NWCSAF/GEO cloud Top Height and Microphysics for convection

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Outline

- Short introduction of NWCSAF/GEO cloud products
- Focus on Cloud Top Height
- Focus on Cloud Top microphysics
- Draw perspective for MTG
- Show an example

CNRM/CEMS Lannion

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Main features of NWCSAF/GEO cloud products

- Four cloud products are computed by NWCSAF/GEO:

  -cloud mask: includes dust and volcanic ash flag

  -cloud type: main cloud categories

  -cloud top temperature and height

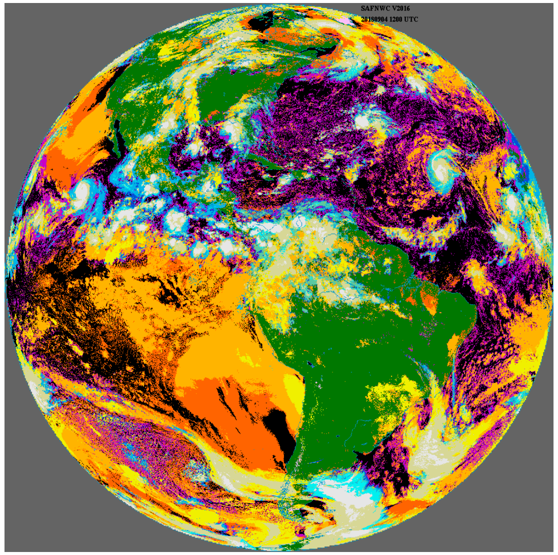
  -cloud microphysics: includes cloud phase, effective radius, optical depth, ice and liquid water path

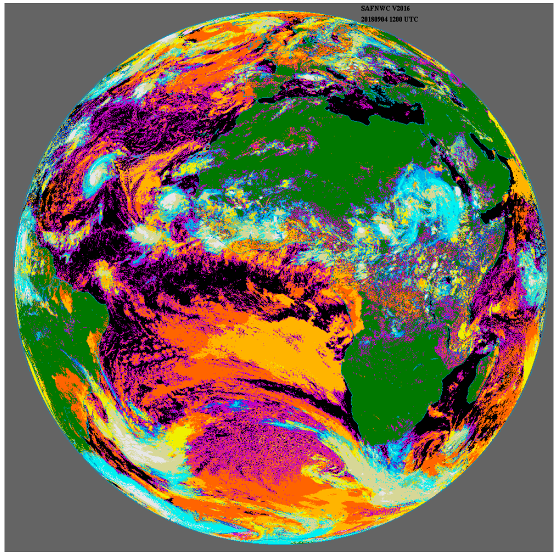
- These cloud products are extracted on areas defined by the user

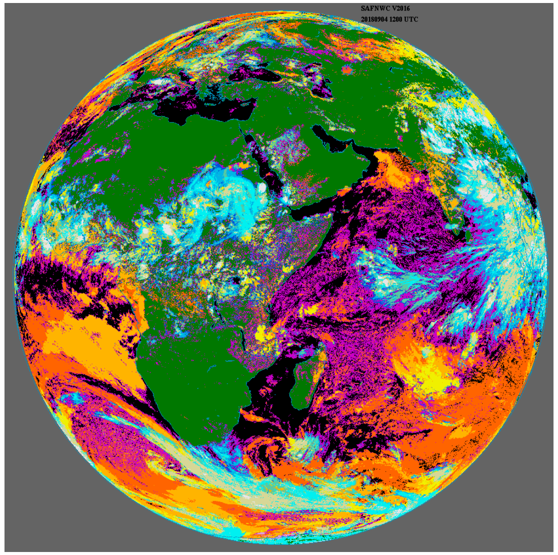
- These cloud products can be extracted from MSG/SEVIRI imagery but also from Himawari-08 AHI and from GOES-16 ABI imagery

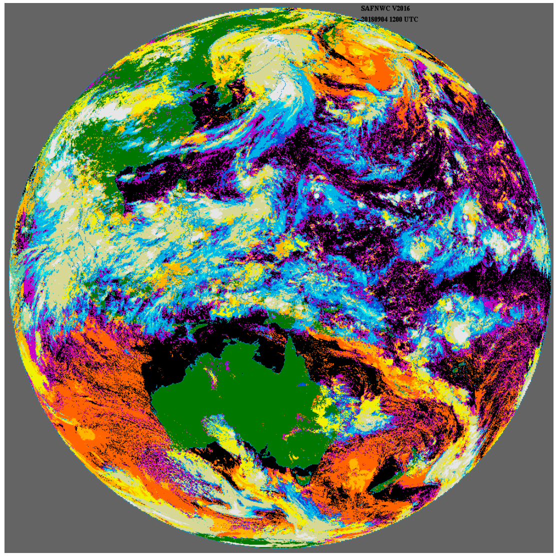
- New version: NWCSAF/GEO v2018 released February 2019

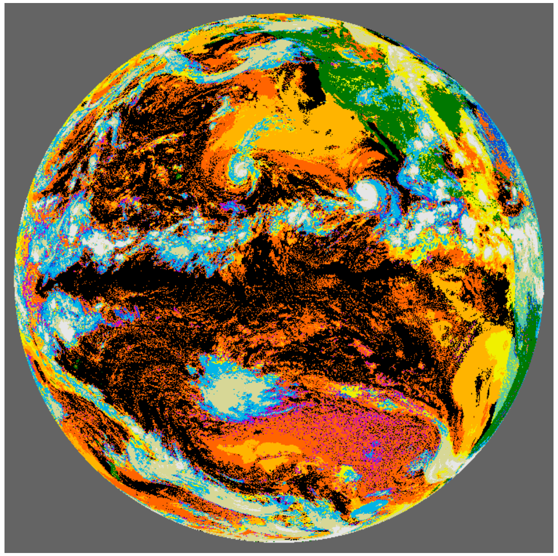
Global coverage MSG, GOES and Himawari











Cloud type
4 september 2018 12UTC

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Main features of NWCSAF/GEO cloud top height

Retrieve cloud height from TOA radiances requires:
-> vertical profile of air temperature & humidity: forecast by NWP
-> vertical profile of simulated opaque clouds radiances : using RTTOV

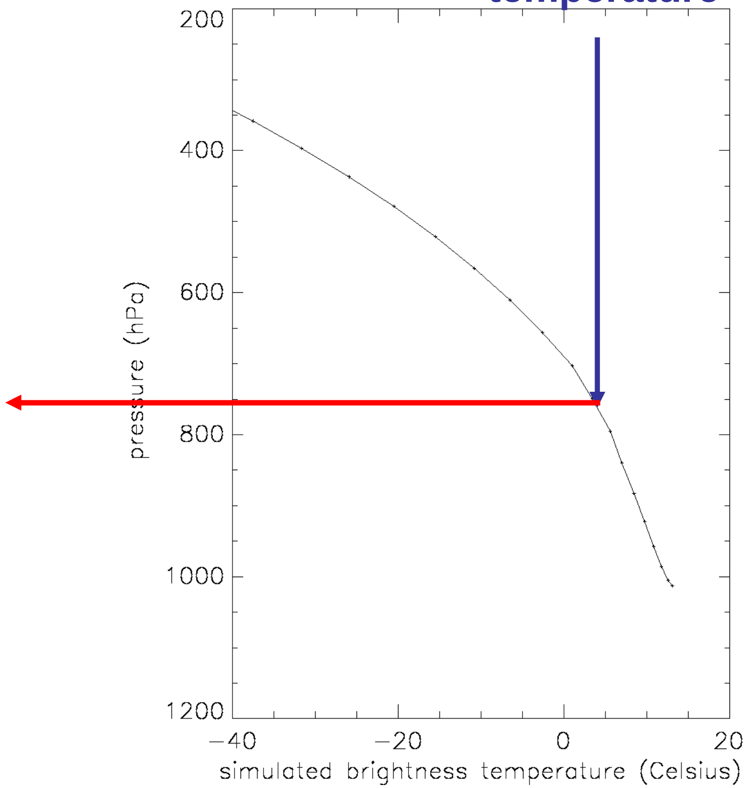
For opaque clouds
The cloud top pressure corresponds to the best fit between the simulated and measured 10.8µm radiances
(! thermal inversion and overshooting clouds)

