Improvement of cloud products with MTG/I
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Plan

- General presentation of MTG/FCI
- Impact of enhanced spatial resolution
- Improvement with the new channels
  - Channel 1.38 for cirrus detection
  - Channel 2.25 to improve microphysic
- The lightning imager
- Conclusion

Enhanced MTG-I capabilities for cloud products

MTG-I will embark a VIS/IR imager (FCI) and a lightning imager (LI)

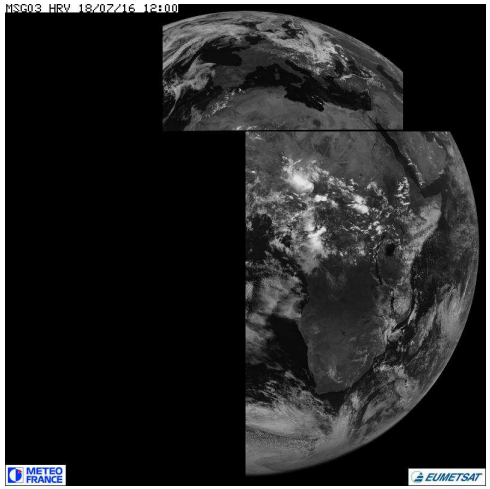
MTG-I/FCI has improved capabilities compared to MSG/SEVIRI :

- better spatial resolution :
  - In full disk mode: 1km for solar channels ; 2km for IR channels
  - In RRS mode: 500m for 2 solar channels ; 1km for 2 IR channels
- cleaner 3.8µm window channel
- additional solar channels (0.4µm, 0.5µm, 0.9µm, 1.38µm, 2.25µm)

The Lightning Imager is a new instrument

This talk details the improvement of NWCSAF/GEO cloud products using new MTG-I capabilities.

Impact of enhanced spatial resolution (1)



FCI Full disk mode:

IR channels: 2km (SEVIRI: 3km)

solar channels: 1km (SEVIRI: 3km (1km for HRV))

FCI RRS mode:

3.8µm and 10.8µm IR channels: 1km (SEVIRI: 3km)

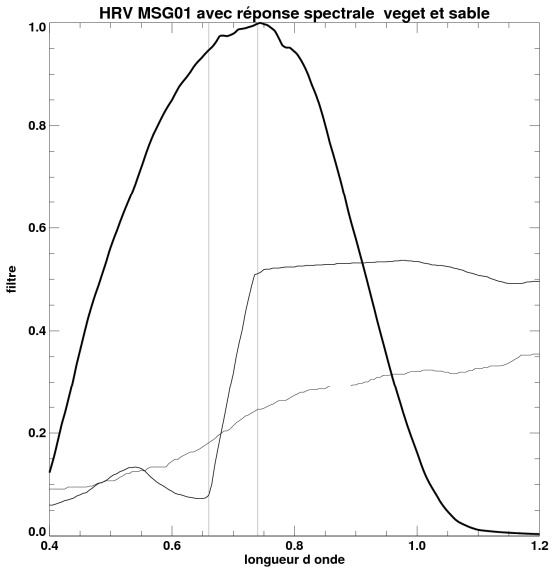
0.6µm and 2.25µm: 500m (SEVIRI: 1km for HRV)

Note that HRV(1km) is less efficient than narrow 0.6µm(1km) for cloud detection:

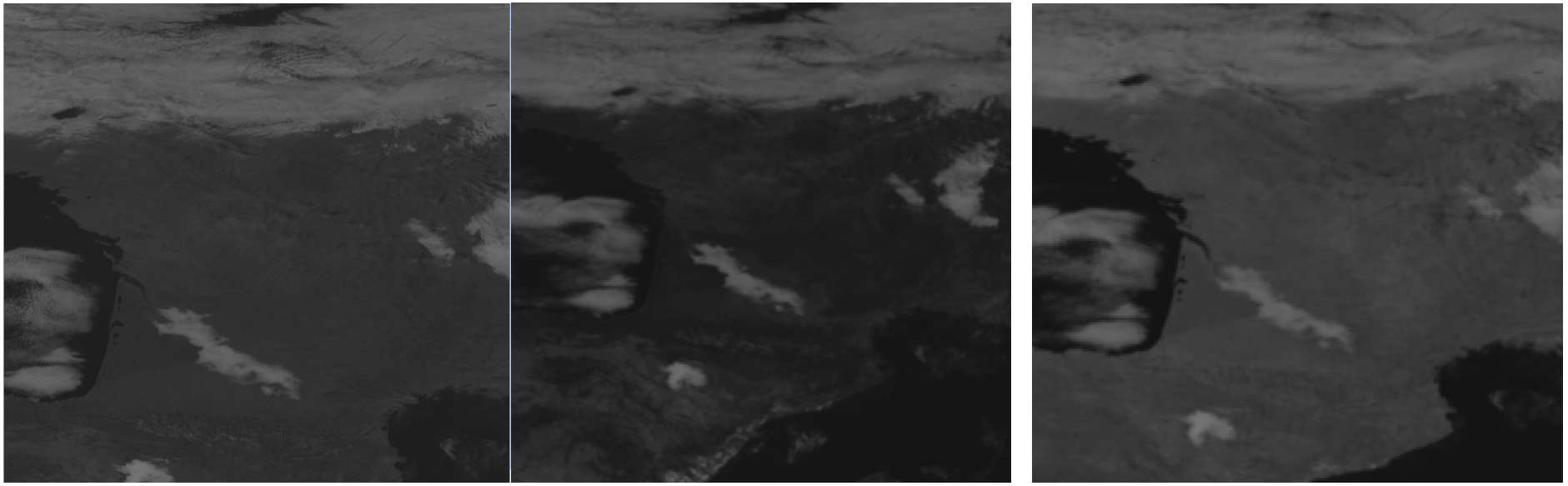
HRV is wide band channel (0.5µm-1µm)

