Nighttime ground-based observations for trace gas retrievals with the Brewer spectrophotometer **WP 2324**

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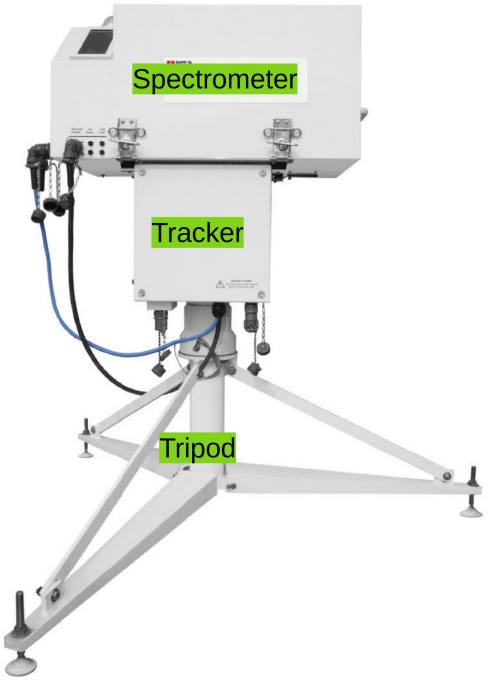
Goals

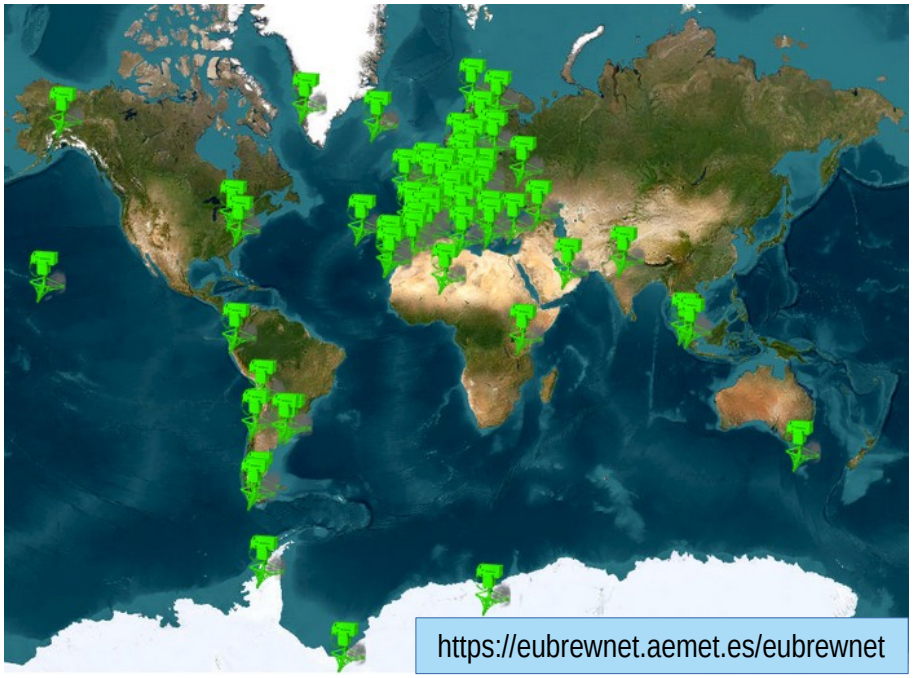
Development of an algorithm for nighttime NO_2 retrievals from Brewer spectrophotometer (BAQUNIN – Rome). Comparison with co-located Pandora

Data quality evaluation approaches for O_3 and NO_2 nighttime and daytime retrievals

Characterisation and correction of spectral straylight in single monochromator Brewers (O_3 retrievals)

The Brewer network





About 200 instruments retrieving total O_3 column (UV, 4 wl)
~80 of them (MkIV) also able to retrieve NO_2 (visible, 5-6 wl)

The measurement technique

Direct sun:

Reference technique for **total O_3** retrievals (>40 years).

Recent improvements of **NO_2** retrievals (daytime)
→ **20 year-long NO_2 VCD record in Rome** published in 2021

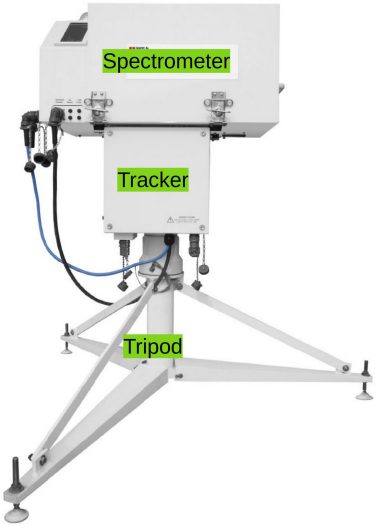
Focused moon:

Only **few studies on nighttime O_3** retrievals

No study on **nighttime NO_2** retrievals with Brewers so far

Moon image projected on entrance slit without diffusers.

Brewer pointing is fixed while the moon drifts accross the slit.



