NWCSAF/GEO: Suspended dust detection

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Outline

- Introduction : Dust flag in CMA product
- Algorithm Description
- Validation
- Preparation for MTG

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Introduction

Dust detection in NWCSAF-GEO :

- Variable : cma_dust accessible in CMA product
- flag data : 0 → no dust
  1 → dust
  2 → undefined
  255 → no determinated
- Available for all pixels for each satellite slot
- Performed according to three different algorithms depending on the conditions : day on sea, day over land and night on sea
- Currently, there is no detection at night over land and in twilight area
- NWCSAF-GEO V2018 allows the processing of several geostationary satellite : MSG, Himawari and Goes

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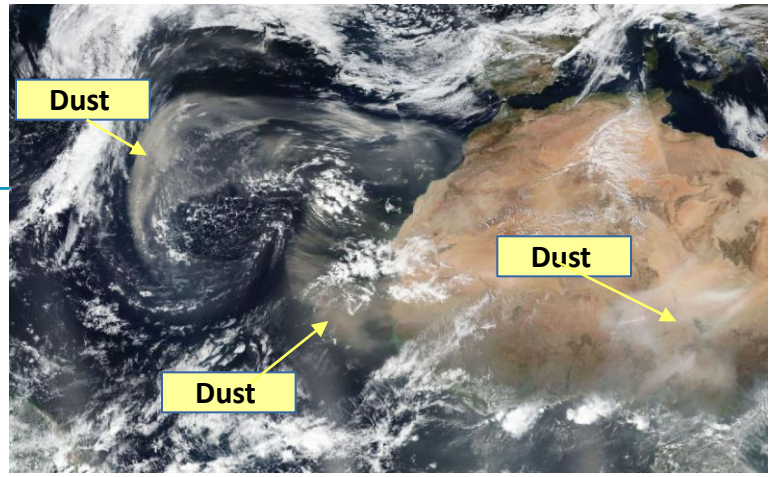
Introduction

