



QA4EO

Effect of clouds on the data quality and uncertainty
of trace gas total column retrievals

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Objective

- Trace gas retrievals are not restricted to cloudless conditions and are still possible with (thin) clouds in front of the sun.
- Investigation of the impact of clouds (thickness and type) for the first time in more detail

Methods / data sets

- Trace gas total columns (NO_2 , O_3 , HCHO and H_2O) for 4 different stations (Rome, Athens, Davos, Izana) and aux data (DQ flags, uncertainty, wrms, atmospheric variability)
- AOD data from AERONET / PFR, COD from PFR
- (All-sky camera)
- Daily plots of all variables, plots for correlation / dependency

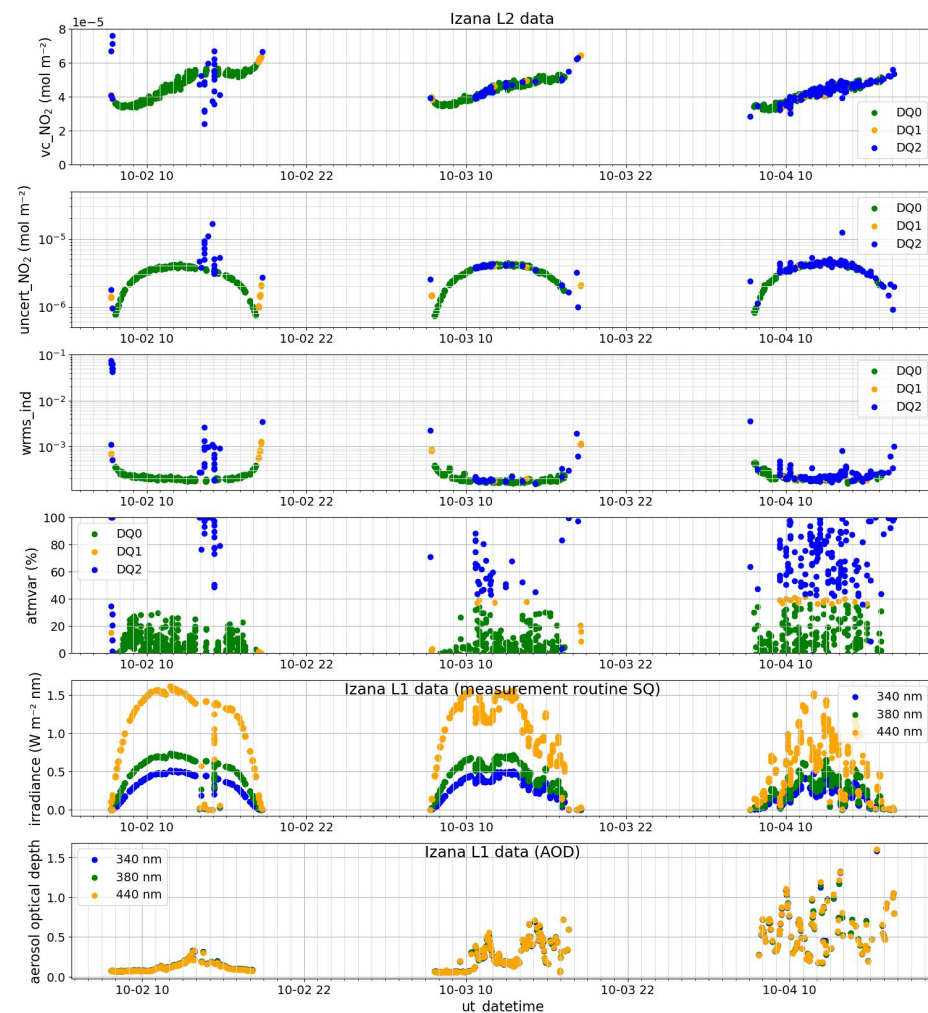
Goal

- investigate if/how additional cloud information (e.g. PFR) can refine quality flagging of PGN operational data products