-> vegetated areas appear brighter than in narrow band 0.6µm channel

-> less contrast between clouds & vegetation in HRV



Impact of enhanced spatial resolution (2)



MSG3 HRV | MSG3 VIS06 | MSG3 VIS08

28 october 2016 at 1300 UTC

Impact of enhanced spatial resolution (3)

The consequences for cloud products:

✓CMA (Cloud mask): improved detection of small size clouds (cumulus or valley fog) using 0.6µm or 10.8µm-3.8µm

✓ CT (Cloud Type): Separation of stratiform/cumuliform clouds
  ✓ Calculation of texture parameters at high spatial resolution

✓ CTTH (Cloud Top height) and CMIC (Cloud microphysic): improved because clouds more often fill the pixel (less fractional clouds)

✓ Cloud products available at better spatial resolution (2km)

Cleaner thermal window channel at 3.8µm

The 3.8µm channel on board MTG/FCI is a cleaner window channel than 3.9µm of MSG/SEVIRI (ie, less atmospheric impact)

-> The low cloud detection at nightime using 10.8µm-3.8µm should be easier because the threshold will be much less dependant on atmosphere and therefore easier to compute

1.38µm solar channel for cirrus identification (1)

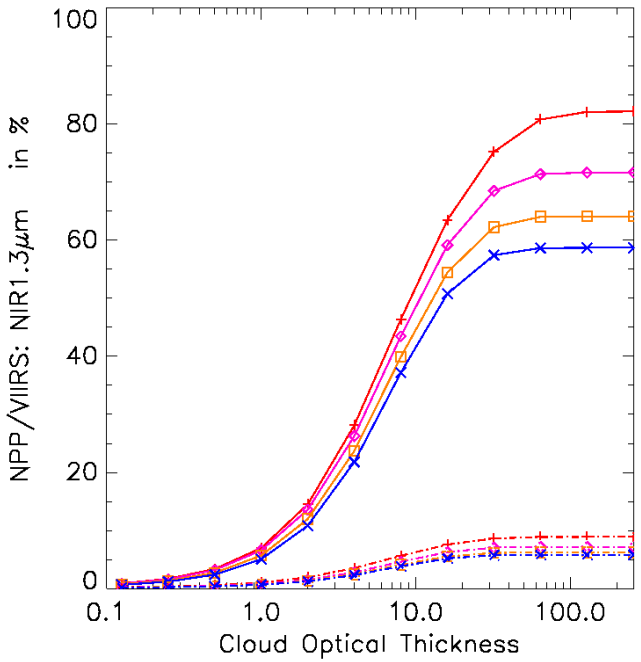
With MSG/SEVIRI, some limitations were identified:

✓Thin cirrus not detected (especially over snow)
✓Thin cirrus could be confused with sub-pixel cumulus clouds

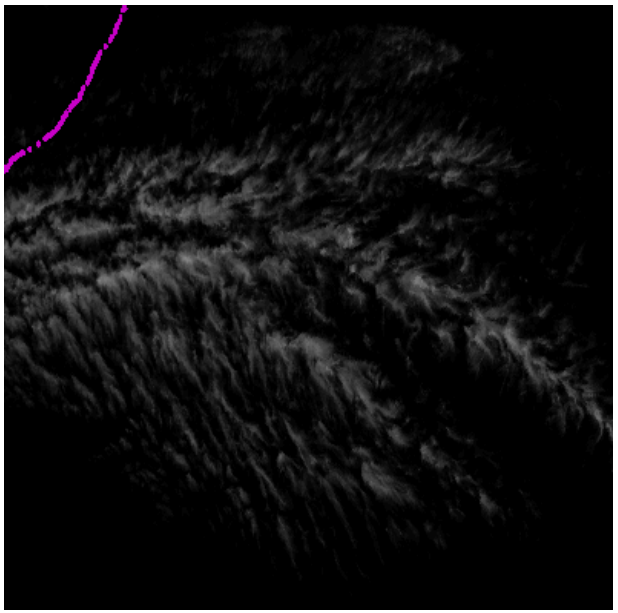
Using 1.38µm channel should help to solve these problems.