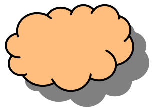
For semi-transparent clouds :
10.8µm radiances contaminated by surface
-> Cloud top pressure computed from a window channel 10.8µm and a sounding channel (13.4µm, 7.3µm, 7.0µm or 6.2µm)

CTTH : illustration of the method for opaque clouds

Measured brightness temperature

Retrieved cloud top pressure

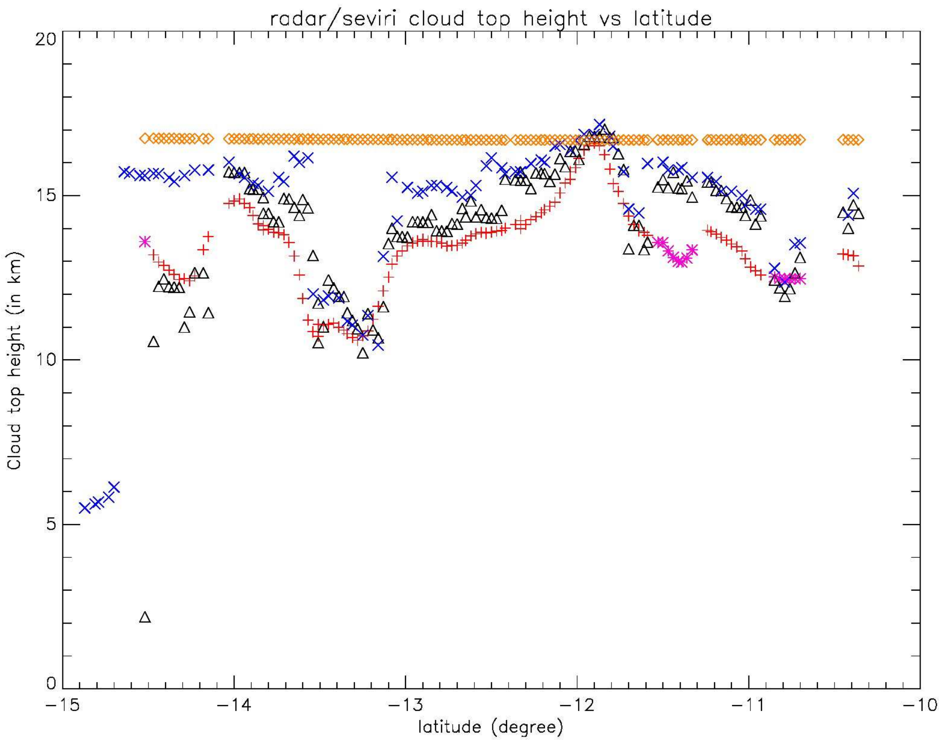


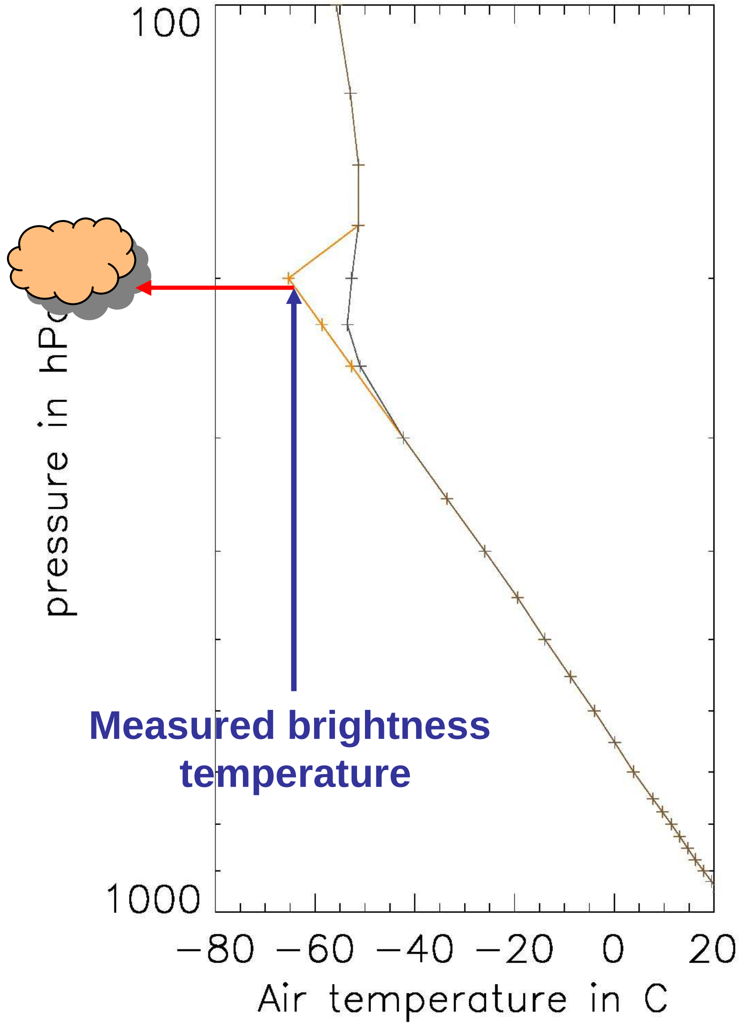


CTTH improvement in v2018

Better CTTH retrieval near troppopause by extrapolating NWP profile above tropause

Δ Radar ◊Tropopause X lidar + seviri





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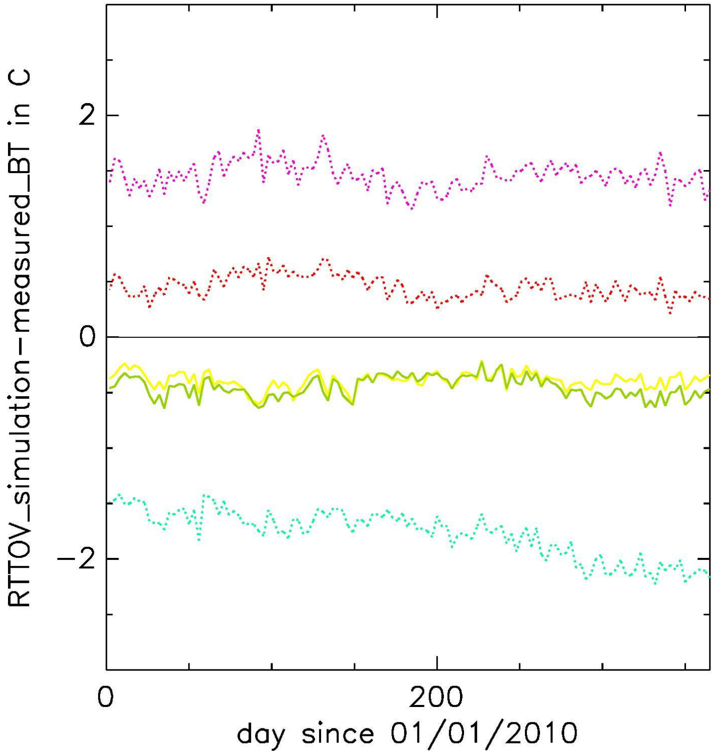
CTTH improvement in v2018

