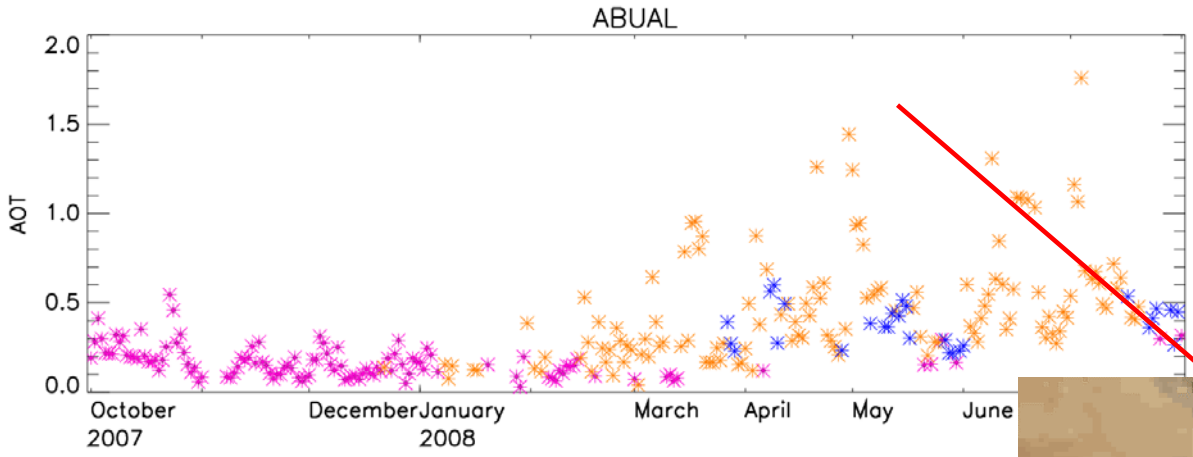


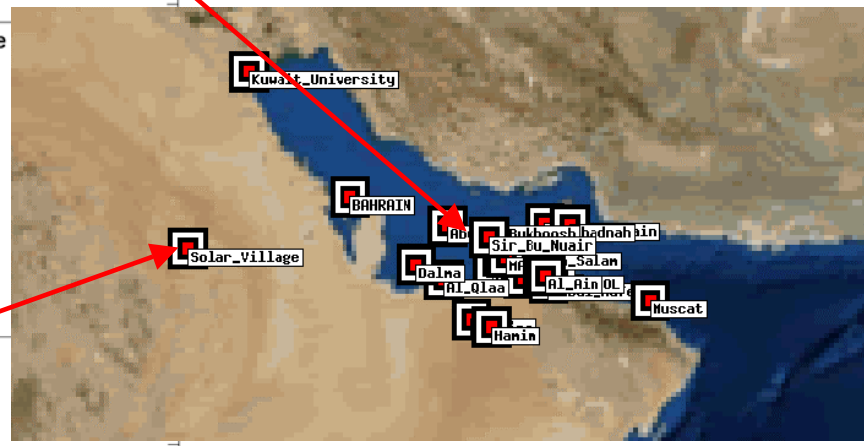
Daytime dust flag

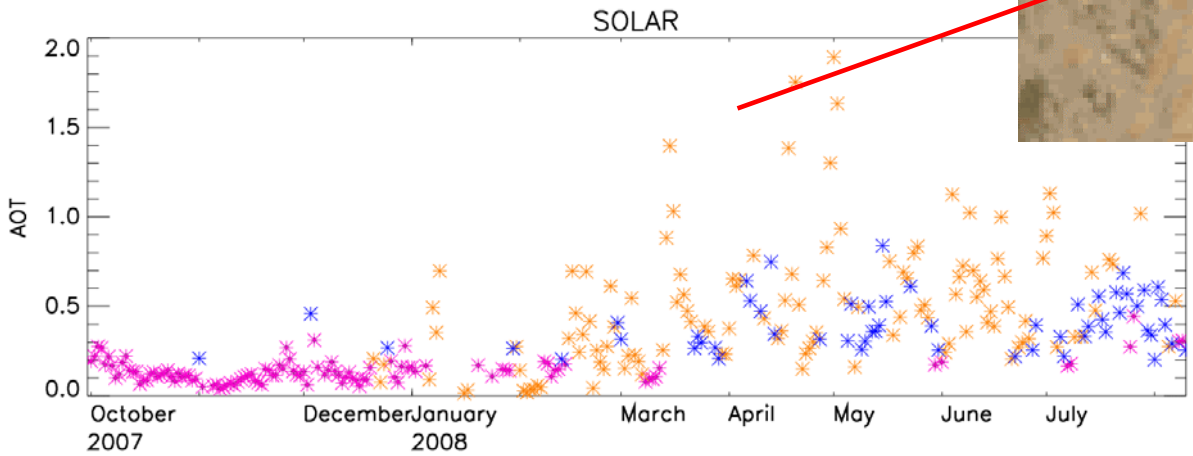


Night-time dust flag

Dust flag (CMa): comparison with aeronet







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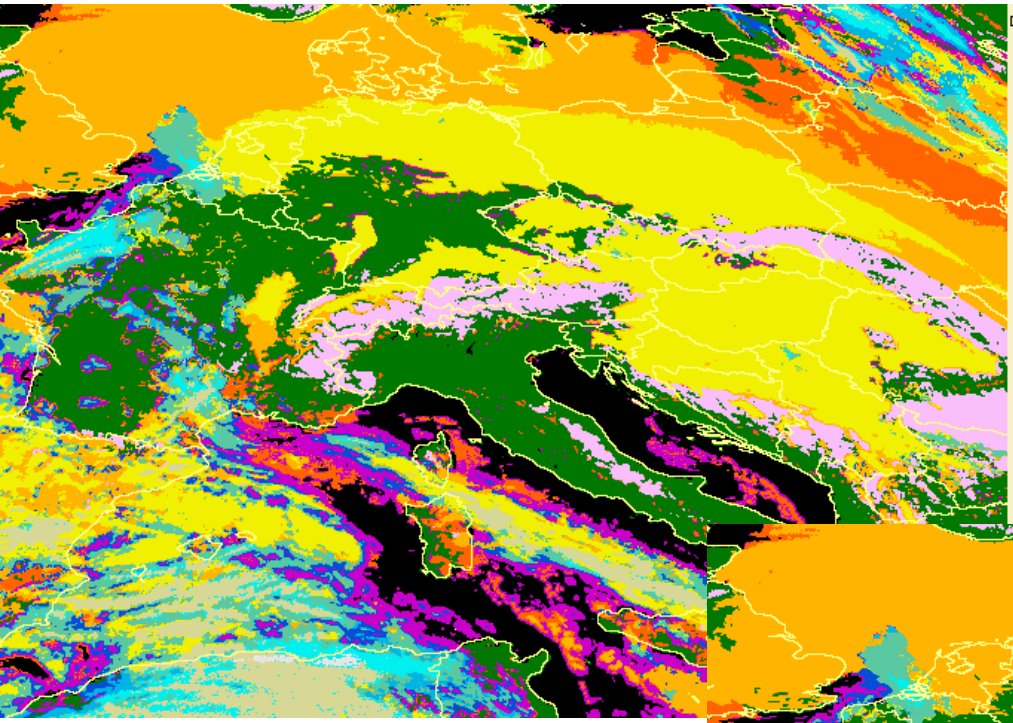
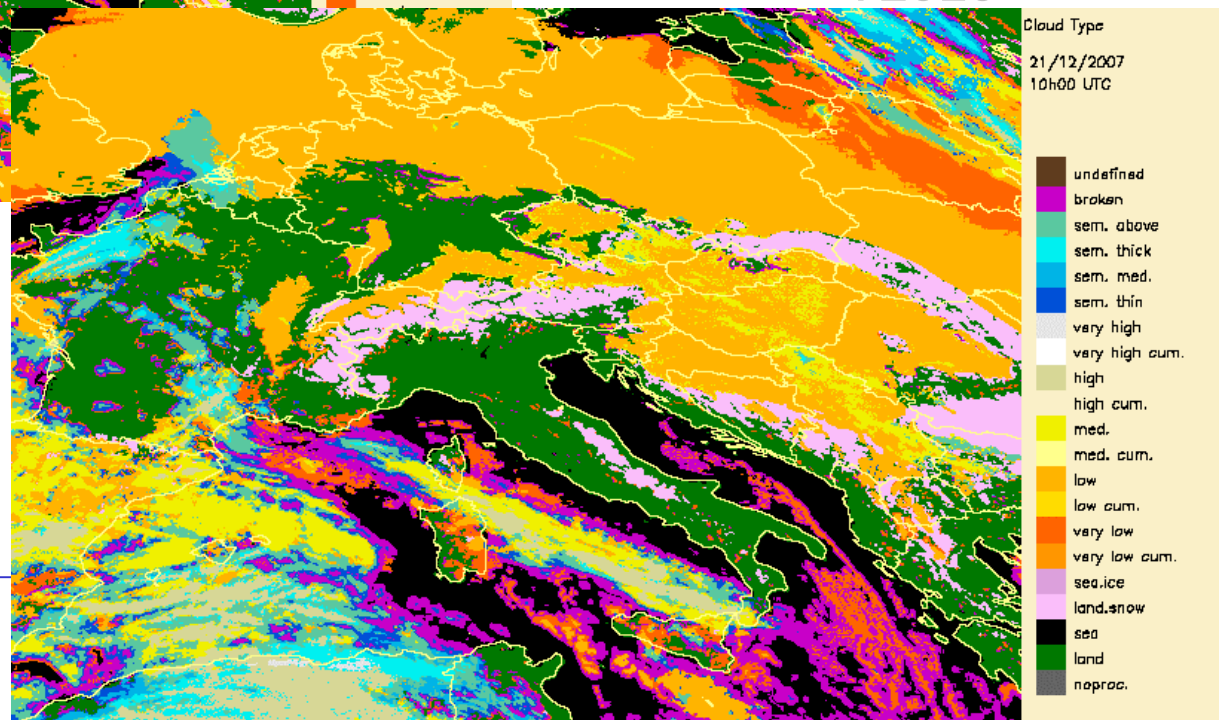
CT: illustration of low clouds improvement



V2009

V2010



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Validation of CT

