



How do mineral dust aerosols impact N₂O retrievals from IASI?

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Retrieval method:

- All IASI cloud-free
- Tikhonov
- Micro-windows
- N₂O (+Ts) only
- RTTOV v13

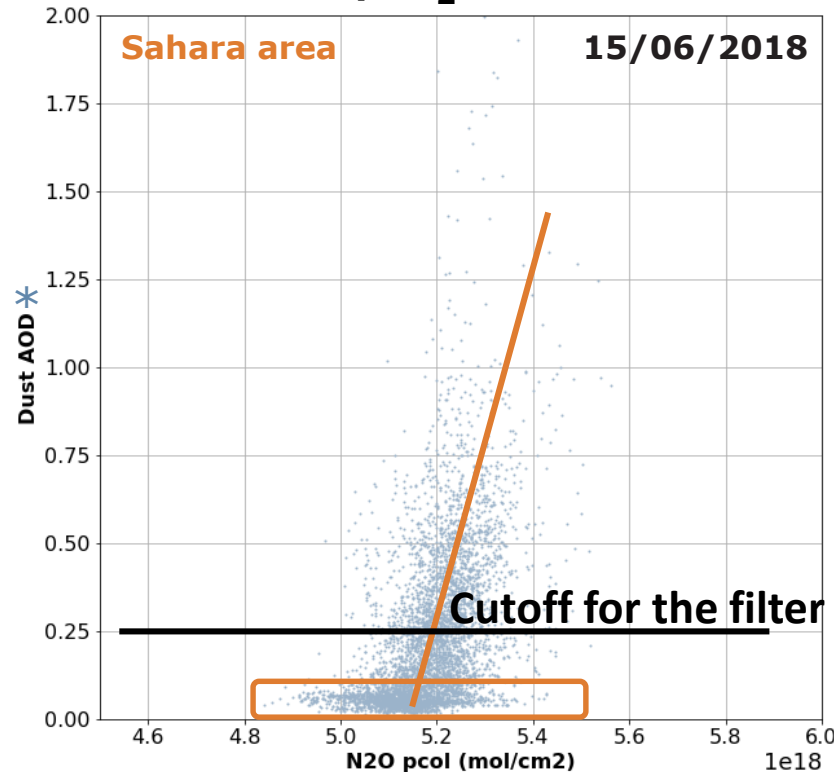
IASI N₂O product:

- At pixel resolution
- Profile (2 DOF)
- Averaging kernels
- Uncertainty 2-3%

Validation against NDACC and TCCON:

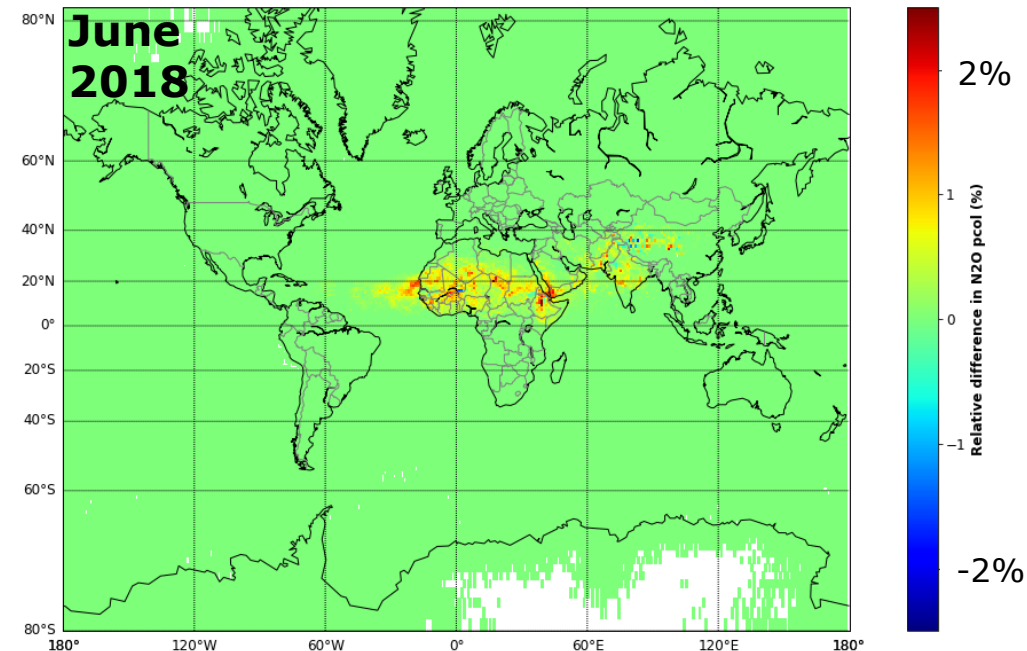
- Bias : median 3% max 4.5% (w. exceptions)
- Higher bias at some high latitude stations
- Std dev usually 2-3%

