EUMETSAT

EUMETSAT Short Courses:

Wildfire Monitoring with Next-Generation Satellites

6 July 2022

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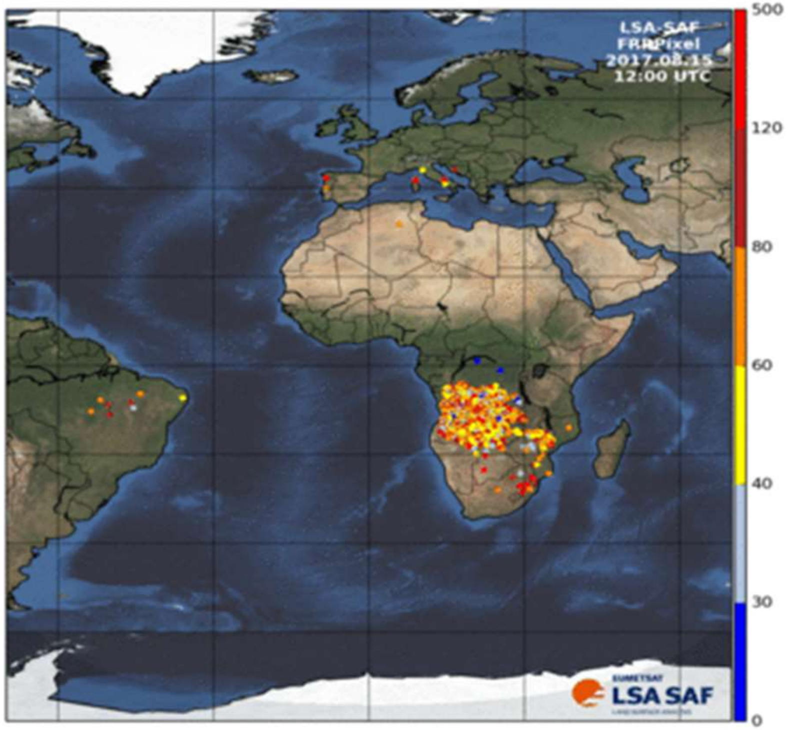
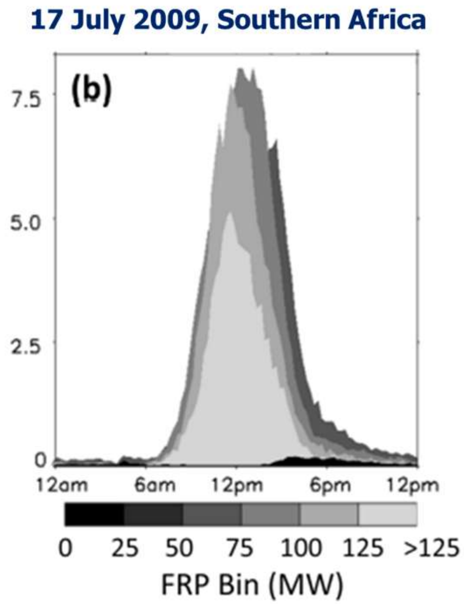
NRT Fire Monitoring

Fire Radiative Power

- ✓ Hot spots detection
- ✓ Intensity [MW]
- ✓ able to detect extremely sub-pixel fires
- ✓ allows the estimation of FRP values as low as ~ 30 - 40 MW



- ✓ Monitor fire diurnal cycle



http://lsa-saf.eumetsat.int

Wooster et al., 2015
https://doi.org/10.5194/acp-15-13217-2015

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NRT Fire Monitoring

Ground projection area of the sensor FOV [m2]