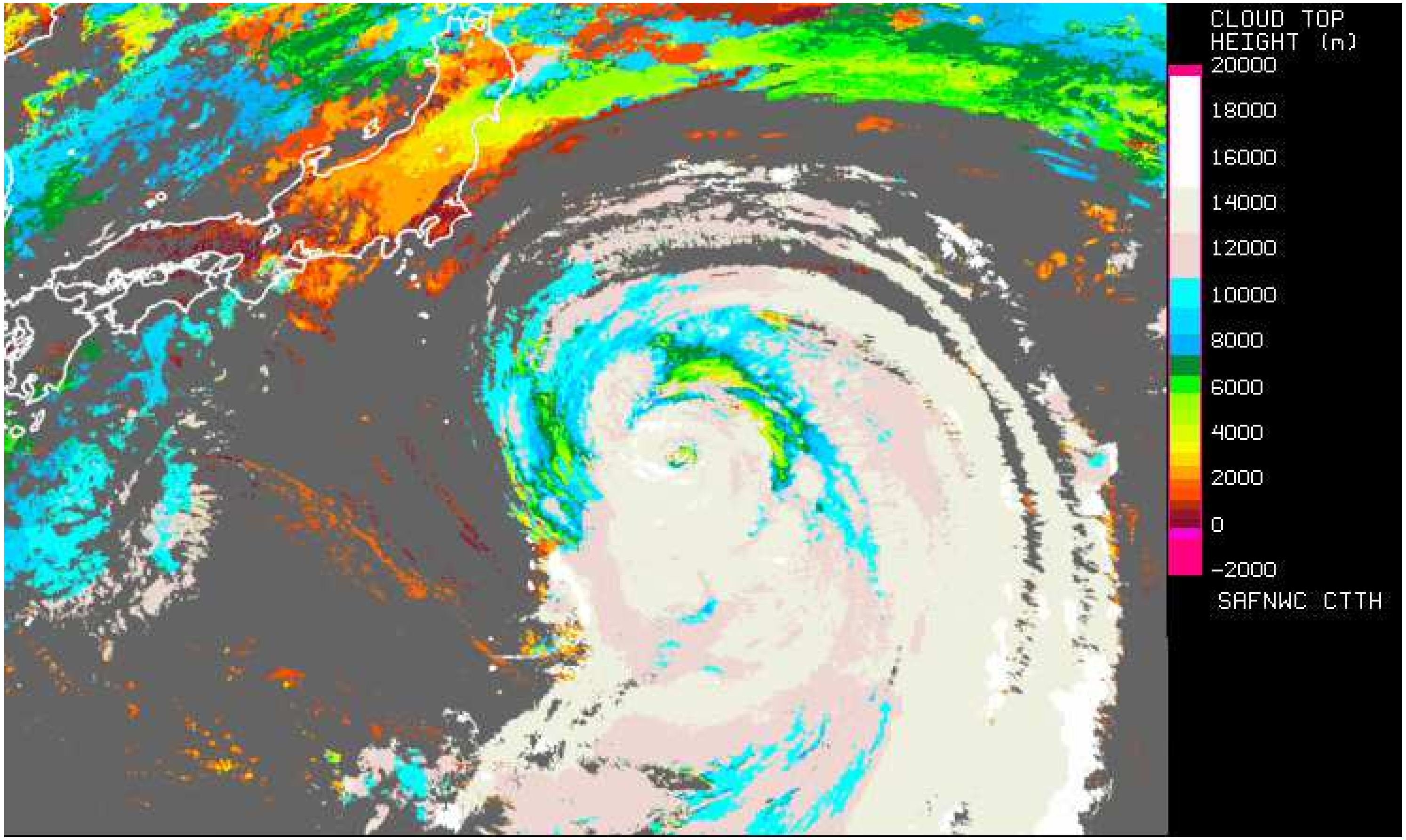


IR bias are monitored and accounted for

MSG2:

WV6.2
WV7.3
IR108
IR120
IR134

Example of CTTH: Atsani Typhon



Example of Atsani Typhon with Himawari-8 (23 August 2015 02hUTC)

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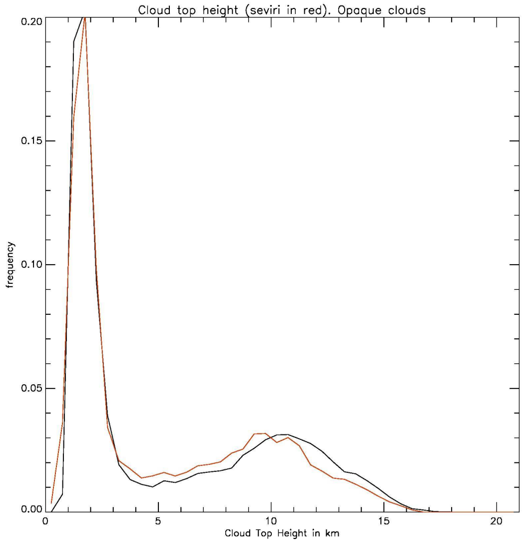
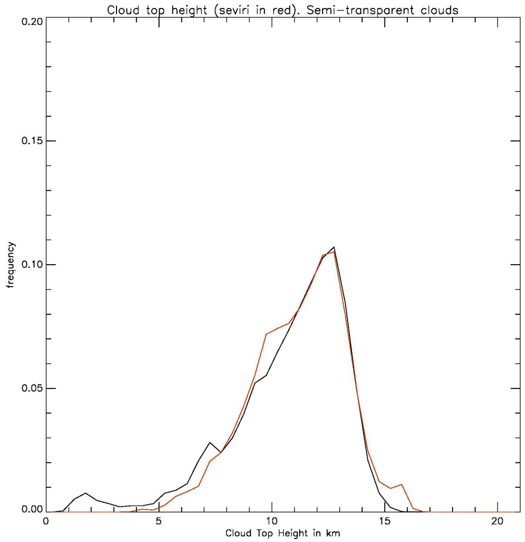
Cloud Top Height validation with Cloudsat radar