1.38µm solar channel for cirrus identification (2)

1.38µm channel is a water vapor absorbing channel
-> no solar reflection occurs in the lower troposphere
-> only high level clouds or high terrain can be seen in this channel



Ice high clouds (solid) or water low cloud (dashed)



VIIRS/channel 1.38µm over western Sahara. Orbit 22745 valid for the 18th march, start 12h53'44''

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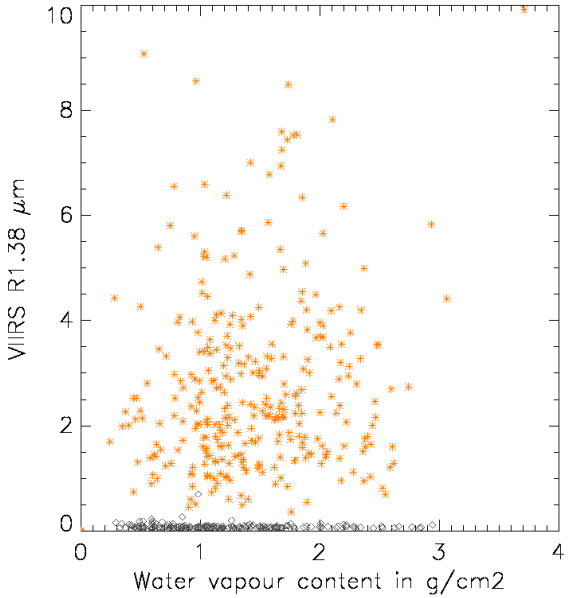
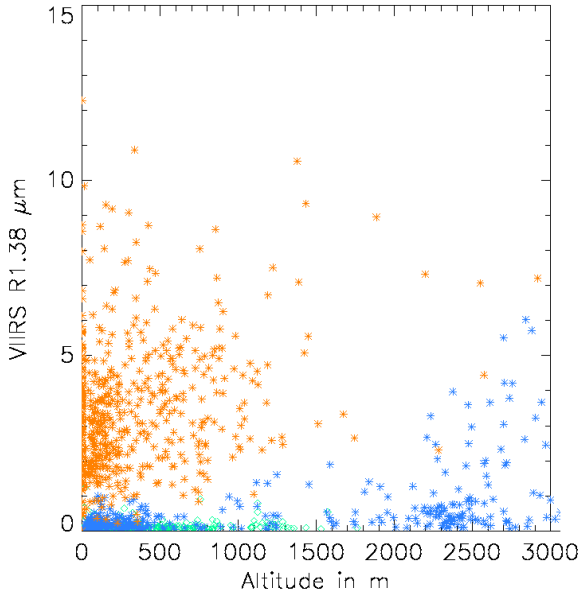
1.38µm solar channel for cirrus detection

Allows an easy detection of thin cirrus

(except in mountaineous regions)





NPP/VIIRS measurements

Brown: cirrus Blue: snow Green: land Black: ocean

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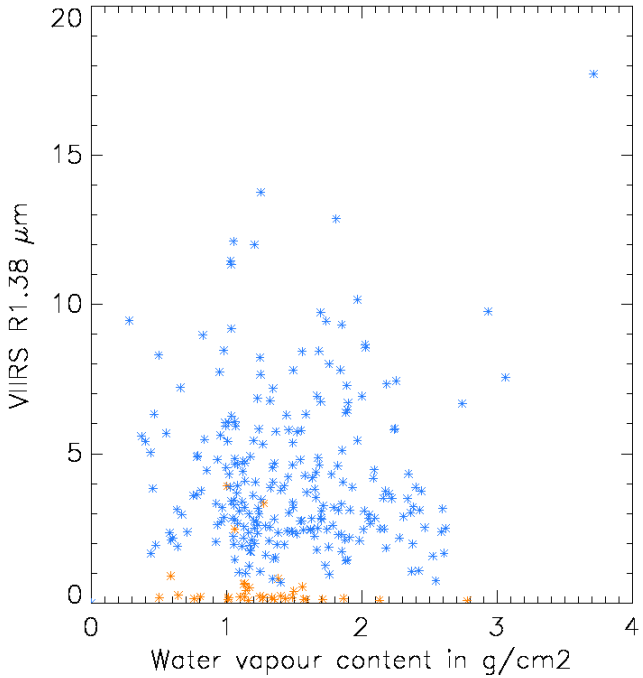
1.38μm channel for cirrus & cumulus identification