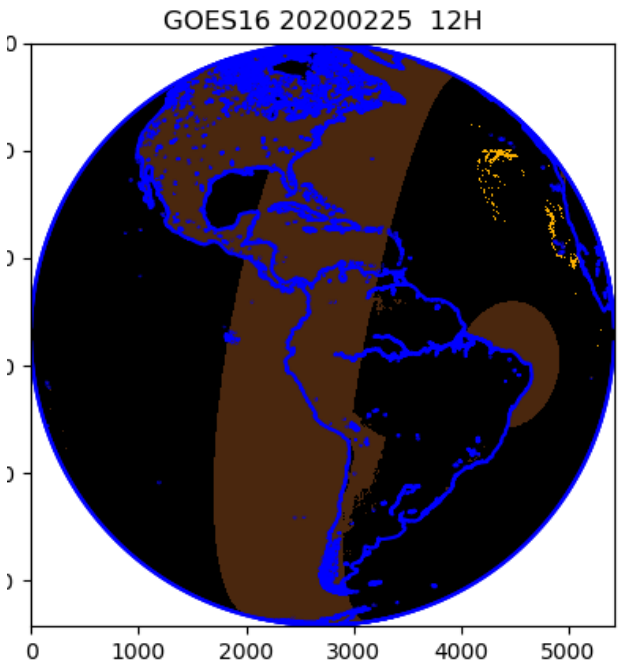
No computed

No dust

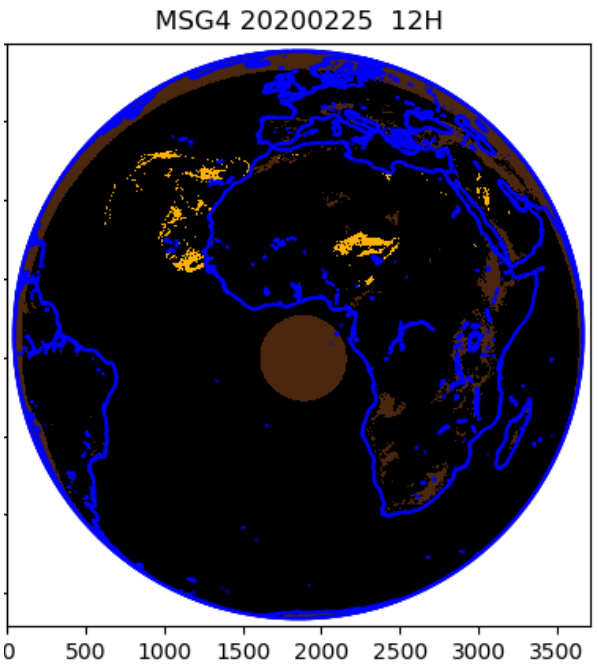
Dust



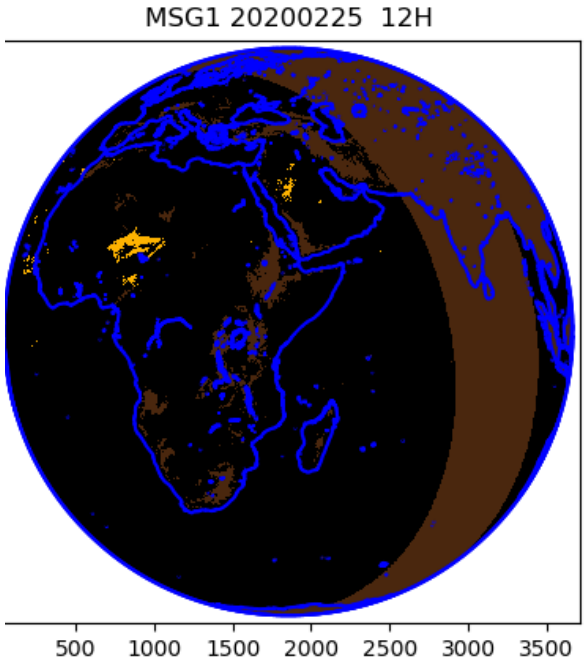
True Color NPP/Viirs : 20200225



GOES16



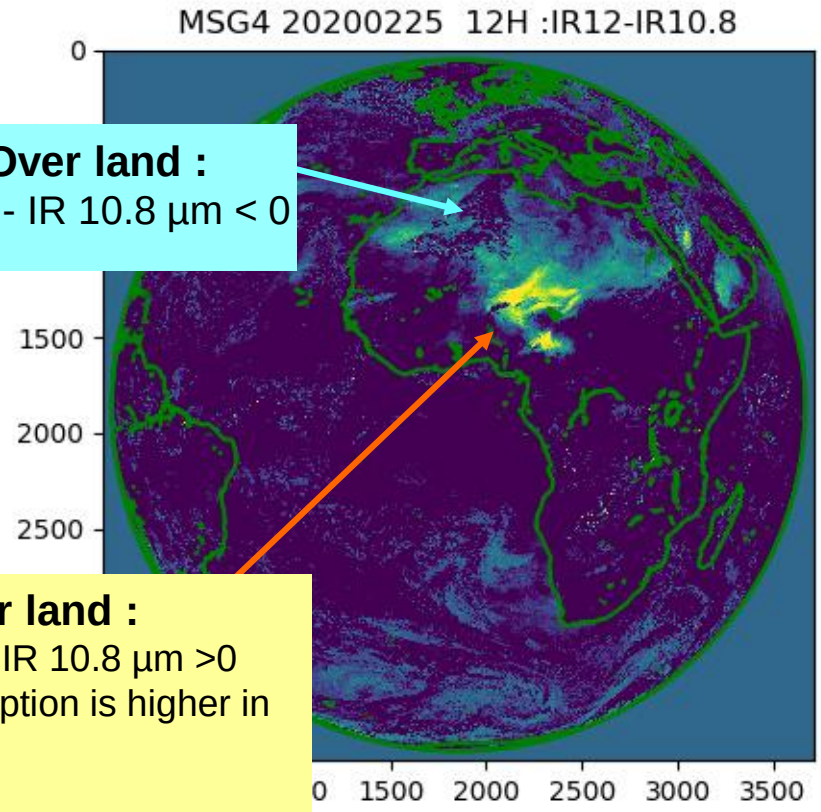
MSG4



MSG1 (IODC)

Algorithm description : thresholding method

By day over land



Clouds Over land :
IR 12 µm - IR 10.8 µm < 0

Dust over land :
IR 12 µm - IR 10.8 µm >0
Dust Absorption is higher in 10,8 µm

MSG04 : IR 12 µm – IR 10.8µm 2020 02 25 12h00

Dust detection

- thresholds on BT differences :
  IR 3.9 µm – IR 10.8 µm
  IR 12 µm – IR 10.8 µm

- threshold on the ration :
  vis0.6 µm / Nir 1.6µm

- Spatial homogeneity of visible reflectance : threshold on infrared and visible variance

To limit false alarms

- threshold on IR 10.8 µm, visible 0.6 µm (not too cold, not too bright)