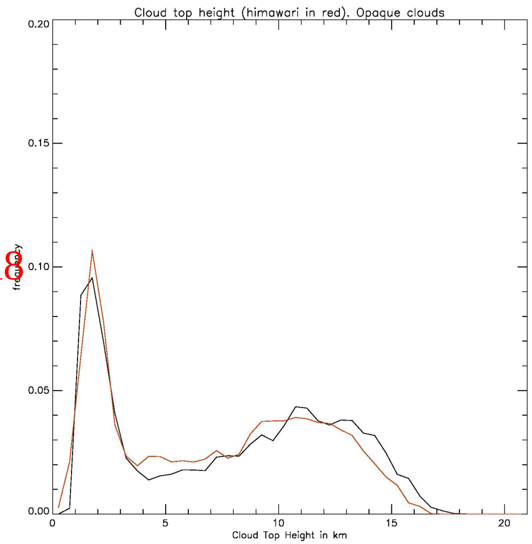
MSG2

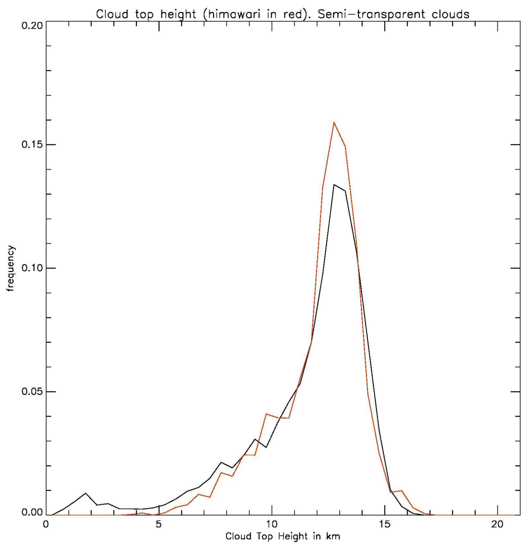




in black : cloudsat radar

Himawari8





Opaque clouds

Semi-transparent clouds

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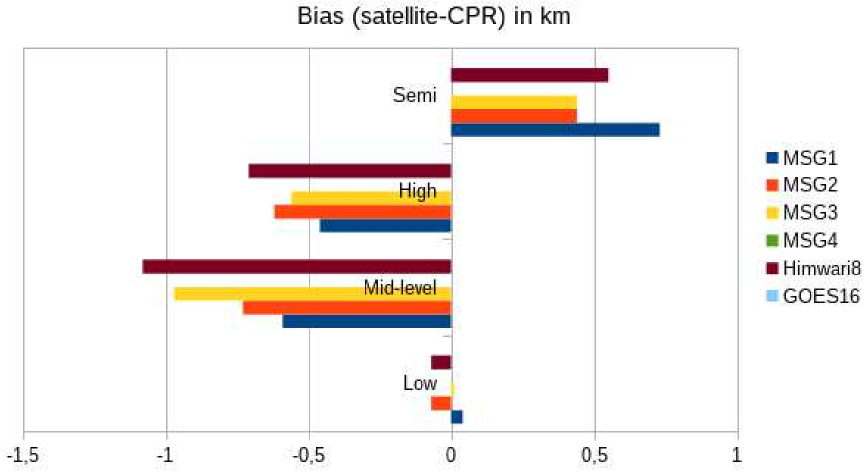
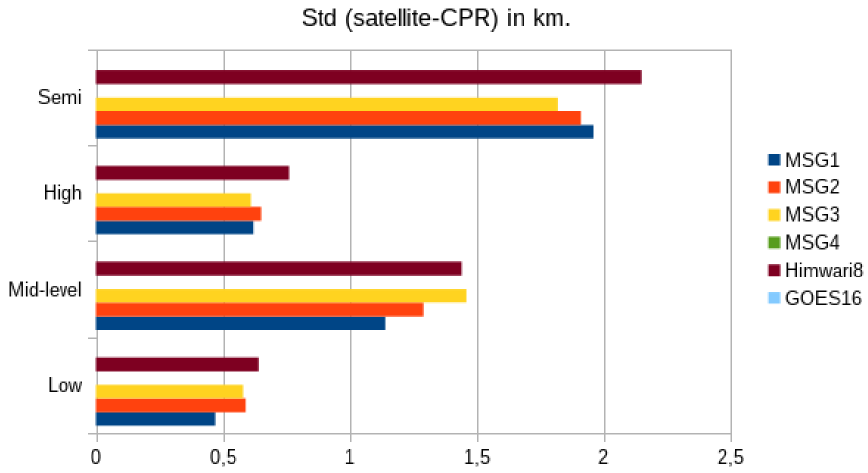
Cloud Top Height validation with cloudsat radar





Very low bias and Std for low level clouds

General agreement between MSG/GOES/Himawari results

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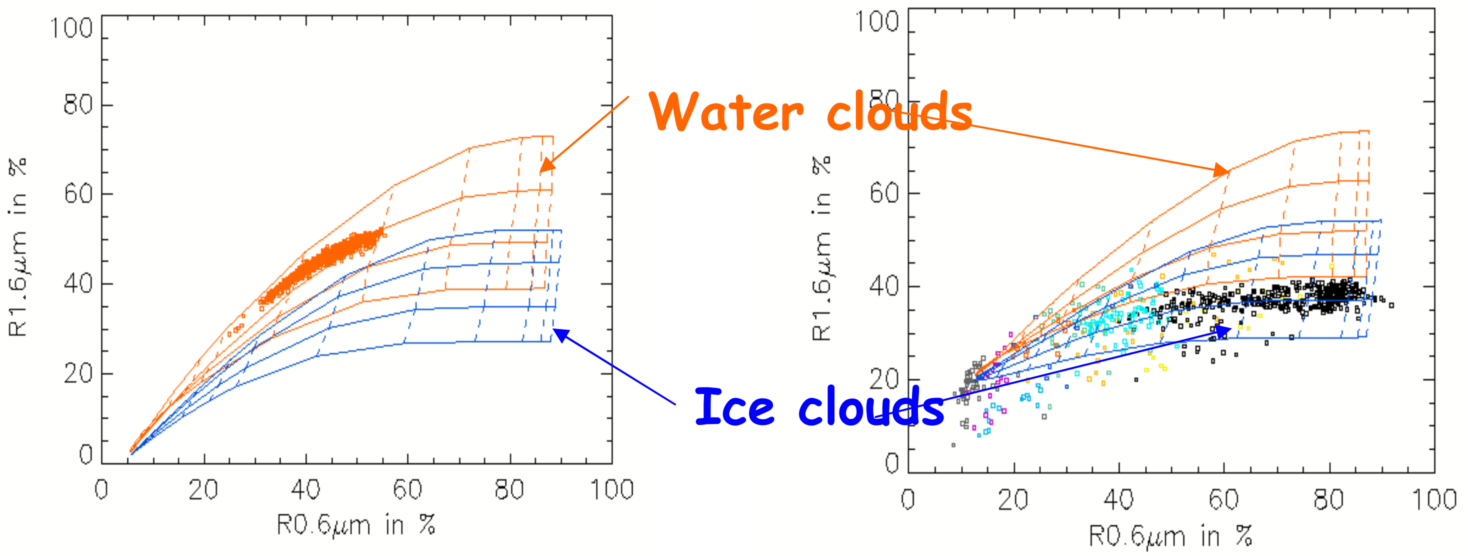
Main features of NWCSAF/GEO cloud microphysics

Cloud phase is obtained (day & night) mainly from 10.8µm and 8.7µm wavelengths, complemented in daytime by the use of 0.6µm, 1.6µm and 2.25µm