Results: Izana NO₂

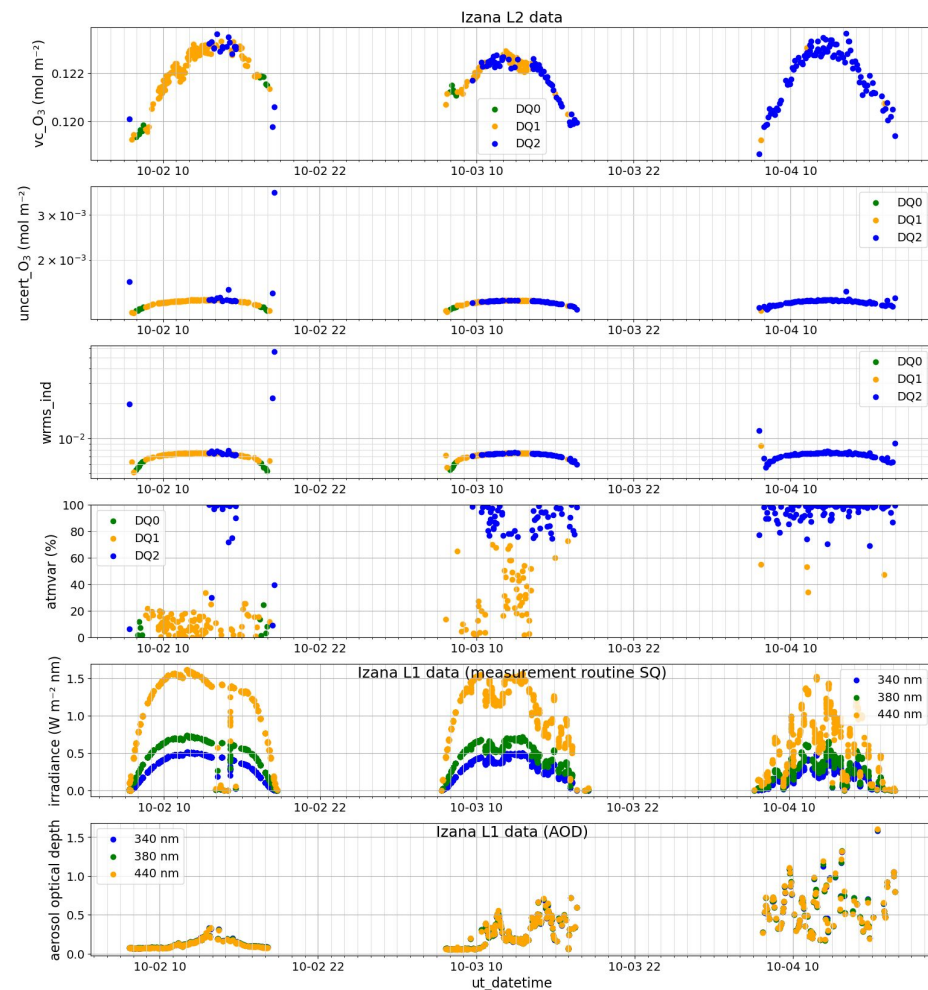
- 02.10.2023: thin cloud at 3 pm, atmvar and vertical column uncertainty (+ wrms_ind) increases
- spread and uncertainty of the vertical NO₂ columns becomes larger and data during this event has the lowest quality (DQ2 flagged)
- 03.10.2023: 3 short cloud events, irradiance reduction only maximal 20 %, uncertainty unaffected
- 04.10.2023: mix of sunshine and thicker clouds during whole day, AOD cloud flagged





Results: Izana O₃

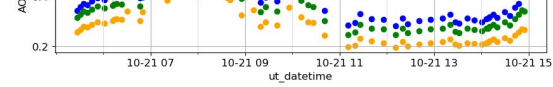
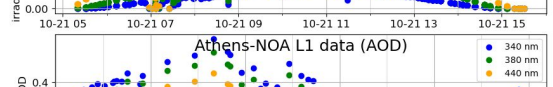
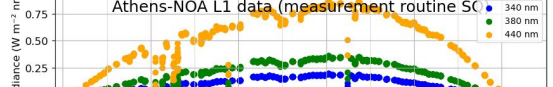
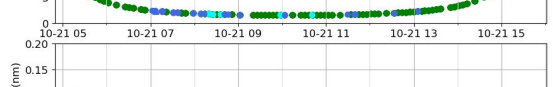
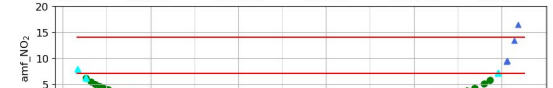
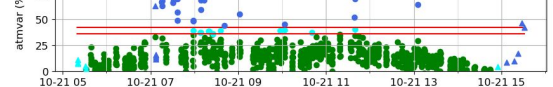
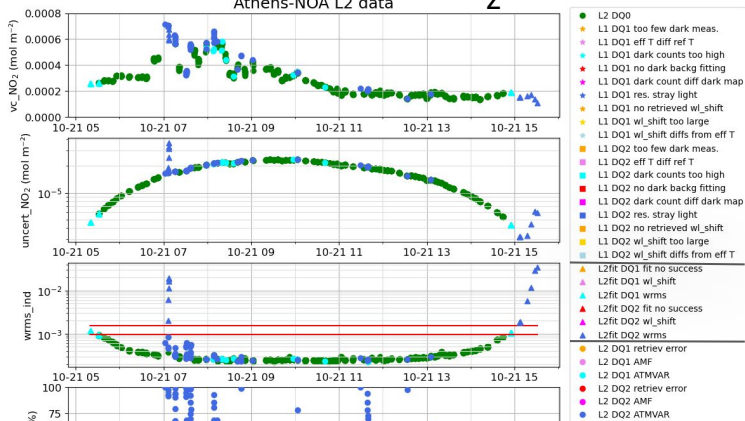
- 02.10.2023: thin cloud at 3 pm increases atmospheric variability to 100 % and thus to low quality
- 03.10.2023: 3 cloud events, irradiance reduction only maximal 20 %, uncertainty unaffected, but data is lowest quality during
 - Quality check of O₃ more sensitive for clouds than for NO₂
- 04.10.2023: mix of sunshine and higher ? clouds during whole day, AOD often cloud flagged