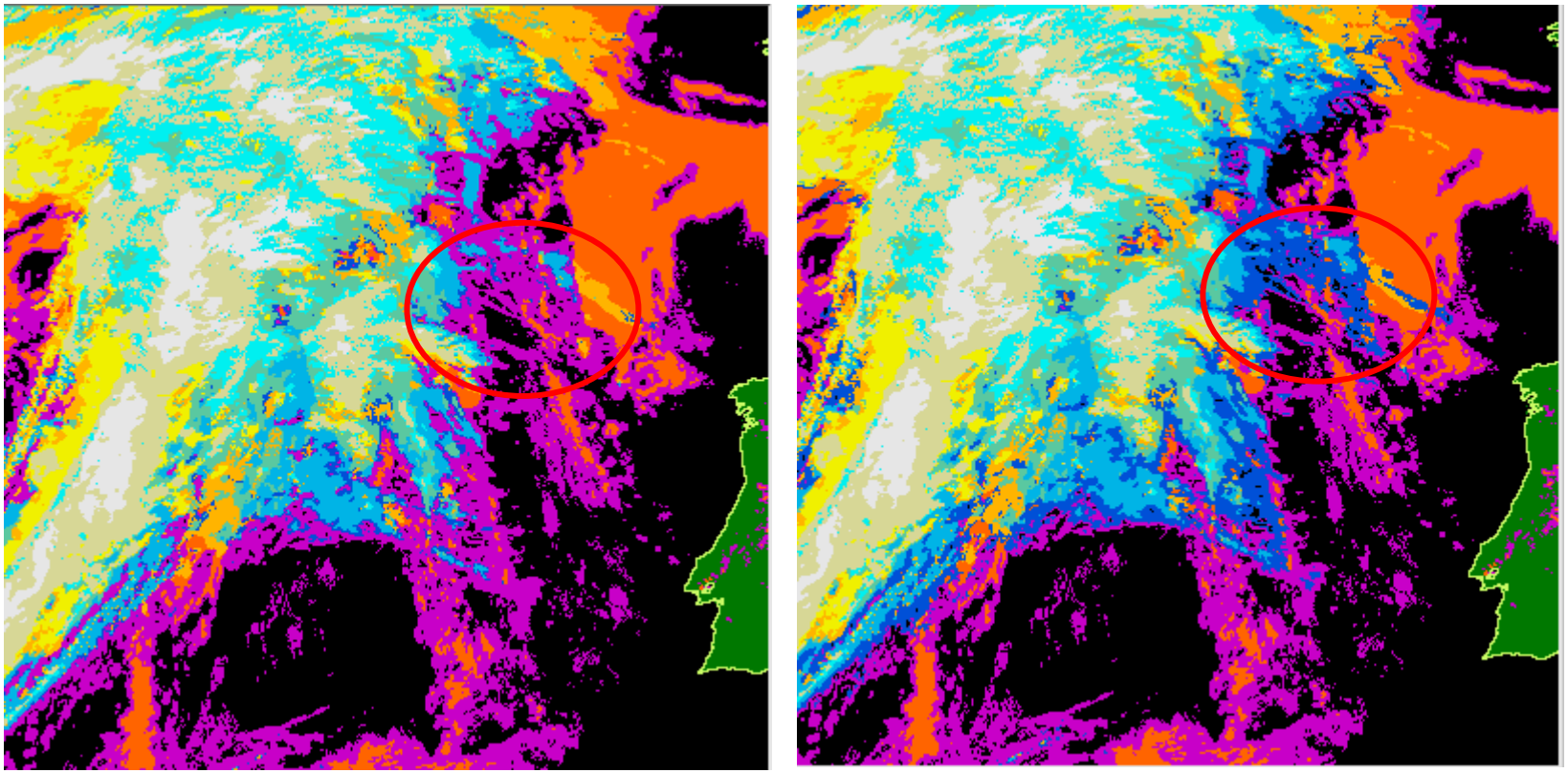
Allows an easy separation of thin cirrus and small cumulus



NPP/VIIRS measurements

Brown: small cumulus Blue: cirrus clouds

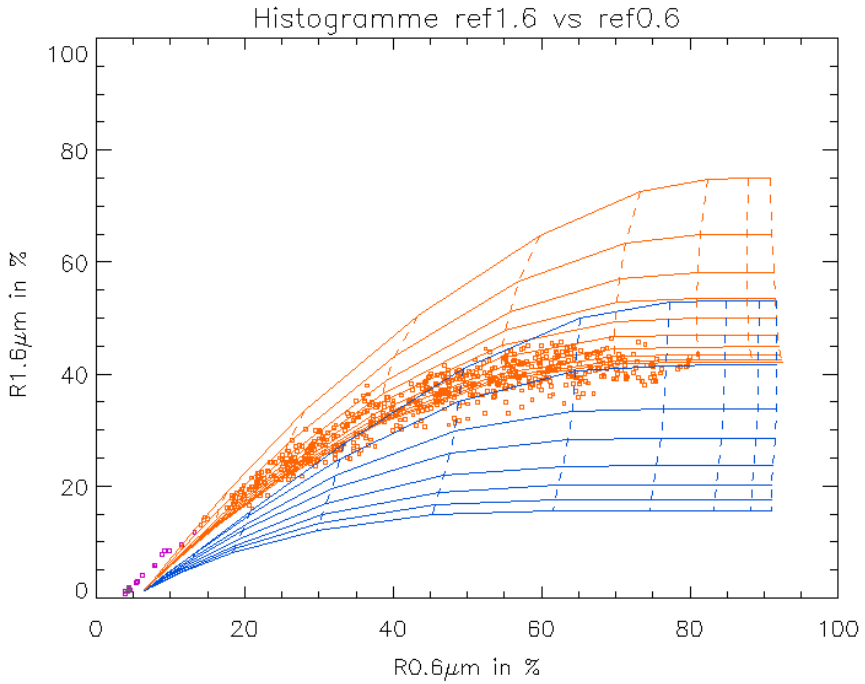
1.38μm channel for cirrus & cumulus identification



Classification valid for 31th may 2016 at 15 UTC

2.25µm channel for cloud phase identification (1)

MSG/SEVIRI 1.6µm absorbing channel is used to identify cloud phase.
Limitations are observed :
water clouds with large droplets could be confused with ice clouds with small crystals