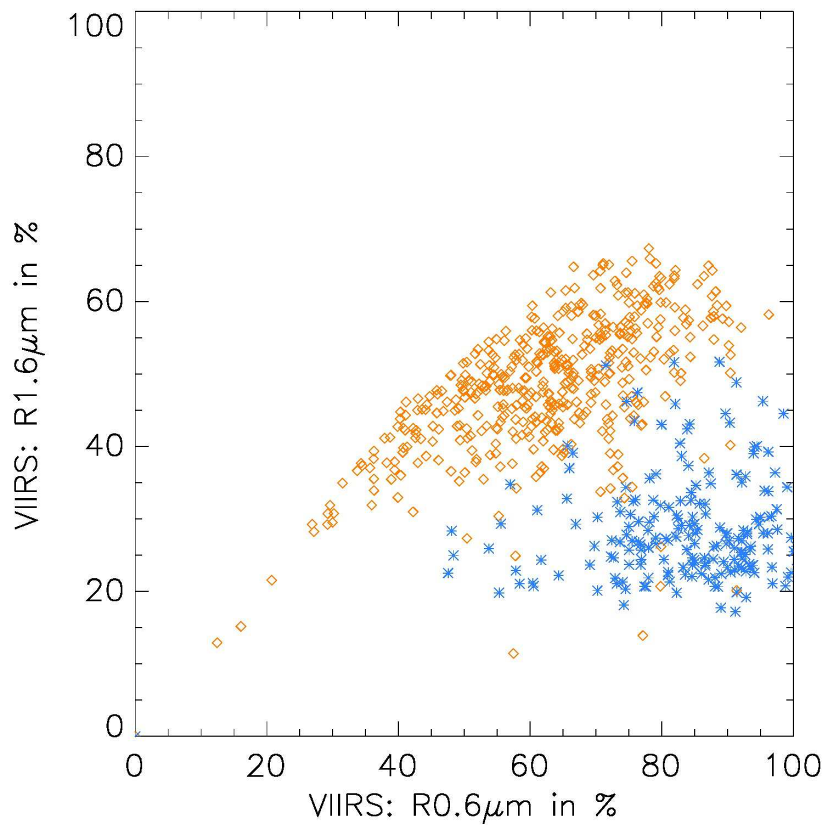


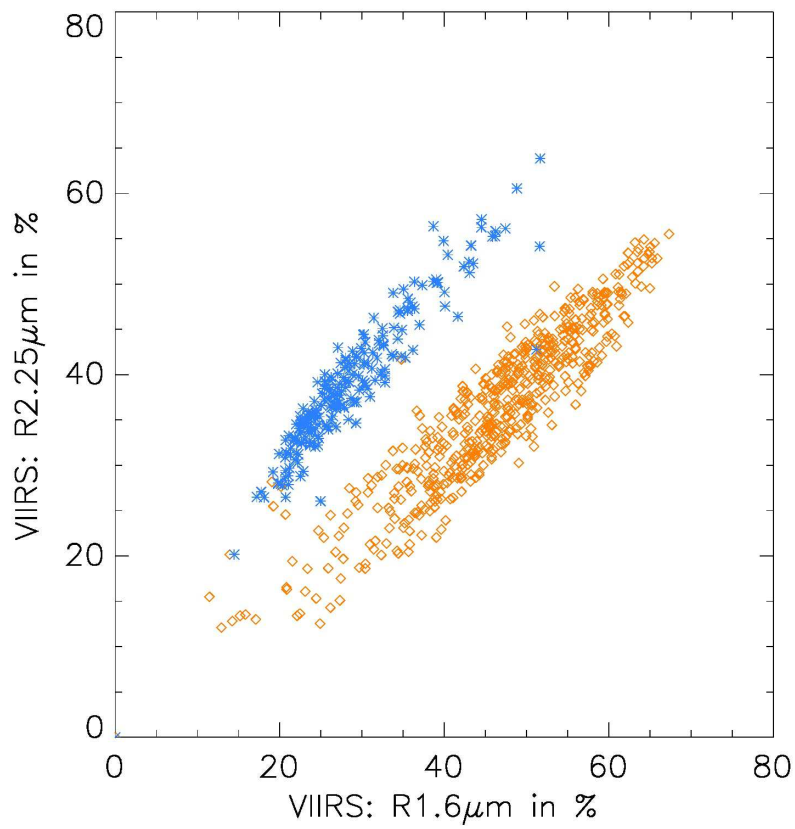
Cloud drop effective radius, optical thickness, liquid and ice water path

- ✓are obtained only daytime
- ✓from comparison between simulation (DISORT; mie(water) or Baum(Ice)) and measurements at 0.6µm and 1.6µm wavelengths (Nakajima method)

Cloud phase improvement in v2018

Use of 2.25µm to improve cloud phase retrieval (daytime)





Blue: ice clouds (Cb/Cs)

Orange: water clouds (St/SC)

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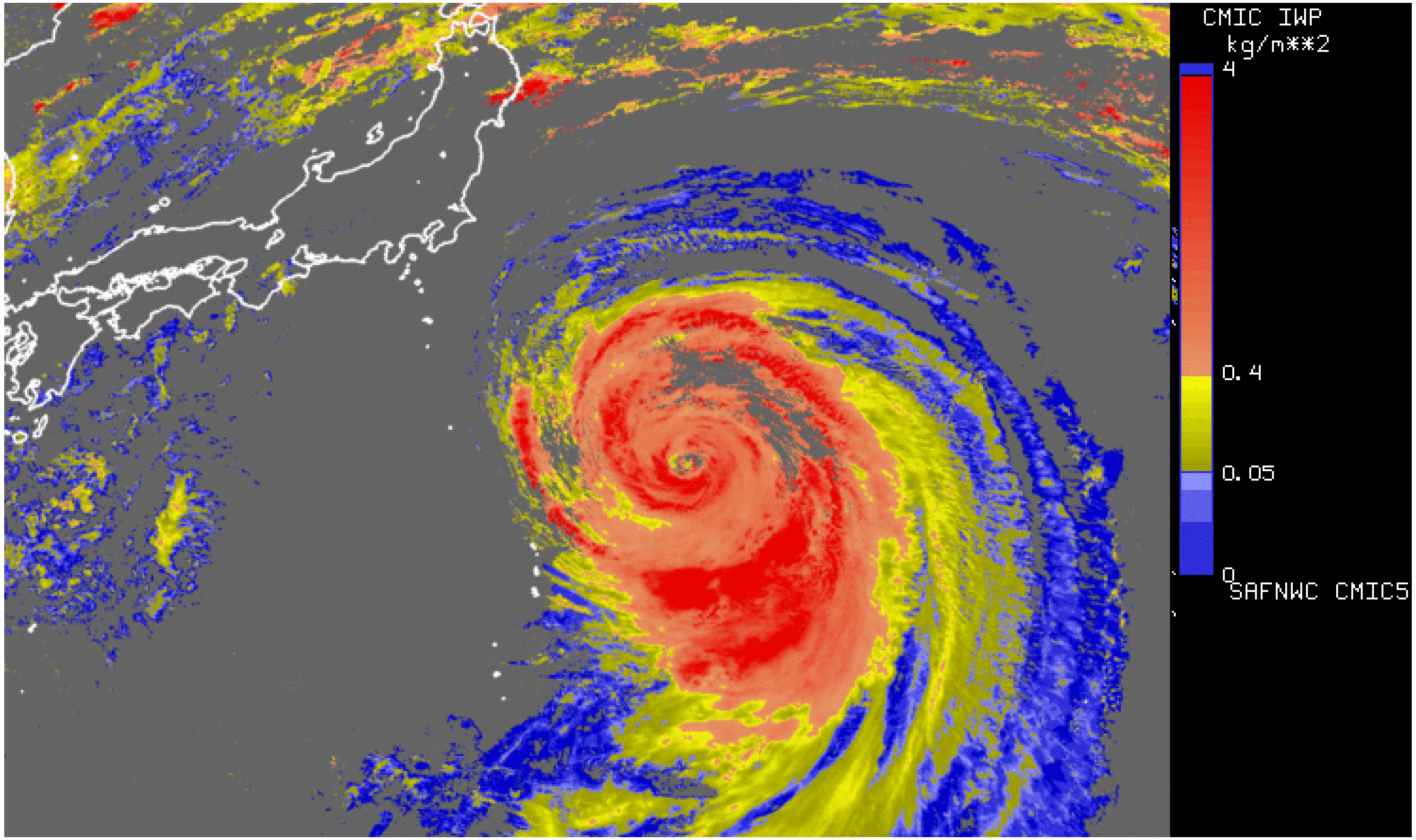
Example of Ice Water Path: Atsani Typhon



Example of Atsani Typhon with Himawari-8 (23 August 2015 02hUTC)