Dust* / N₂O correlation



The impact of dust on N₂O retrievals does not show up in the validation (no « dusty » FTIR measurements...)

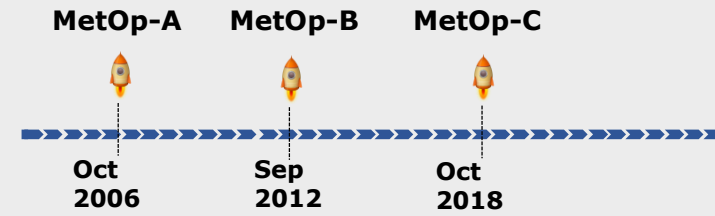
N₂O pcol monthly average: relative impact (%) of **NOT using the dust product to filter the N₂O retrieval**



* Mineral Aerosol Profiling from Infrared Radiance, our in-house dust retrieval from IASI, see Callewaert et al, AMT 2019



Why study N₂O? And why with IASI?



N₂O: Third most important anthropogenic greenhouse gas

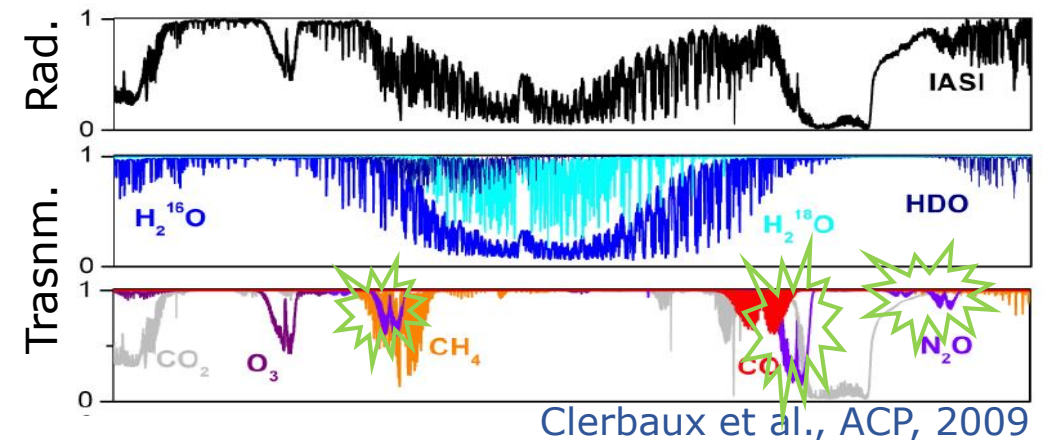
- N₂O has ~**265-398 times the CO₂ global warming potential**
- N₂O is **about 1000 times less abundant than CO₂**
- Atmospheric lifetime of about 120 years (average)
- increased by more than 20% from 270 ppb in 1750 to 333 ppb in 2020

Main source of reactive N in the stratosphere

- N₂O is photolysed in NO
- NO catalyses **O₃ destruction**

IASI characteristics:

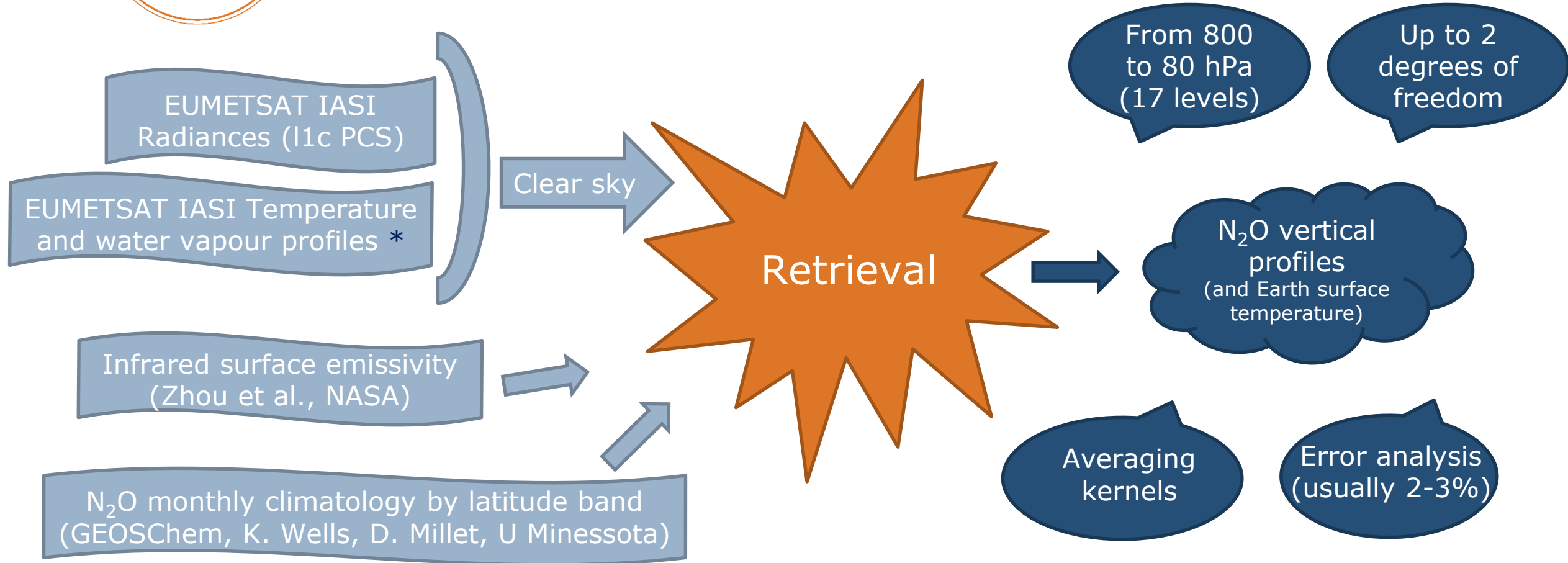
- Nadir FTIR, 2200km swath
- Pixels of 12km diam (nadir) to 20x40km ellipse (swath edge)
- Sun-synchronous
- "Morning train", local solar time: ~9h30 and 21h30 "night-time" observation



Long-term observations, (almost) global coverage 2 times per day, three N₂O spectral bands covered.



Our N₂O retrieval: ins and outs



* Version of those EUM. products is not consistent over time. Version 6 is significantly better, leading to much lower variability in the quality of our N₂O product. Version 6 starts on 30/09/2014 and we only use data from that version in this presentation.



Our N₂O retrieval: strategy and summary of validation

Retrieval

Method:

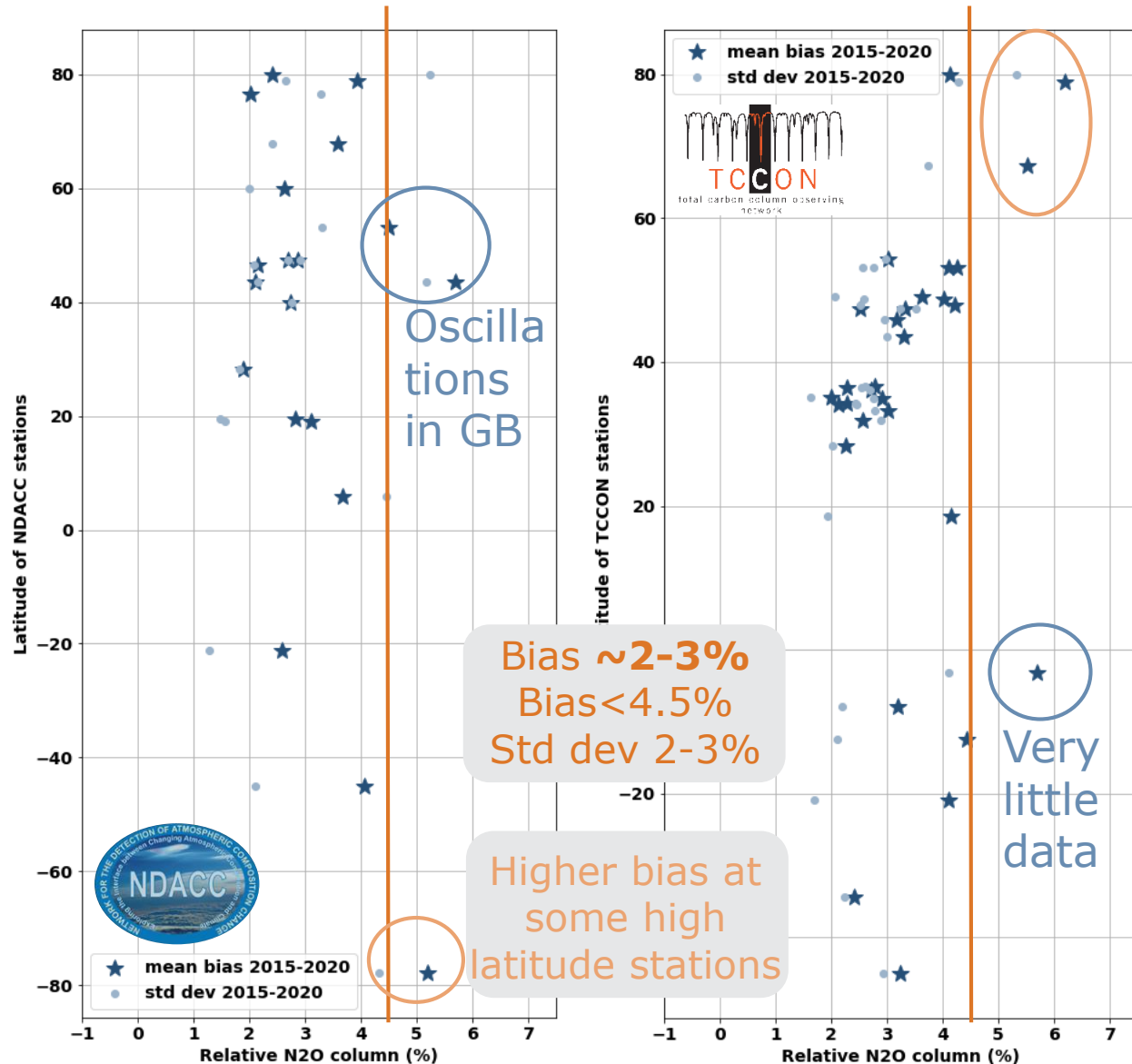
- Tikhonov regularisation
- L1 matrix (constrains the profile shape but not concentration values)
- Regularisation parameter: 5

Spectral microwindows:

- 64 channels between 2170 and 2215cm⁻¹
 - Avoiding other gases
- Avoiding highest RTTOV bias/variability (also leading to high values and variability of residuals)
- Spectral noise 0.2K (~ reported IASI noise)

Radiative transfer:

- RTTOV v13 (NWPSAF, 2020)
- Predictors v13 (NWPSAF, 2020)
- Variable gases: N₂O (retrieved) and H₂O (not retrieved, using EUM. IASI level2)