- smooth in infrared and visible channel

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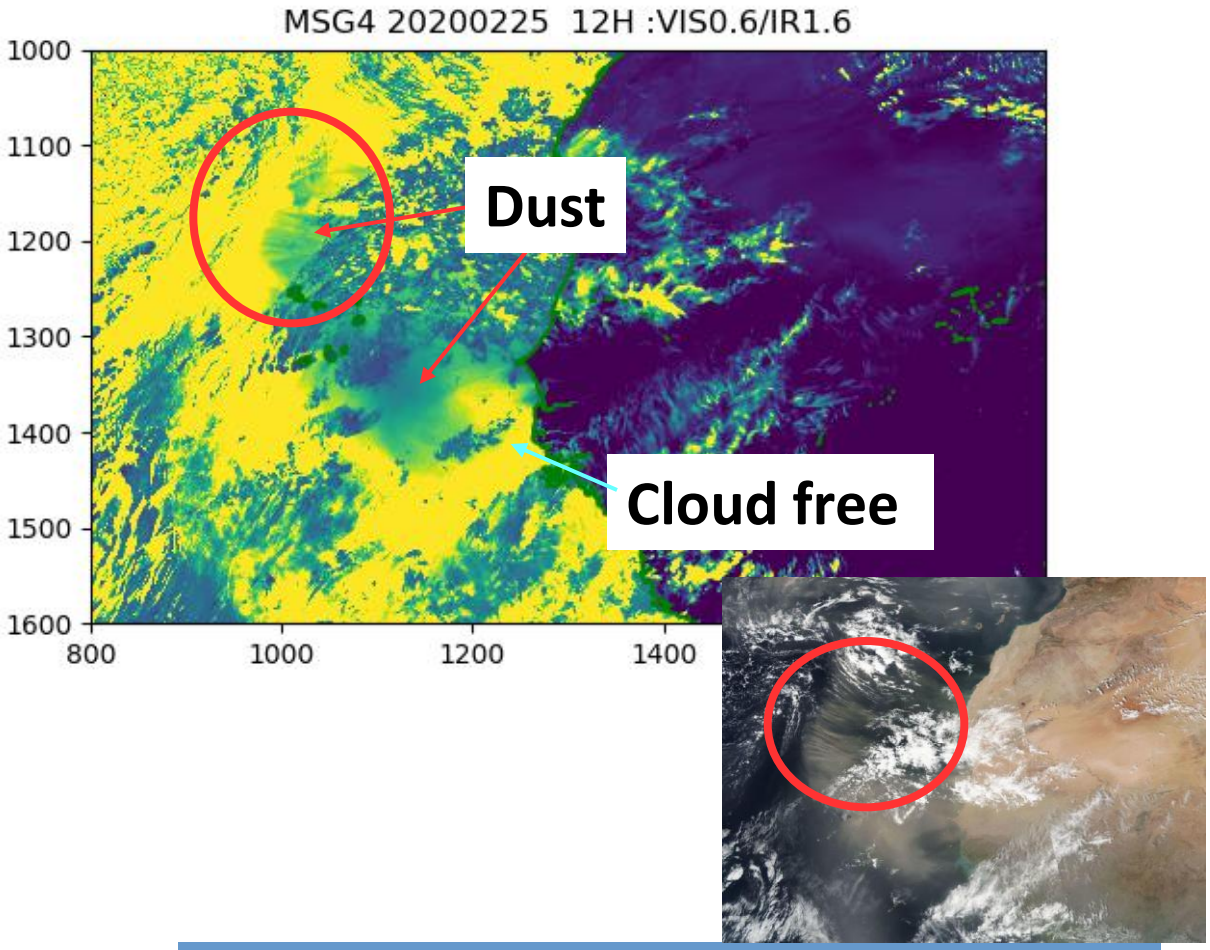
Algorithm Description : thresholding method

By day over sea



MSG04 : VIS 0.6 µm/IR1.6 µm 2020 02 25 12h00

Dust detection

- threshold on differences between IR12µm - IR10.8 µm

- threshold on the ratio vis 0.6µm / Nir 1.6µm

- threshold on infrared and visible variance

To limit false alarms :

- threshold on IR10.8µm (not too cold) ,
IR8.7µm -IR10.8µm (low cloud filter)

- threshold on reflectance (not too bright)

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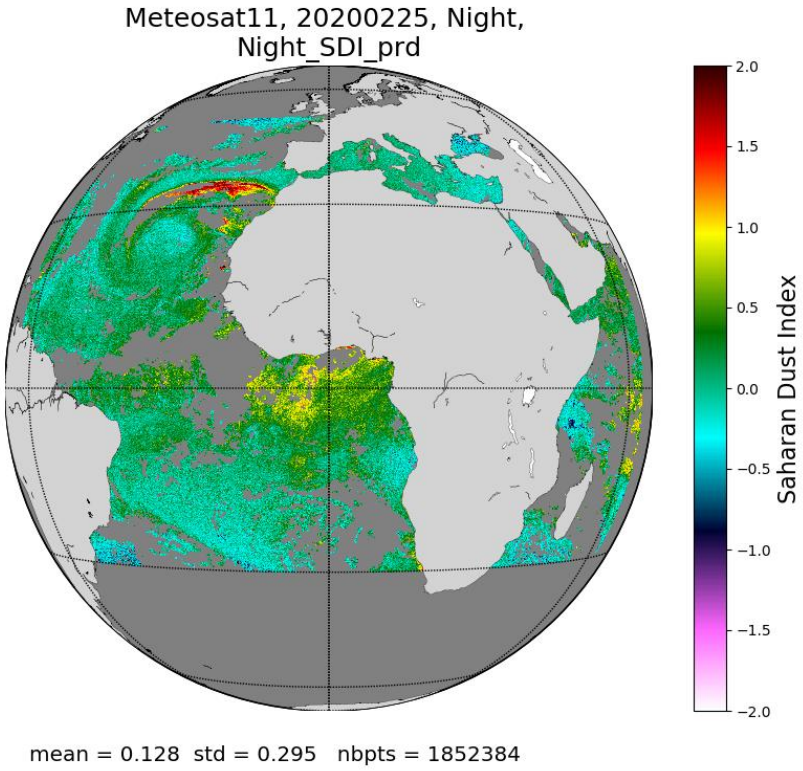
Algorithm Description : thresholding method

