Validation of SAFNWC/GEO cloud Top Height and Microphysics

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Outline

- Eumetsat NWCSAF background
- Cloud Top Height and Microphysics algorithm
- Cloud Top Height and microphysics validation
- Conclusion

Eumetsat NWCSAF background

- NWCSAF is part of Eumetsat ground segment
- NWCSAF is a consortium hosted by spanish meteorological service
- NWCSAF develops and distributes one operational sofware suite to process geostationary metorological satellites
- 140 users are registered, including most European national meteorological services
- This software includes four clouds products developped by Météo-France
- This presentation will focuse on cloud top height and microphysics products retrieved from MSG, GOES and Himawari

Cloud Top Height algorithm

- Retrieve cloud height from infrared 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)
- 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)

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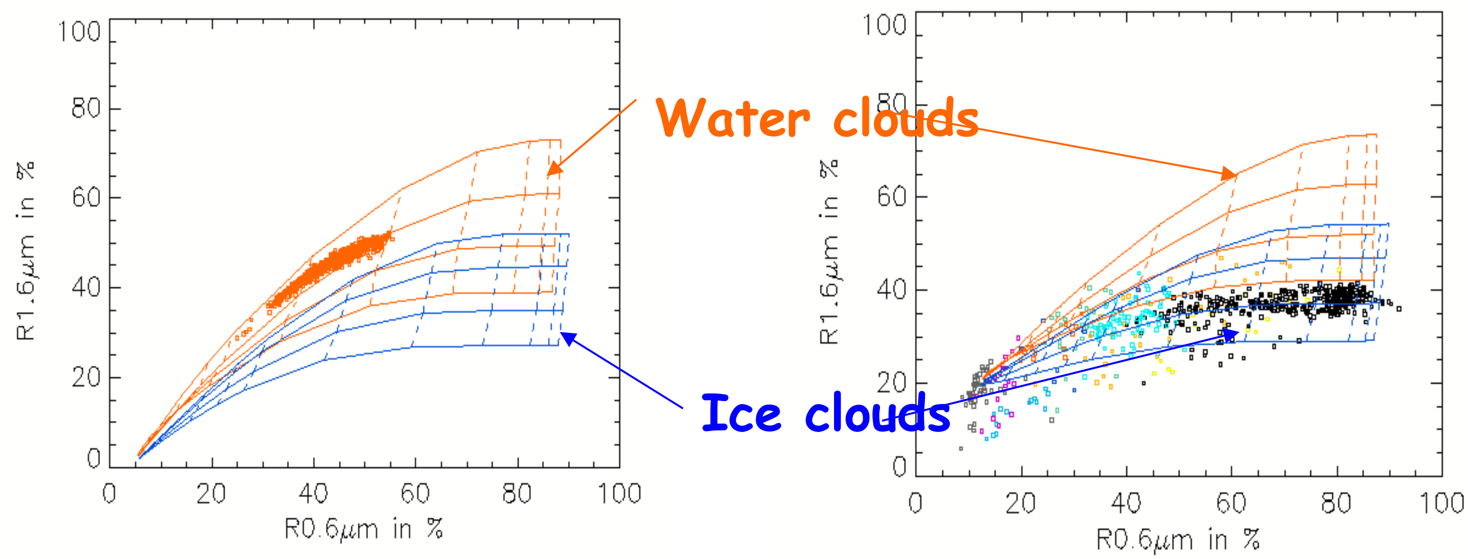
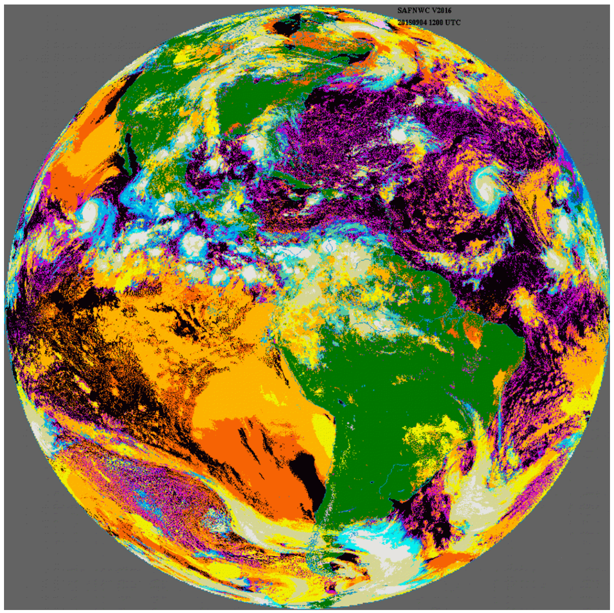
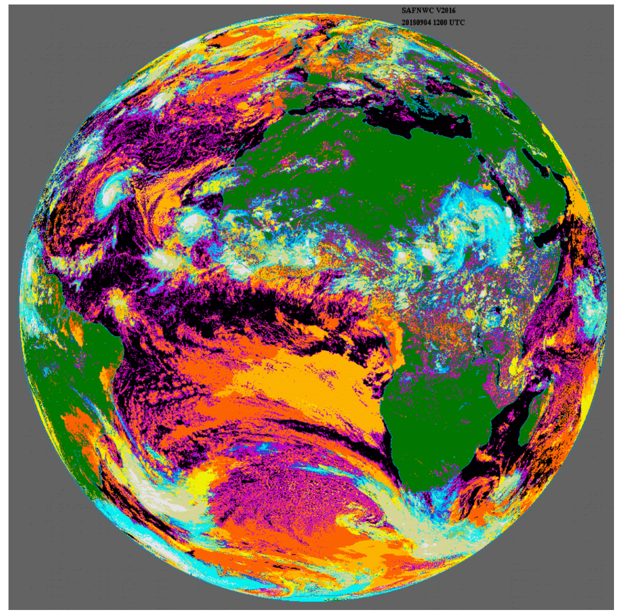
Cloud Microphysics algorithm