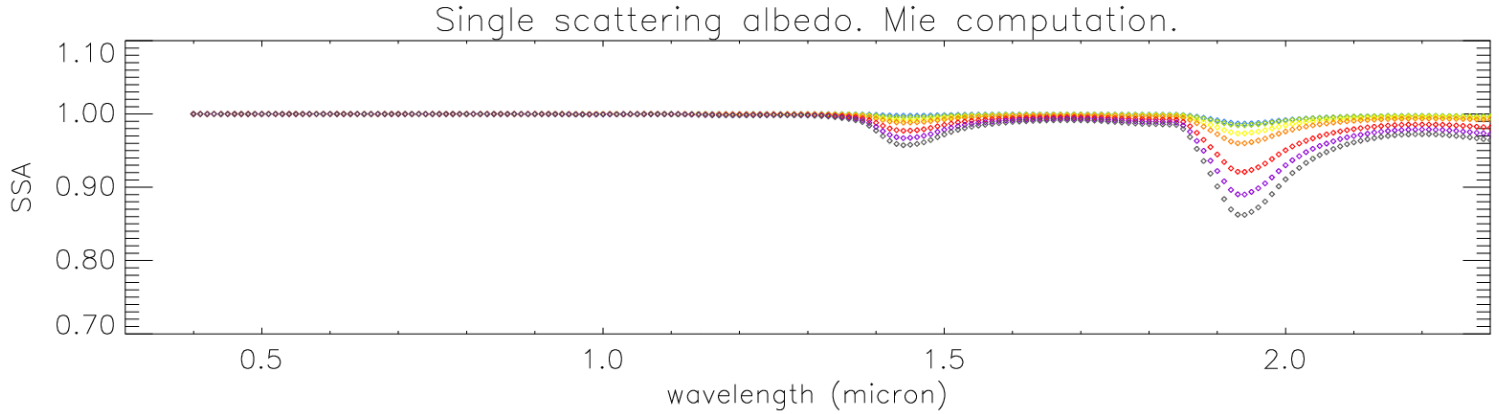


Simulations(curves) and SEVIRI measurements
(blue: ice clouds ; brown: water clouds)

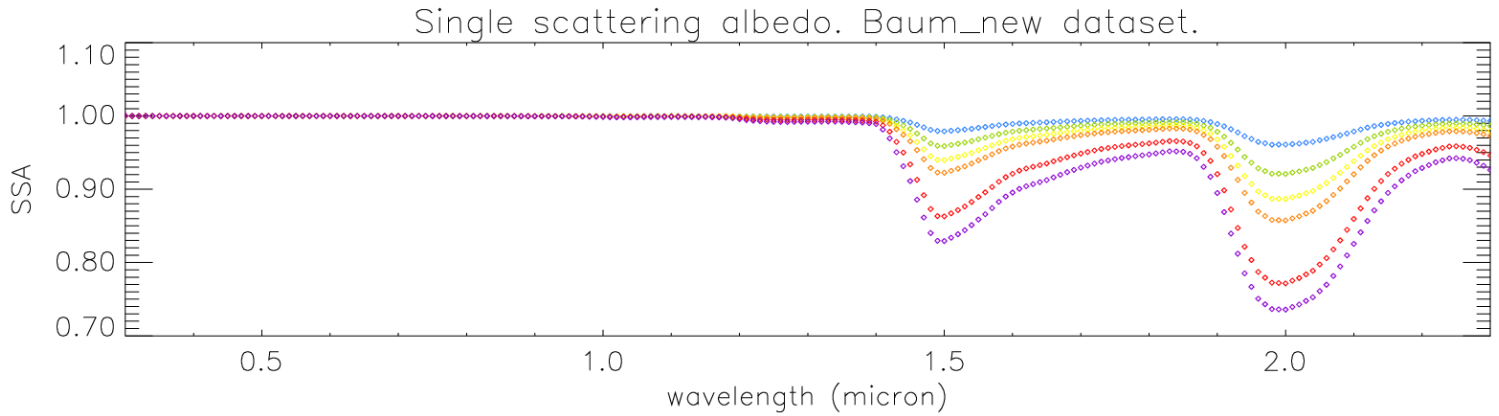
Using 2.25µm absorbing channel should help to solve these problems.

2.25µm channel for cloud phase identification (2)

2.25µm is a channel where ice clouds absorb solar radiance (as at 1.6µm):