By night over sea

Sahara **D**ust **I**ndex = a*(ir10.8-ir12)+b*(ir3.9-ir8.7)+c
(given by OSISAF)



MSG04 : SDI 2020 02 25 at 00h

Dust detection

- **threshold on SDI**

- **threshold on IR 10.8 µm – IR 3.9 µm**

To limit false alarms

- **thermal test (not too cold) : threshold on IR 10.8 µm**

- **hight cloud : threshold on IR 10.8 µm – IR12 µm**

- **low cloud : threshold on IR 8.7 µm - IR10.8 µm**

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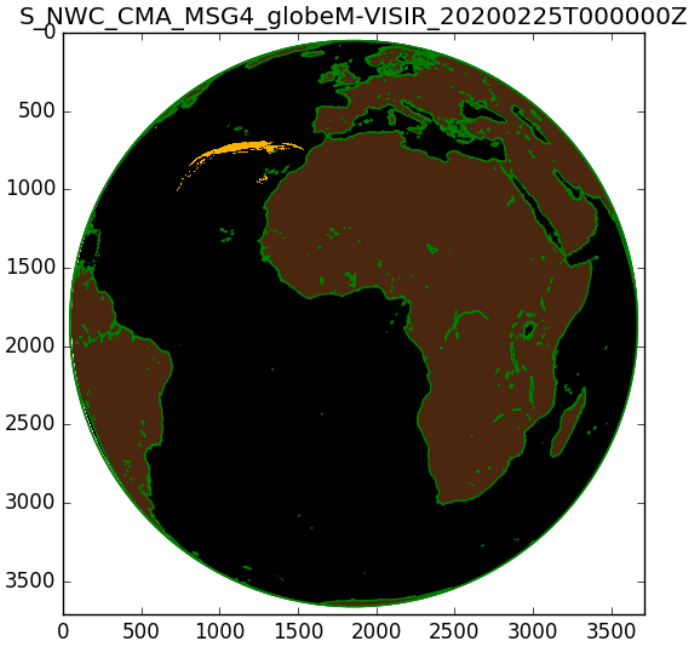
Algorithm Description : thresholding method