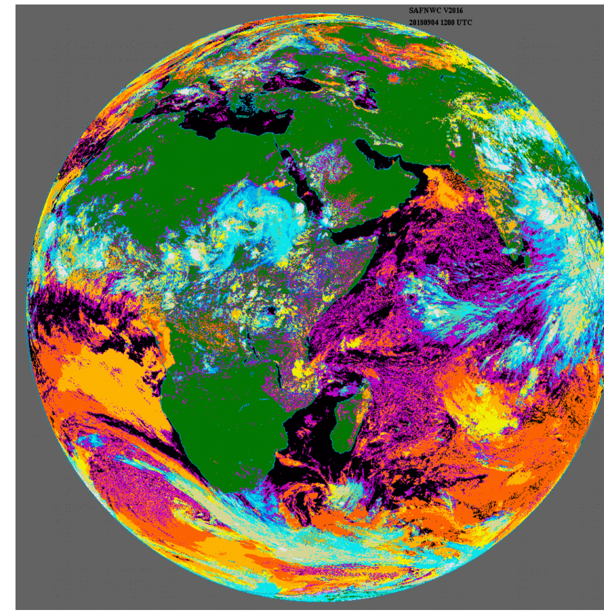
- Cloud phase is obtained (day & night) mainly from 10.8µm and 8.7µm wavelengths, complemented in daytime by the use of 0.6µm, 1.6µm and 2.25µm.
- Cloud droplet/crystal size, optical thickness, liquid and ice water path
  - retrieved only daytime
  - from comparison between simulation (DISORT; mie(water) or Baum(Ice)) and measurements at 0.6µm and 1.6µm wavelengths (Nakajima method)

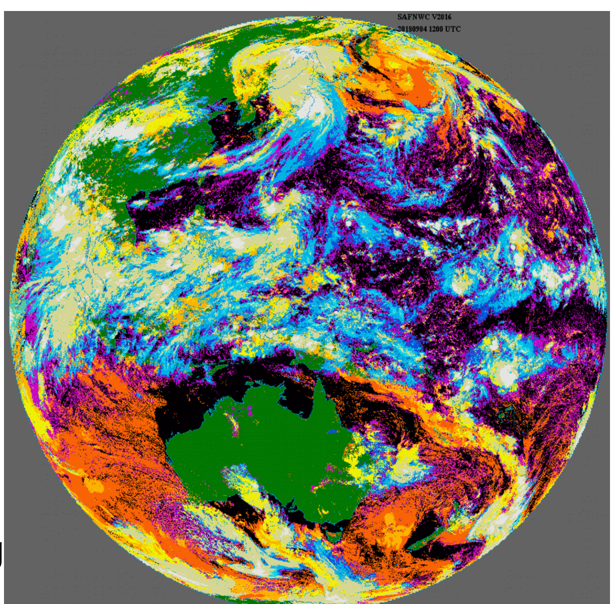


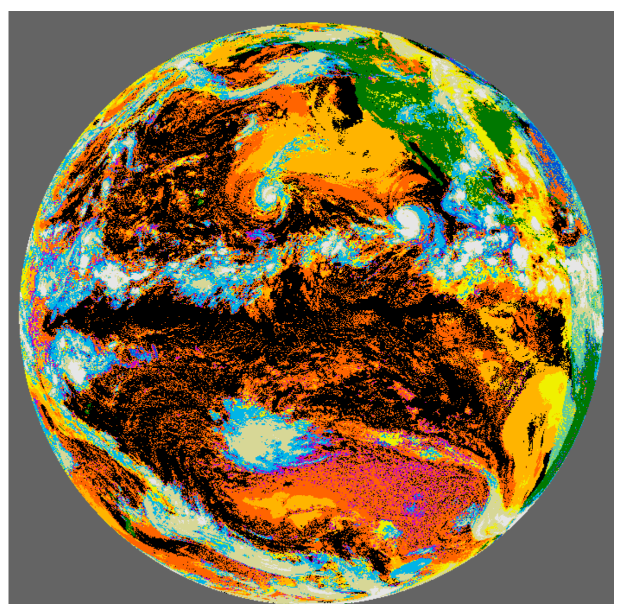
Global coverage using MSG, GOES and Himawari











