Extended Ground-Based Remote Sensing of NO2: Continuous Sun and Lunar DOAS Measurements with New Correction Methods

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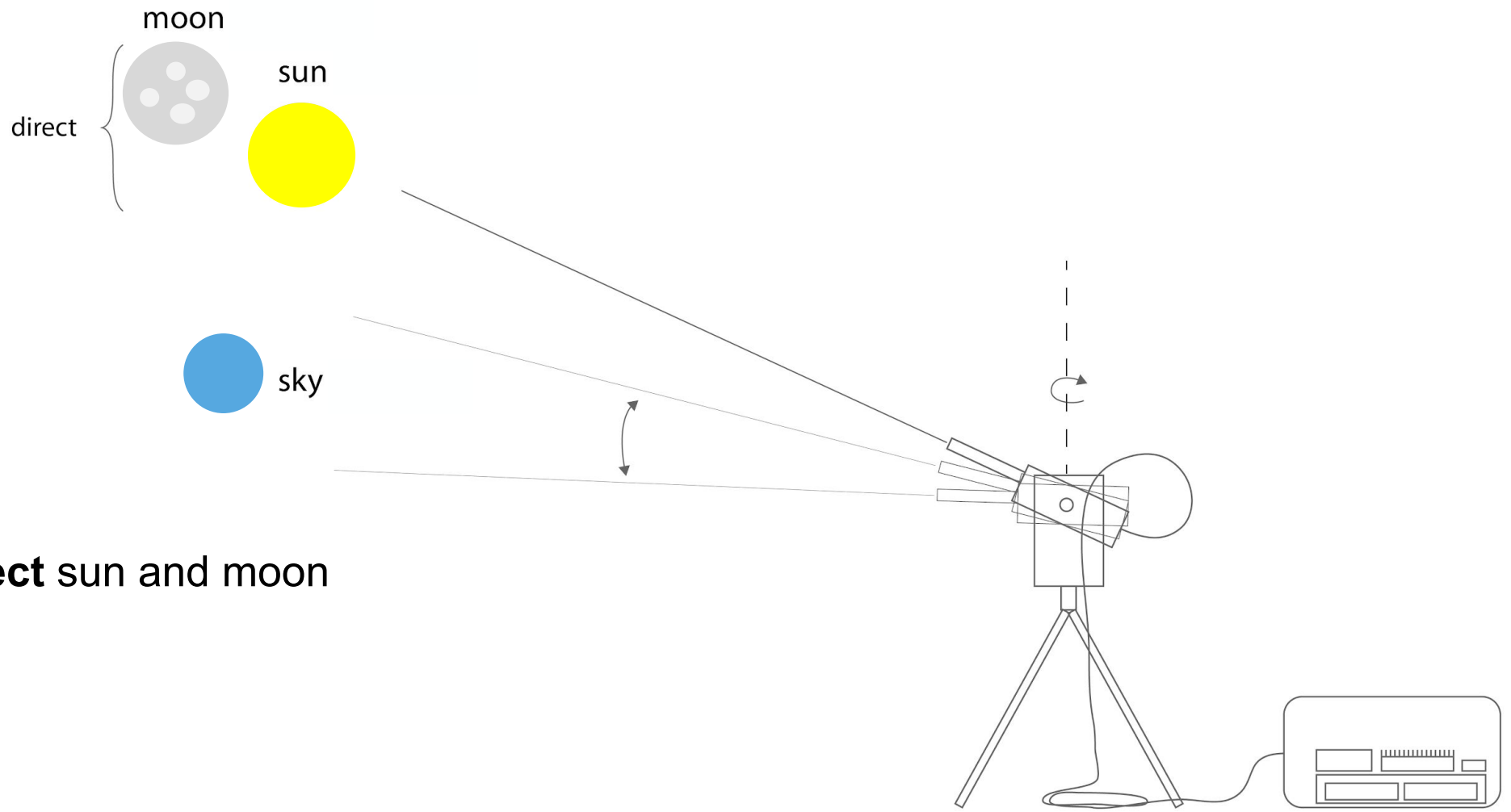
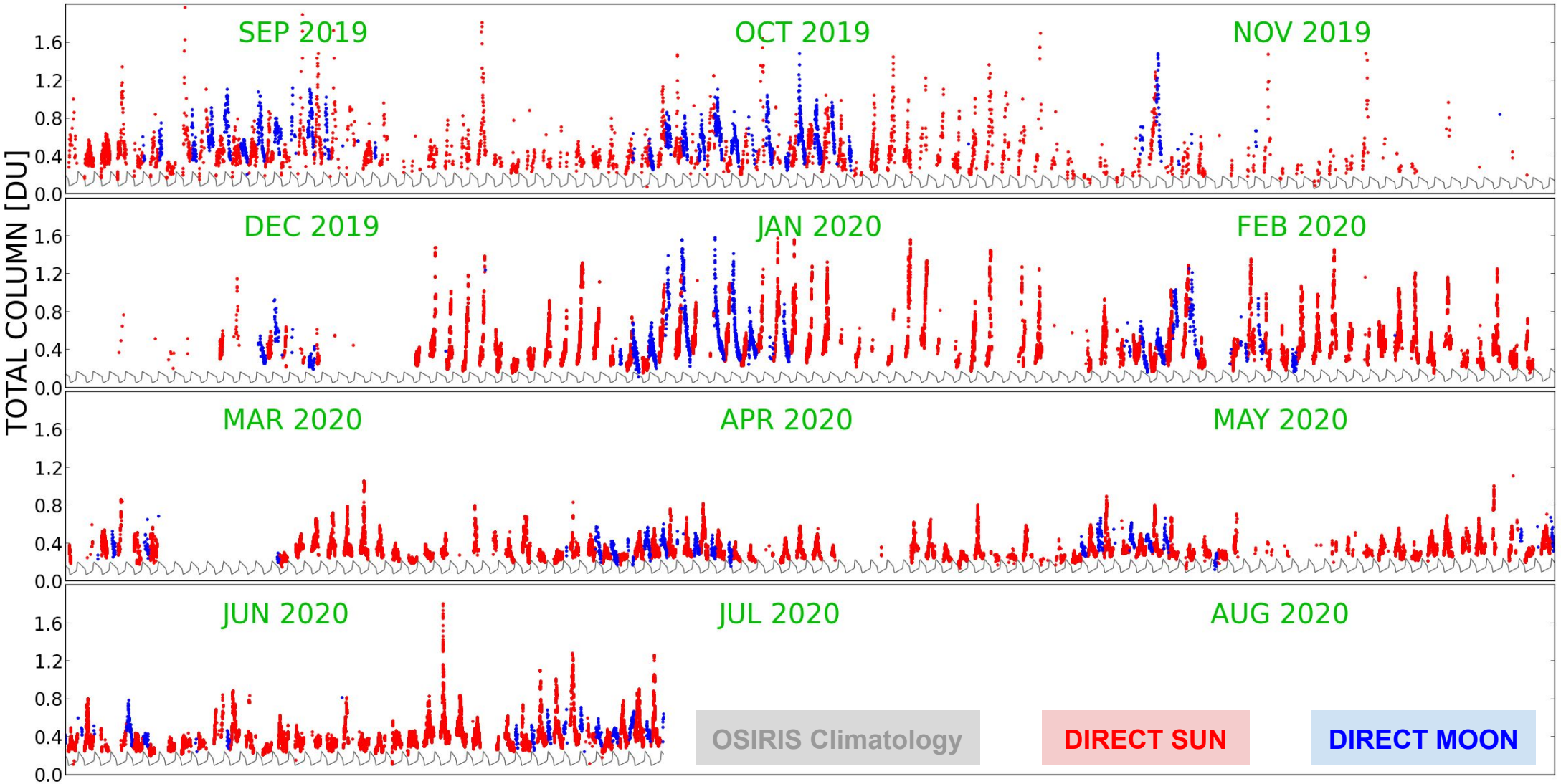
PGN data products