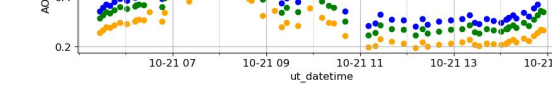
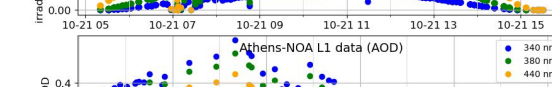
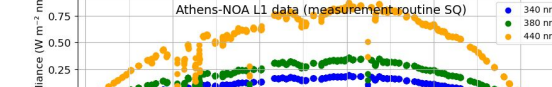
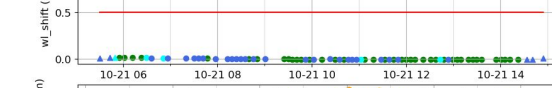
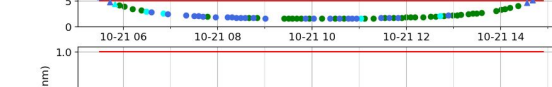
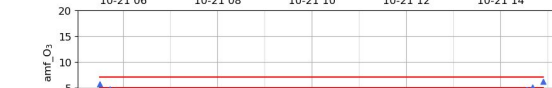
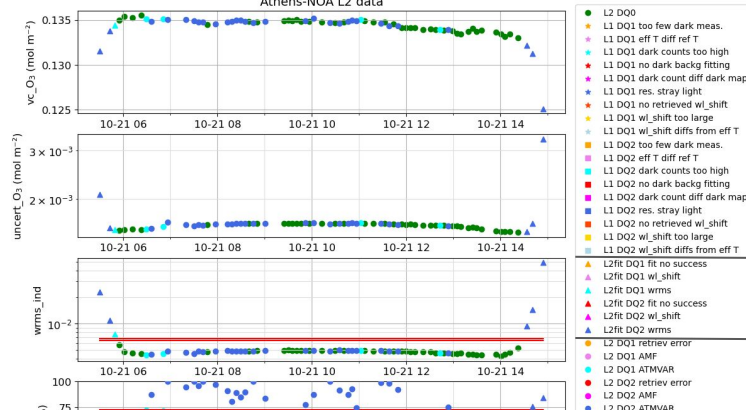
Results: Athens-NOA NO₂