Cloud type
4 september 2018 12UTC

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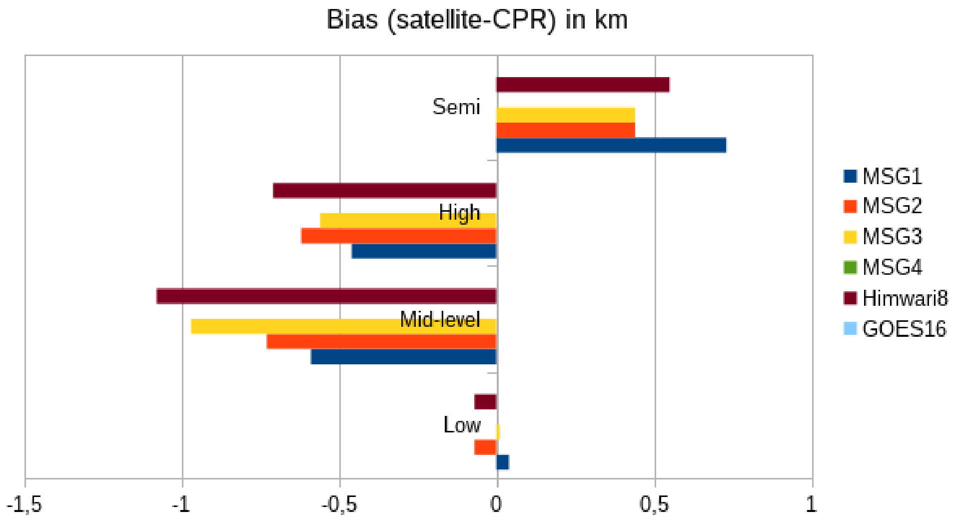
Validation dataset

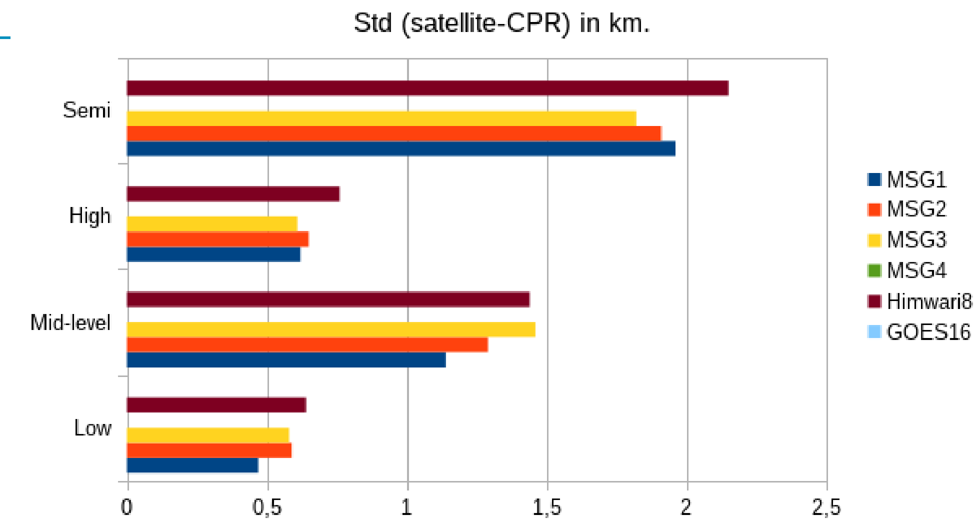
- Satellites and period (2 days per month over one year):
  - MSG1-IO (Oct 2016 – Sept 2017)
  - MSG2 (2010)
  - MSG3 (Oct 2016 – Sept 2017)
  - MSG4 (Feb -July 2018)
  - Himawari8 (Aug 2015-Sept 2017)
  - GOES16 (Jan – July 2018)

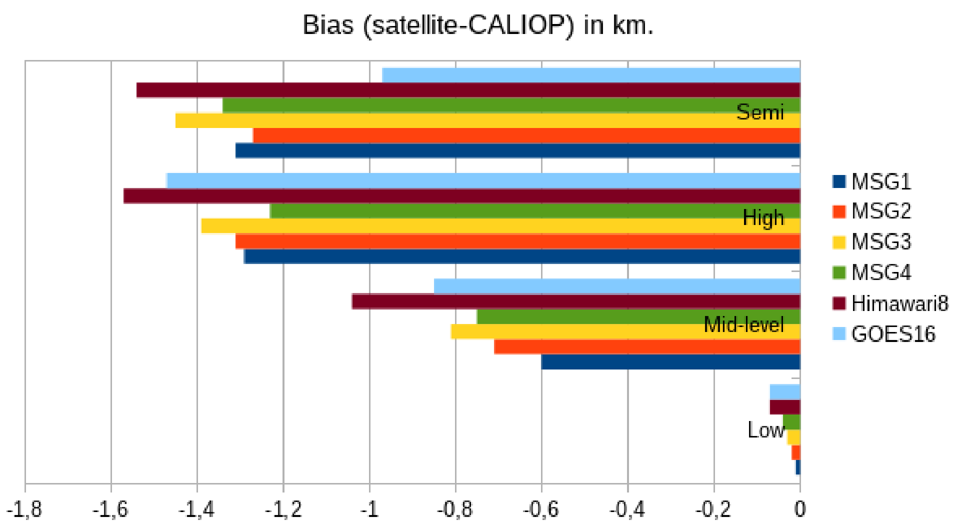
- Data used for validation :
  - AMSR microwave imagery
  - Caliop lidar and CPR radar measurements