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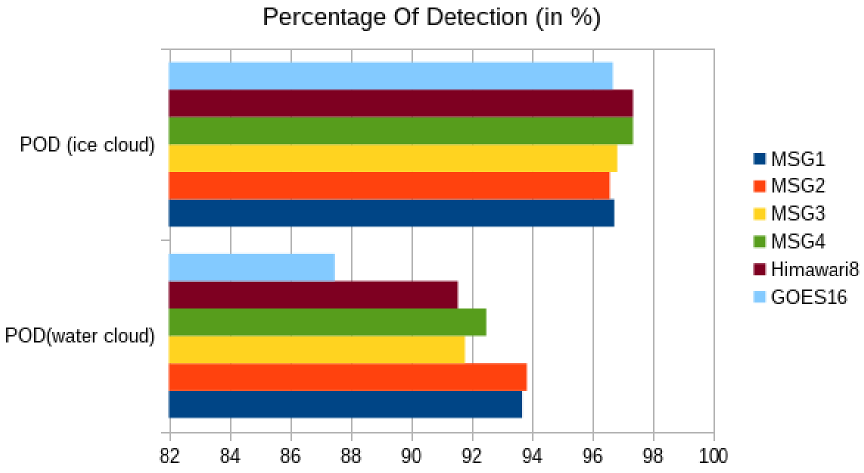
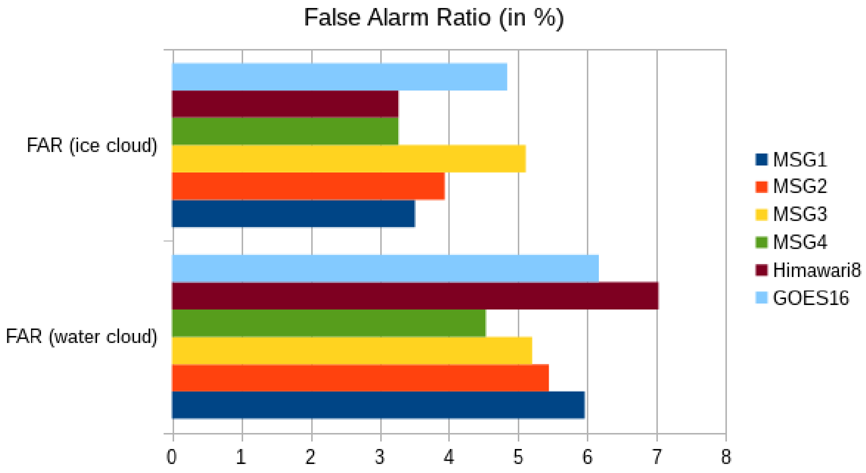
Cloud phase validation with Caliop lidar

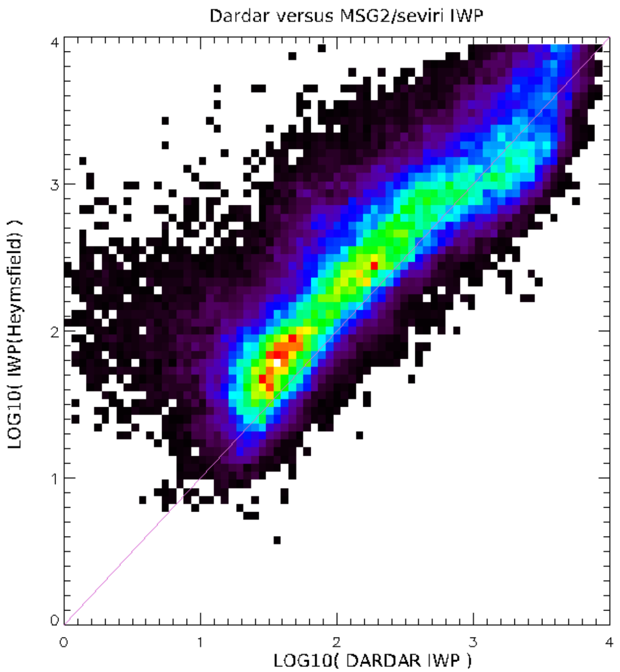


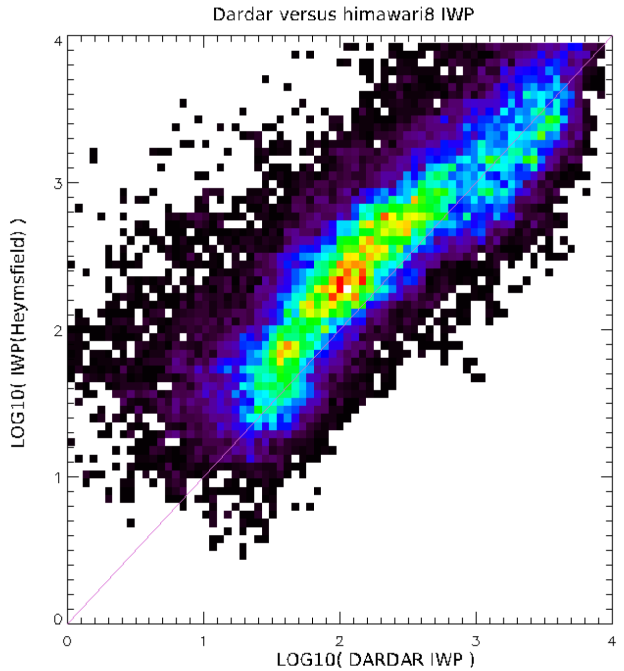


Better score at daytime and at large viewing angles

Cloud Ice Water Path validation with radar & lidar

MSG2





Himawari8

Dardar (ice cloud retrieval from radar & lidar)

IWP : $(Tau\_cloud/0.065)^{(1/0.84)}$ heymsfield formulae used in NWCSAF/GEO

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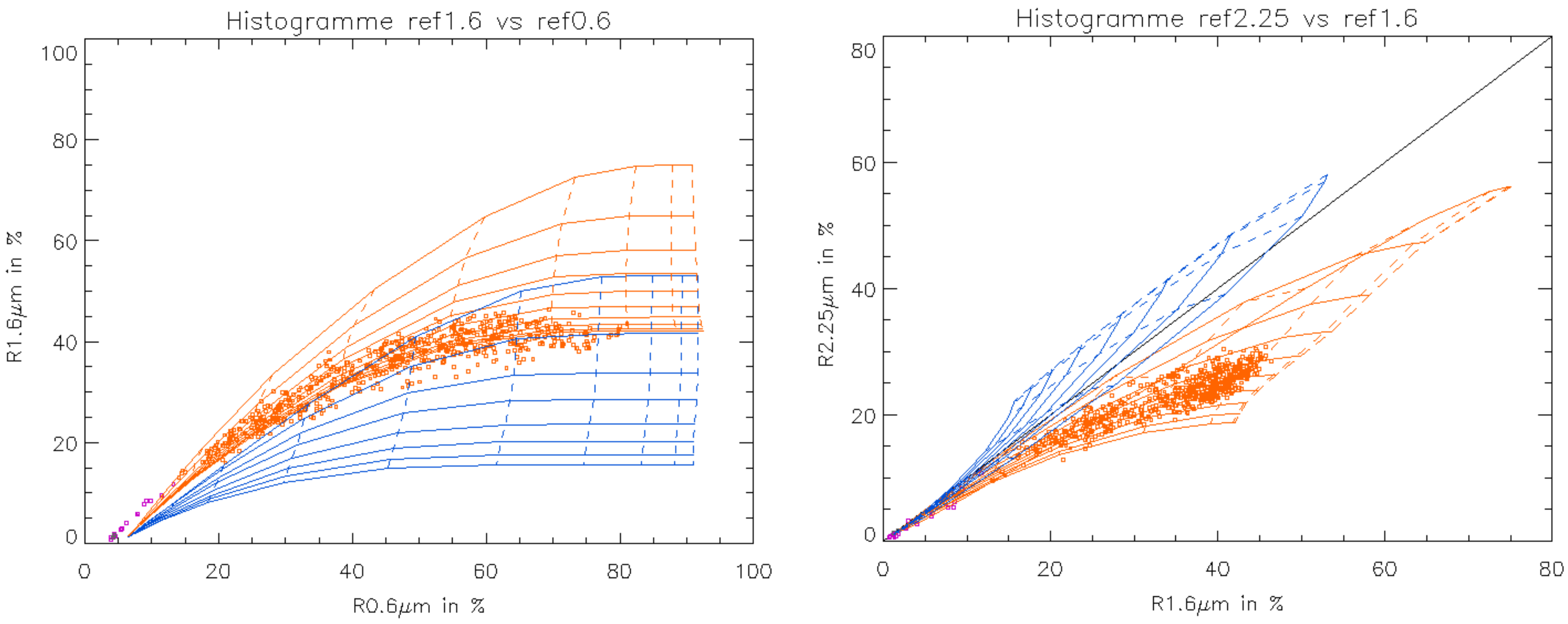
MTG perspective: use of 2.25 for cloud phase



Improved cloud phase for identification of cumulus glaciation

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MTG perspective: high spatial resolution

High spatial resolution in RSS mode:

- -CTTH could be computed at 1km resolution
- -Cloud microphysic could be computed at 500m resolution

-> usefull for small cumulus characterisation

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MTG perspective: St/Cu separation

- High resolution texture analysis to identify stratiform and cumuliform clouds
- A prototype is being developped.