direct sun and moon
sky

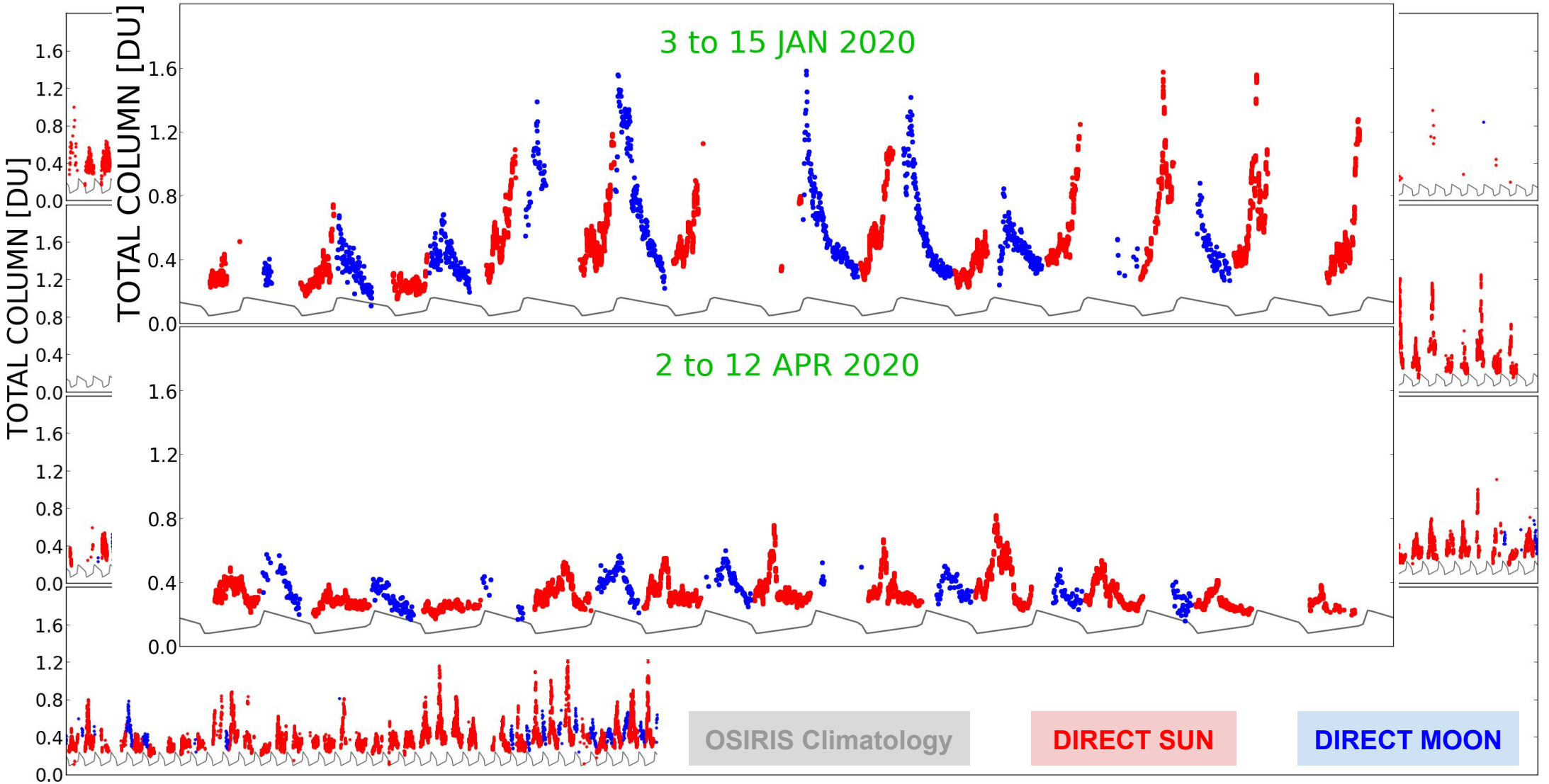
NO2 products

Rome



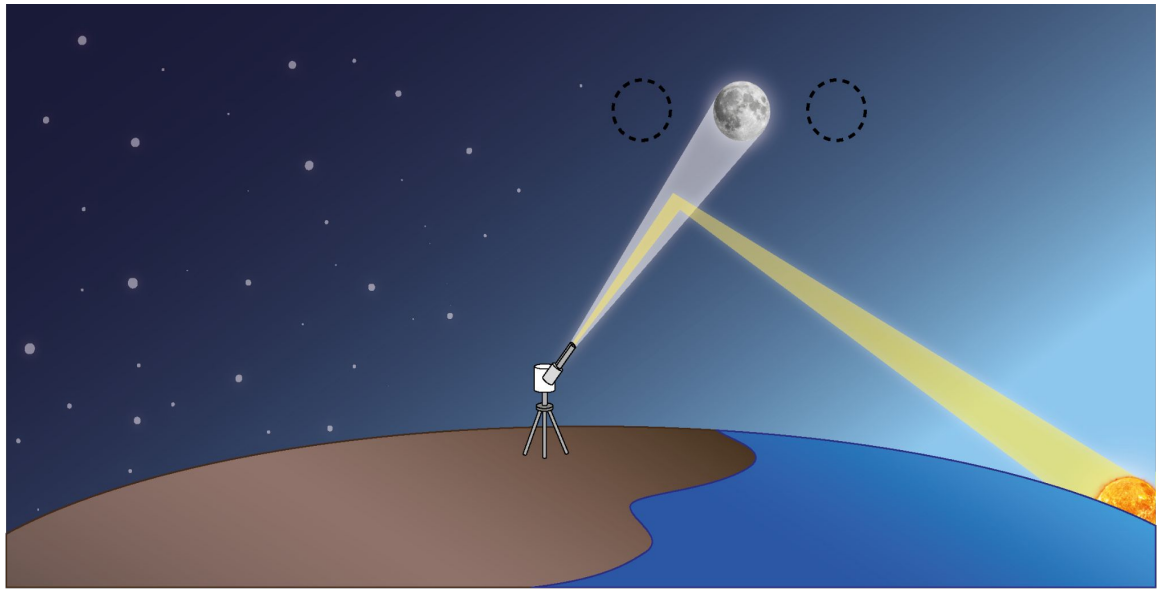
NO2 products

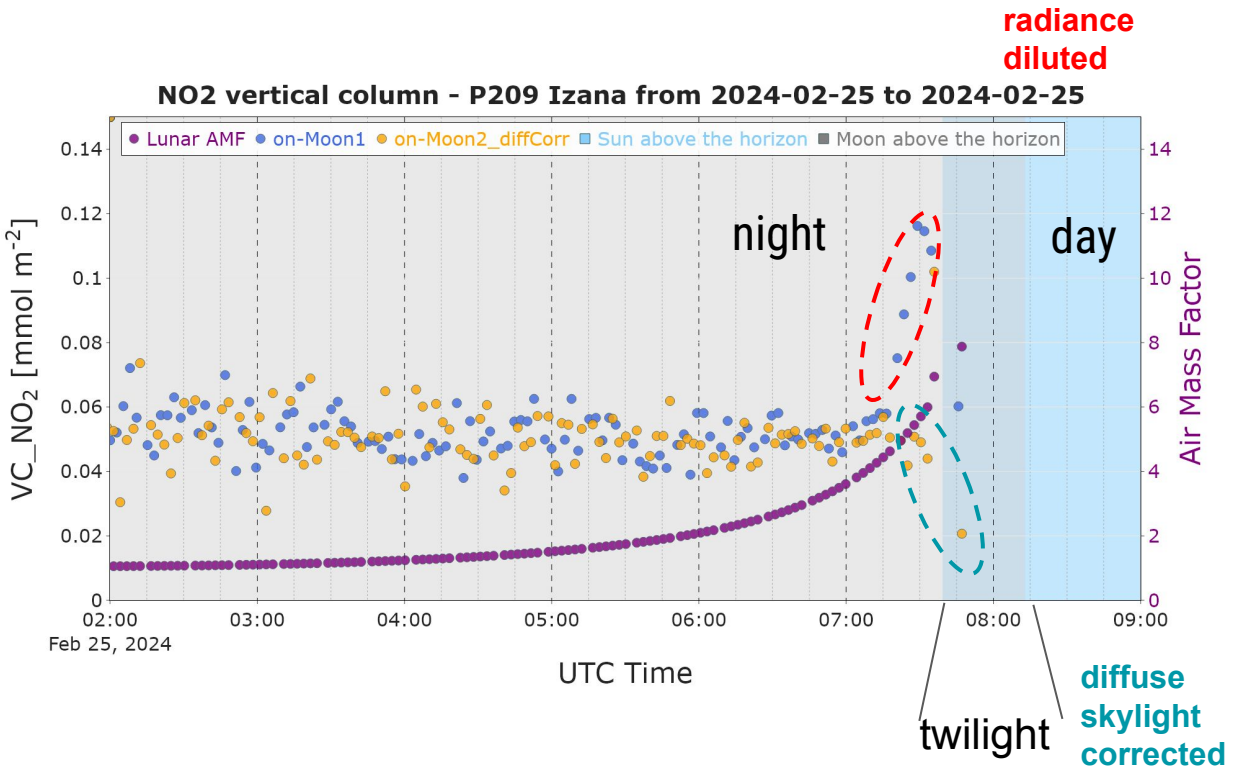
Rome



Lunar measurements during twilight

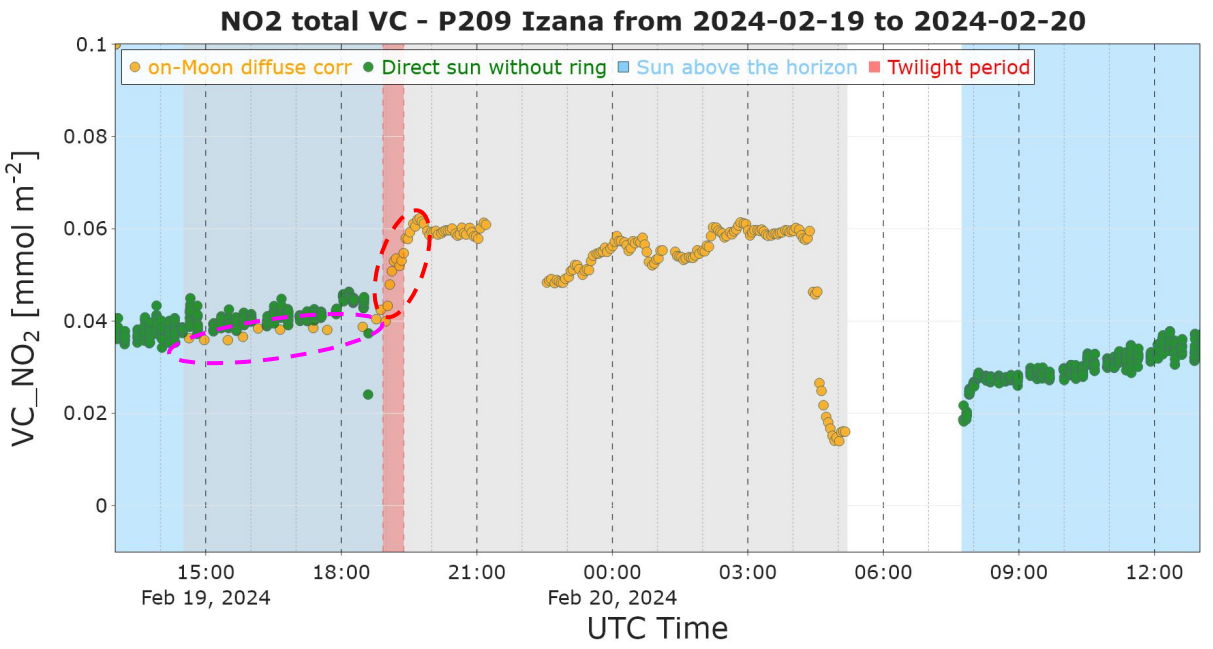
- Measurements near the **horizon** or during **twilight** suffer from enhanced **scattered light** with **high AMFs**, causing systematic biases in retrieved NO2 columns.
- Scattered solar light is removed by subtracting **off-moon measurements**





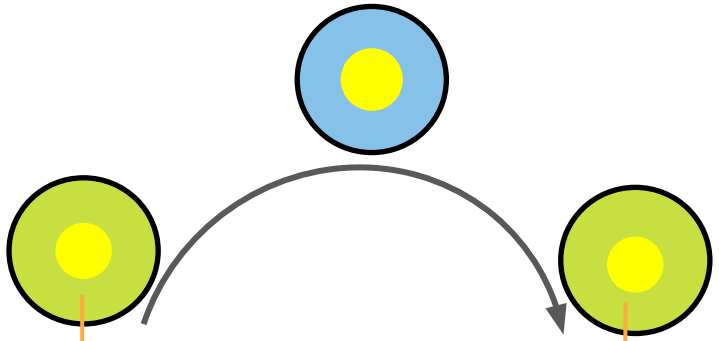
Lunar measurements during twilight

- **Enhance** data quality **during lunar-to-solar transition by** improving **twilight lunar measurements**
- Schedule **improvement** of on-/off moon measurements **expands lunar measurements** into whole twilight
- New lunar routine enables to measure NO2 during day, as soon as **moon rises** above horizon
- Shows a **good alignment** with direct sun measurements

