Global sensitivity analysis to assess instrument capability for the study of the future Meteosat Third Generation/Flexible Combined Imager (MTG/FCI) to detect aerosols

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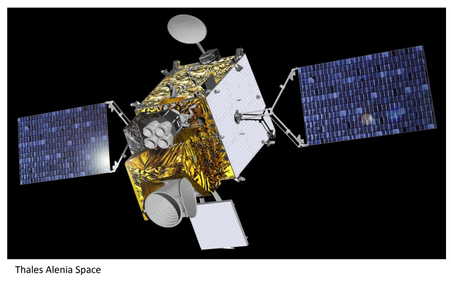
PARTNERS

Future: Meteosat MTG


Thales Alenia Space

Meteosat Third Generation is the next European generation of geostationary meteorological satellites

- 1/3 of entire earth surface observed by 1 satellite
- Full scan every **10 min** with a spatial resolution between 0.5 and 2 km at nadir, depending on channel
- **16 channels** of observation included in the imager (FCI)

Channel	Central Wavelength, λ_0	Bandwidth, $\Delta\lambda_0$	Spatial Resolution
VIS 0.4	**0.444 µm**	**0.060 µm**	**1.0 km**
VIS 0.5	**0.510 µm**	**0.040 µm**	**1.0 km**
VIS 0.6	0.640 µm	0.050 µm	1.0 km; 0.5 km
VIS 0.8	0.865 µm	0.040 µm	1.0 km
VIS 0.9	**0.914 µm**	**0.020 µm**	**1.0 km**
NIR 1.3	**1.380 µm**	**0.030 µm**	**1.0 km**
NIR 1.6	1.610 µm	0.050 µm	1.0 km
NIR 2.2	**2.250 µm**	**0.050 µm**	**1.0 km; 0.5 km**
IR 3.8 (TIR)	3.800 µm	0.400 µm	2.0 km; 1.0 km
WV 6.3	6.300 µm	1.000 µm	2.0 km
WV 7.3	7.350 µm	0.500 µm	2.0 km
IR 8.7 (TIR)	8.700 µm	0.400 µm	2.0 km
IR 9.7 (O_3)	9.660 µm	0.300 µm	2.0 km
IR 10.5 (TIR)	10.500 µm	0.700 µm	2.0 km; 1.0 km
IR 12.3 (TIR)	12.300 µm	0.500 µm	2.0 km
IR 13.3 (CO_2)	13.300 µm	0.600 µm	2.0 km

Objective : How to assess the capability of MTG/FCI to detect dust aerosols ?