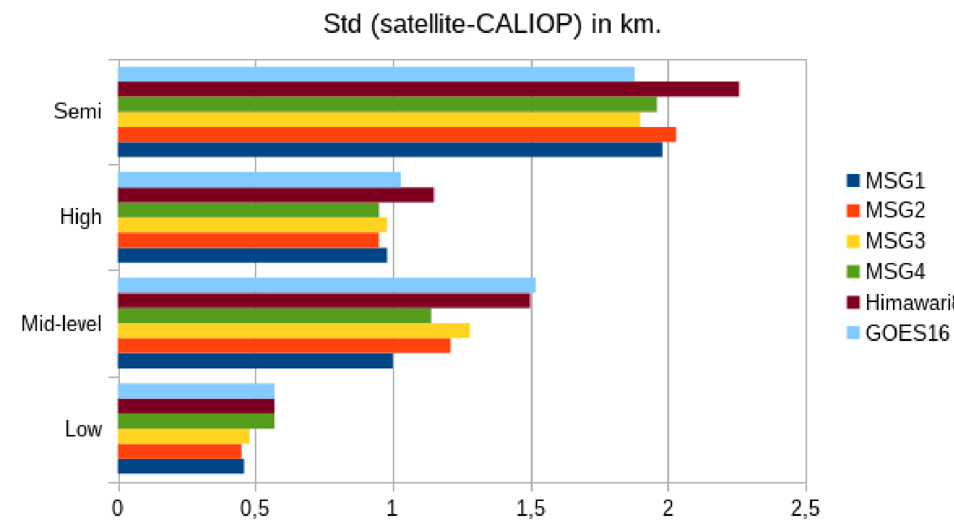
- To ensure all instruments view the same cloud layer :
  - Too thin caliop cloud layer (optical thickness lower than 0.2) are rejected
  - Colocation lidar/radar/microwave satellite is performed in homogeneous areas
  - Viewing angles are limited to 65 degrees

Cloud Top Height validation with radar and lidar









Bias larger with CALIOP lidar
Very low bias and Std for low level clouds
General agreement between MSG/GOES/Himawari results

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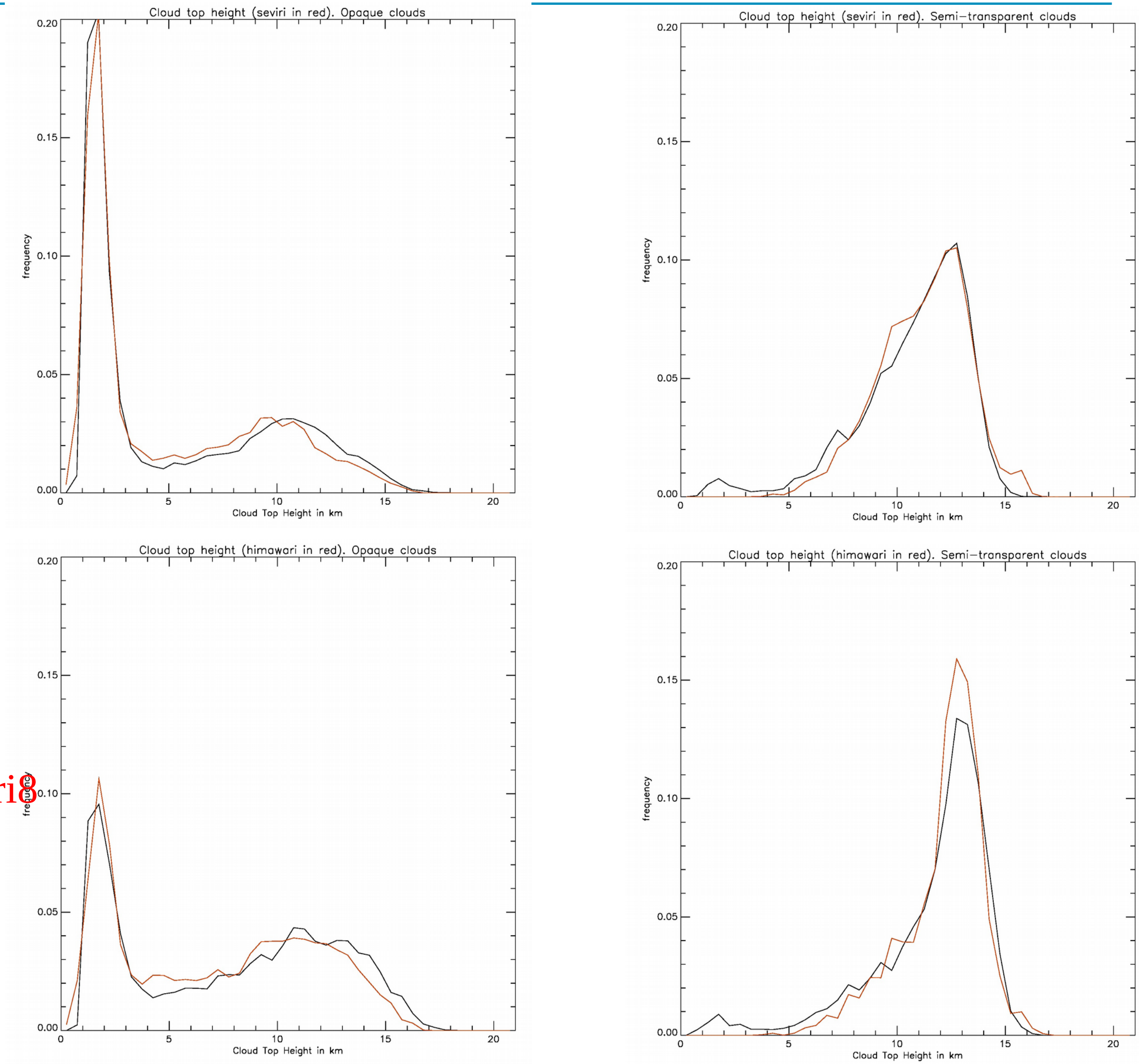
Cloud Top Height validation with CPR radar