Stefan-Boltzmann constant = 5.67x10-8 W.m-2.K-4

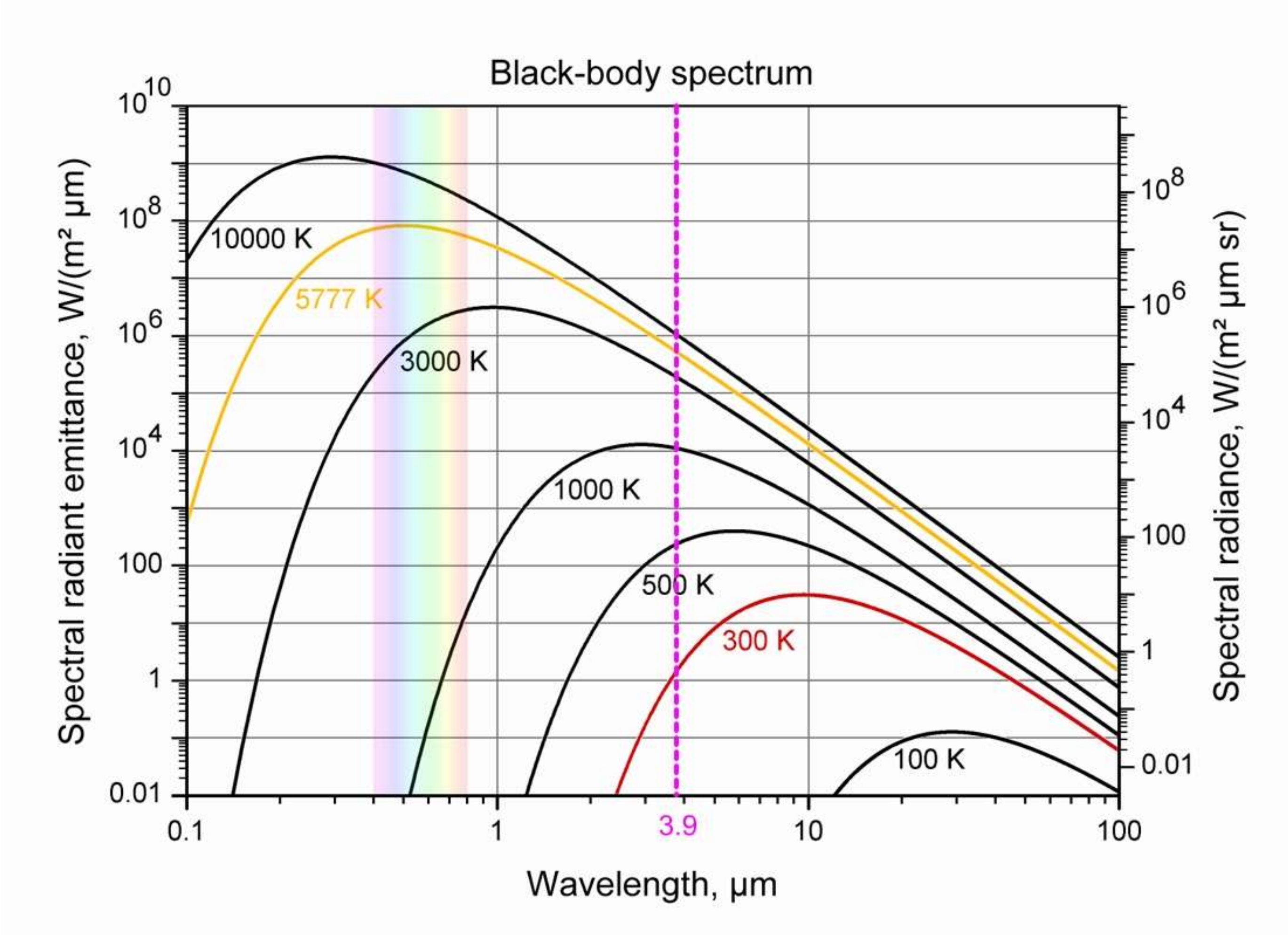
$$\mathrm{FRP} = \frac{A}{\tau x 10^6}\left(\frac{\sigma}{\rho}\right)(L - L_b) \quad [\mathrm{MW}]$$

Atmospheric transmittance

converts the FRP into units of MW.

Constant = 4.6754 x 10-9 [W·m−2·sr−1 ·μm−1 · K−4]