CMA Dust flag : OPERATIONAL

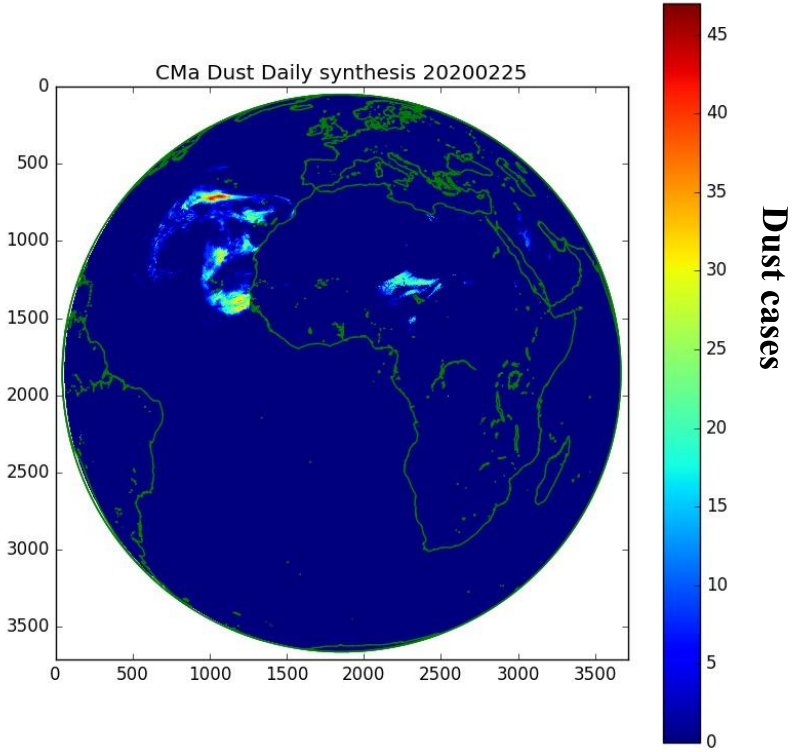


No computed

No dust

Dust

CMa Dust Daily synthesis



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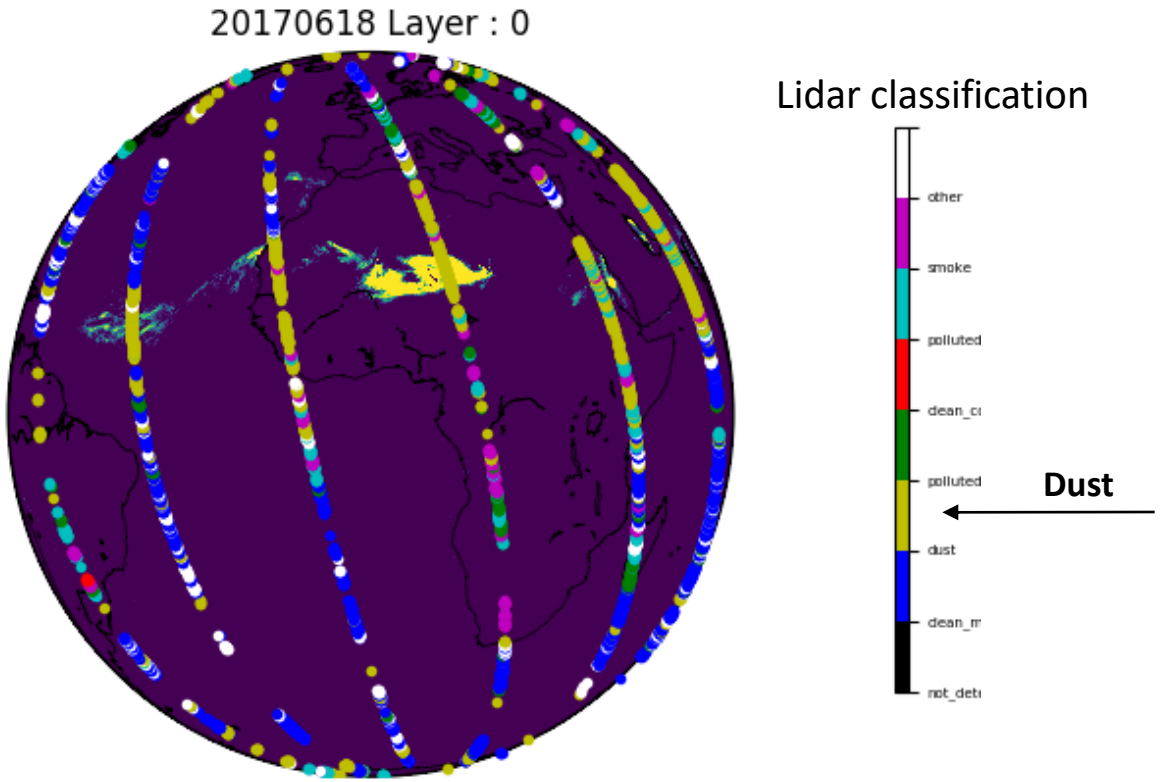
Validation : Method

CMa Dust daily synthesis + Lidar aerosols classification



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Validation : Results

MSG3 CMA DUST	% of CMA Dust detections vs lidar detection	False Alarms
By day over sea	47 %	0 %
By day over land	5 %	0 %
By night over sea	31 %	0,01%

By day over land, CMA Dust flag only detects 5 % of lidar dust observations

No false alarms

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Preparation for MTG : Algorithm improvements

Dust algorithm improvements for MTG :

By day over land :

- the thresholds have been reajusted
- a test on 8,7 μm – 10,8 μm and 3,9 μm - 8,7 μm have been added
- a threshold depending on solar angle has been added on the difference using 3,9 μm : 3,9 μm – 10,8 μm (to limit degraded detections at low sun elevation (morning and evening))

By day over sea :

- thresholds have been reajusted

By night over sea :

- threshold on SDI has been relaxed

By night over land :

- New algorithm has been created using simulations of brightness temperature with radiative transfert model (RTTOV) over clear sky