MSG2

Himawari8



in black : cloudsat radar

Opaque clouds

Semi-transparent clouds

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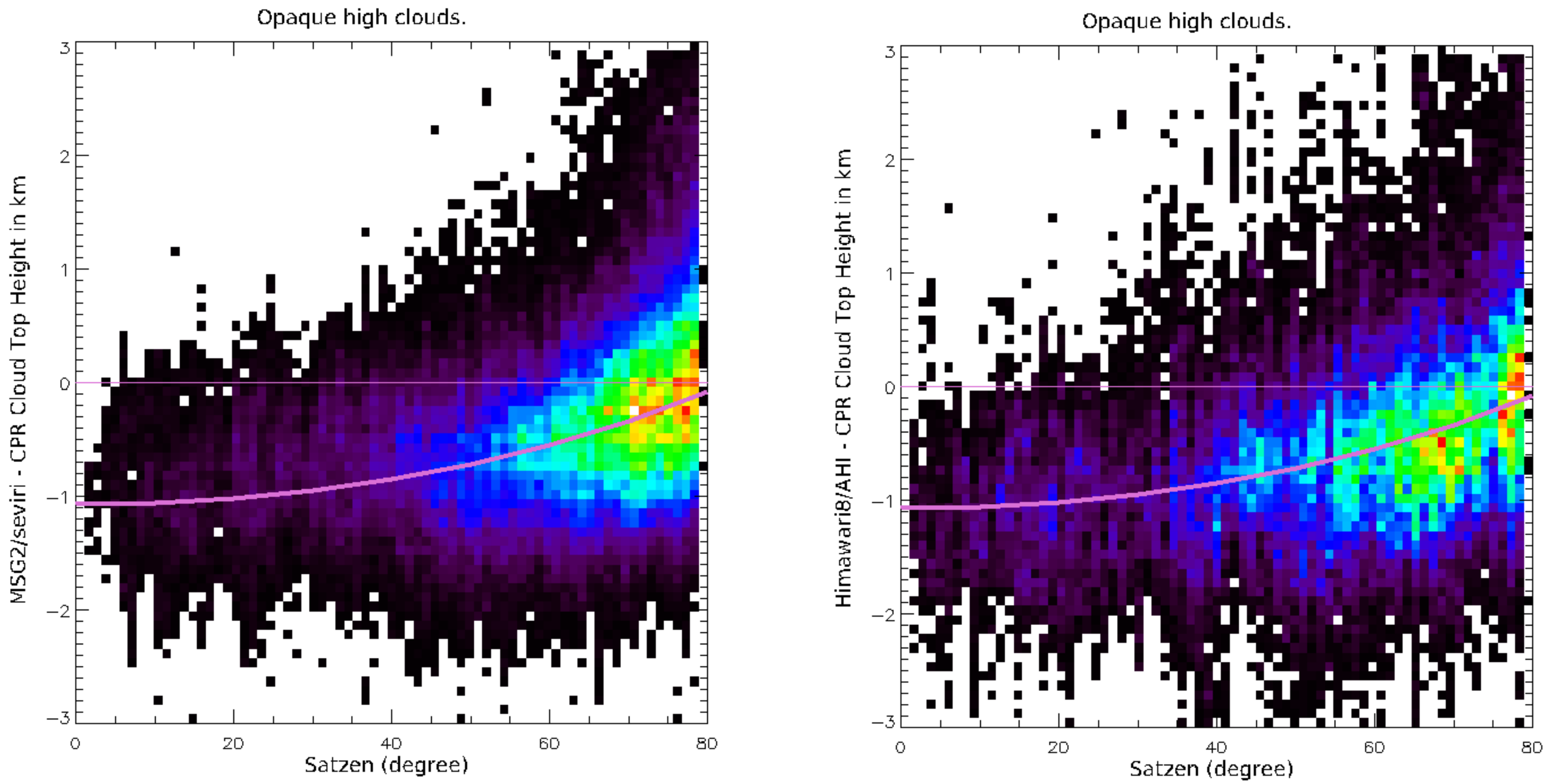
Cloud Top Height validation with CPR radar



-Smaller bias at disk edges due to thinner layer at top of cloud contributing to measurements.