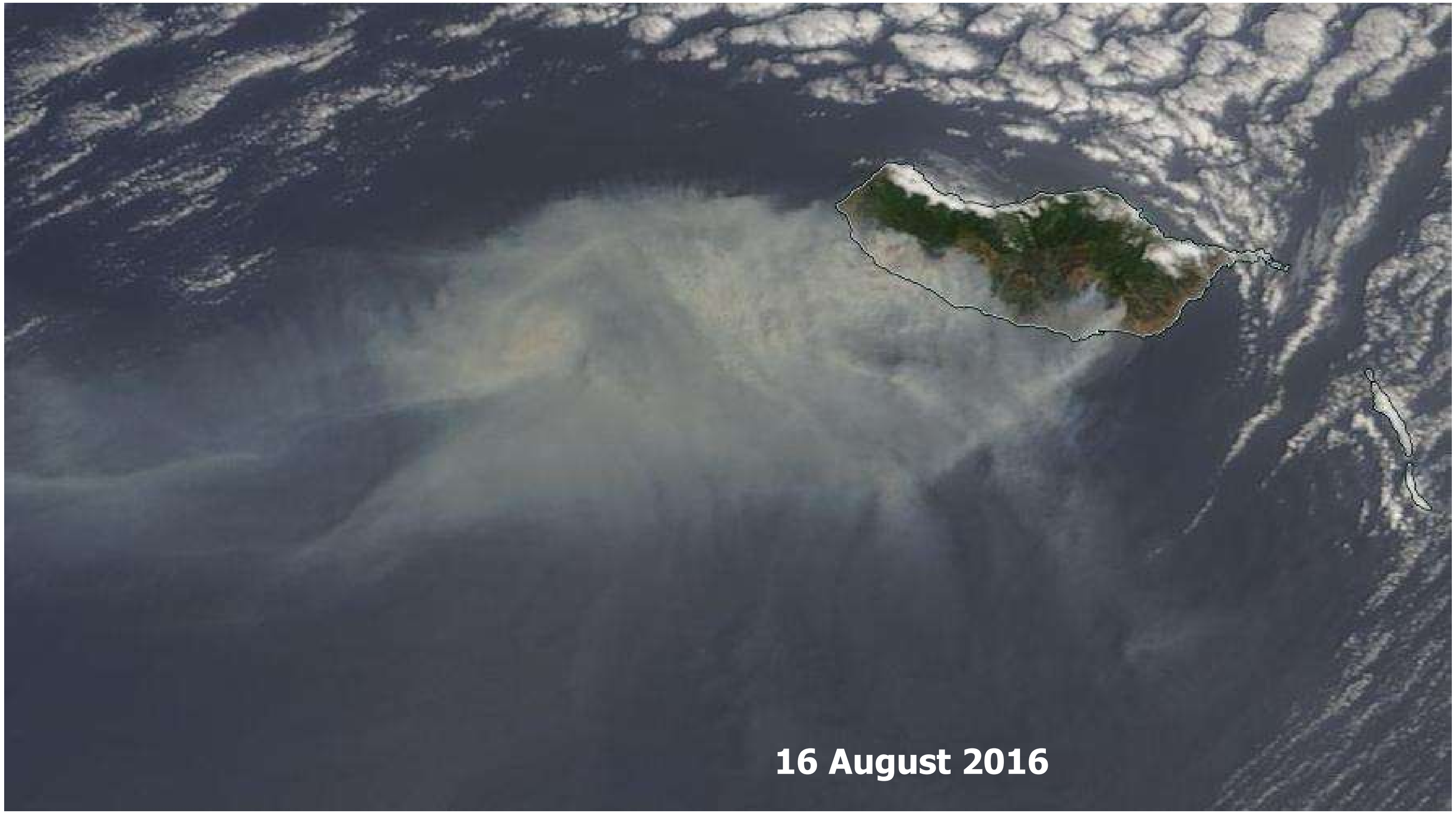
NRT Fire Monitoring



Fires produce smoke and trace gases emissions

True Color RGB

TERRA/MODIS



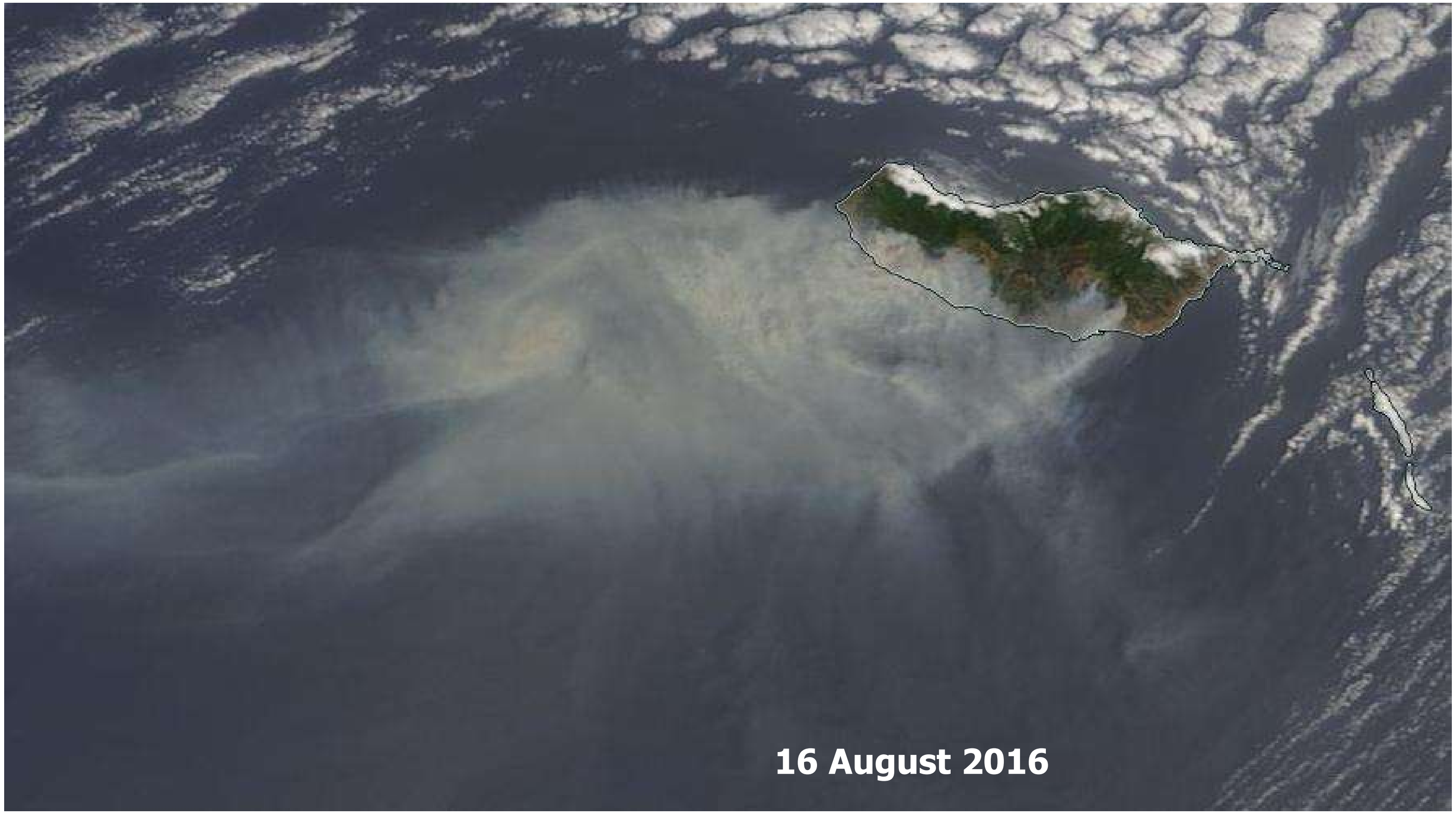
https://worldview.earthdata.nasa.gov/