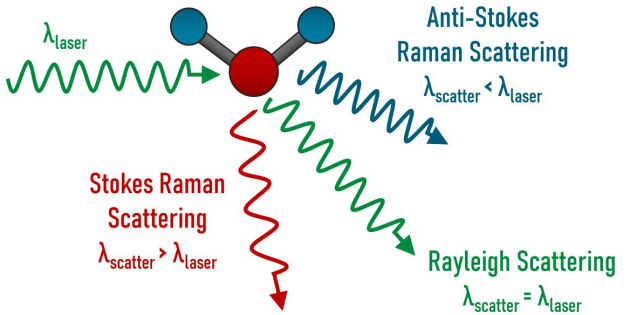


Solar measurements at very high AMFs

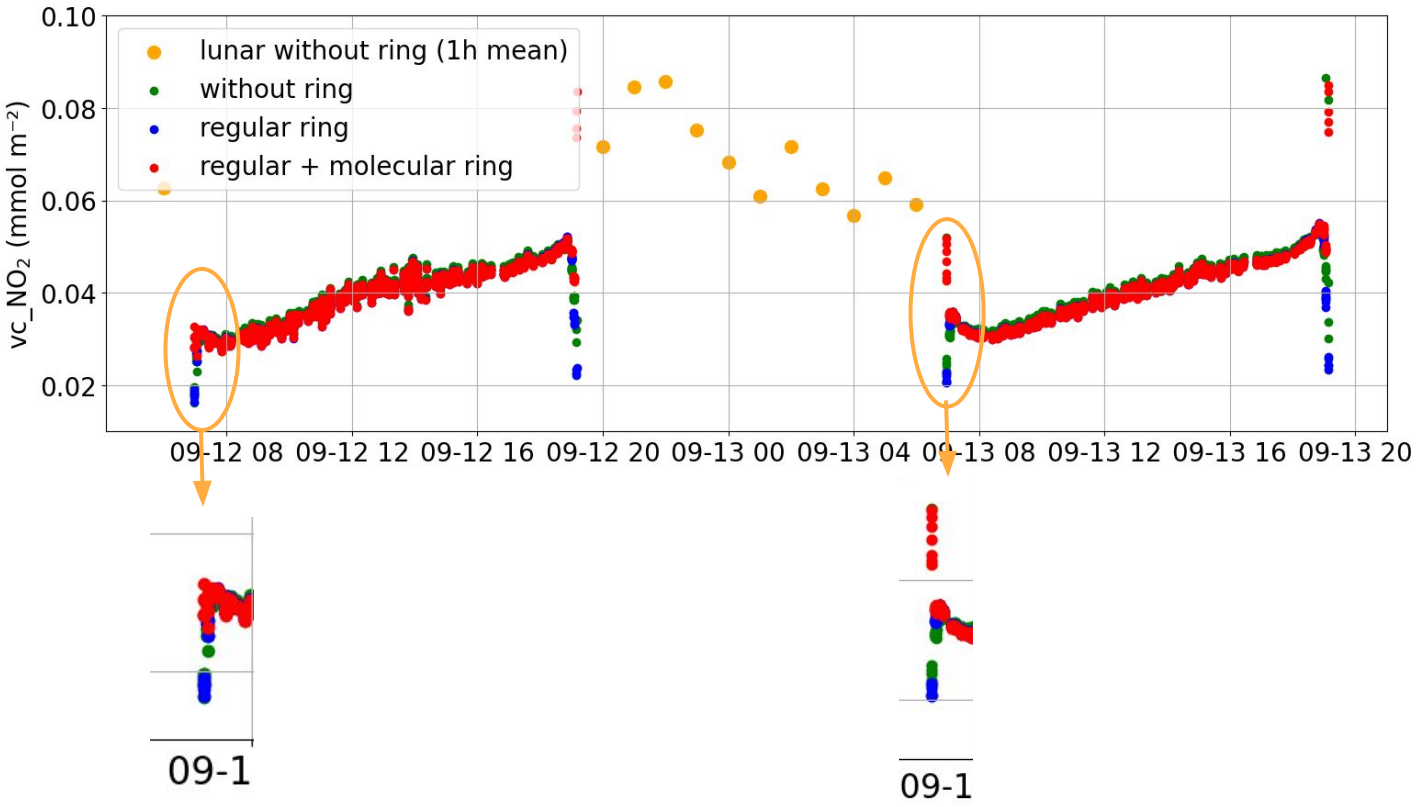
instrument FOV



Radiance distortion part is inelastically scattered