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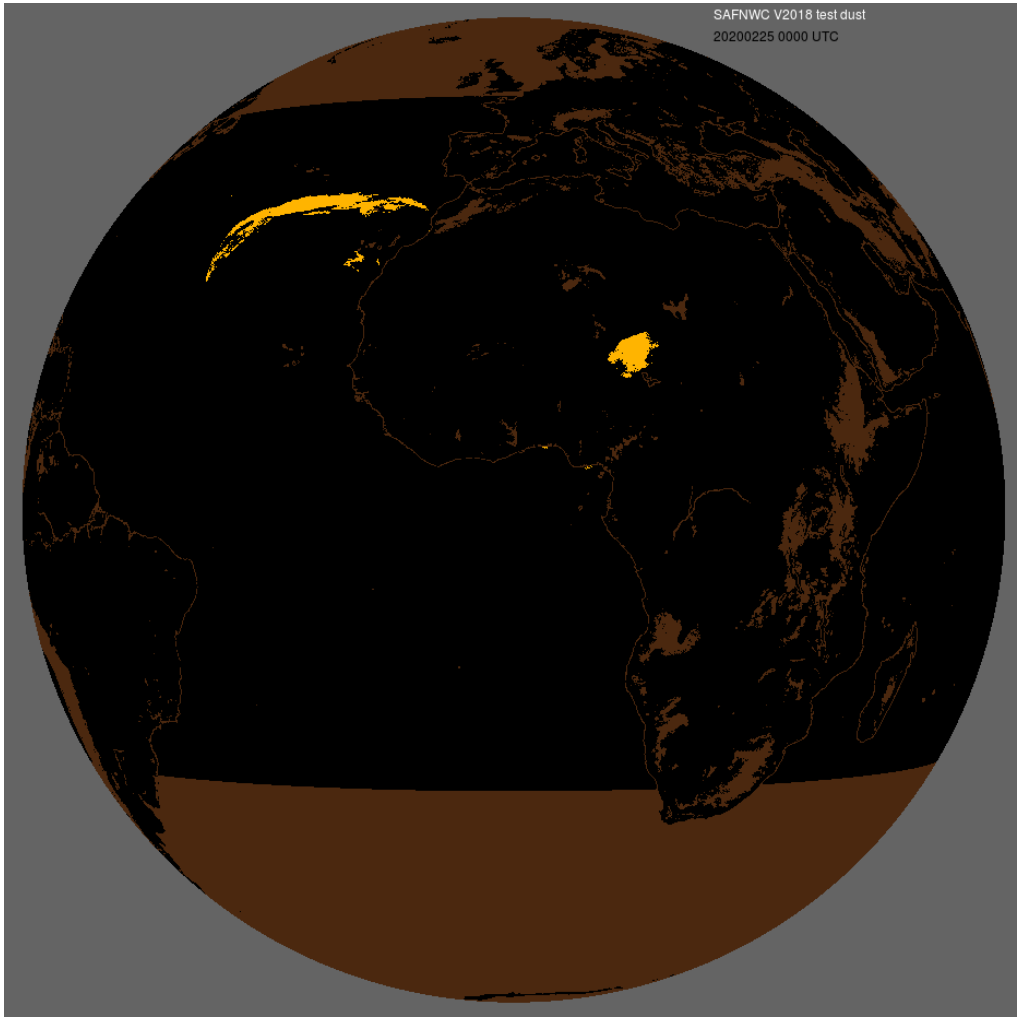
Preparation for MTG : Algorithm improvements

Dust flag with new algorithm :



Algorithm improvement by day and night +new algorithm by night over land :
MSG4 2020-02-25

Preparation for MTG : Algorithm improvements

MSG3 CMA DUST	% of CMA Dust detections vs lidar detection	False Detections
By day over sea	48 %	0 %
By day over land	12.5 %	0,04 %
By night over sea	37 %	0,01%
By night over land	6 %	0,01%

Algorithm improvement by day and night +new algorithm by night over land : Validation with MSG3 + lidar

Channel from Goes16 and Himawari8 similar to those MTG :

Test the new algorithm :

over land with Himawari 8

over sea with Goes 16

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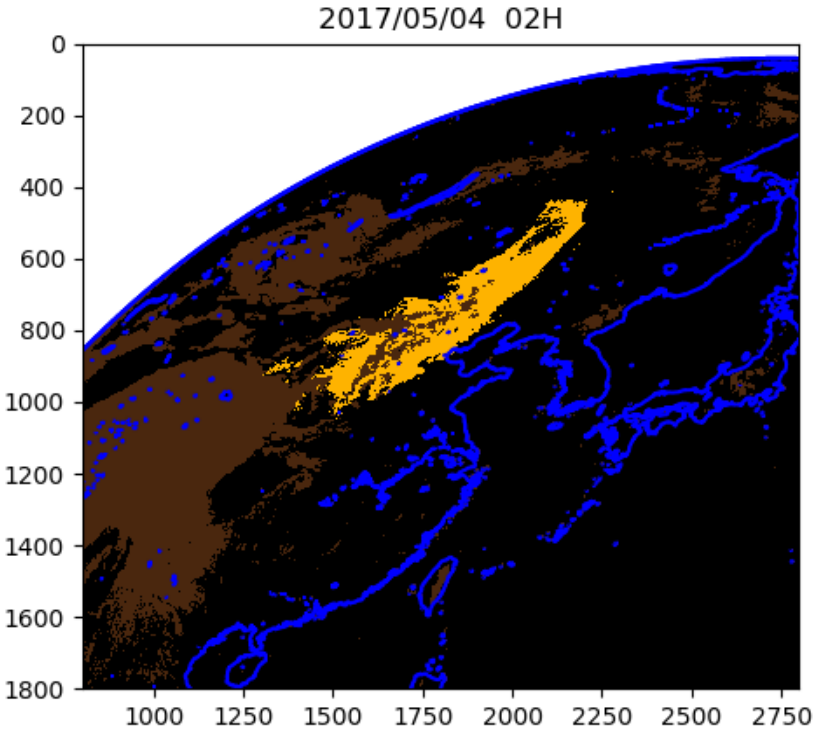
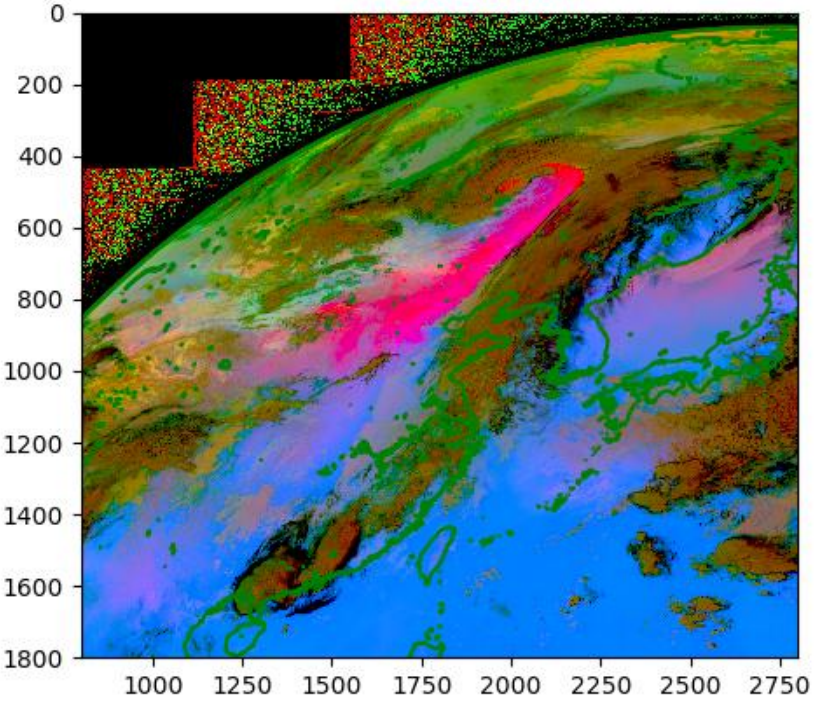
Preparation for MTG : new algorithm applied on Himawari 8