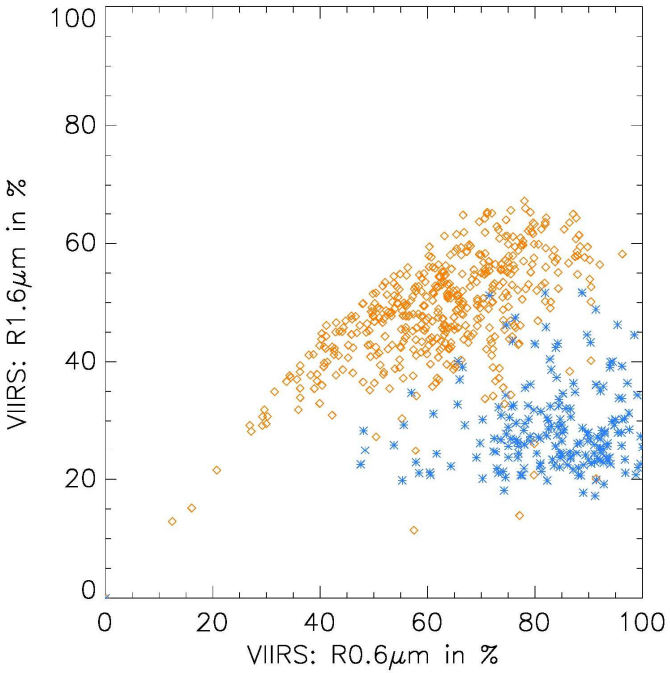


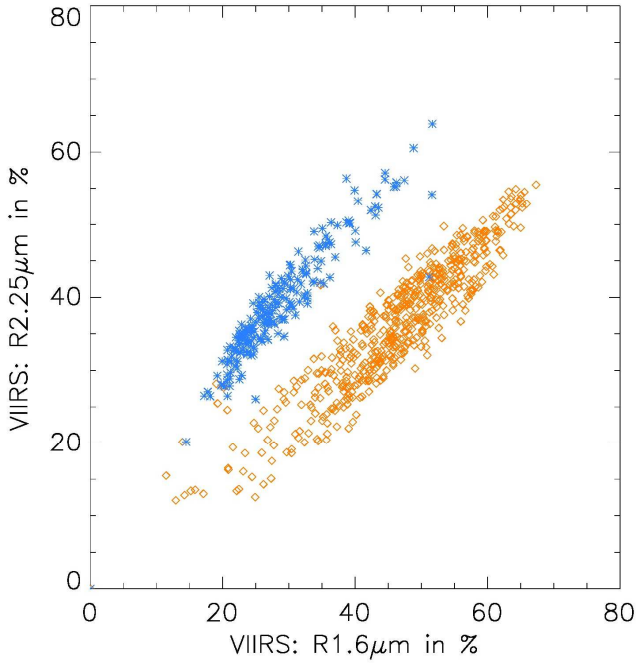
Single-scattering Albedo for water cloud (Mie) and Ice cloud (Baum dataset)



2.25µm channel for cloud phase identification (3)

The combined use of 1.6µm and 2.25µm will improve the cloud phase identification.