WP Phase 1

Assessment of Brewer ephemeris algorithm accuracy

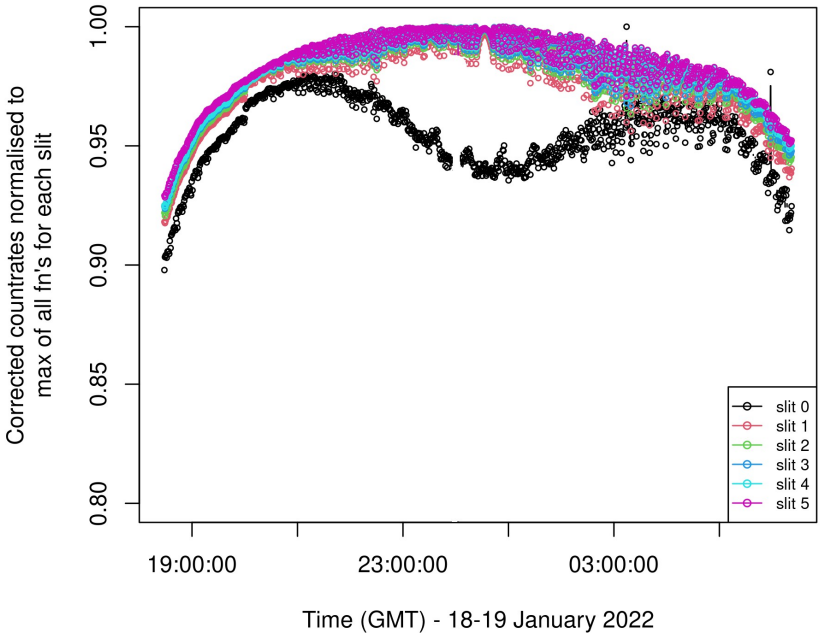
New nighttime schedule in Rome

First tests of NO_2 retrieval algorithm (using 6 wavelengths, to improve SNR → new routine)

Issues

- Brewer #067 operating at Sapienza (Rome) waiting for recalibration and repair (September 2022)

- Instabilities at 425 nm → Test of a new diffusing filter



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WP Phase 2

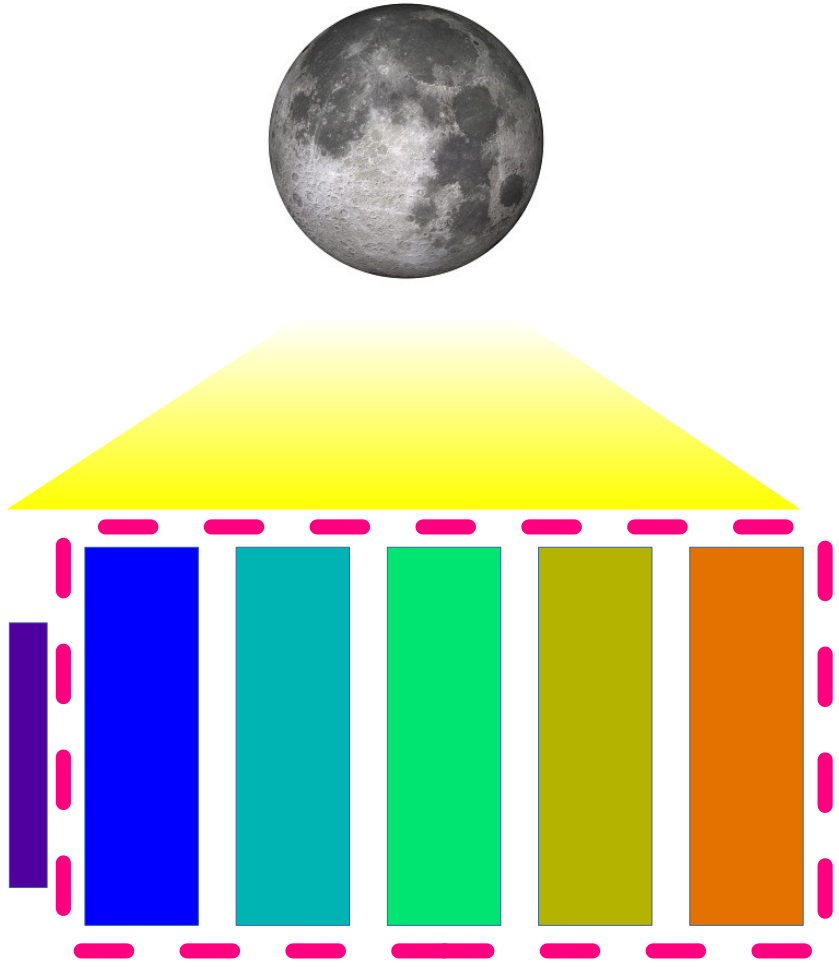
New retrieval algorithm only using the **5 longest** wavelengths (431-453 nm)