Fires produce smoke and trace gases emissions

True Color RGB

TERRA/MODIS

Colour	Channel [µm]
Red	VIS0.67
Green	VIS0.56
Blue	VIS0.49



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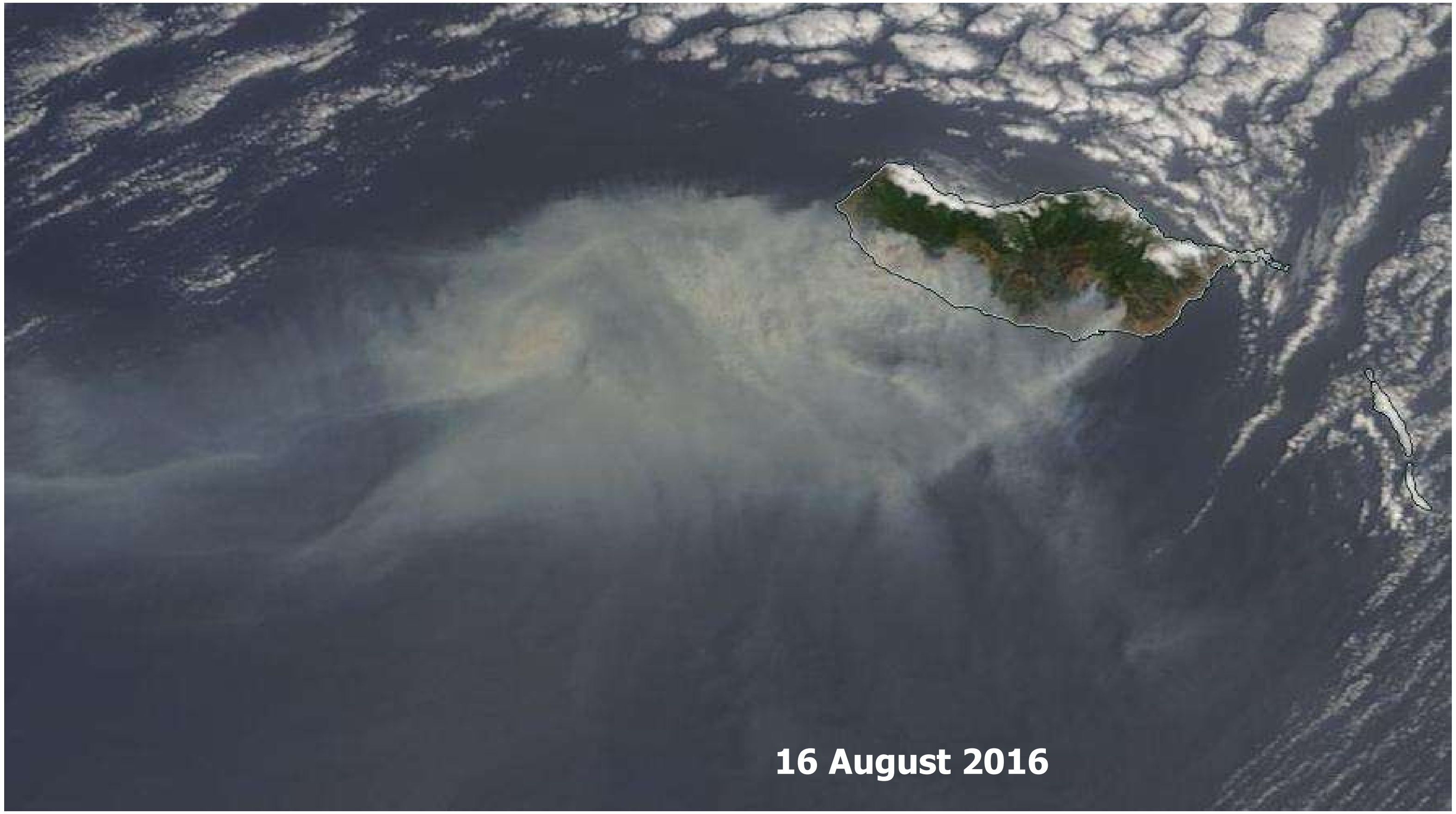
NEW for FCI!