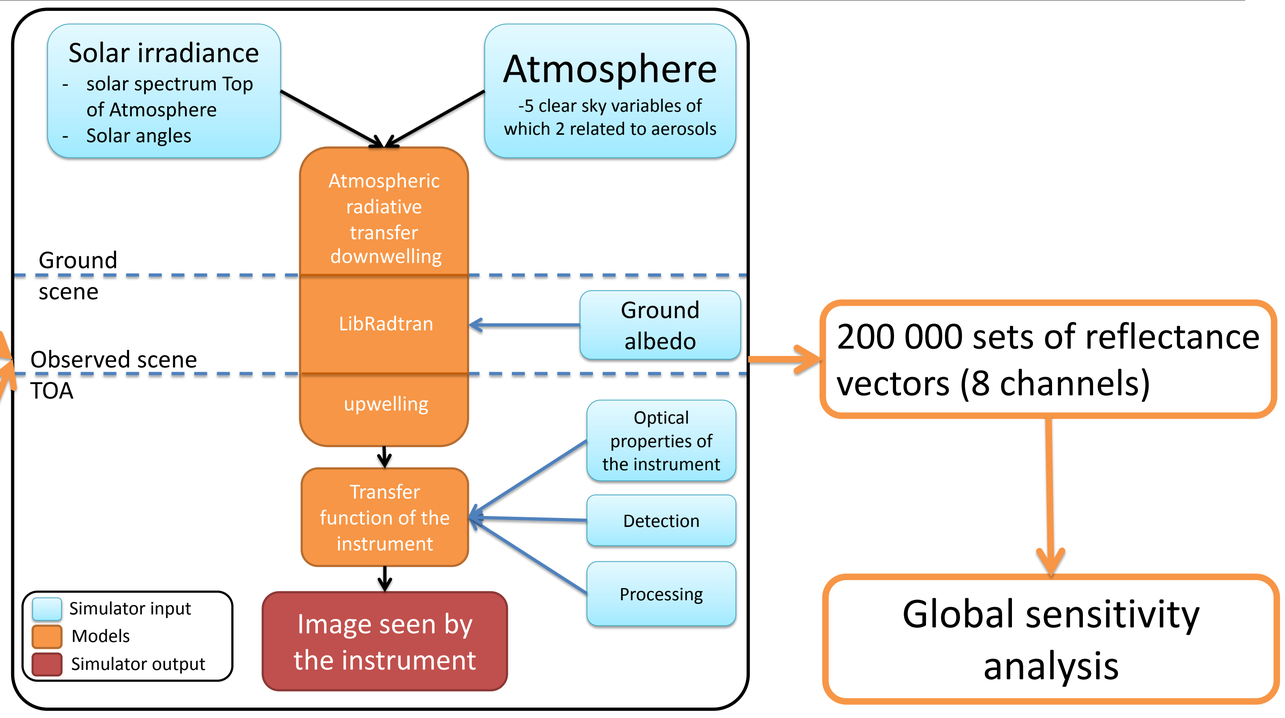
Simulator

200000 sets of atmospheric conditions:

- AERONET, Tamanrasset_INM (level 2.0 and 1.5) ➔ Aerosol Optical Depth (AOD), Water Vapor (WV)
- MODIS MCD43B3 2000-2004 ➔ ground albedo
$$\rho_G = (WS + BS)/2$$
- MACC Ozone Product, closest grid point of Tamanrasset ➔ Total Column Ozone

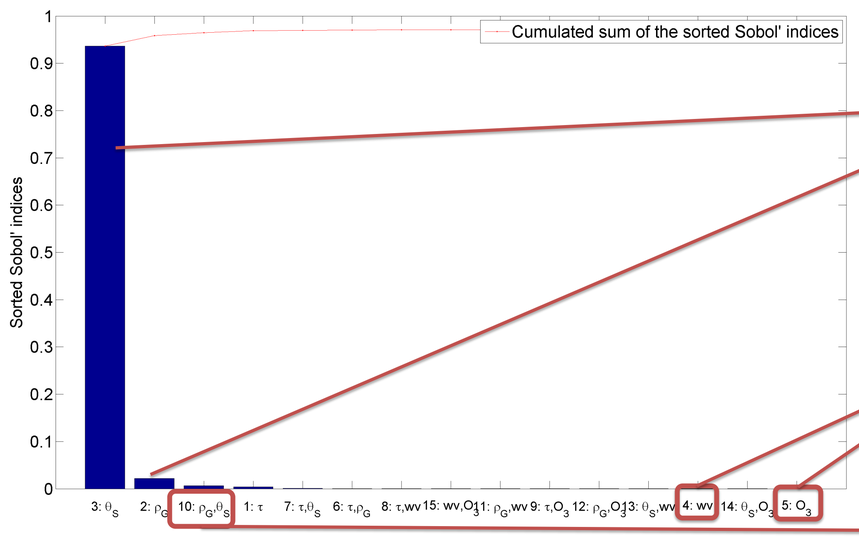
MTG/FCI properties for each channel:

- Spectral response function
- Calibration
- Signal to Noise Ratio



Scheme of the simulator

Global sensitivity analysis (example on VIS04)