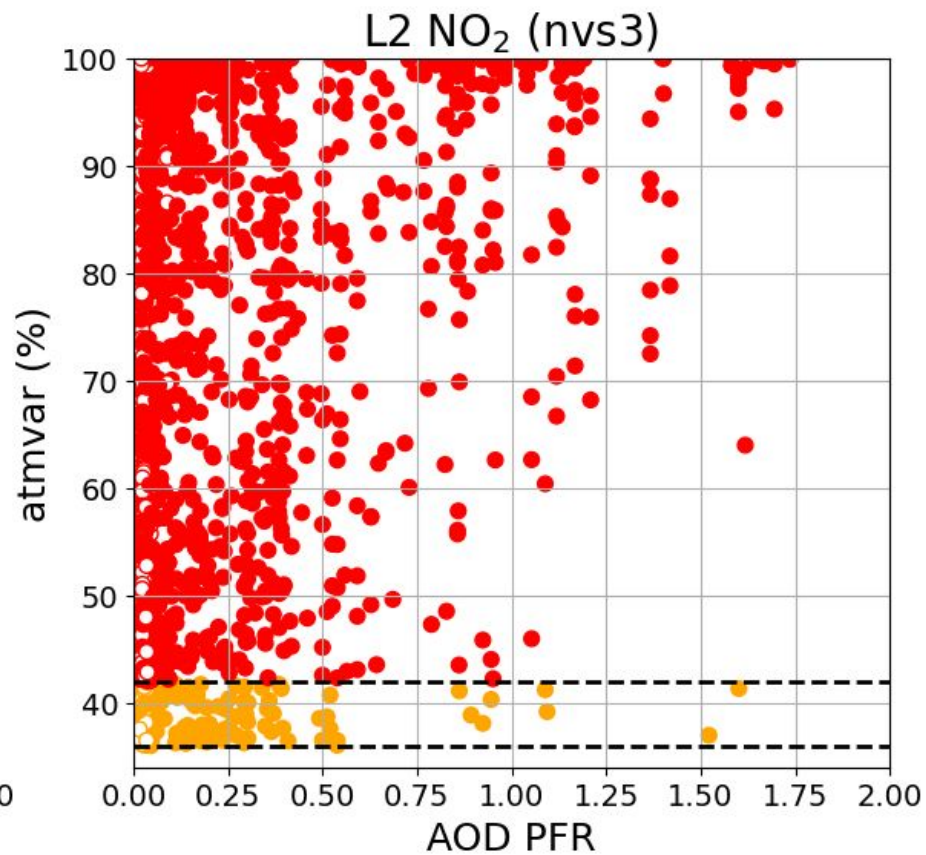
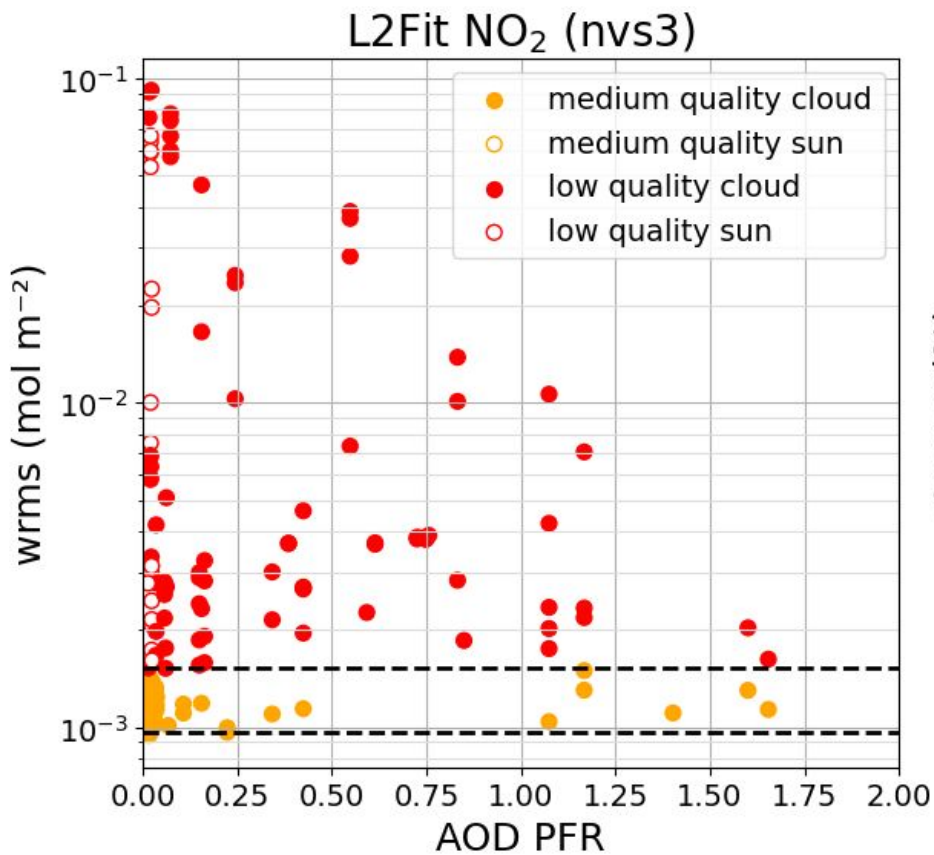
Athens-NOA L2 data