Comparison of cloud type manually labelled (interactive targets) and computed from SEVIRI (CT):

- Only targets Europe and adjacent seas are retained
- Cover a period of 18 months
- Following cloudiness are compared:
  - SEVIRI: most frequent type in a 5x5 target
  - interactive target: manually labelled

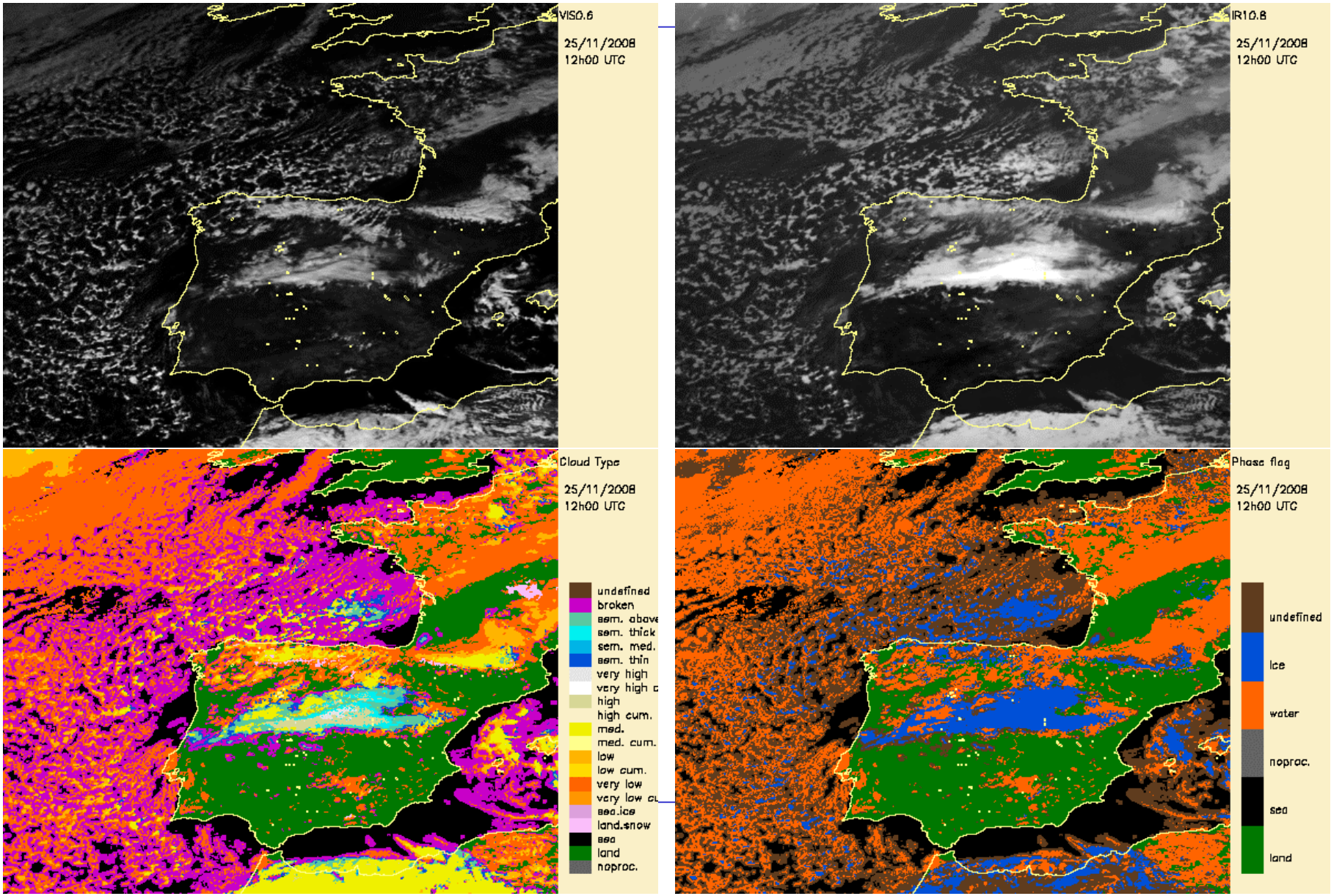
Validation of CT: illustration of low cloud improvement

User accuracy : probability of a pixel classified into a category to really belong to this category