Brewer #067 **repaired** and put back into operation

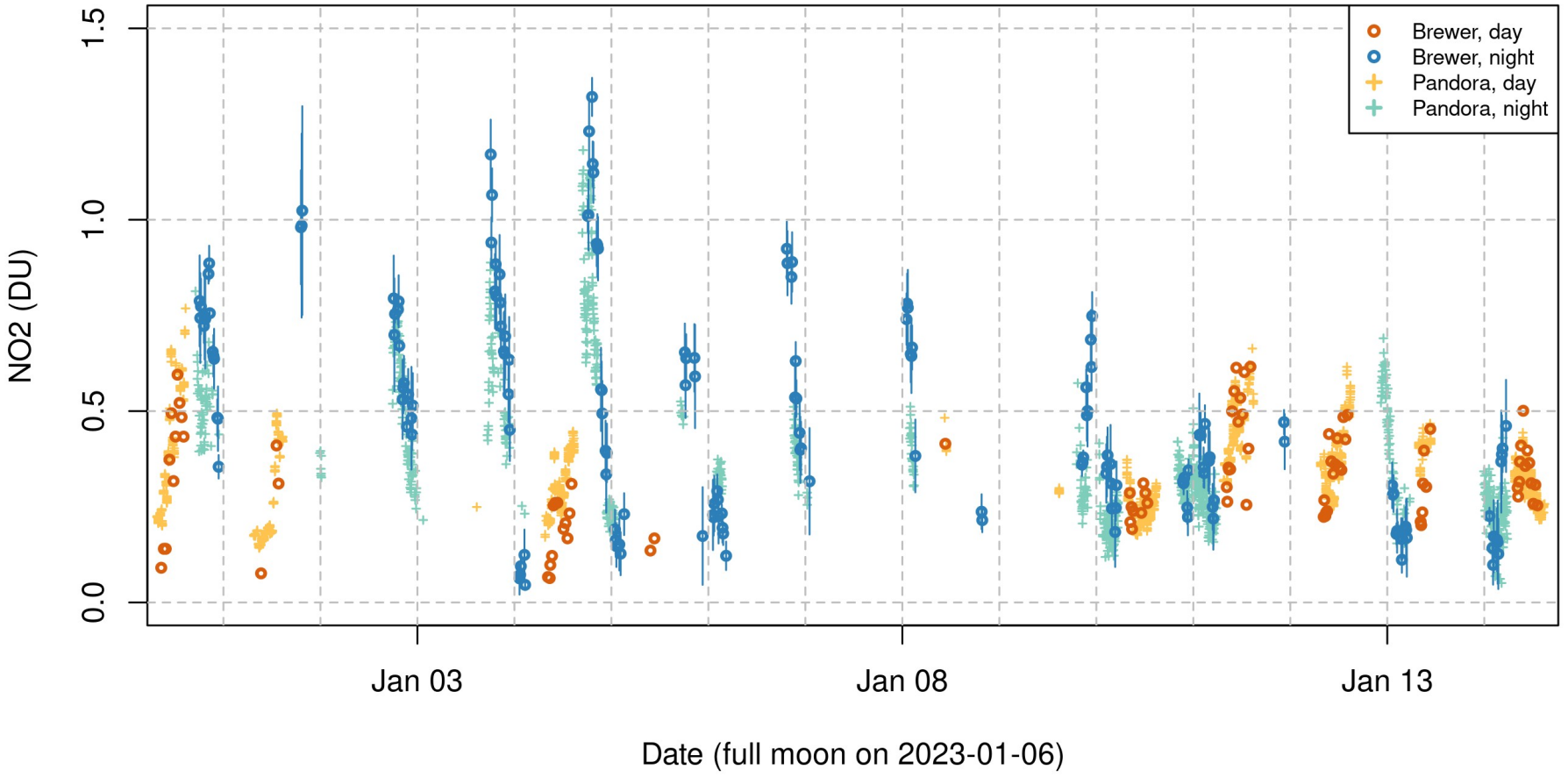
New nighttime O_3 and NO_2 datasets

New **straylight correction** algorithm by Savastiouk and Diémoz → applied to O_3 retrievals (Brewer #067)

NO_2 retrievals unaffected by straylight



Preliminary NO_2 comparison with Pandora



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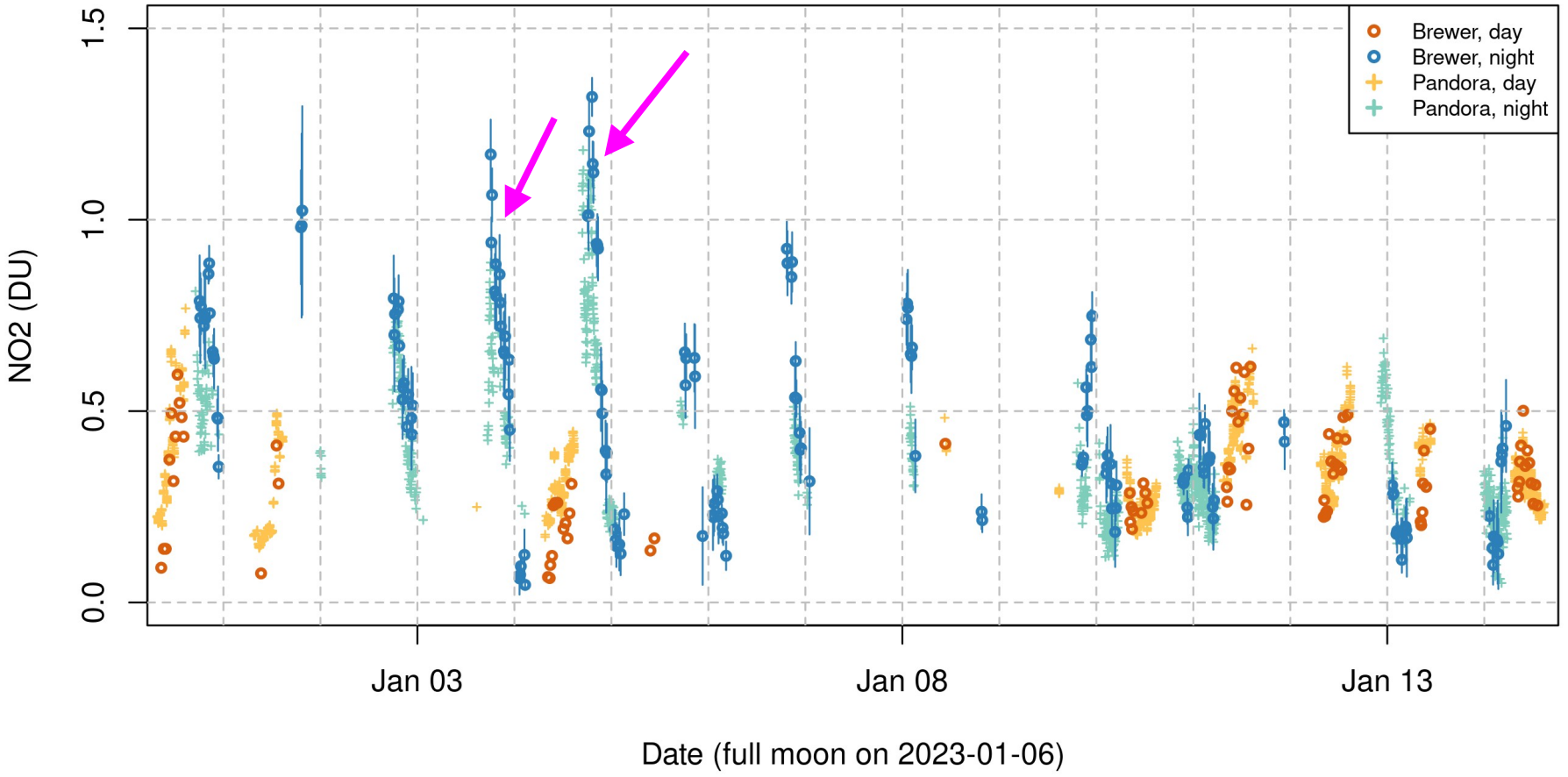