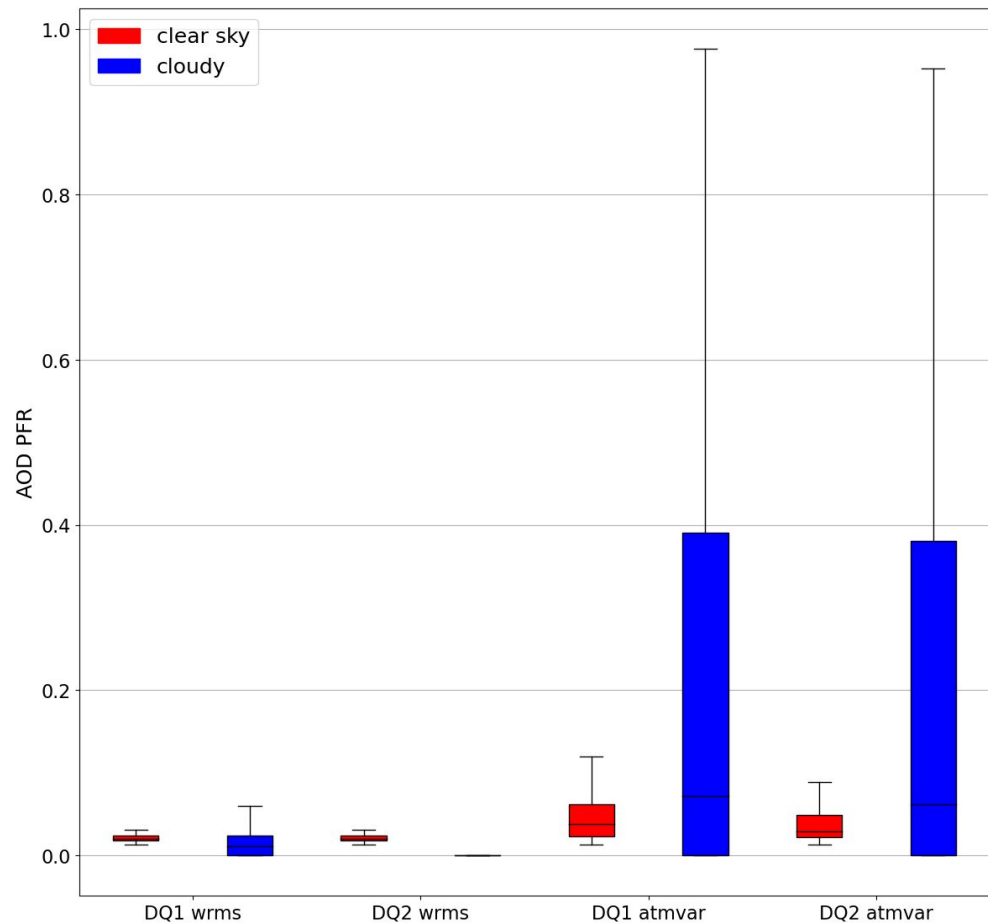


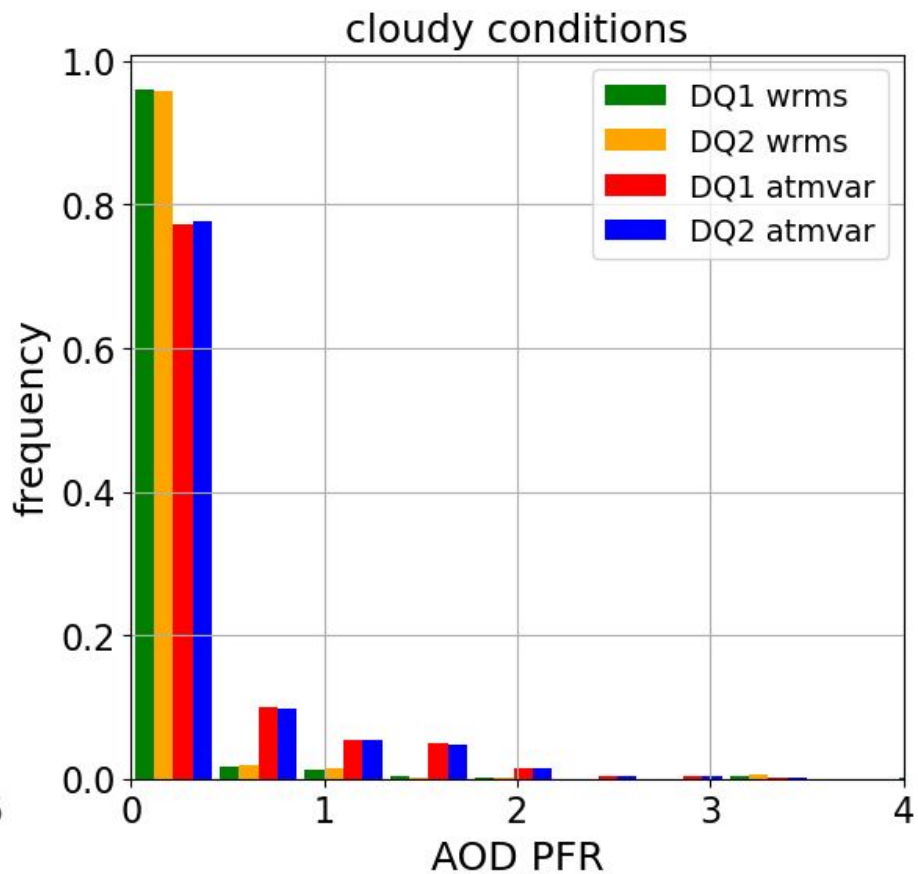