	Low clouds	Mid-level clouds	Semitransparent	High clouds
All illumination	**93.82 %** **93.40%**	**49.84 %** **36.66%**	90.95 %	79.43 %
Daytime	**90.75 %** **90.89%**	**52.71 %** **47.87%**	94.08 %	78.40 %
Nightime	**95.53 %** **94.82%**	**49.78 %** **28.86%**	85.12 %	80.15 %
Twilight	**96.50 %** **96.34%**	**36.23 %** **25.49%**	82.14 %	84.62 %

V2009 V2010

Illustration of cloud phase (CT)



Validation of cloud phase (CT)

Comparison of cloud top phase derived from radar/lidar and computed from SEVIRI:

- September 2003-October 2004
- SIRTA instrumented site (LMD, Palaiseau, near Paris):
  - Lidar: 532 and 1064 nm linearly polarized
  - Radar: 95Ghz

Validation of cloud phase (CT)

	Water phase detected	Ice phase detected
Water phase observed	a	b
Ice phase observed	c	d

$$KSS = \frac{a.d - b.c}{(a+b).(c+d)}$$

$$HR = \frac{(a+d)}{(a+b+c+d)}$$

	Contingency table		KSS	HR
CT Cloud phase flag	128	28	0.62	0.83
	64	337		

Validation of CTTH with CALIOP

Comparison of cloud top pressure computed from SEVIRI (V2009)

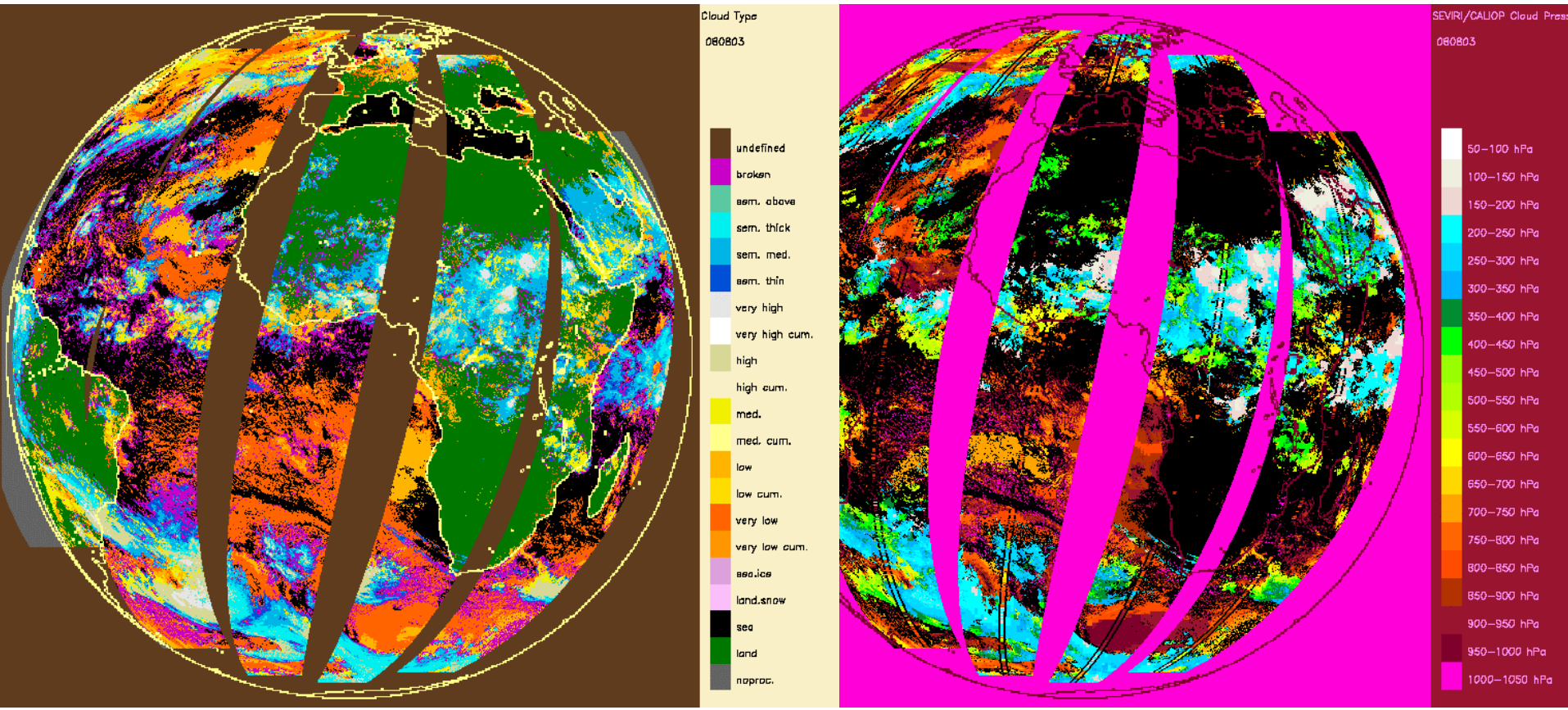
And derived from space-born lidar (CALIOP on A-train constellation) :

- April and August 2008
- Not too thin cloud layer (CALIOP optical thickness > 0.2)
- Only spatially homogeneous cloud layer (in area of 9*9 IR pixels)
- Closest in time
- Viewing angle < 65 degré
- No parallaxe correction

This study was performed in collaboration with G.Sèze from Laboratoire de Meteorologie Dynamique, Paris.