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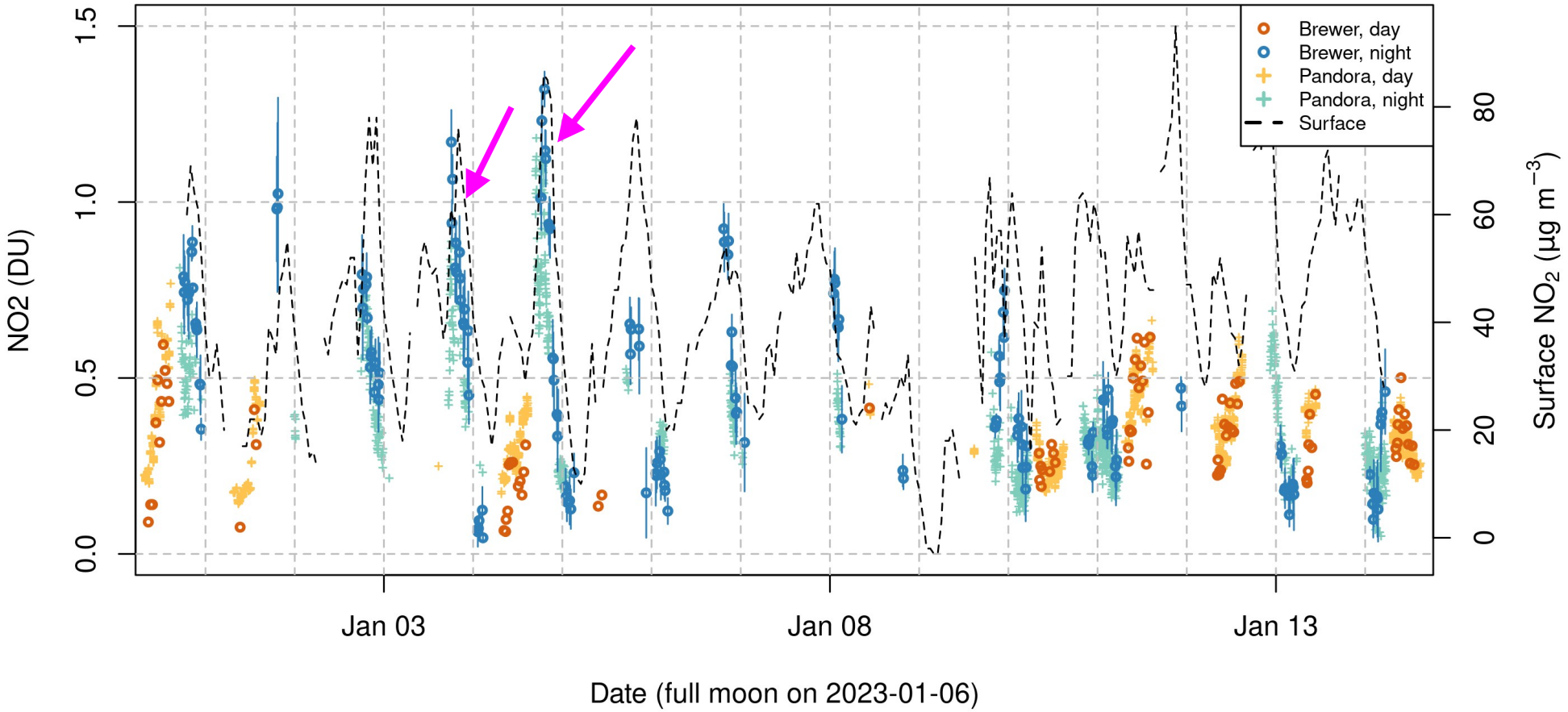
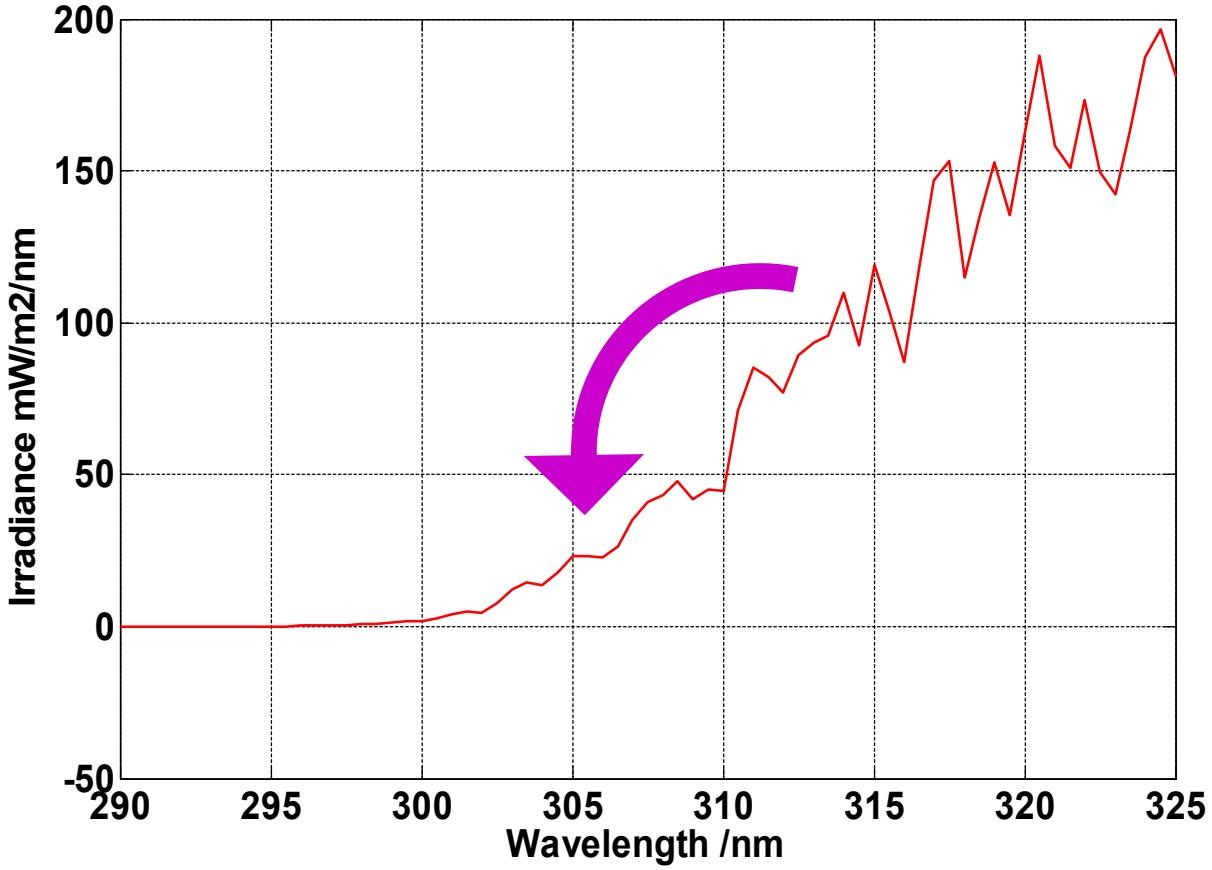