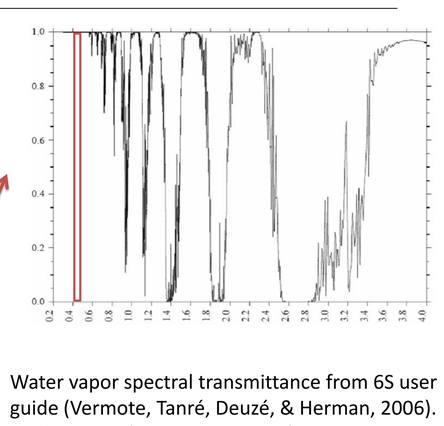


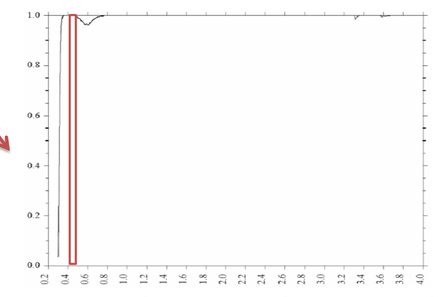
1st and 2nd order Sobol Index calculated for 5 input variables for the **Vis04** channel of the FCI

θ_S and ρ_G rank #1 and #2 in agreement with the radiative transfer equation

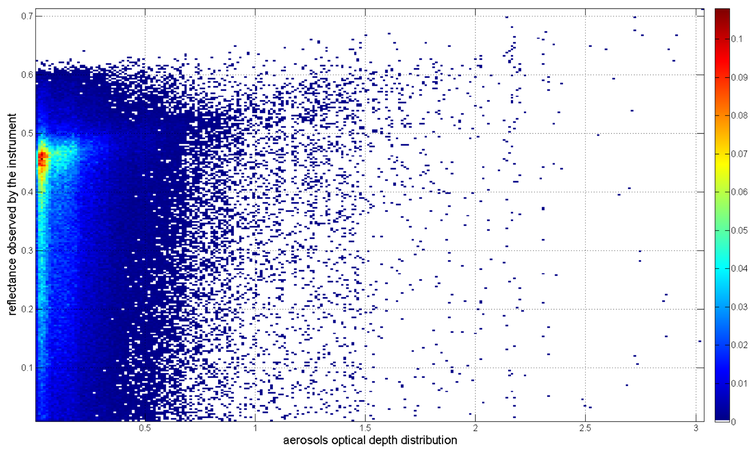
Total column content of water vapor or ozone has no impact on this channel

Cross-term (θ_S, ρ_G) rank #3

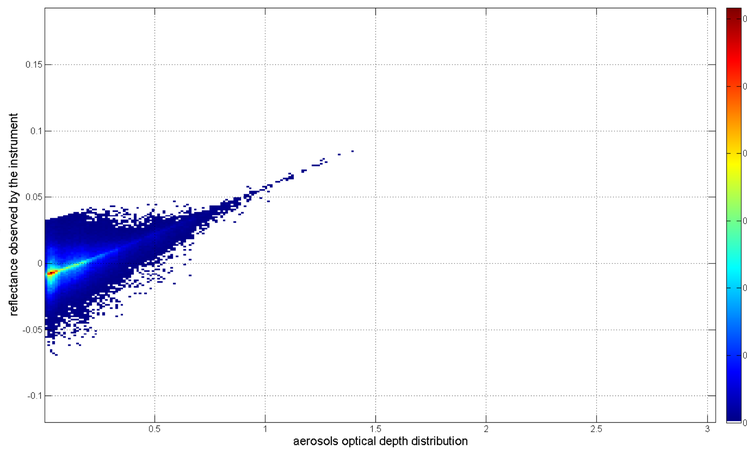

Water vapor spectral transmittance from 6S user guide (Vermote, Tanré, Deuzé, & Herman, 2006). VIS04 spectral response is in red.


Ozone spectral transmittance from 6S user guide (Vermote, Tanré, Deuzé, & Herman, 2006). VIS04 spectral response is in red.

Results



Removal of the influence of θ_S and ρ_G



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Conclusion

Relative influence of variables may be deduced from the GSA and removed, thus reducing the uncertainty of the reflectance residual with AOD.
Leading to the estimation of the capabilities of MTG/FCI to detect aerosols which are deduced from narrower dispersion.

References:

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