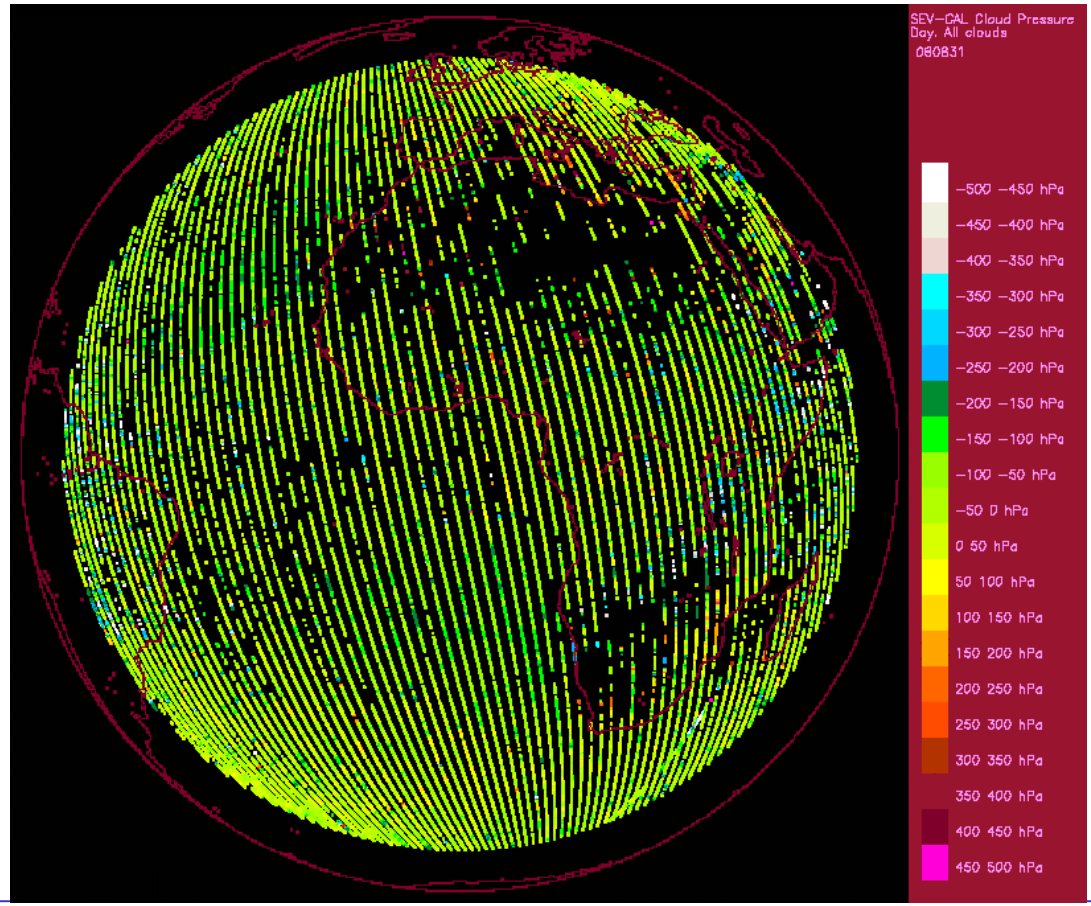
Validation of CTTH with CALIOP

Colocated SEVIRI/CALIOP

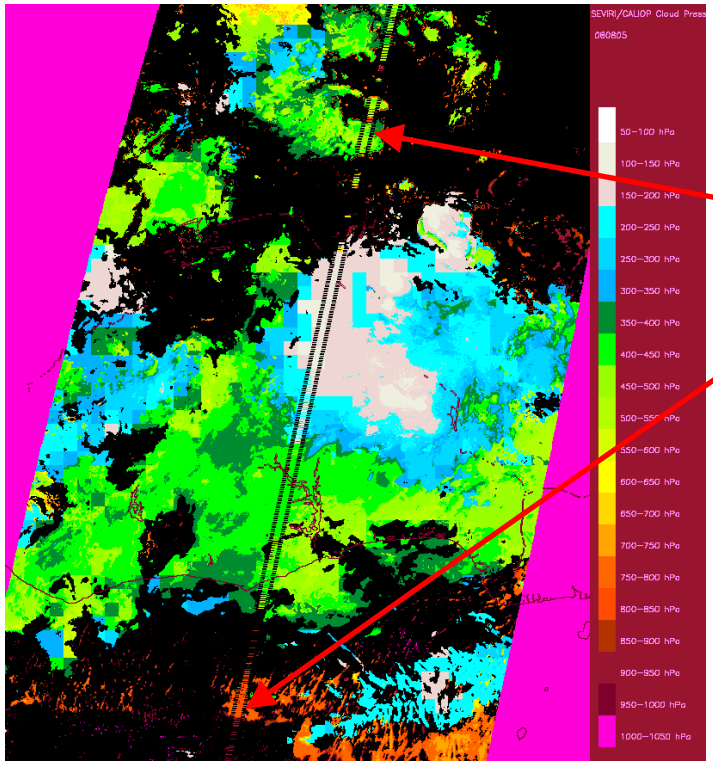


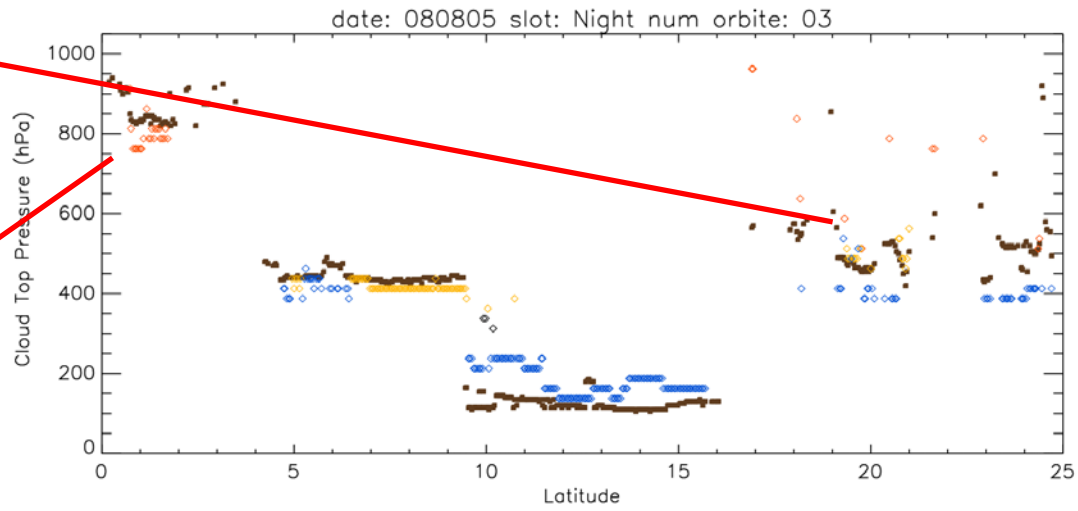
Validation of CTTH with CALIOP

Illustration of CALIOP coverage for one month (daytime passes)