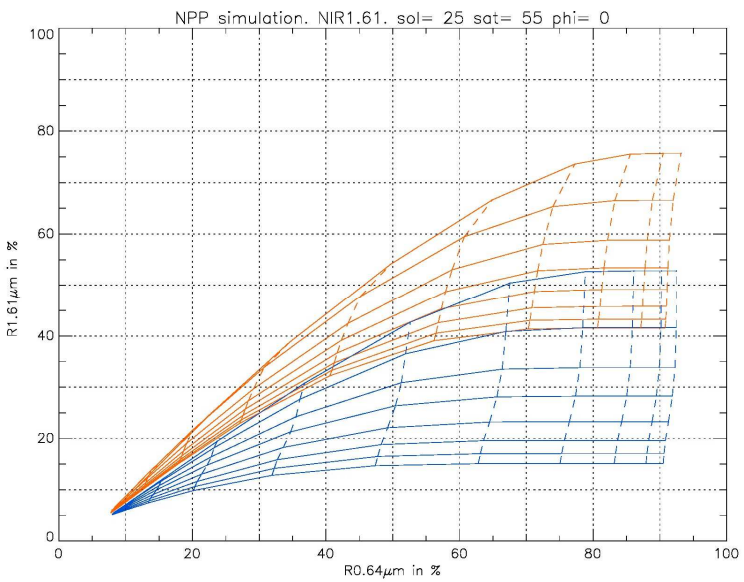


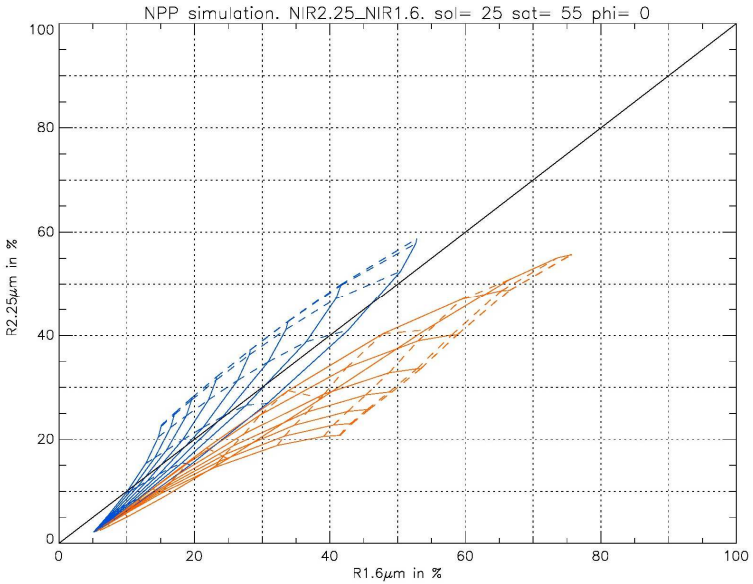


NPP/VIIRS measurements

In blue: thick ice clouds In brown: low level clouds

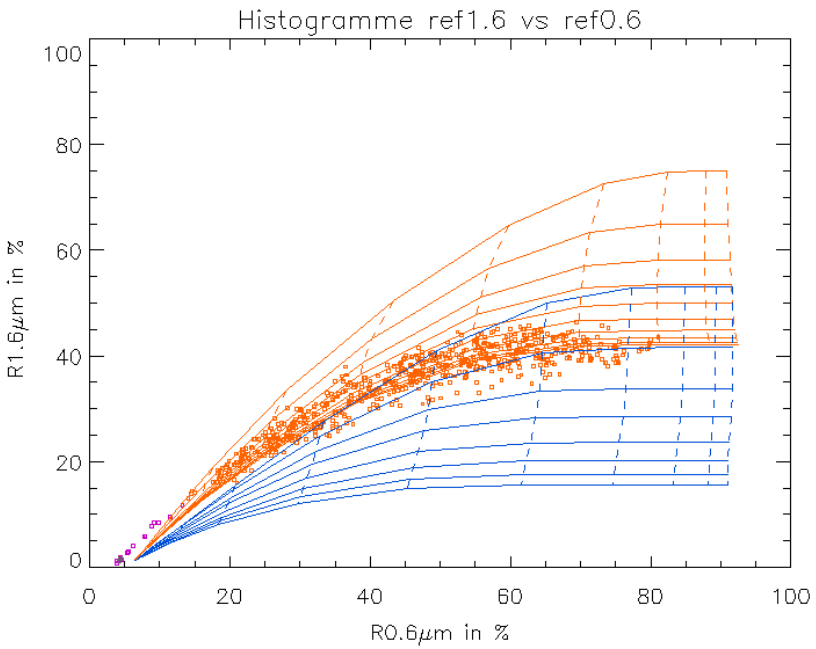
2.25μm channel for cloud phase identification (4)

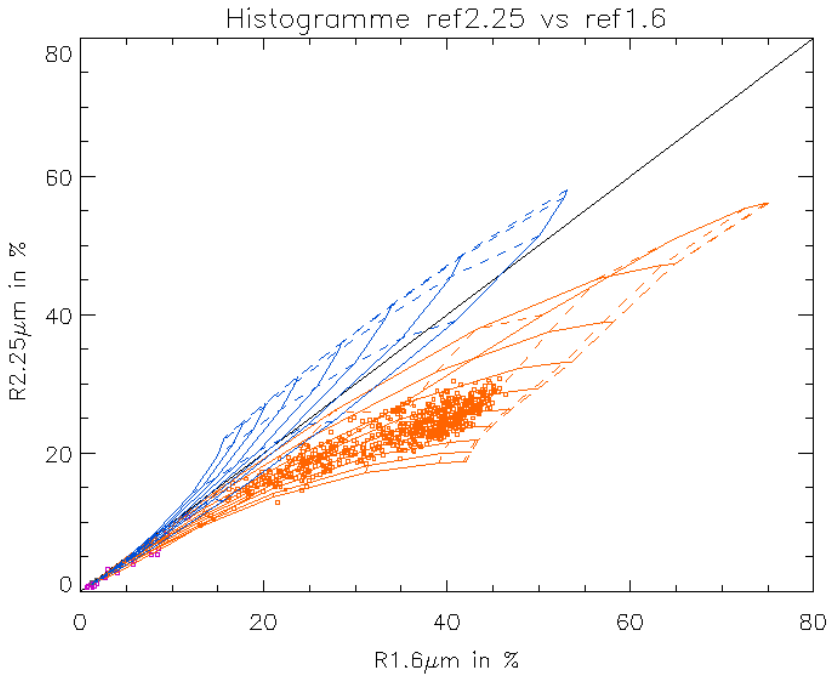




This is confirmed with NPP/VIIRS simulations
(blue: ice clouds ; brown: water clouds)

2.25μm channel for cloud phase identification (5)