-This effect can be modelled with RTTOV12 (curve). Not yet accounted for in NWCSAF/GEO SW

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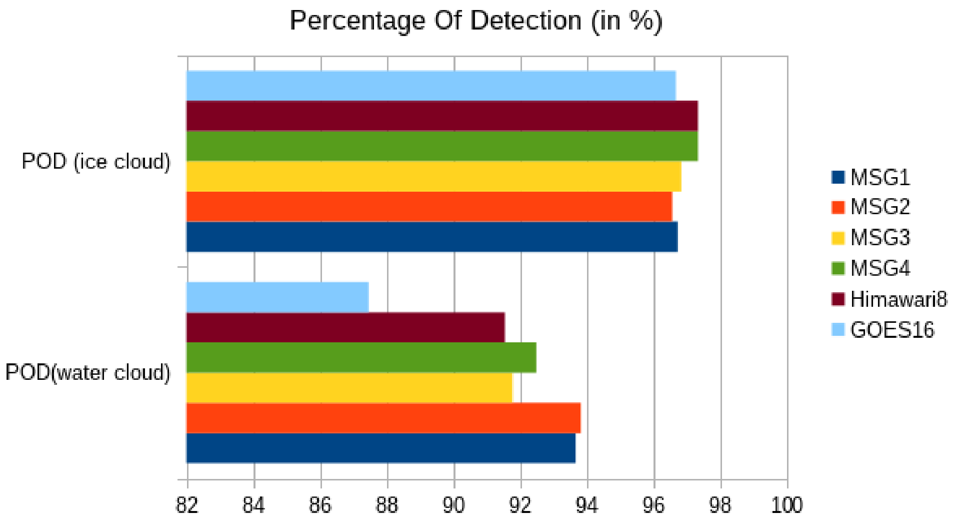
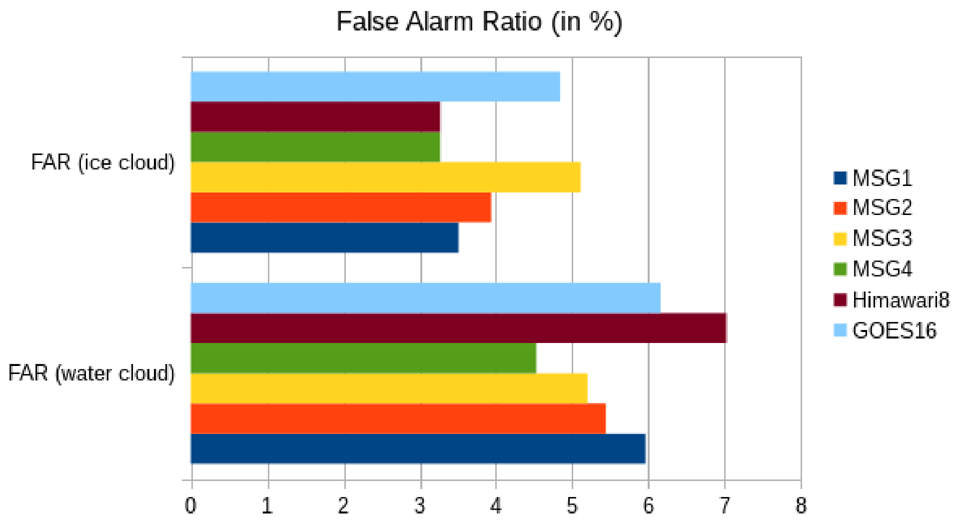
Cloud phase validation with lidar



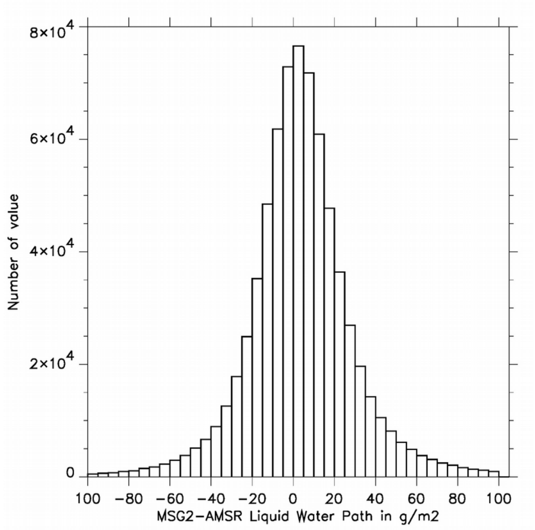


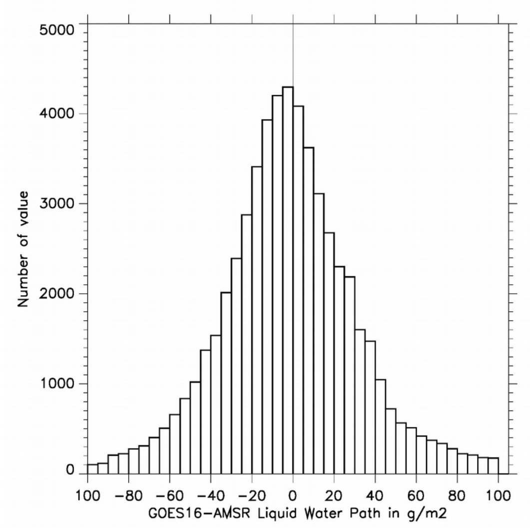
-POD for water clouds are slightly lower for GOES16.