Straylight correction on O_3



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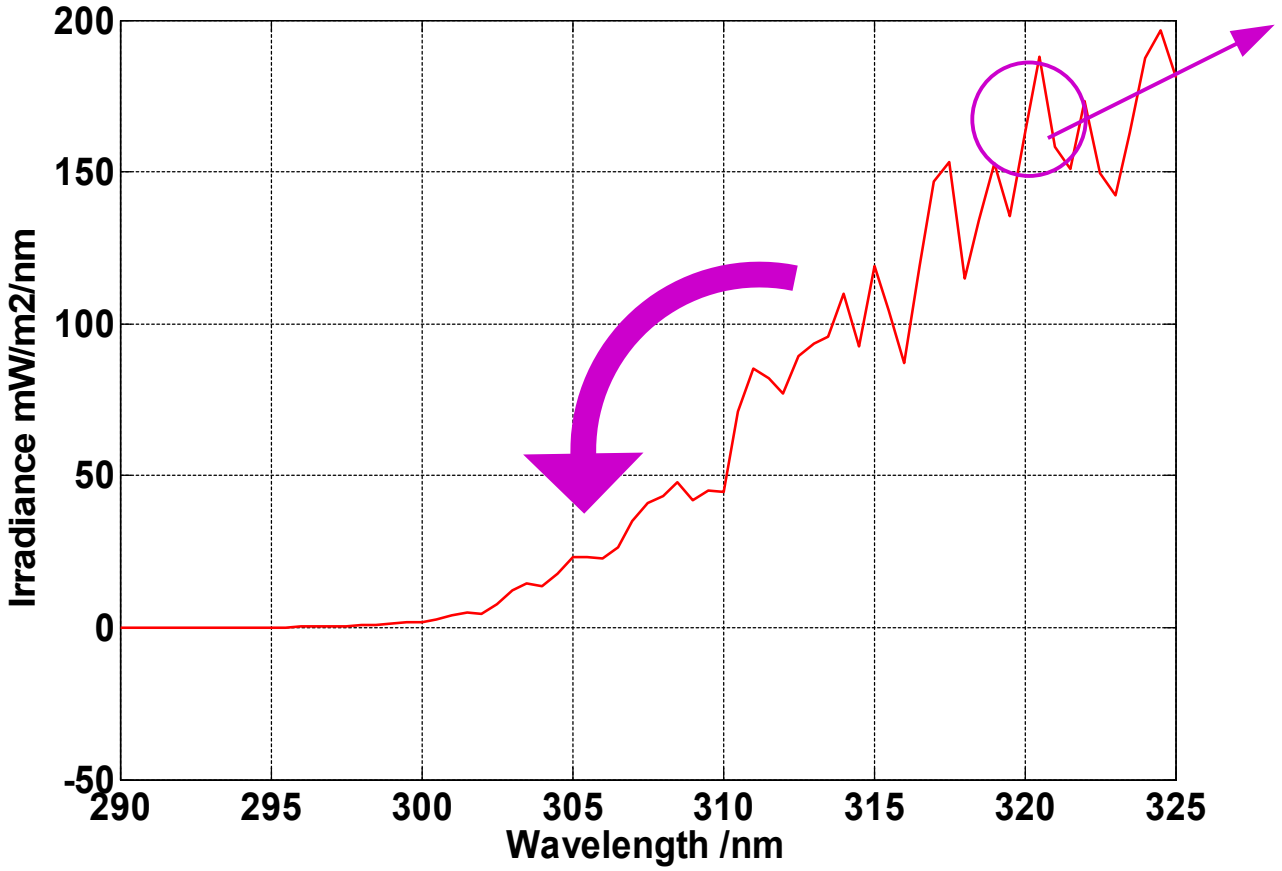
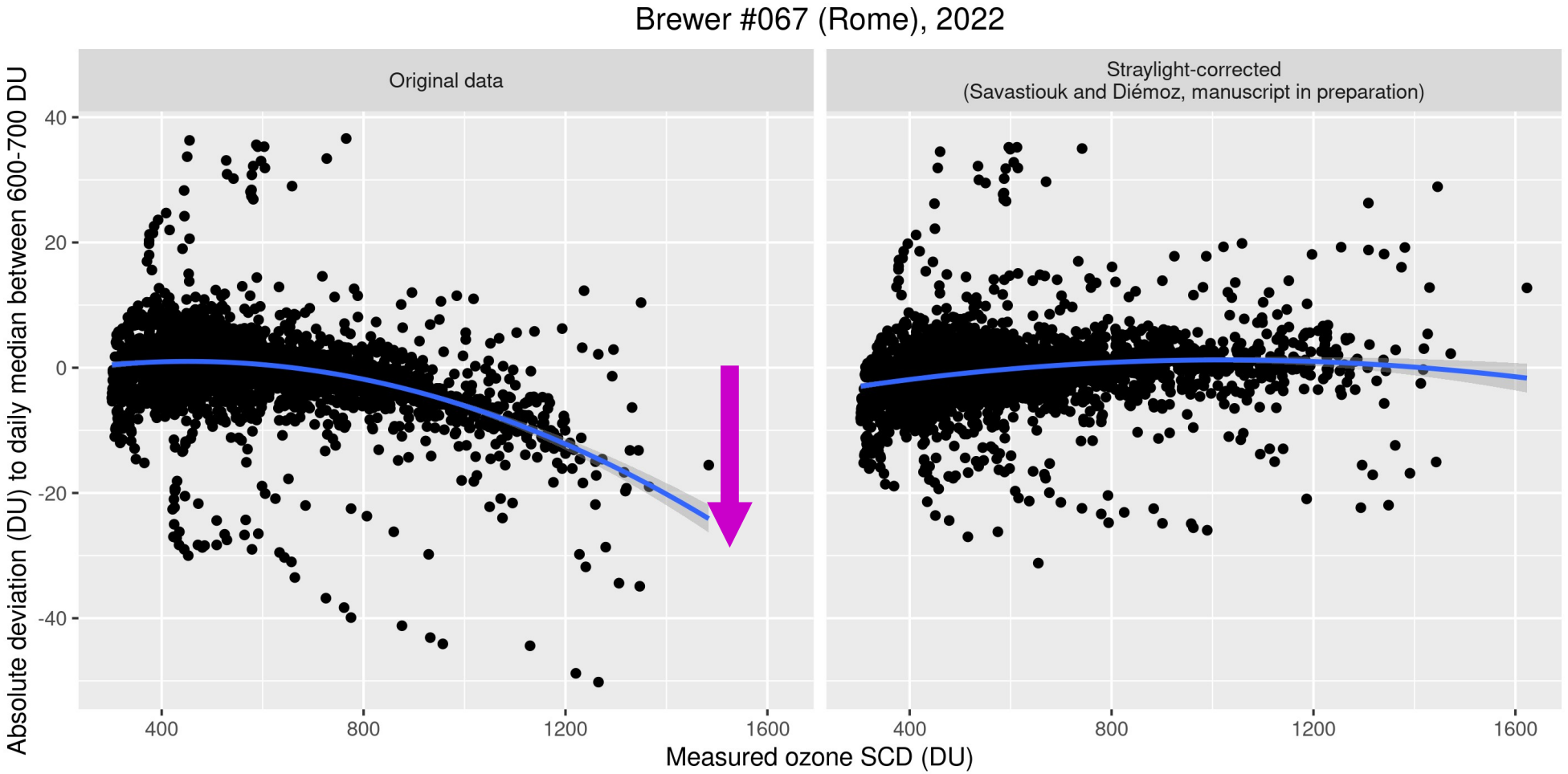