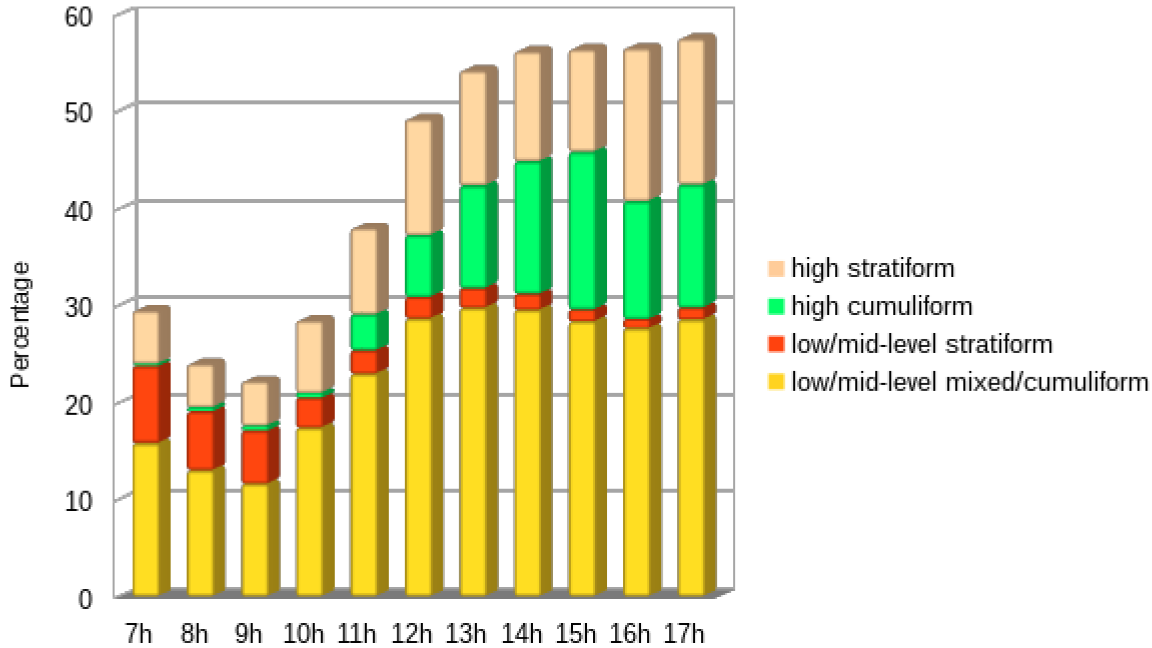

Illustration: 22 May 2018 over France

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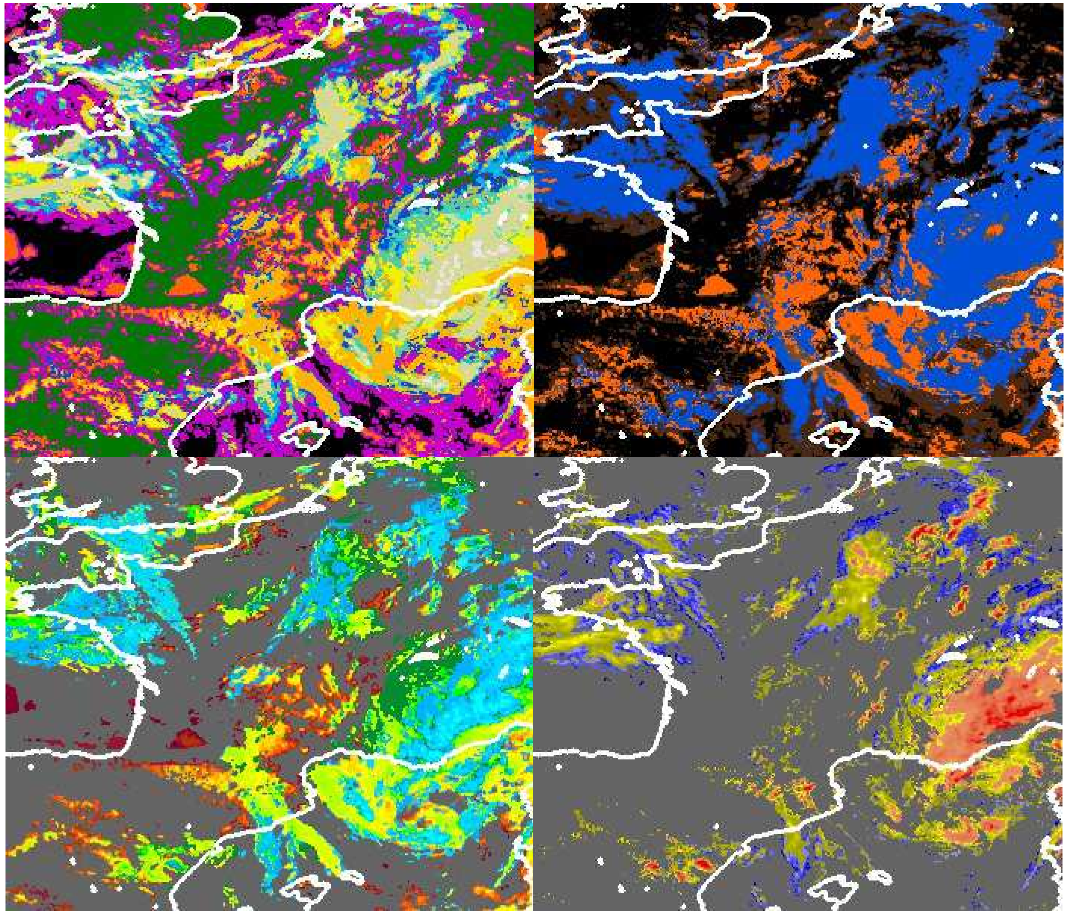
Example: 22th May 2018 over France