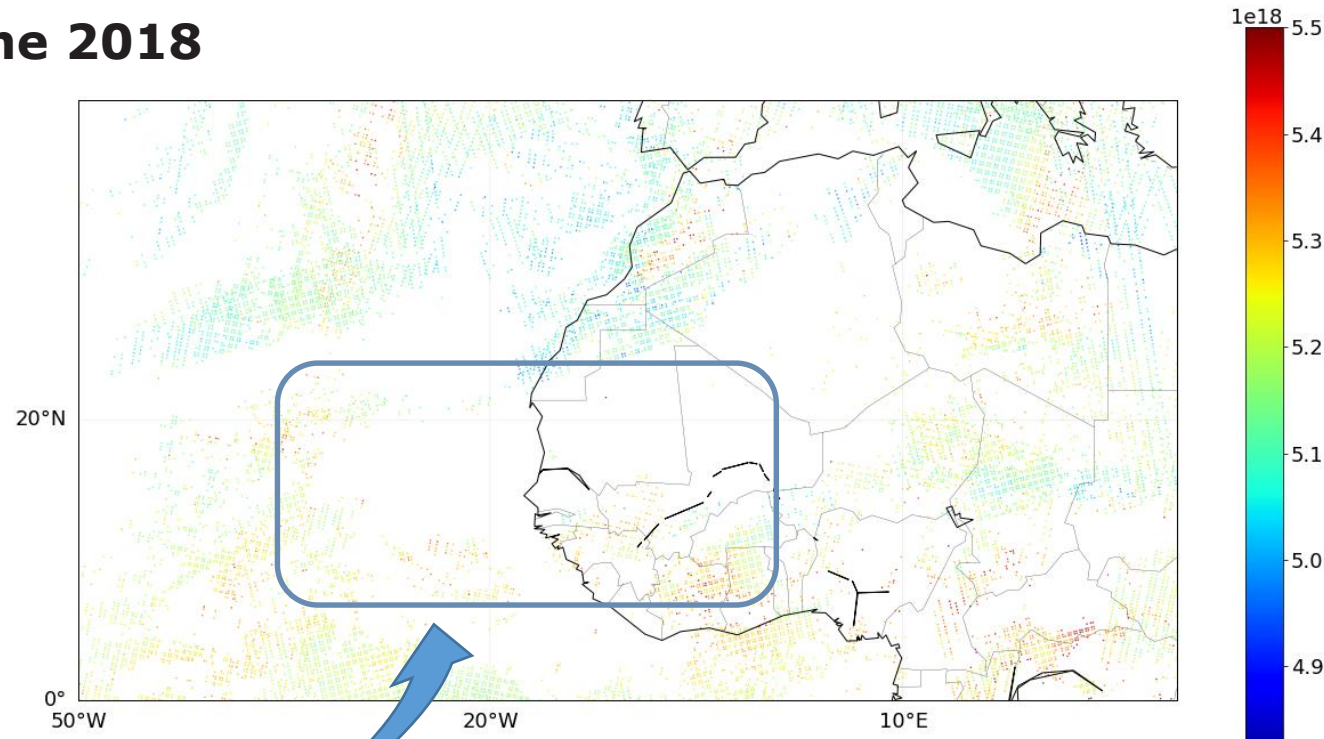
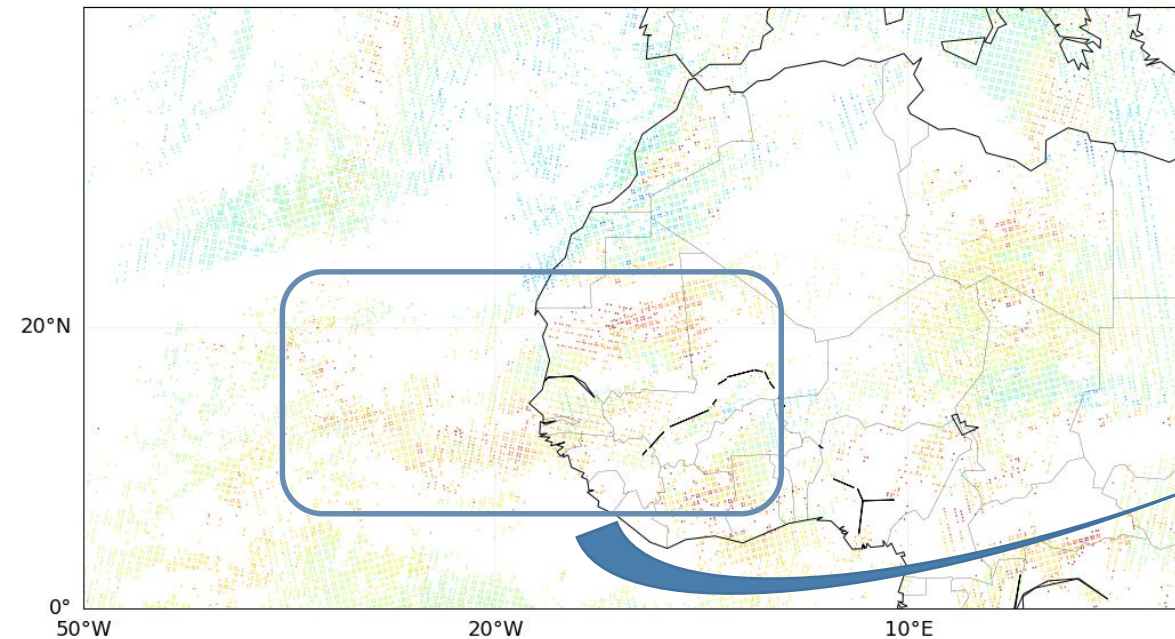