Solution: subtract an instrument-dependent fraction (%) of light at 320 nm to the count rates measured at the 5 operating wavelengths in the UV range

No parametrisation of straylight vs airmass

Once raw data are corrected, they can be processed with any software already available to retrieve O_3

Straylight correction on O_3



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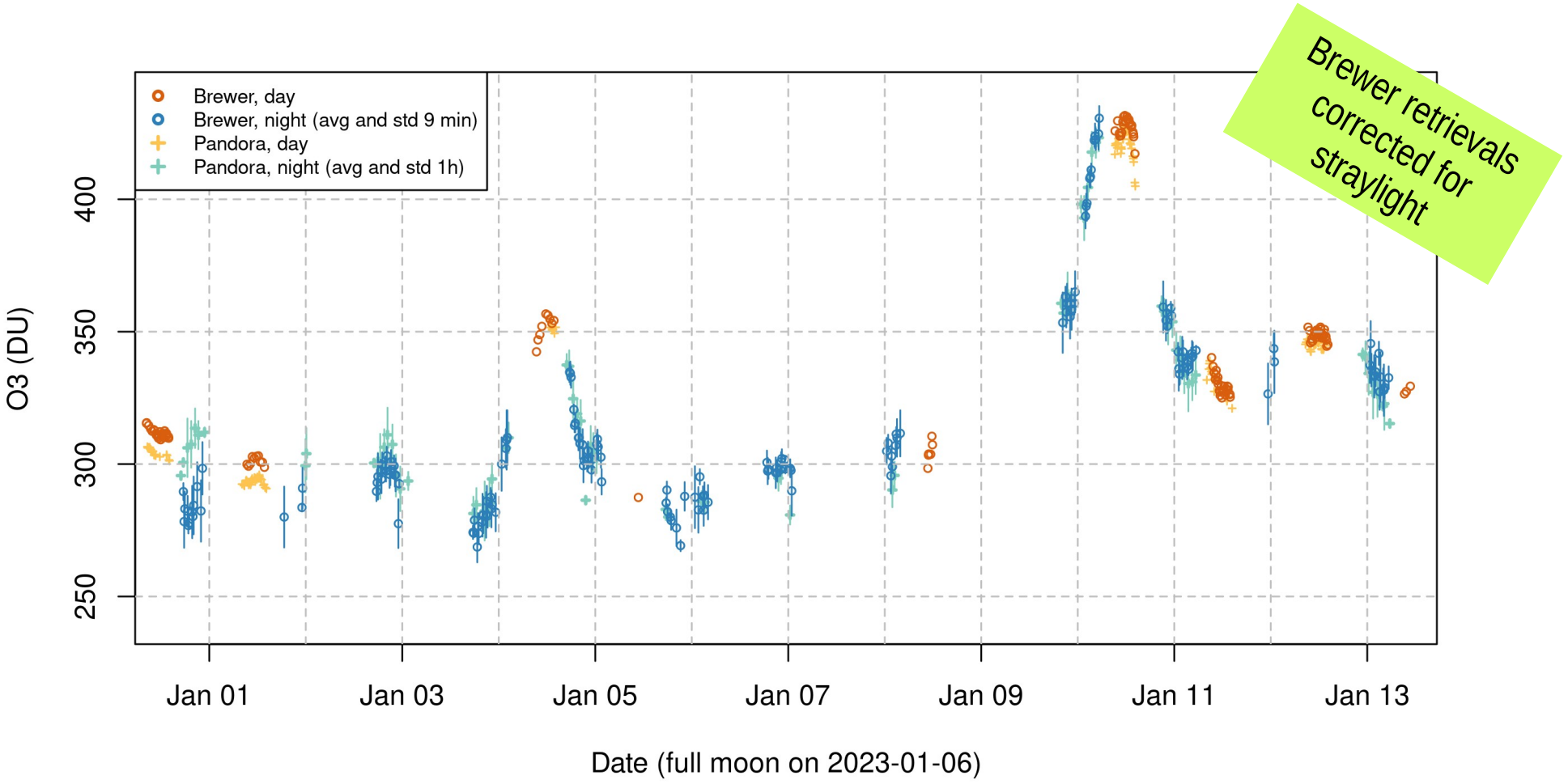