CT

CMIC/Phase



CTTH/alti

CMIC/IWP

22 May 2018 10h

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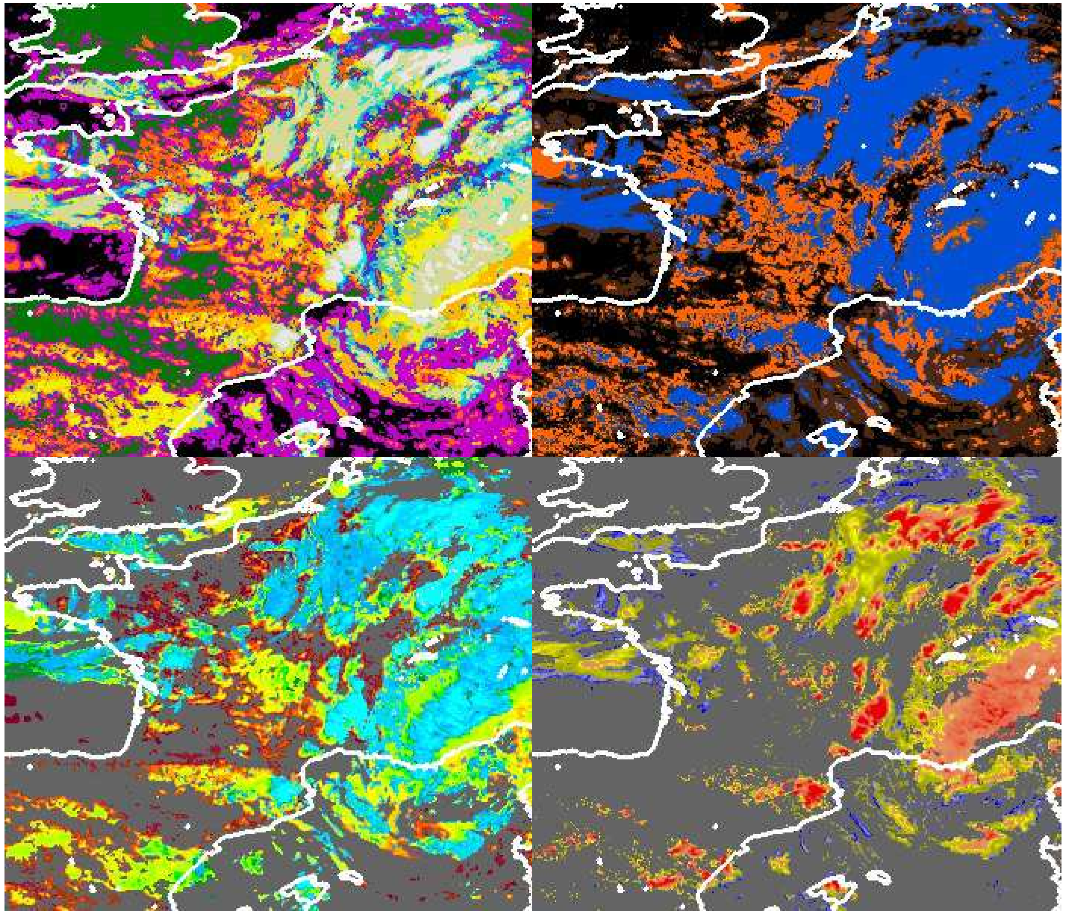
Example: 22th May 2018 over France

CT

CMIC/Phase



CTTH/alti

CMIC/IWP

22 May 2018 12h

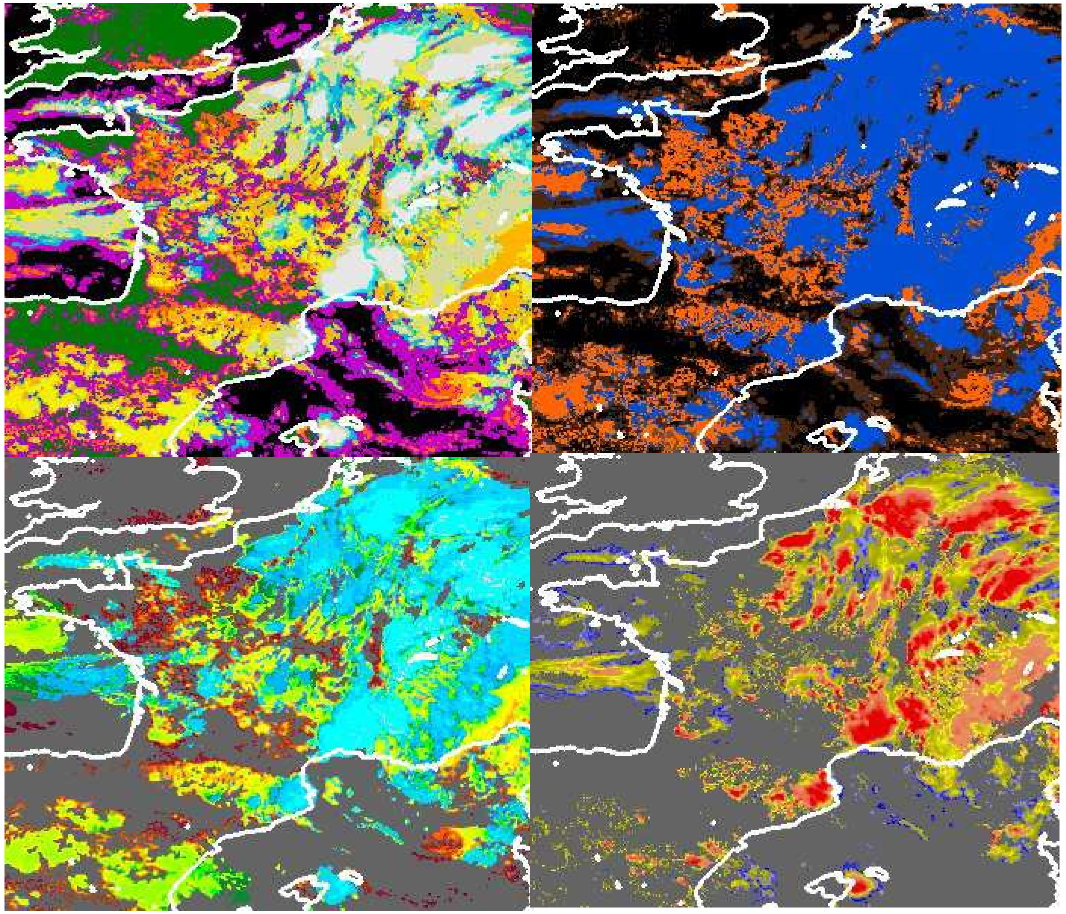
NWC SAF

METEO FRANCE

Example: 22th May 2018 over France

CT

CMIC/Phase



CTTH/alti

CMIC/IWP

22 May 2018 14h

NWC SAF

METEO FRANCE

Example: 22th May 2018 over France

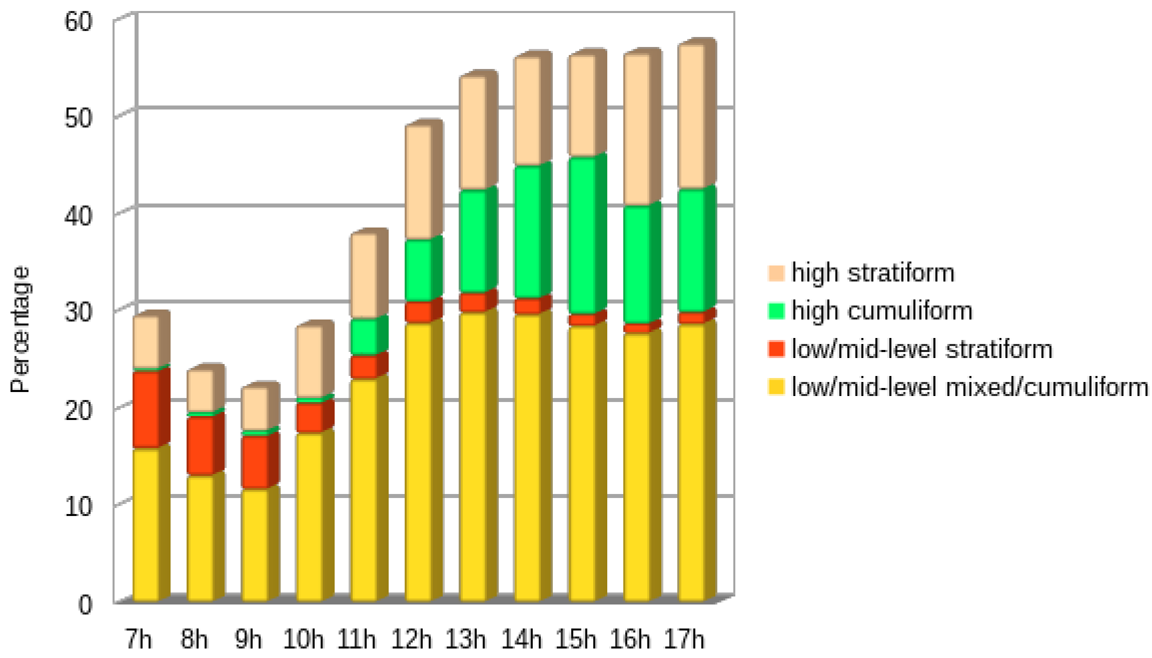


Illustration: 22 May 2018 over France


Thank you for your attention !