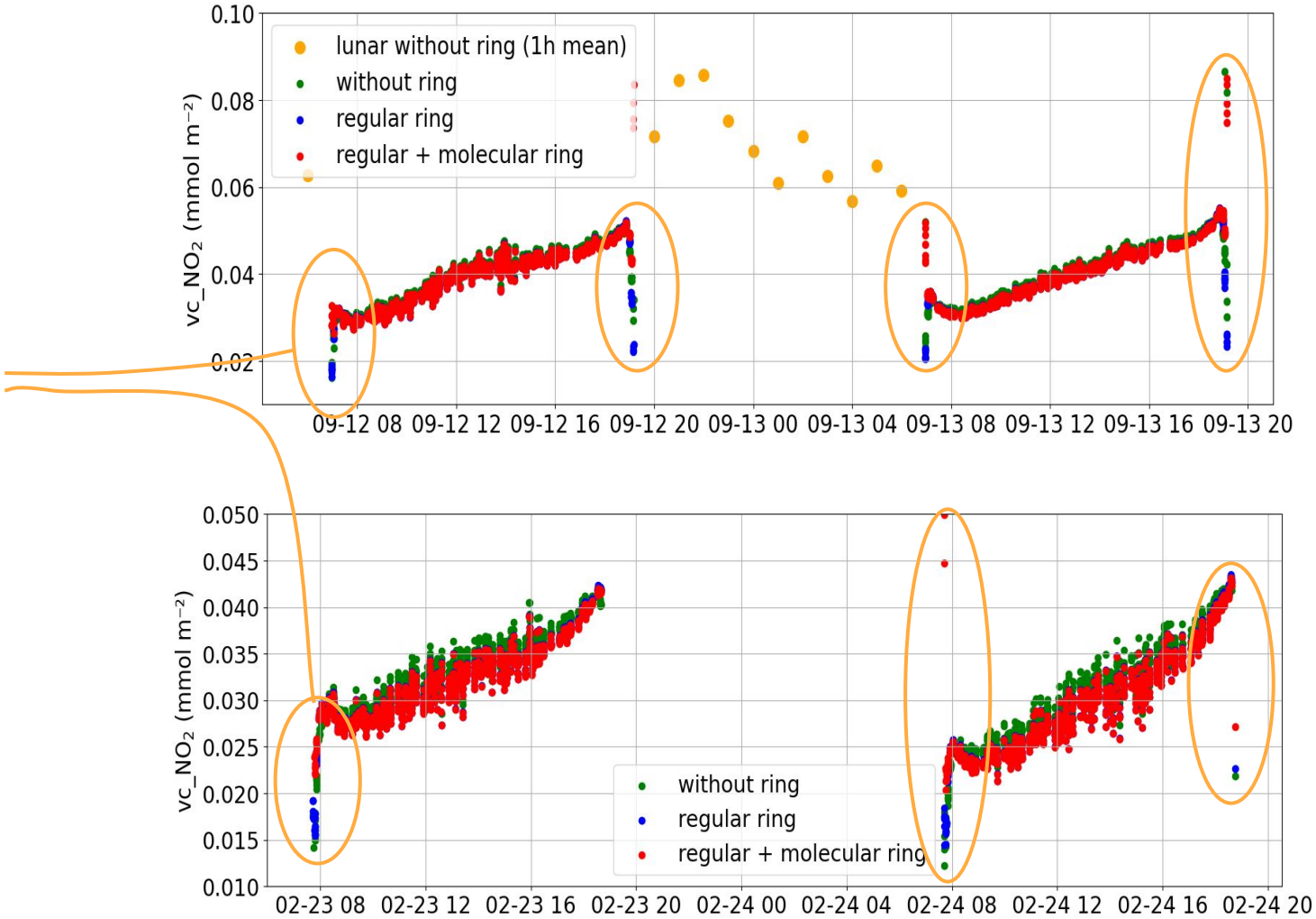
Total columns **NO2** at Izana



➔ unphysical biases removed if "molecular Ring effect" is considered!