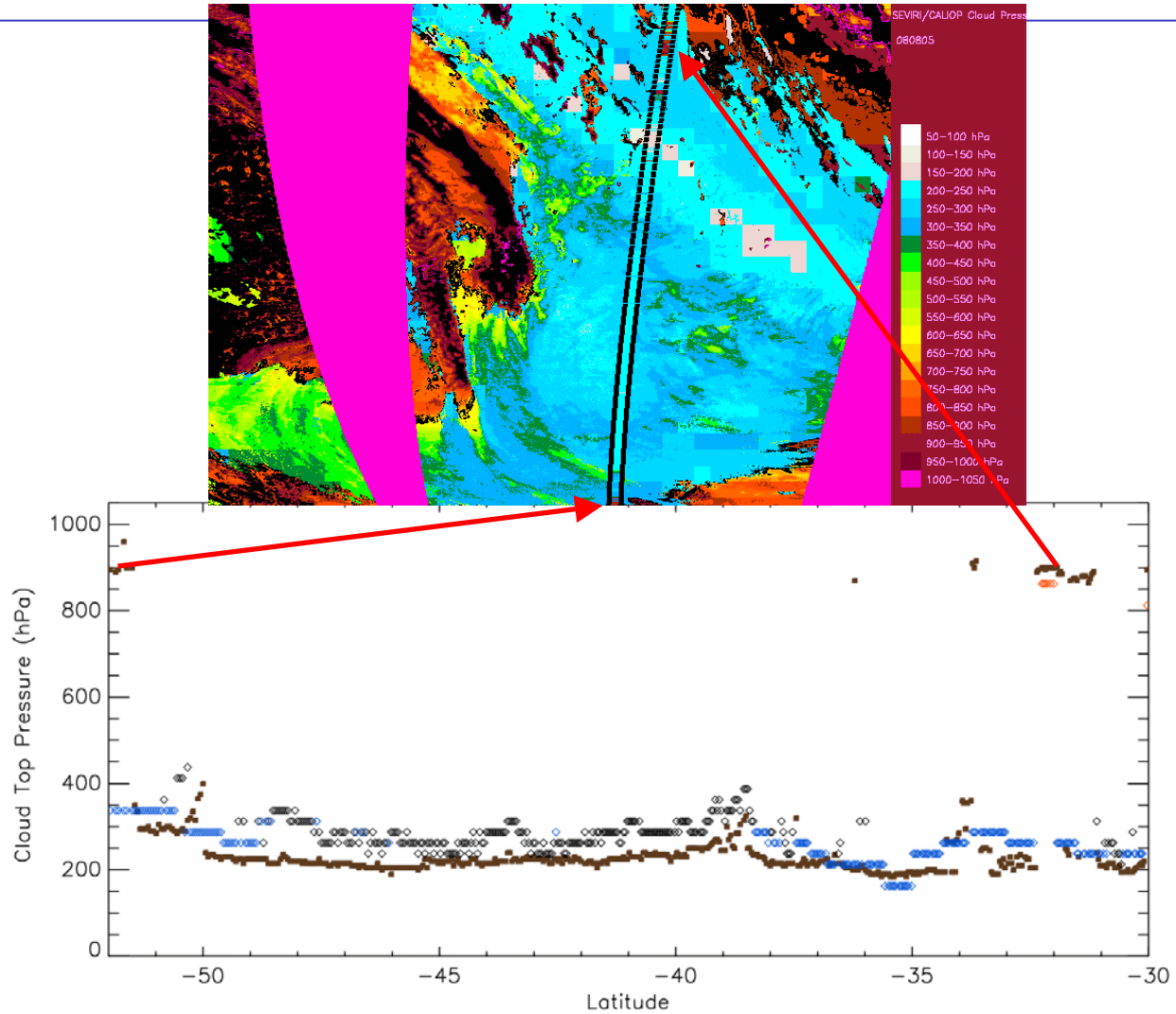


Validation of CTTH with CALIOP



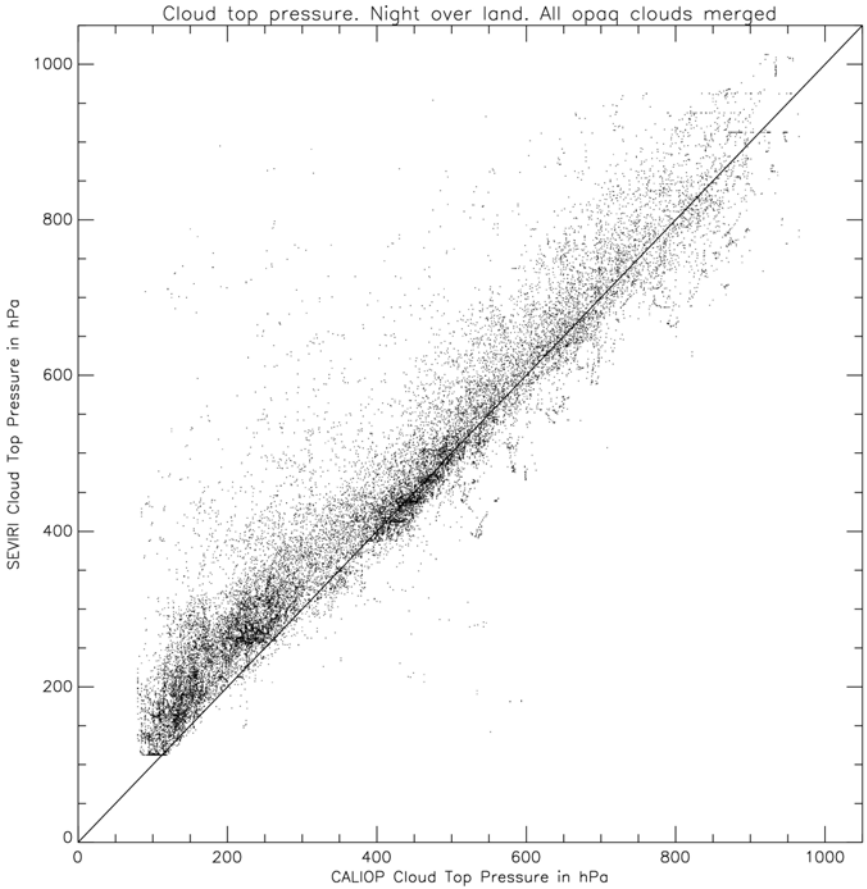


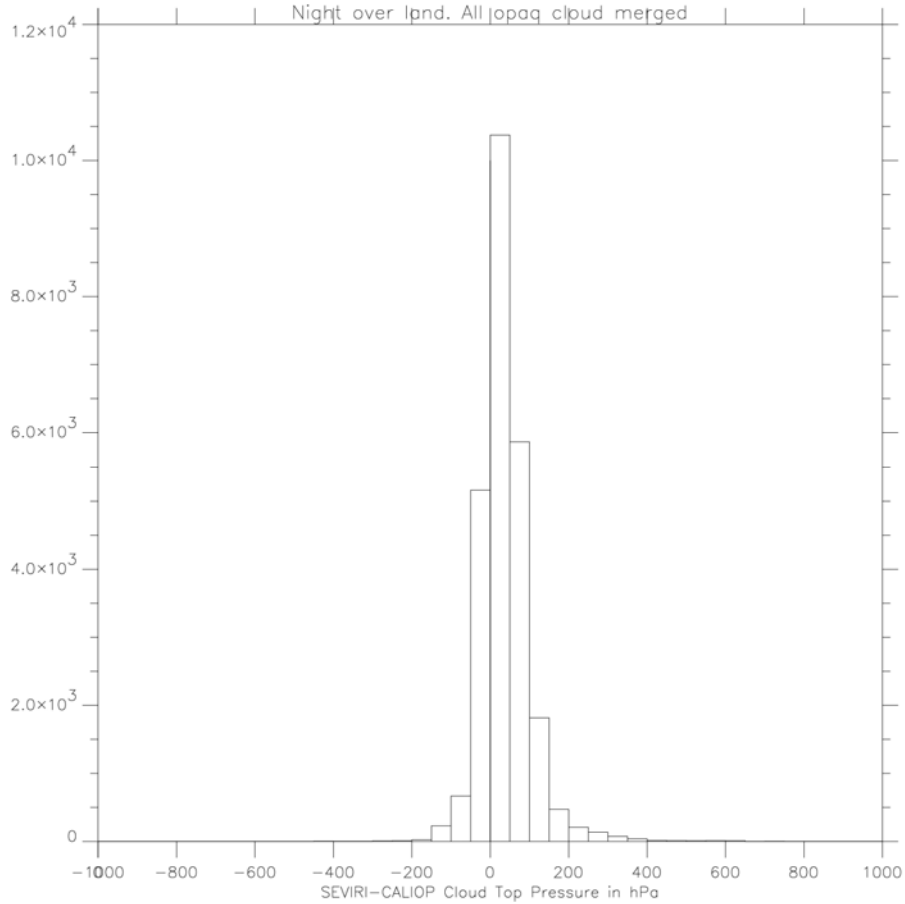
Validation of CTTH with CALIOP



Validation of CTTH with CALIOP

Opaque clouds over land (nighttime)





Validation of CTTH with CALIOP

Score for CTP_SEVIRI - CTP_CALIOP over sea
CALIOP optical thickness > 0.2 or > 0.02

Cloud type	Mean (hPa)	Rms (hPa)	Number	
Low opaque	-0.54	74.23	81 027	Night
Mid-level or high opaque	39.83	51.77	26 792	
½ transparent	-17.14 28.24	144.24 93.56	34 511 46 186	
Cloud type	**Mean (hPa)**	**Rms (hPa)**	**Number**	
Low opaque	-6.53	74.36	58 690	Day
Mid-level or high opaque	41.71	50.38	32 700	
½ transparent	-10.03 15.7	116.09 83.85	30 216 35 273	

Outlook

Until end CDOP-1:

-Decrease night-time snow/cloud confusion (V2011)

-Study on the use of on-line RTTOV to improve Cma;
->to be finalised in CDOP-2

-Start studies to prepare MTG

Evolution of products in CDOP-2:

-see second part of presentation

-to be discussed during this workshop

SAFNWC/GEO cloud products in CDOP2

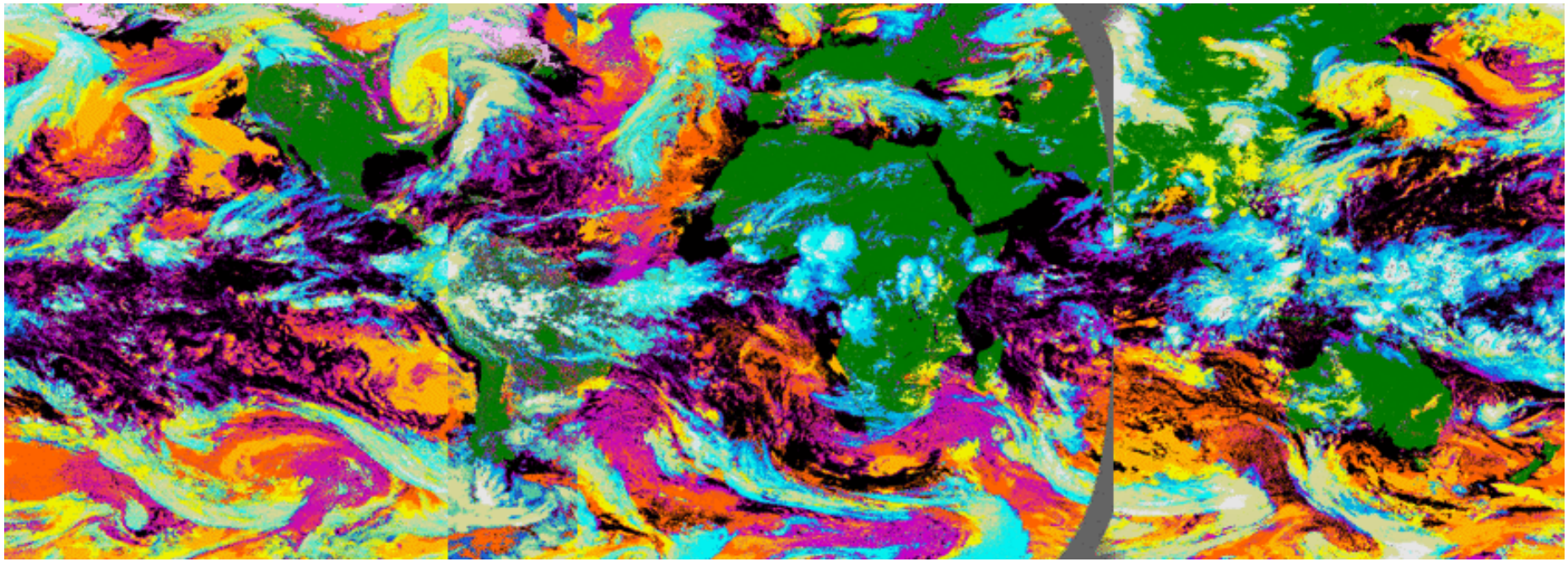
27th April 2010

Madrid

Hervé Le Gléau, Marcel Derrien, Marie-Paule Raoul
Météo-France / CMS lannion

A single software for MSG, MTG, GOES, MTSAT...

→ soft transition from MSG to MTG



Satellite data processed at ICARE Thematic Centre by Bruno SIX, in collaboration with Geneviève SEZE for MEGHA-TROPIQUES project, using SAFNWC package scientifically adapted by Meteo-France SAFNWC team.

SAFNWC/GEO Cloud chain

- **SAFNWC/GEO/Cloud1/CMA** : Cloud Mask (continuous **PGE01**)
- **SAFNWC/GEO/Cloud1/DUST** : Dust Cloud Detection (continuous **PGE01**)
- **SAFNWC/GEO/Cloud1/ASH** : Volcanic Ash Detection (continuous **PGE01**)
- **SAFNWC/GEO/Cloud2/CT** : Cloud Type (continuous **PGE02**)
- **SAFNWC/GEO/Cloud2/CMIC** : Cloud Microphysics (continuous **PGE02**)
- **SAFNWC/GEO/Cloud3/CTTH** : Cloud Top Temperature and Height (continuous **PGE03**)

Origin of already identified requests for improvement

SAFNWC IOP PAR workshop (2005)

Operational Review 2006 and 2008

Mail on help desk (2007)

2008 SAFNWC user survey

2009 Convection Working Group

2010 SAFNWC user survey

Requests to be updated during user workshop and prioritized

List of already identified requests for improvement

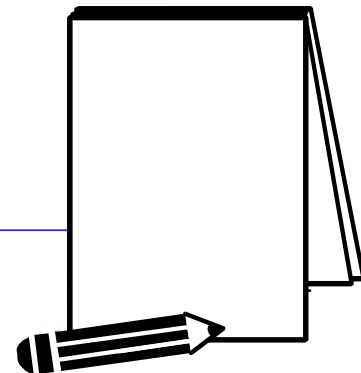
-Cma: decrease confusion of fire with clouds

-Cma: improve cloud detection in low solar elevation at high latitude
(should be possible through RTTOV on line applied to 8.7 IR channel, development will start in CDOP1 will be finalized in CDOP2)

-Cma: improve information on atmospheric dust ???:
better dust detection or
additional information (optical depth…)

-Cma: decrease night-time snow false alarm over cold grounds
(planned V2011)

-Cma/CT: detect thin cirrus over snow-covered ground -> new CT class



List of already identified requests for improvement

-Compute additional parameters in multilayer:
which ???

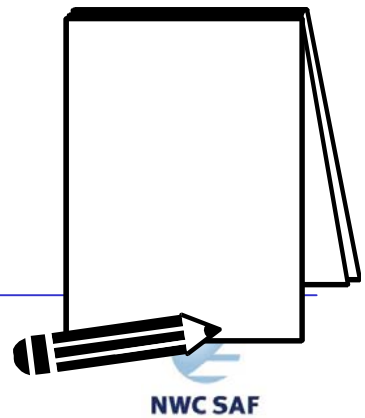
-Compute additional cloud parameters in broken clouds
(CTTH & microphysic?)