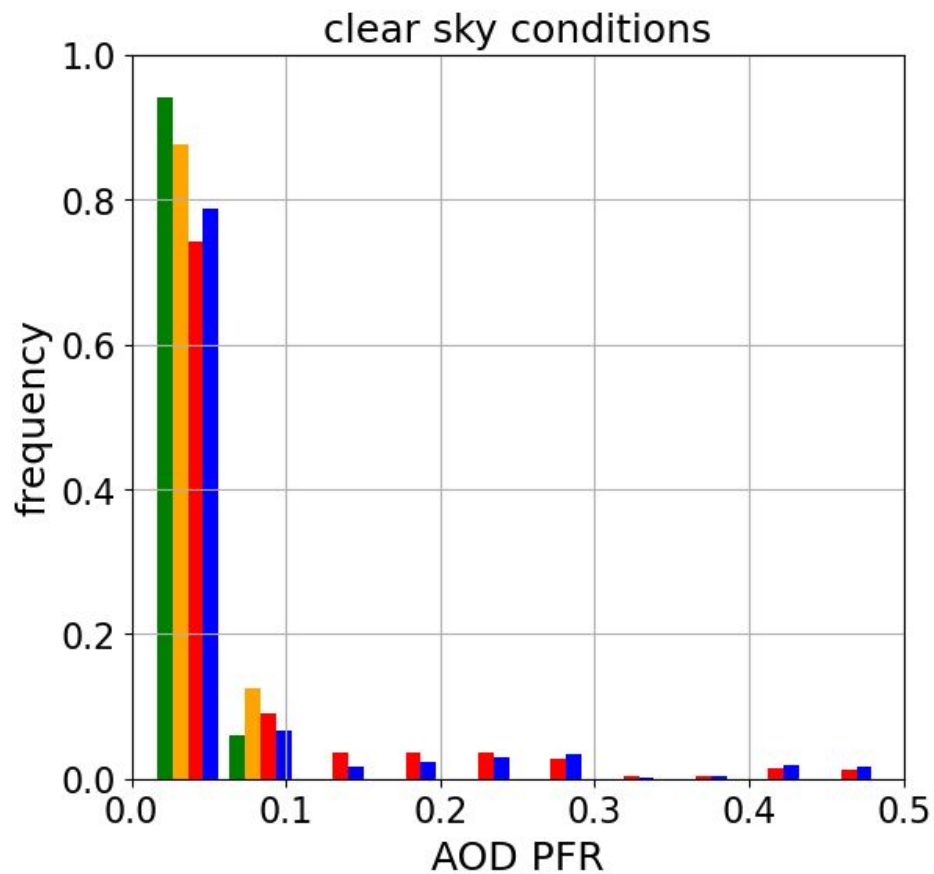
Results: Athens-NOA O₃