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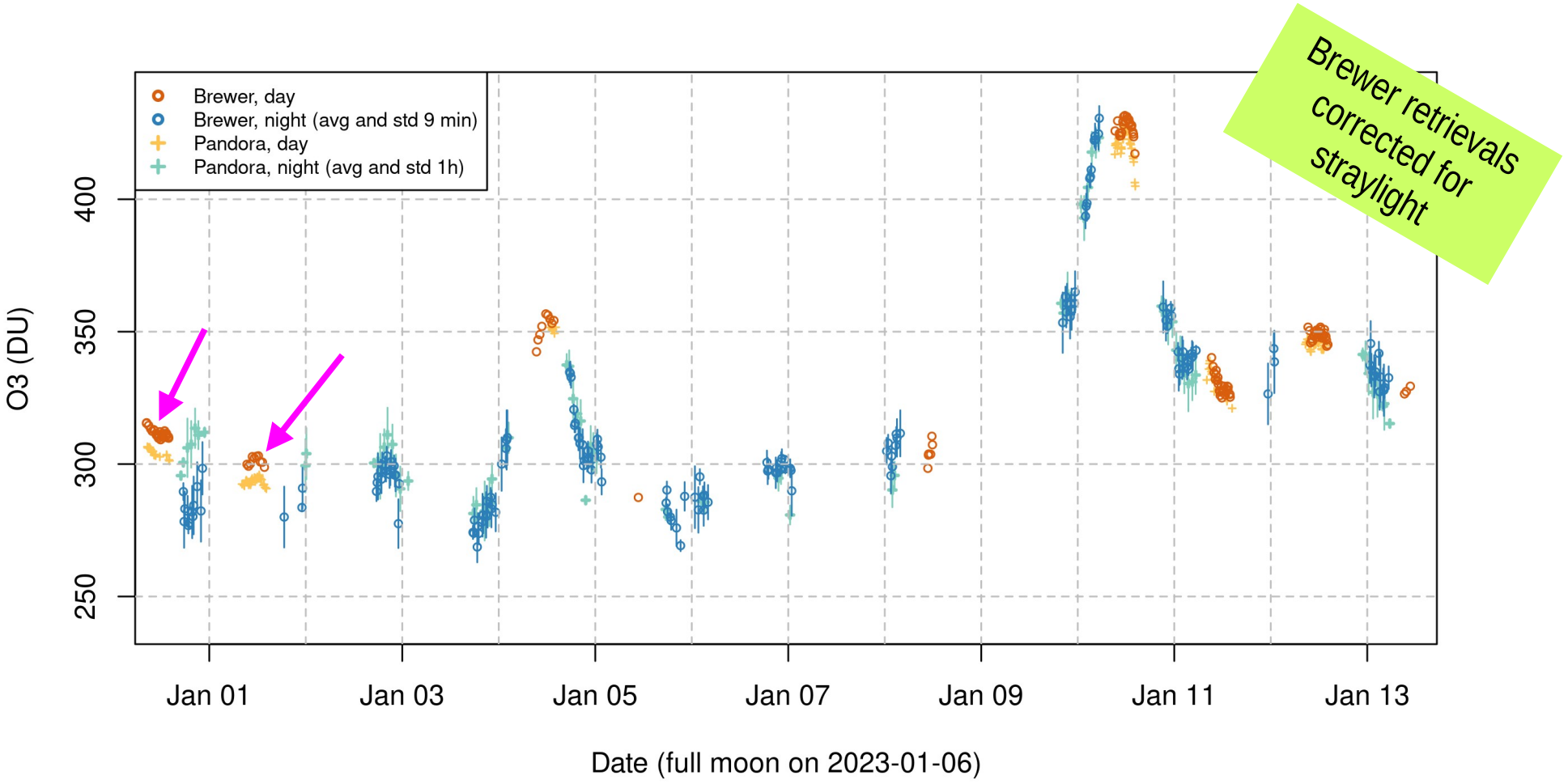