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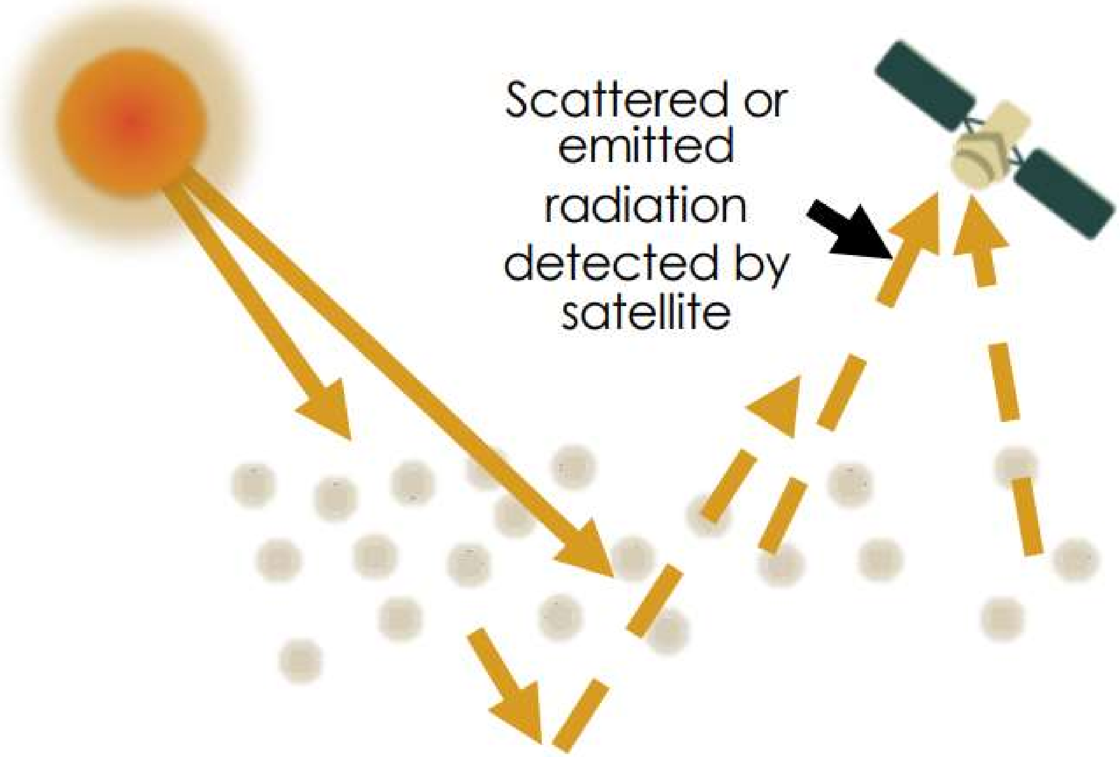
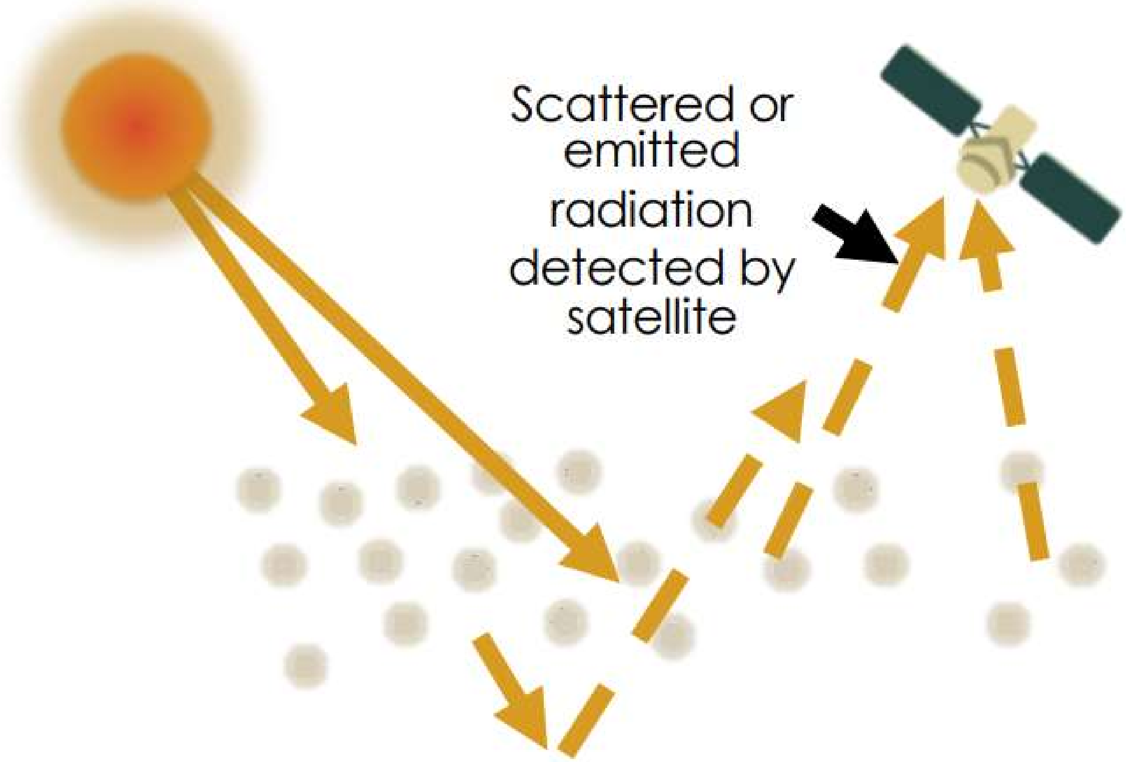
Can we quantitatively measure aerosols and gases?

