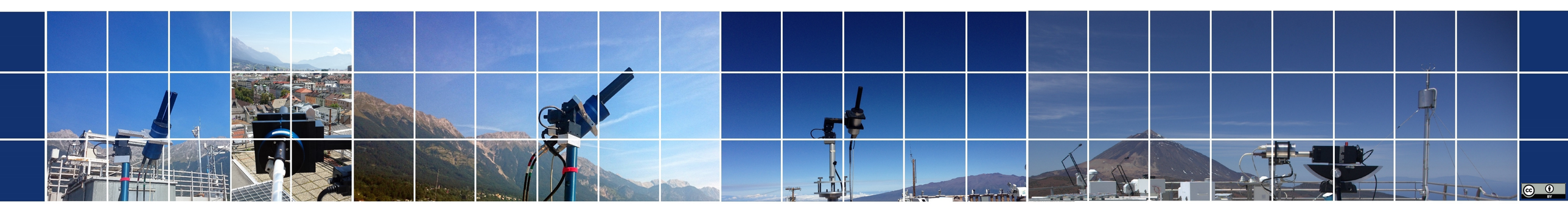

More accurate Pandora total ozone columns

improved laboratory calibration and simultaneous retrieval of effective ozone temperature

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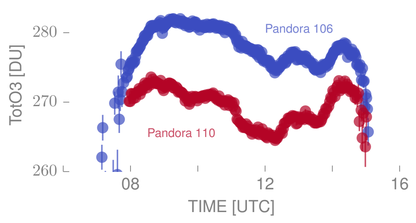
CURRENT PANDORA TOTAL OZONE RETRIEVAL

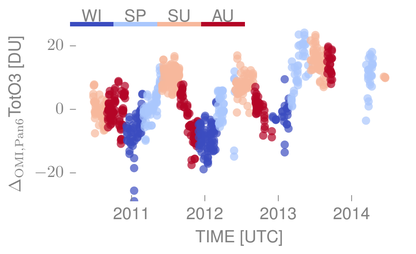
The current operational Pandora total ozone column algorithm (TotO3) uses an extraterrestrial reference from the literature. Advantage: Pandora leaves the lab and can measure TotO3. No field calibration or comparison to other instruments is needed. The accuracy of TotO3 is estimated to 10 DU.

LIMITATIONS IN CURRENT RETRIEVAL

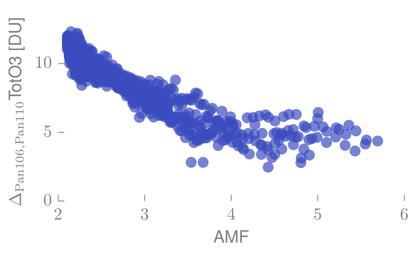
The accuracy is driven by three effects:
First, **missing absolute calibration** typically causes bias in the data, since the spectral sensitivity varies between instruments.



Second, the algorithm uses a **constant effective ozone temperature** of 225 K (TempO3) leading to a seasonal differences compared to instruments which include TempO3 in the retrieval.



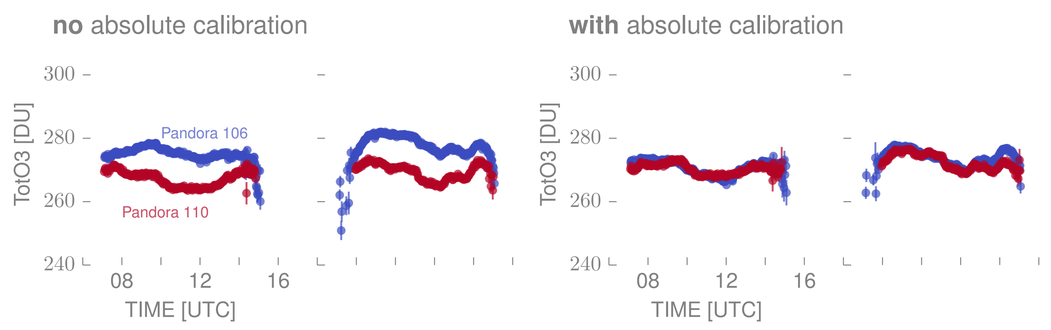
Third, **missing stray light correction** (spatial and spectral) causes deviations at high solar zenith angles.



Effects one and two are discussed here.

INCLUDING ABSOLUTE CALIBRATION

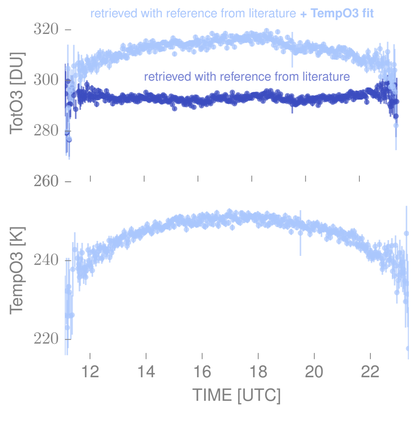
Absolute calibration removes offset between TotO3 obtained from collocated Pandoras.