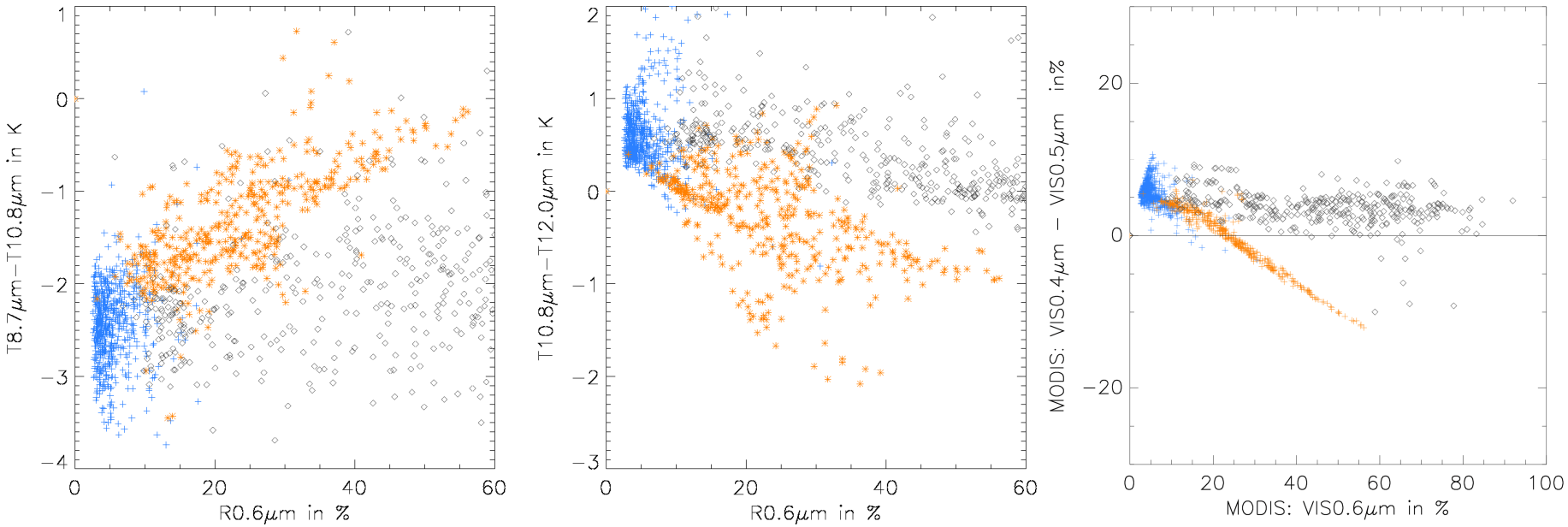


This is confirmed with Himawari simulations and measurements
(blue: ice clouds ; brown: water clouds)

0.4µm & 0.5µm for dust cloud identification

Dust cloud over ocean are separated from low clouds using IR SEVIRI channel

Use of 0.4µm & 0.5µm channel should improve separation over ocean



MODIS measurements

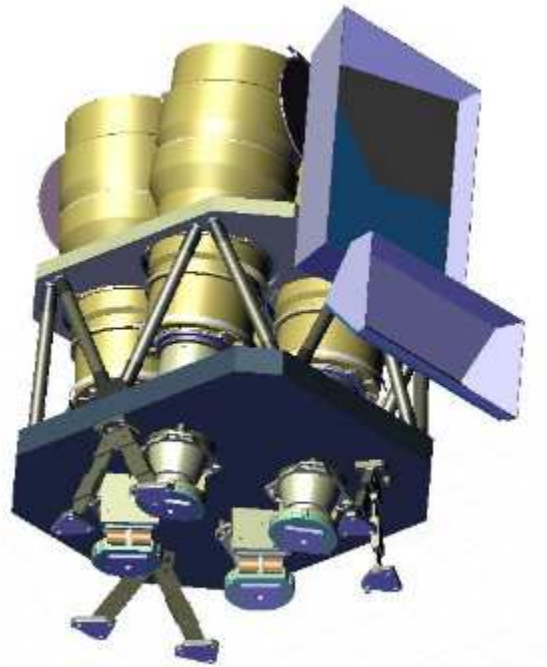
Blue: Ocean Black: low clouds Brown: dust clouds

Use of LI

Use of Lightning Imager (LI) should be useful for convection identification:

-for RDT for the convection diagnosis

-for cloud stratiform/cumuliform identification planned in CT



NWCSAF 2017-2022

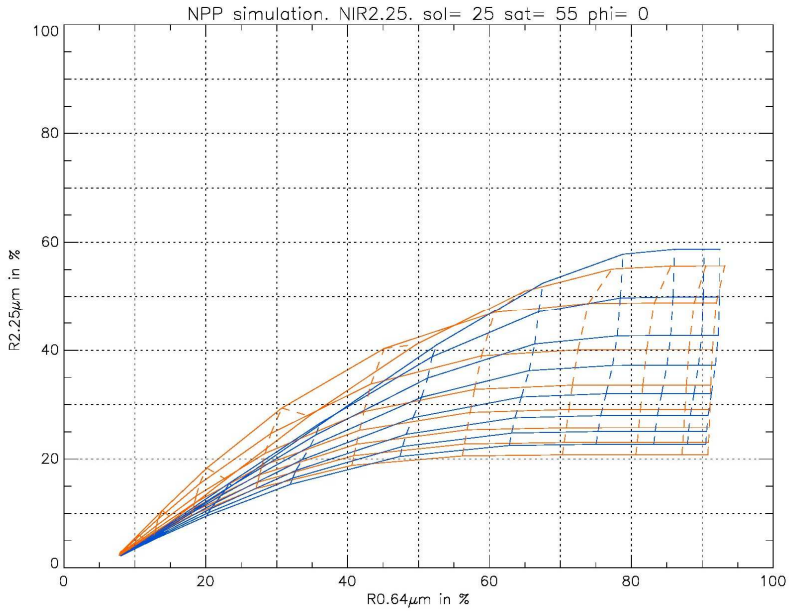
- NWCSAF/GEO will take benefit of channel 1.38µm and 2.25µm to improve cloud products
  - Better detection of thin cirrus
  - Determination of the cloud phase
- High resolution will be used for cloud detection and for stratiform/cumuliform separation
- Plan for cloud products computed at high spatial resolution are beyond 2022
- Prototyping will be performed using japanese (Himawari8) and american (GOES-R) meteorological geostationary satellites to be ready for MTG-I
  - Himawari8/AHI channel 2.25µm
  - GOES-R/ABI channels 1.38µm and 2.25µm
  - GOES-R/LI

NWCSAF 2017-2022

In case MTG/FCI in RRS mode, up to now only 4 channels (0.6µm, 2.25µm, 3.8µm, 10.8µm) are planned to be disseminated (at high spatial resolution).

- -> it is clearly not enough to get good quality cloud products

(for example the identification of cloud phase will be impossible from these 4 channels:



-> The users should request Eumetsat to disseminate more channels