All satellite remote sensing measurements of the troposphere are based on the use of electromagnetic radiation and its interaction with constituents in the atmosphere



Can we quantitatively measure aerosols and gases?



Satellites measure reflected radiation (at different wavelengths)

The different atmospheric constituents (aerosols or gases) leave different a "spectral fingerprint" in the radiation

Retrieval algorithms to derive physical quantities

AOD

Aerosol optical Depth (AOD) is a quantitative measure of aerosols in the atmosphere

measure of scattering/absorption of visible light by aerosols (sum of aerosol extinction at all atmospheric levels, from surface up to the top of the atmosphere)

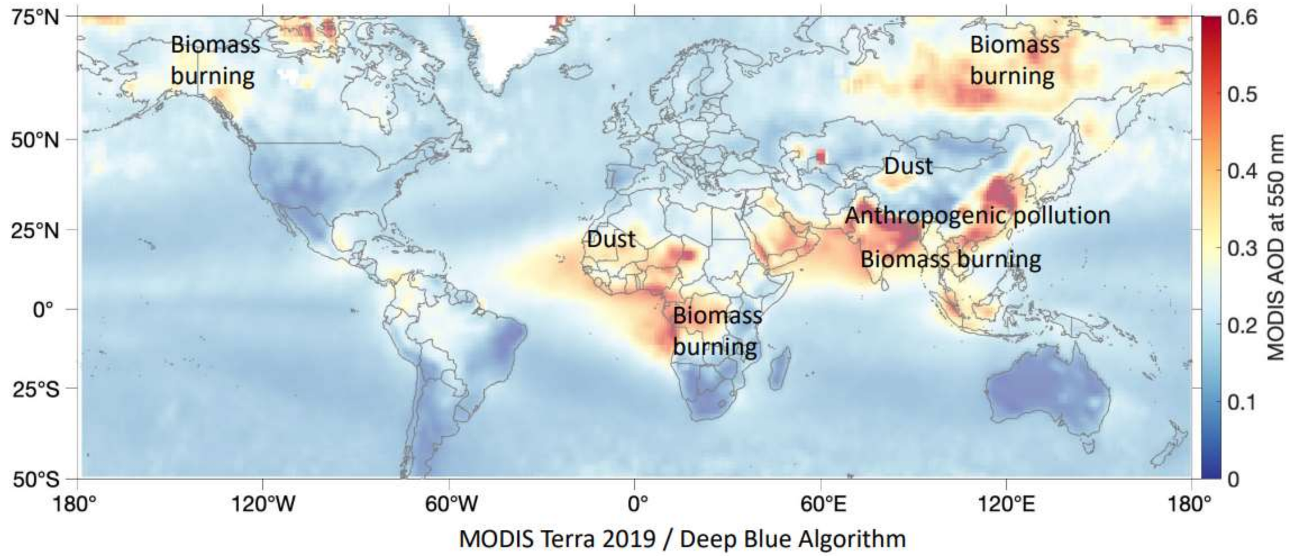
$$AOD = \int_{surf}^{TOA} \beta_e(s)\,ds$$

[unitless]