INCLUDING EFFECTIVE OZONE TEMPERATURE

TempO3 fitting in the current algorithm **does not work** due to intrinsic differences between the measurements and the reference from literature.

As a consequence, the **fitted TempO3 typically shows a diurnal cycle**.

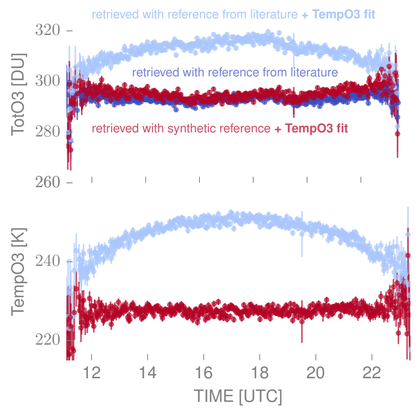


EFFECTIVE OZONE TEMPERATURE WITH SYNTHETIC REFERENCE

Synthetic reference means gas-absorption-free (“quasi extraterrestrial”) reference built from measured data.

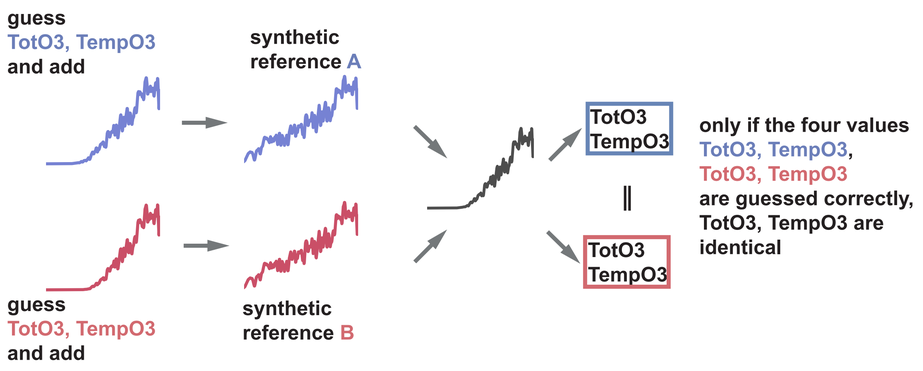
Problem: **You need to find the correct TotO3 and TempO3 values in the measurement(s).**
⟶ Auto-Cross-Calibration (AXC)

After AXC, the **synthetic reference enables you to fit TempO3** in addition to TotO3.

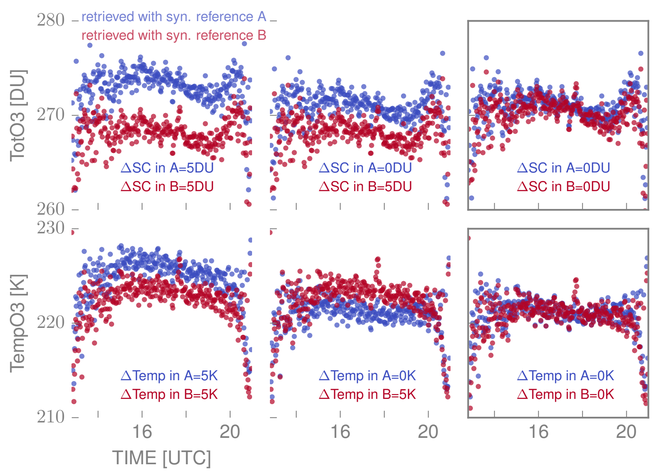


AUTO-CROSS-CALIBRATION (AXC)

AXC makes use of **non-linear** behavior in the algorithm **once TempO3 is fitted** too. Apply retrieval on a test dataset (black) using two different measurements as reference spectra (blue and red):



Example:



Correct guesses of TotO3 and TempO3 in both references (right column in figure) **give the correct TotO3 and TempO3** in the test dataset.

Note: AXC minimization only converges if very good first guesses of TotO3 and TempO3 in the references are given. Therefore the need for absolute calibrated data.

CONCLUSIONS / OUTLOOK

- Absolute calibration improves accuracy significantly. It is currently not part of the Pandonia operational lab calibration, but should be so in the future.
- Effective ozone temperature can be retrieved using synthetic reference.
- AXC allows to build gas-absorption-free, synthetic reference. AXC is not operational yet.
- Stray light calibration is still to be implemented in order to improve TotO3 for high solar zenith angles.