How do dust aerosols impact the N₂O retrieval?

1 June 2018

« Basic » quality control

- Spectral residual RMS < 0.2K
- Each spectral residual < 0.4 K
- N₂O DOF > 0.75
- 200K < Ts < 350K
- Max 10 iterations



When also removing IASI scenes for which our **MAPIR* dust AOD** > 0.25

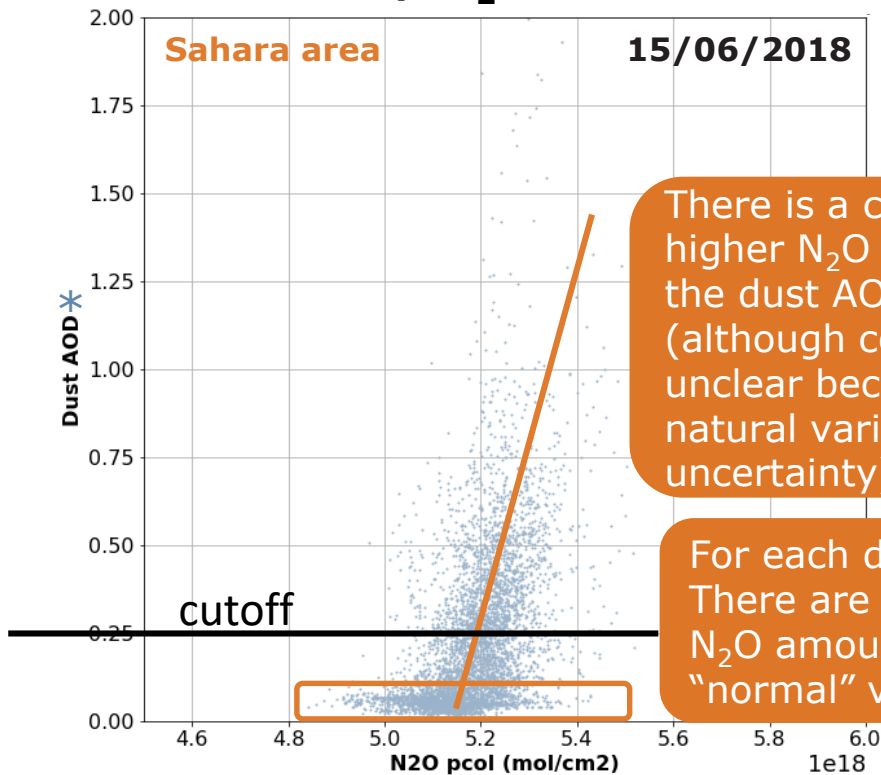
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Dust* / N₂O correlation



There is a clear tendency to higher N₂O amount when the dust AOD is higher (although correlation is unclear because of the natural variability and uncertainty)

For each dust amount, There are different N₂O amounts (the "normal" variability)

Important note:

The impact of dust **does not show up in the validation!** (no « dusty » FTIR measurements...)

N₂O pcol monthly average: relative impact (%) of **NOT using the dust product to filter the N₂O retrieval**

-> **overestimation** of up to **2%** in dusty areas during the dusty season
-> impacts the seasonal cycle in those areas