AOD is wavelength dependent, often products give AOD e.g. at 550 nm

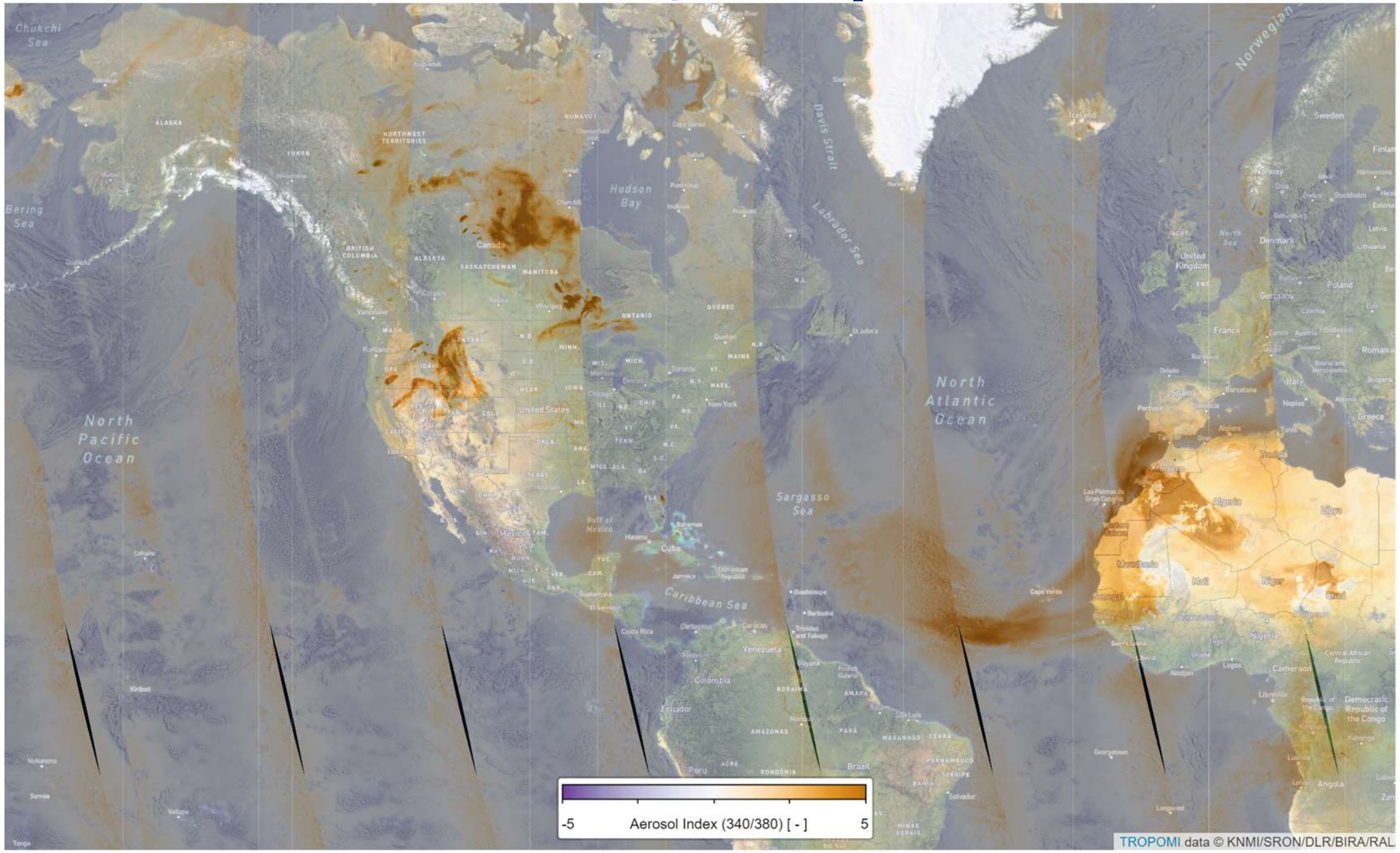
AOD retrieval not possible in regions with clouds

AOD does not inform about the type of aerosol!