-CTTH: Improve cloud top height:

-For near-tropopause/overshooting/cold U or ring shape clouds

-For low clouds in case thermal inversion
(difficult with passive IR; heavily rely on NWP information)

-Reduce square aspect
(default segment size: 16 should changed by user)



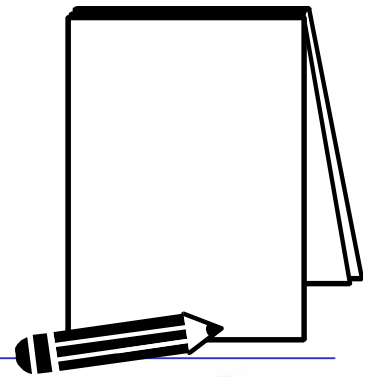
List of already identified requests for enhancement

-CT: Add micro-physics
(cloud top phase in v2010)

-CT: Include stratiform/cumuliform separation

-CT: add a new class Ci/snow

-Cma: add a smoke flag
(apparantly requested over land: may be very difficult to achieve)



Optimize use of MTG capability for cloud products

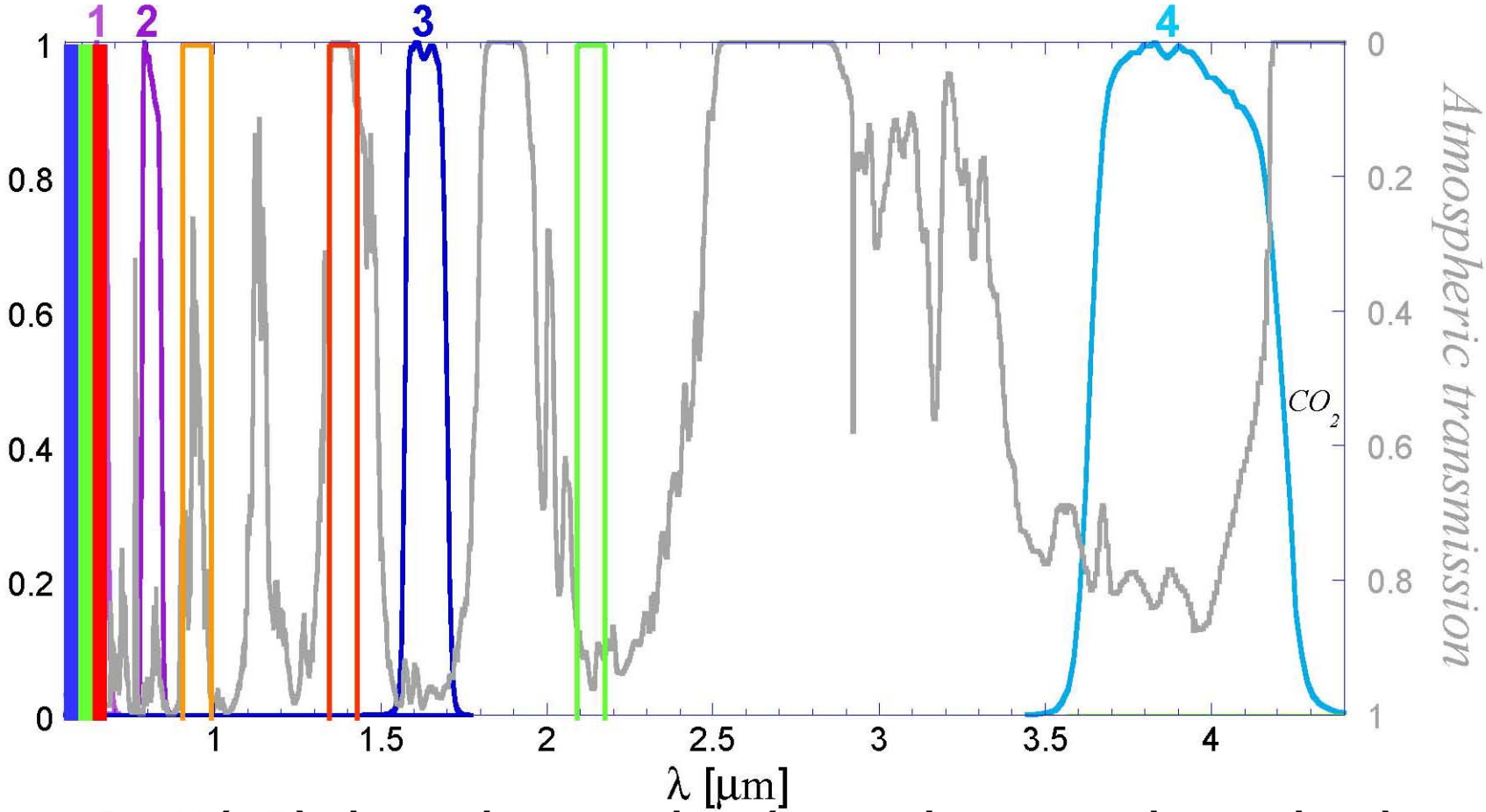
Use new FCI (MTG imager) channels

Product retrieved at different spatial resolution (VIS or IR)

Use of IRS (MTG sounder) to improve products (height, microphysics)

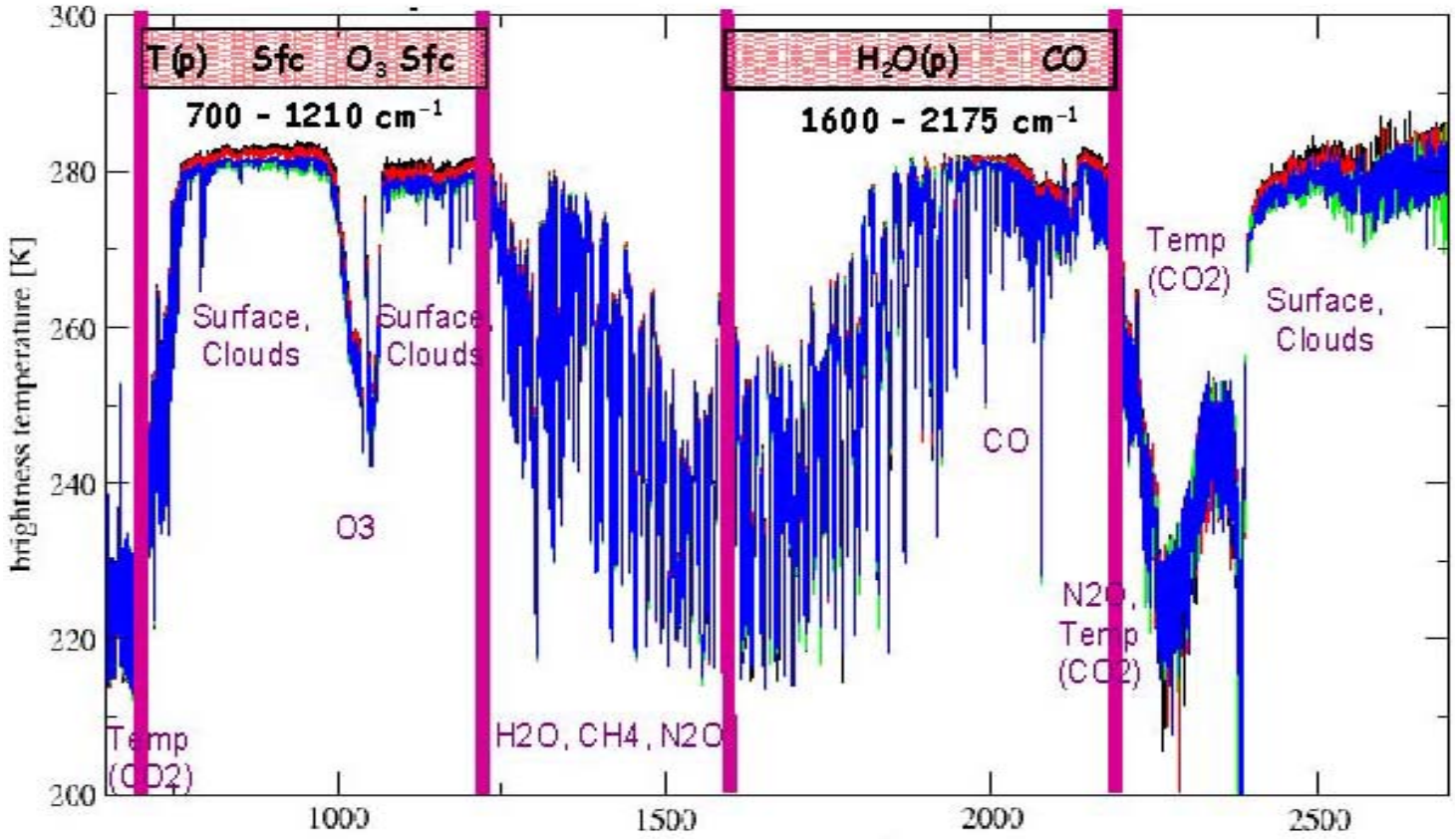
Use of lighting to improve cloud type

Use new FCI (MTG imager) channel



- **B + V (+ R) : image in true colour (vegetation, aerosols, smoke…)**
- **0.9 µ : integrated water vapour content**
- **1.3 µ : thin cirrus**
- **2.2 µ : cloud microphysics, snow**