By Day



New algorithm applied with Himawari data



RGB dust

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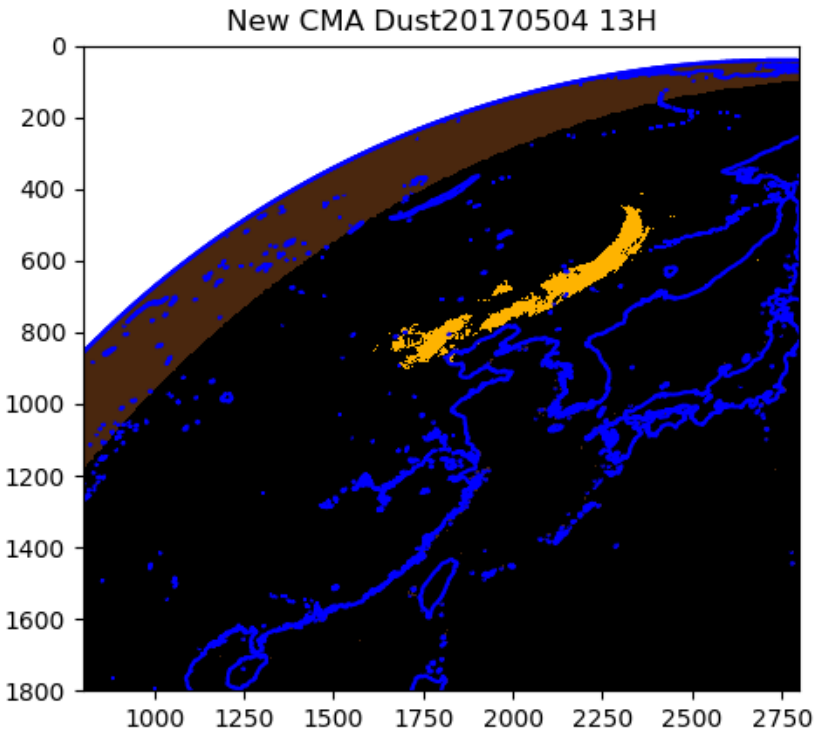
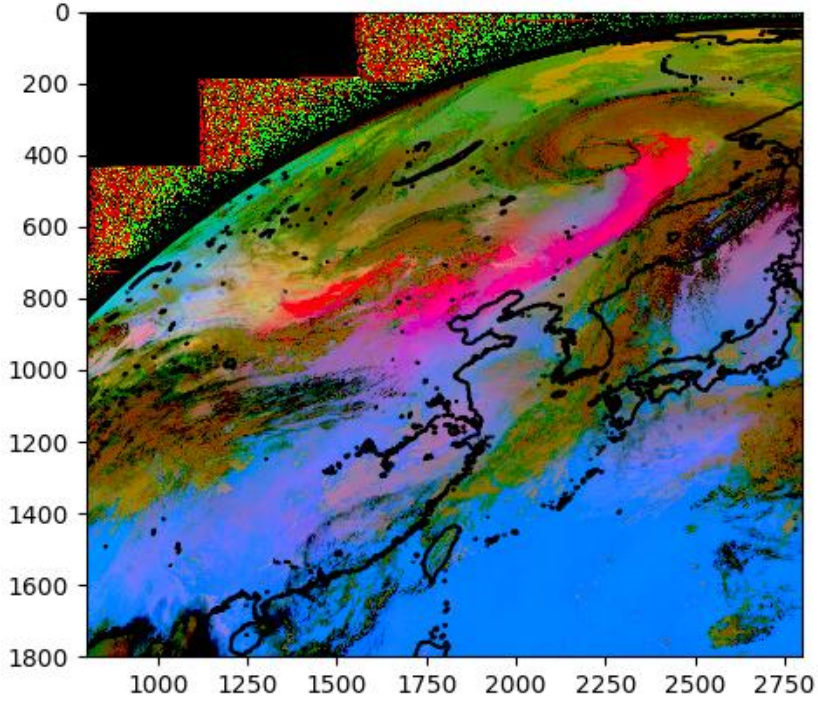
Preparation for MTG : new algorithm applied on Himawari 8