-Better score at daytime and at large viewing angles

Cloud liquid water path validation with AMSR

	MSG1	MSG2	MSG3	MSG4	Himawari8	GOES16
Bias (in g/m^2)	-1.79	5.45	-6.67	-3.70	6.28 1.21	2.48
std (in g/m^2)	27.40	32.76	29.07	29.36	36.40 34.78	46.80
Correlation coefficient	0.85	0.80	0.82	0.82	0.79 0.80	0.65





-Std is larger for GOES16

-Bias very sensitive to accuracy of solar channel calibration

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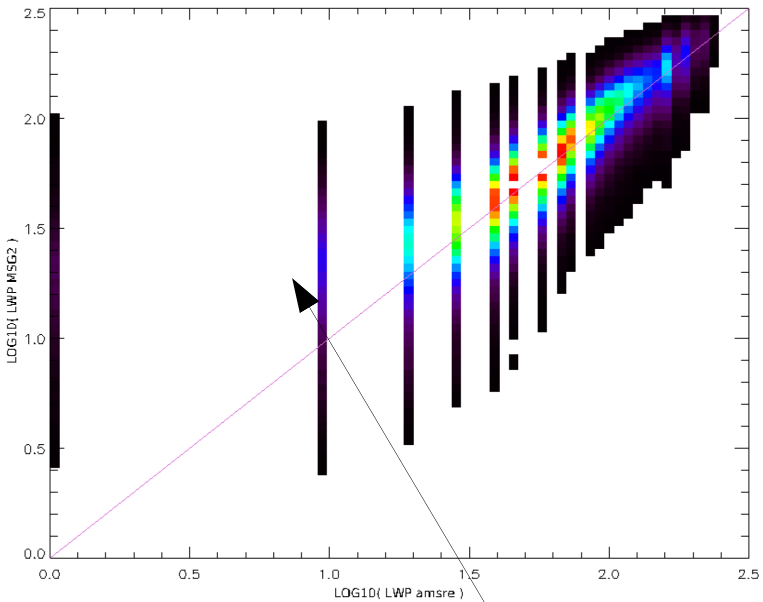
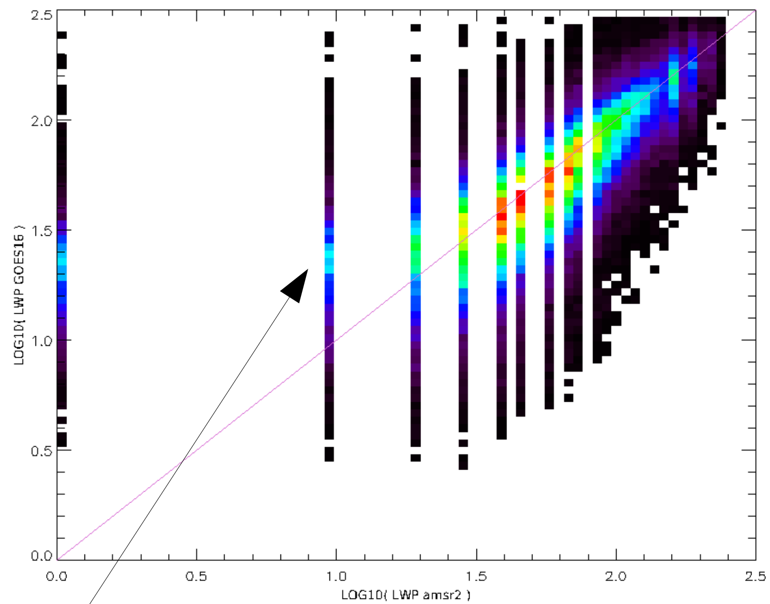
Cloud Liquid Water Path validation with AMSR