Use IRS MTG sounder



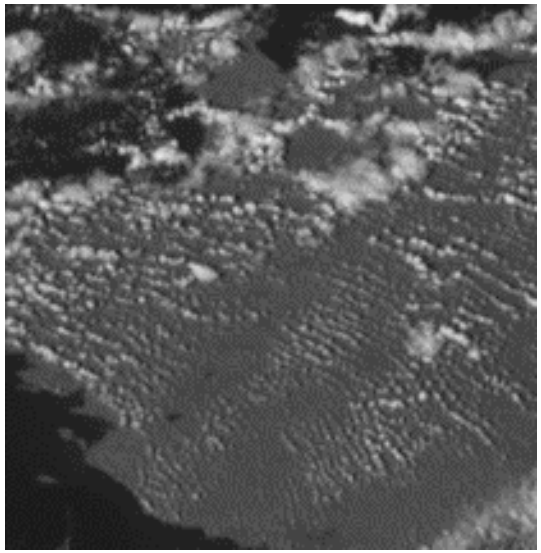
Spectral resolution :

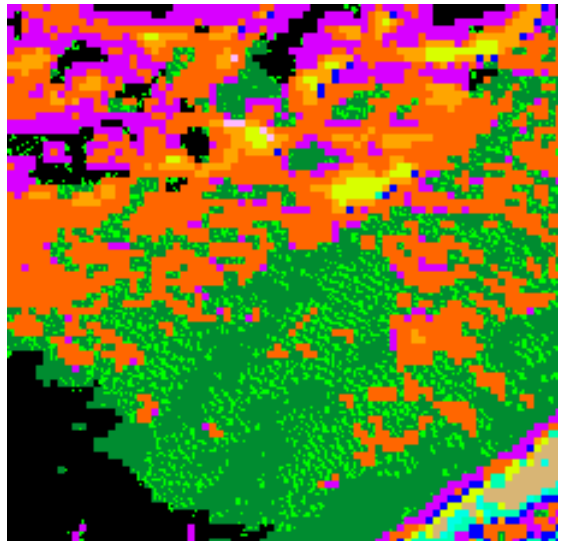
0.745 cm^{-1}

(≠ IASI : 0.25 cm^{-1})

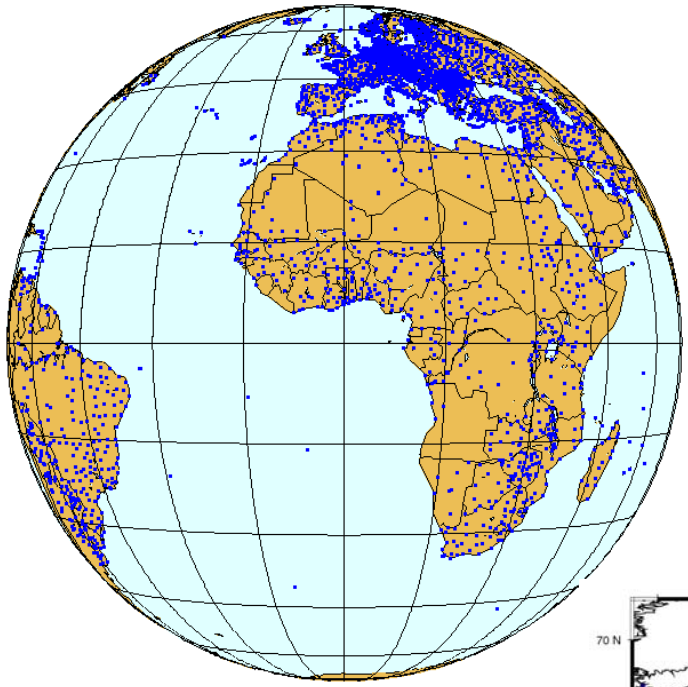
Product at different horizontal resolution

Illustration with HRV:
in light green cloud identified with HRV
(displayed at HRV resolution)

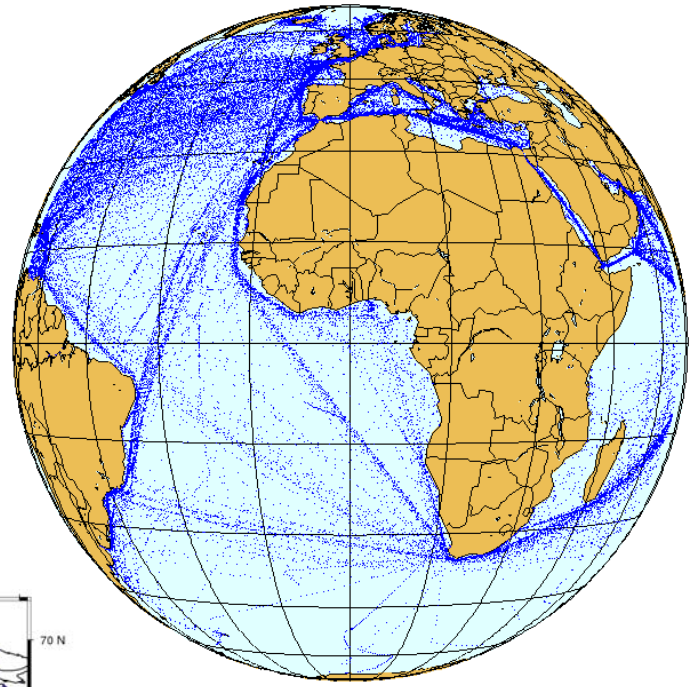


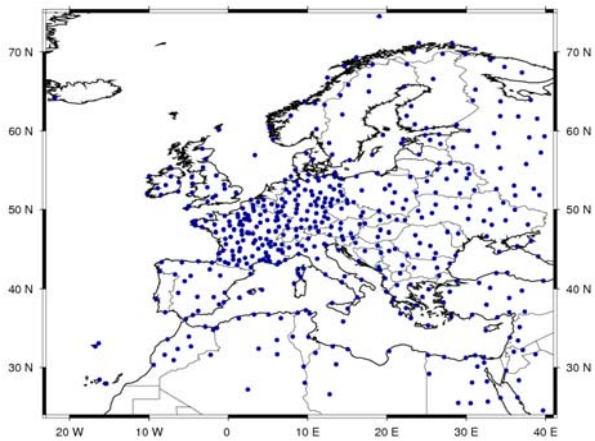


Enhancement of cloud product validation in CDOP-2



Synop and Ship





Enhancement of cloud product validation in CDOP-2

Colocated SEVIRI/CALIOP