UV Aerosol Index

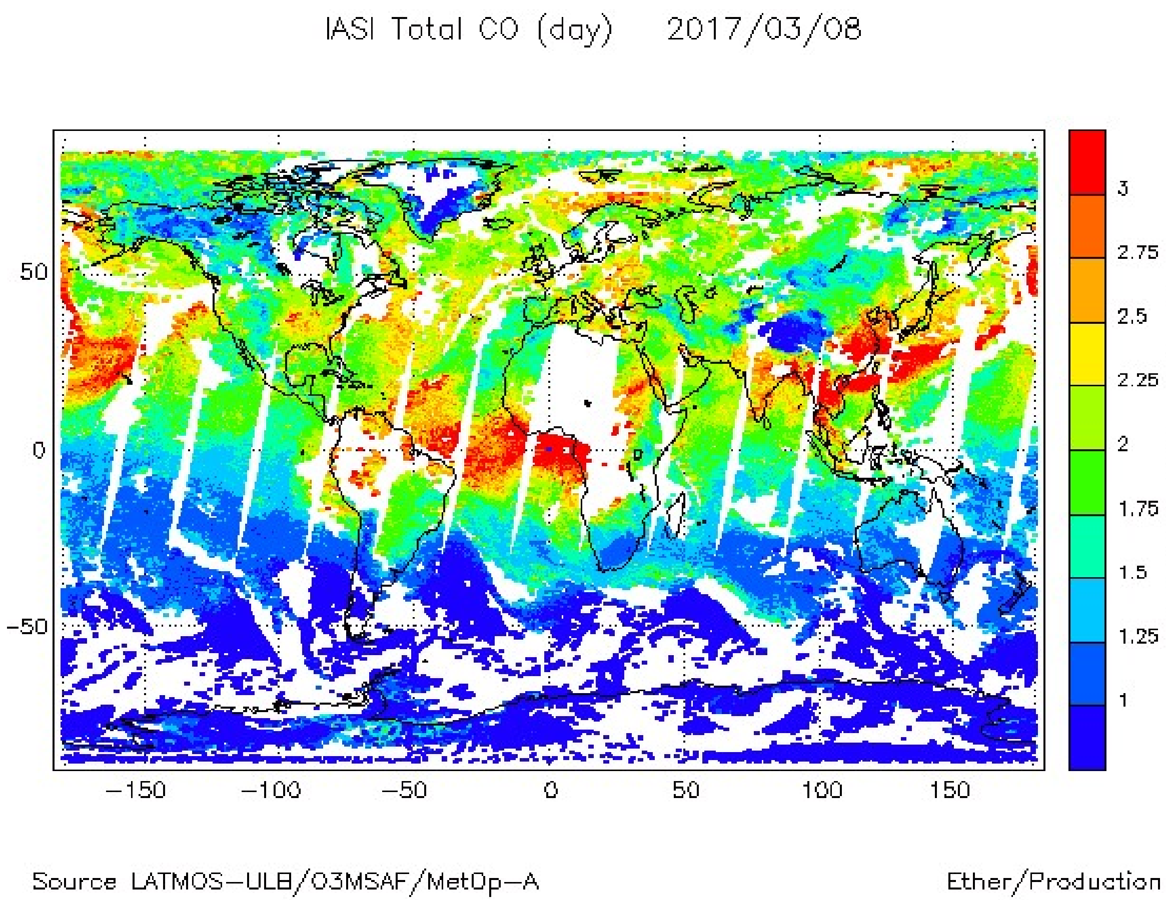
S5P/TROPOMI UVAI,10 July 2021

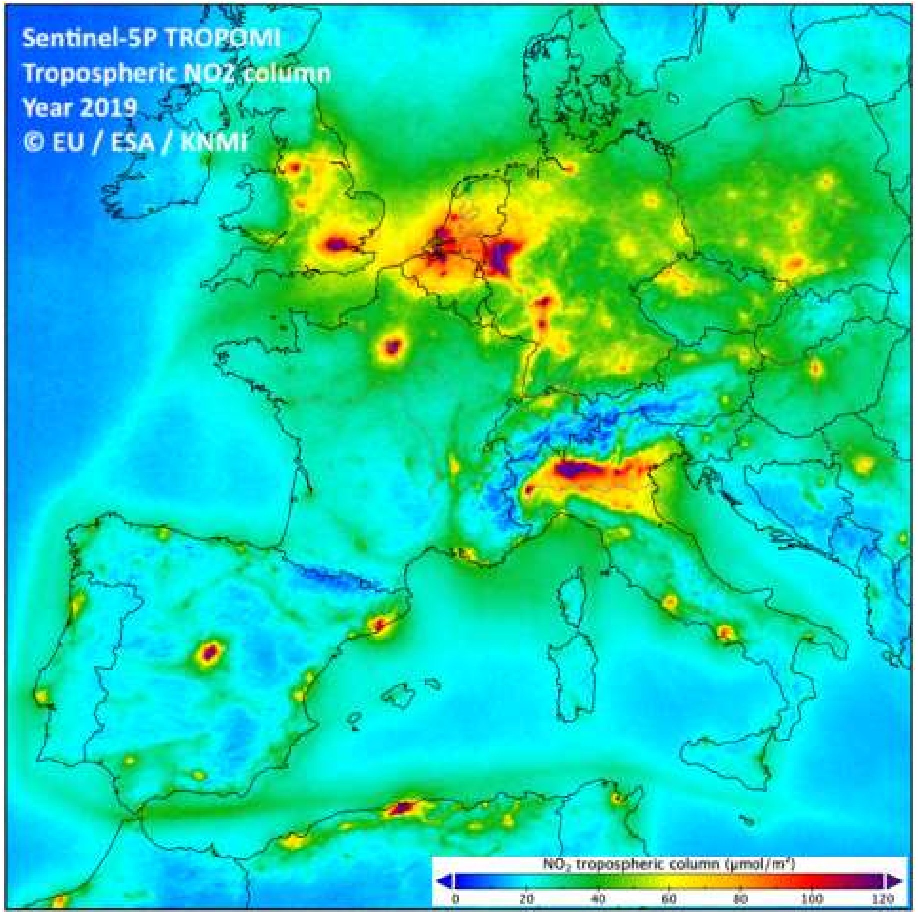


- Uses **UV wavelengths** (340-380 nm): GOME-2, TROPOMI
- Sensitive to absorbing aerosols: smoke, dust, volcanic ash
- Can also be calculated in the presence of clouds
- Provides more complete view of the plume but doesn't indicate the amount of aerosols

http://www.tropomi.eu/

Trace Gases





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Key instrumentation/mission for AC:

OMI
NASA AURA

- Since 2004
- Polar orbit
- Trace gases, **aerosols,** clouds, UV- radiation
- FMI as the co-PI institute with KNMI

GOME-2 and IASI
Metop-A, B. and C

- Since 2006, 2012, and 2018
- Metop-A no data after Oct/Nov. 2021
- Polar orbit
- Trace gases, **aerosols,** methane, clouds, UV- radiation

TROPOMI
Copernicus sentinel 5p

- Since 2017,
- Polar orbit
- Trace gases, **aerosols**, clouds, UV- radiation, methane

MODIS
NASA Terra and Aqua

- Since 1999, and 2002
- Polar orbit
- **Aerosols,** clouds, fire detection

VIIRS NOAA/NASA
SNPP and JPSS

- Since 2011, and 2017
- Polar orbit
- **Aerosols**, clouds, fire detection