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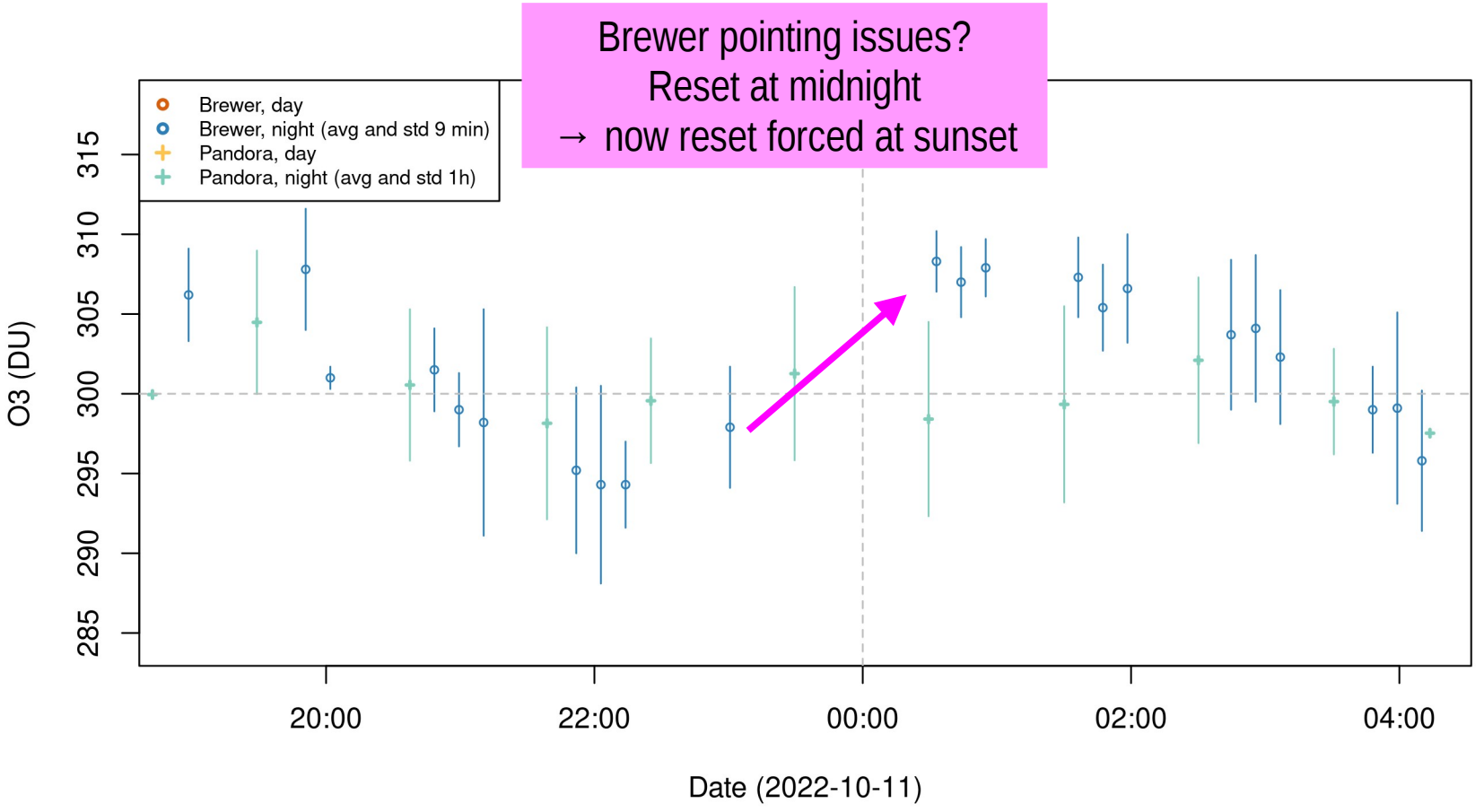


WP tasks

- Development of algorithm for NO_2 retrievals and test
- Characterisation of spectral straylight
- Straylight-corrected daytime and nighttime O_3 datasets
- Data quality evaluation, including cloudscreening

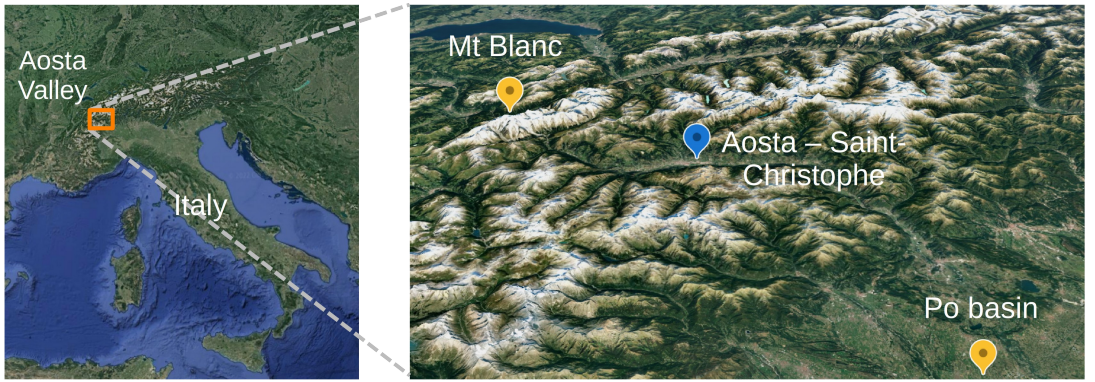
To-do list before the end of the WP

- O_3 influence on NO_2 retrievals
- Products in harmonized data format (GEOMS)
- Dissemination of lunar products through the BAQUNIN web site

Future developments

- Further investigation of the observed midnight **discontinuities**, with focus on **pointing**
- Combined **uncertainty**
- Automated processing for **real-time products**
- Retrievals at another **observation site (Aosta–Saint-Christophe, Italian Alps)**

* similar instrumentation
* complex orography
* proximity to Po Valley



Thank you for your attention!

New NO_2 algorithm

- Dispersion function and resolution based on 2022 characterisation
- Recalculation of NO_2 differential absorption coefficient
- Recalculation of interferences from known atmospheric absorbers (O_3, O_2–O_2)
- Recalculation of weightings for the linear combination
- Assessment of instrumental artifacts (e.g., effect of differential filter attenuation)
- Recalculation of extraterrestrial coefficient (e.g. by transfer from the 6-wavelength algorithm during the day or from Pandora)

Preliminary O_3 comparison with Pandora