By Night



New algorithm applied with Himawari 8 data



RGB dust

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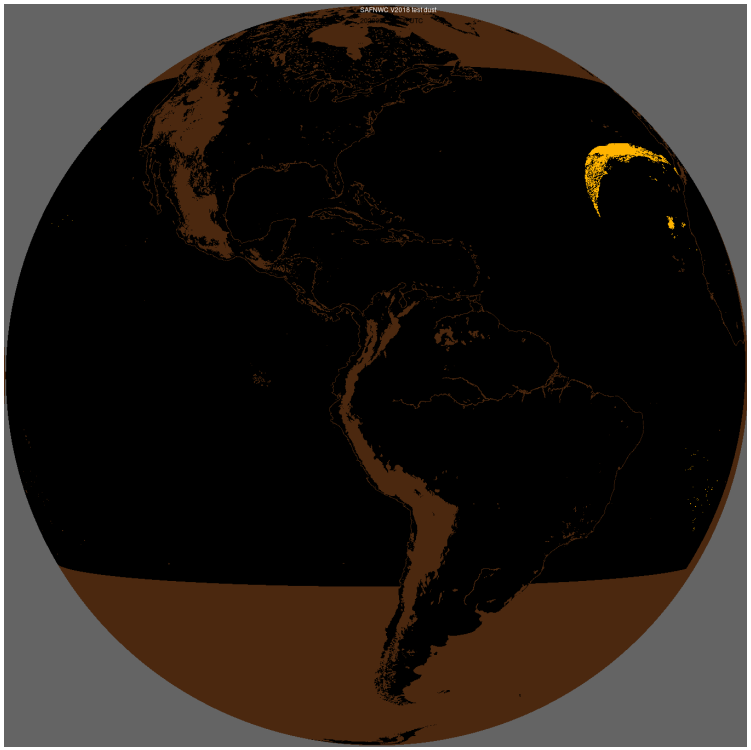
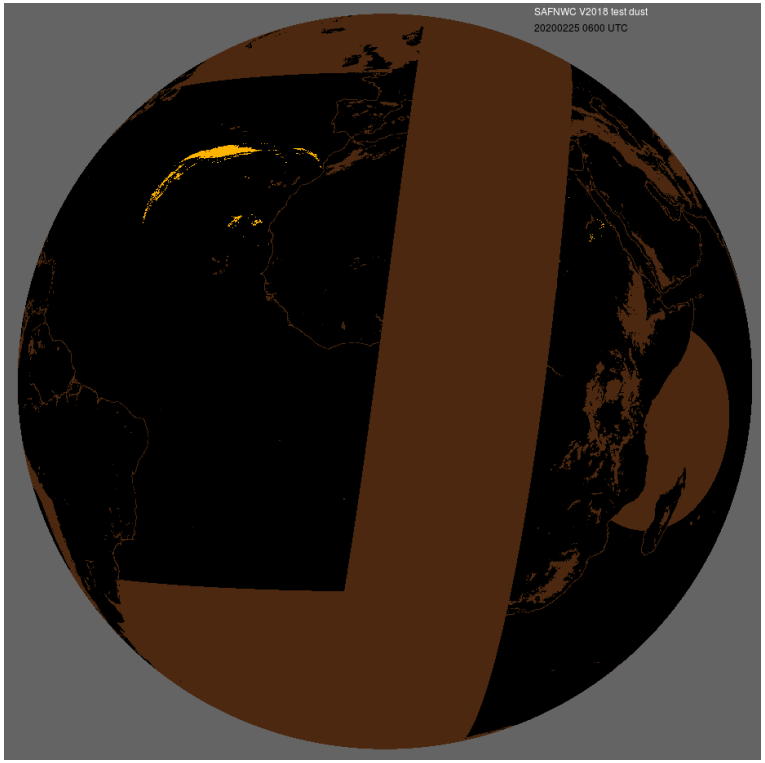
Preparation for MTG : new algorithm applied on Goes 16





Goes 16

By night over sea
20200225 at 06h00

MSG04

Conclusion

For MTG :

- the new algorithms have been improved especially by day over land

- A Night algorithm over land has been created but detects very few cases compared to lidar observations

- The new algorithms applied with Goes 16 and Himawari 8 channels present a good behaviour

- This new version of dust flag will be available in the SAFNWC GEO software version delivered for MTG during 2022

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