Solar measurements at very high AMFs

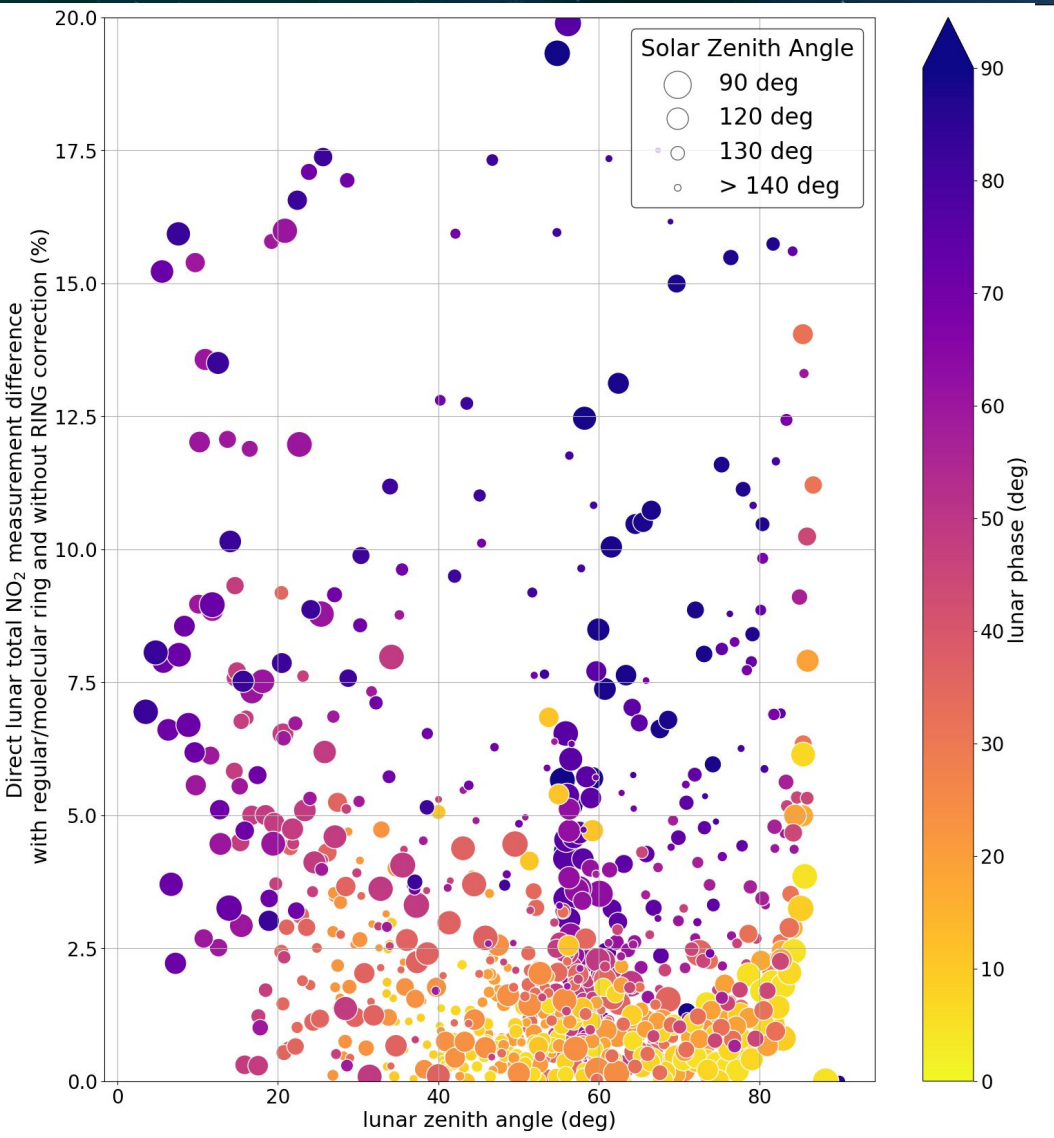
- **molecular Ring correction upwardly corrects** the vertical NO2 column immediately **after sunrise** and **before sunset**, respectively
- correction **towards lunar measurements** into “right” direction



Lunar measurements at very high AMFs

- **molecular ring correction** removes **unphysical biases** also for direct **lunar measurements** during **twilight**

- **increases** vertical NO2 columns, especially during **high AMFs** away from full moon, around full moon effect is smaller (mostly < 5%)



Summary

- Improvement of direct NO2 lunar measurements during twilight by optimisation the schedule of off-moon/ on- moon measurement routines

- Systematic biases in direct sun and lunar NO2 measurements could be reduced by considering molecular Ring effect in the algorithms