Athens-NOA L2 data









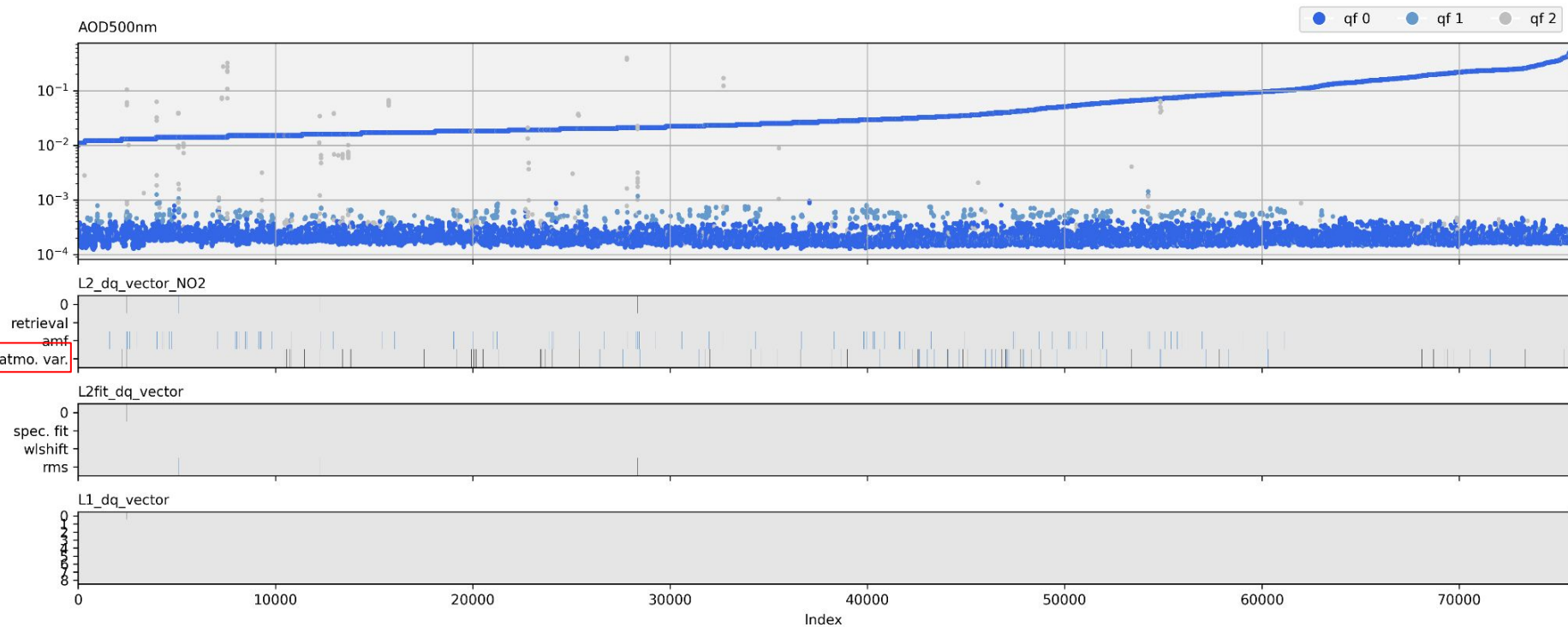


Izana 121 N02

2023

clear

Increasing AOD \longrightarrow

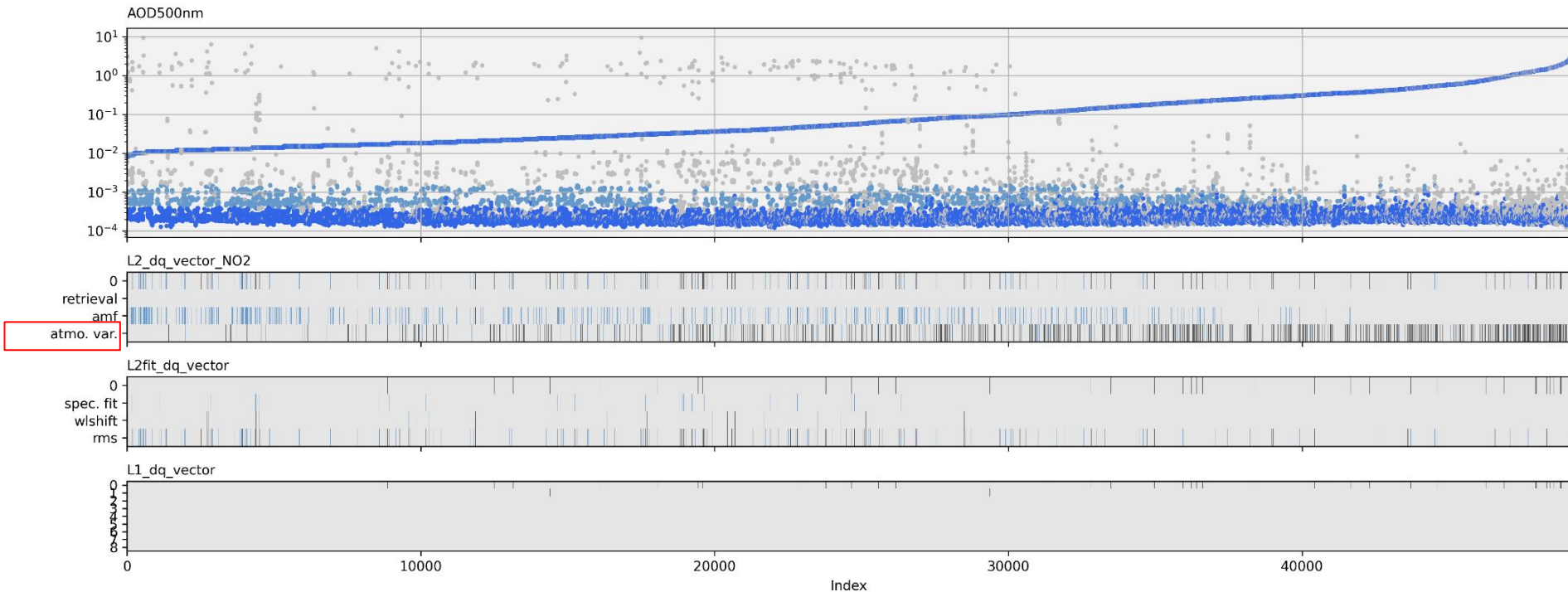




Izana 121 N02

cloudy

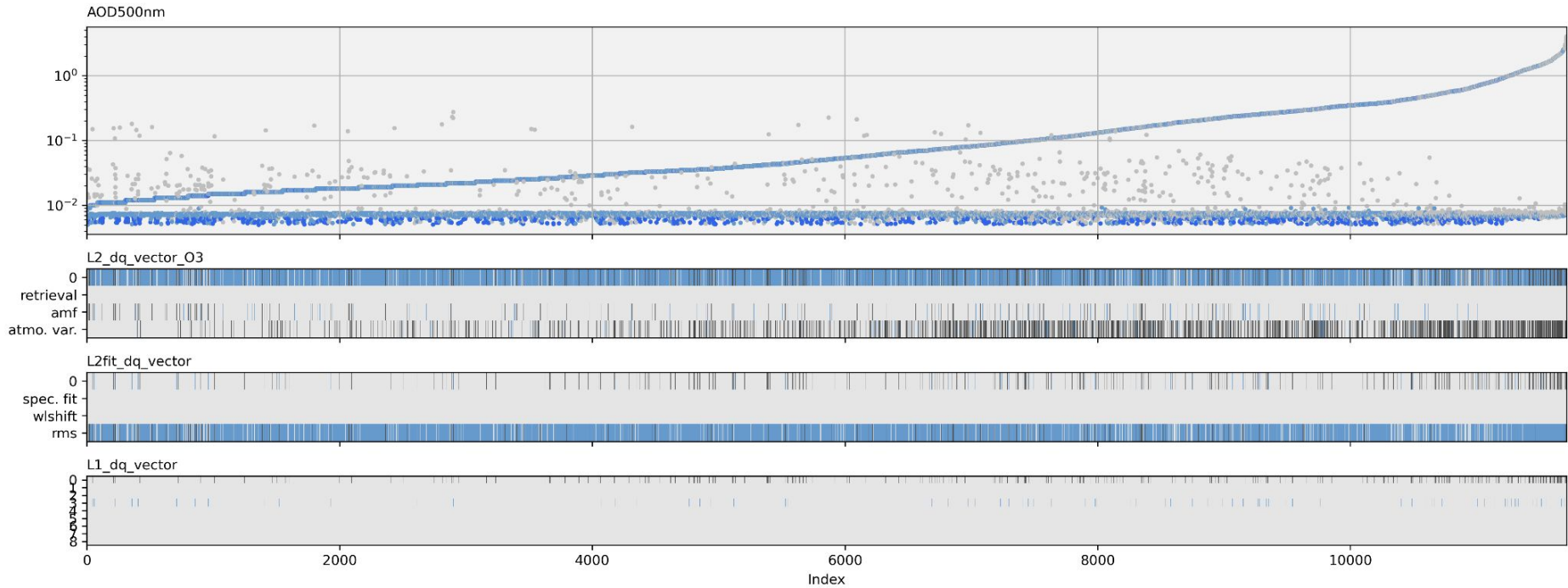
Increasing COD \longrightarrow





Izana 121 Ozone

cloudy



Conclusion / outlook

- Investigation of the impact of clouds (thickness and type) for the first time in more detail
- Highly dimensional visualization / analysis

- Atmospheric variability criteria is too strict (DQ1, medium data quality often too conservative)

- Refinement of DQ criteria