MSG2



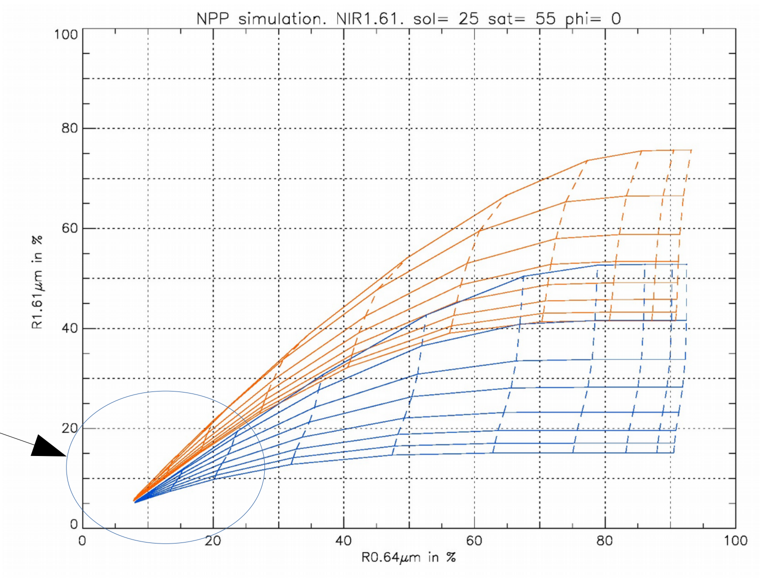
GOES16

One explanation for larger bias for GOES16 :

large number of cases with very low AMSR LWP

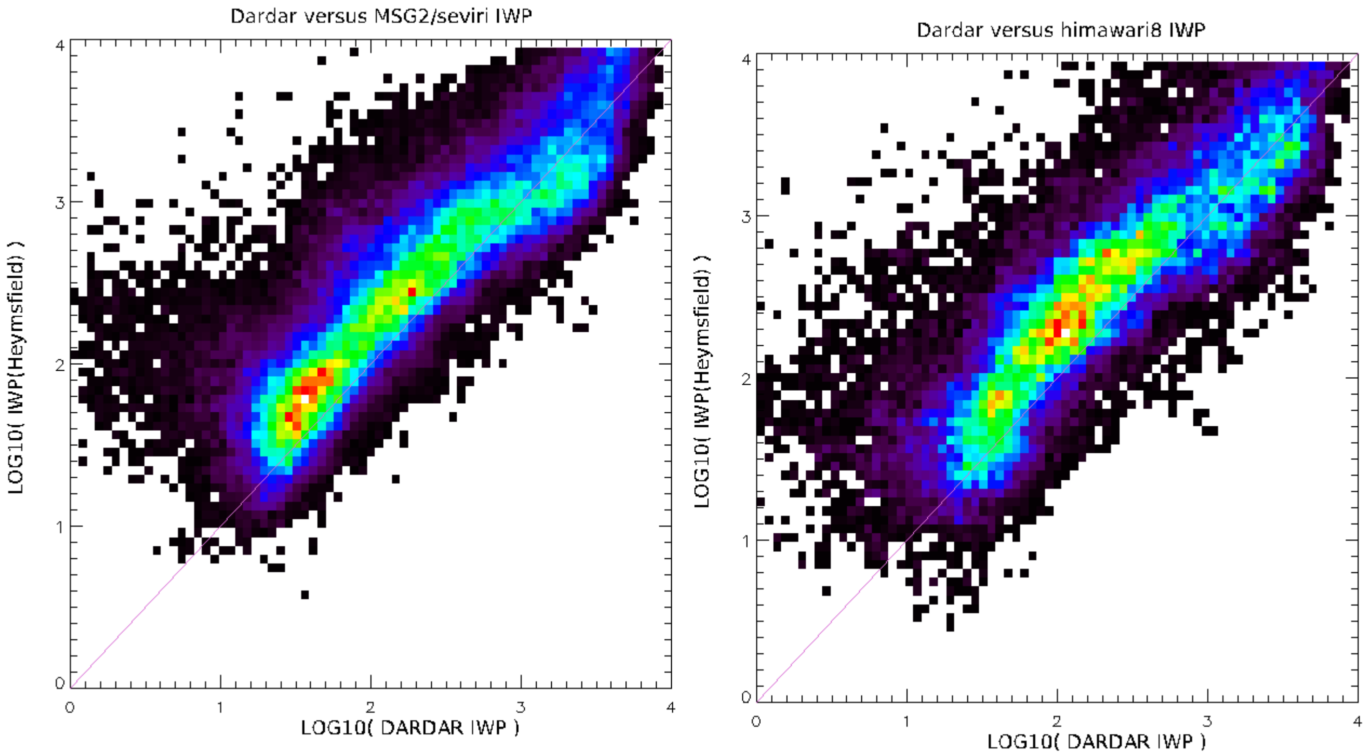
→ corresponds to thin water clouds

for which LWP retrieval may not be correct



Cloud Ice Water Path validation with radar & lidar (1)

MSG2



Himawari8

Dardar (ice cloud retrieval from radar & lidar)

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

IWP : $0.63*(Tau\_cloud/0.065)^{(1/0.84)}$ would fit much better DARDAR data

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Conclusion and perspective

- NWCSAF/GEO allows to retrieve validated cloud products for a set of geostationary satellite (MSG, GOES, Himawari) allowing a global coverage

- Main objective for the coming years : prepare MTG (launch Q4 2021)

  — Prototyping using Himawari

  — Postdoc position is proposed to analyse in depth the impact MTG/FCI spectral characteristics for cloud phase identification (Météo-France Lannion)

- More information on the NWCSAF SW suite : www.nwcsaf.org

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Thanks for your attention !
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