



New and improved data from the Pandonia Global Network for satellite validation

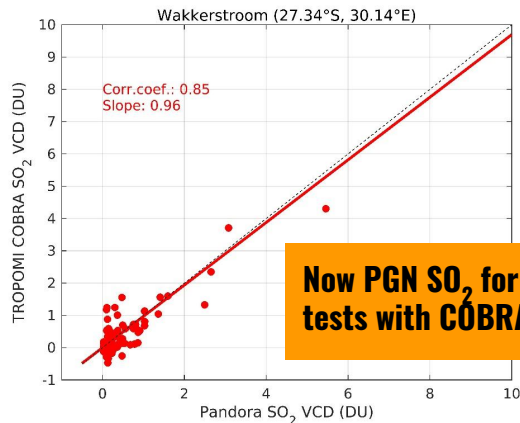
Alexander Cede^{1,2}, Martin Tiefengraber^{1,3}, Manuel Gebetsberger¹, Michel van Roozendaal⁷, Henk Eskes⁸, Christophe Lerot⁷, Diego Loyola⁹, Nicolas Theys⁷, Isabelle De Smedt⁷, Nader Abuhassan², Thomas Hanisco², Angelika Dehn⁴, Jonas von Bismarck⁴, Stefano Casadio⁴, Luke Valin⁶ and Barry Lefer⁵

¹LuftBlick, ²NASA/GSFC, ³Univ. Innsbruck, ⁴ESA/ESRIN, ⁵NASA/HQ, ⁶US EPA, ⁷BIRA-IASB, ⁸KNMI, ⁹DLR

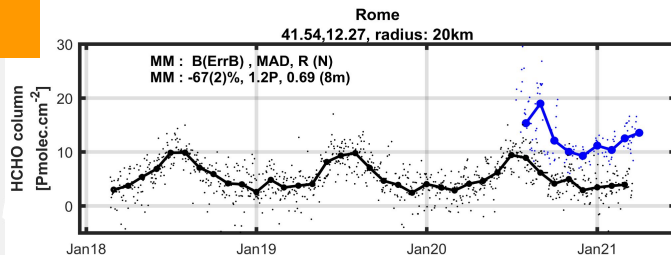
EGU21-13302

PGN is starting to release the new and improved v1.8 data this week (instrument-per-instrument)

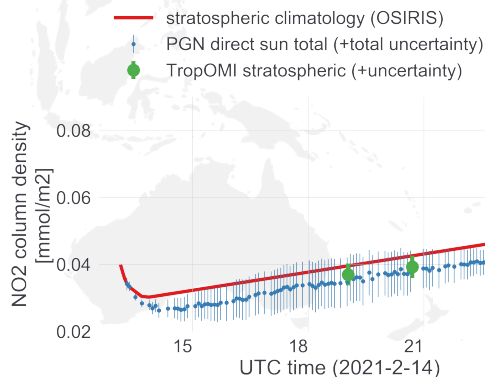
Some appetizers of the new data are shown in this presentation.



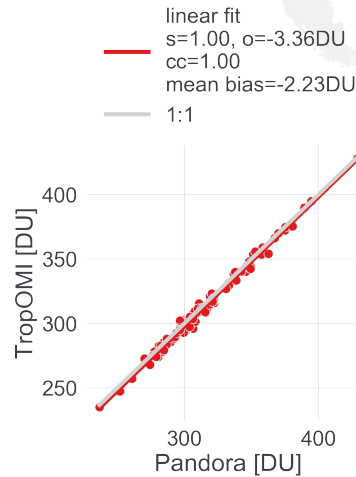
New PGN HCHO vs TROPOMI



Now PGN SO₂ for tests with COBRA ...



Improved PGN NO₂ with full uncertainty & better temperature treatment



Improved PGN O₃ with effective O₃-temperature included

New and improved data from the Pandonia Global Network for satellite validation

Alexander Cede^{1,2}, Martin Tiefengraber^{1,3}, Manuel Gebetsberger¹, Michel van Roozendael⁷, Henk Eskes⁸, Christophe Lerot⁷, Diego Loyola⁹, Nicolas Theys⁷, Isabelle De Smedt⁷, Nader Abuhassan², Thomas Hanisco², Angelika Dehn⁴, Jonas von Bismarck⁴, Stefano Casadio⁴, Luke Valin⁶ and Barry Lefer⁵

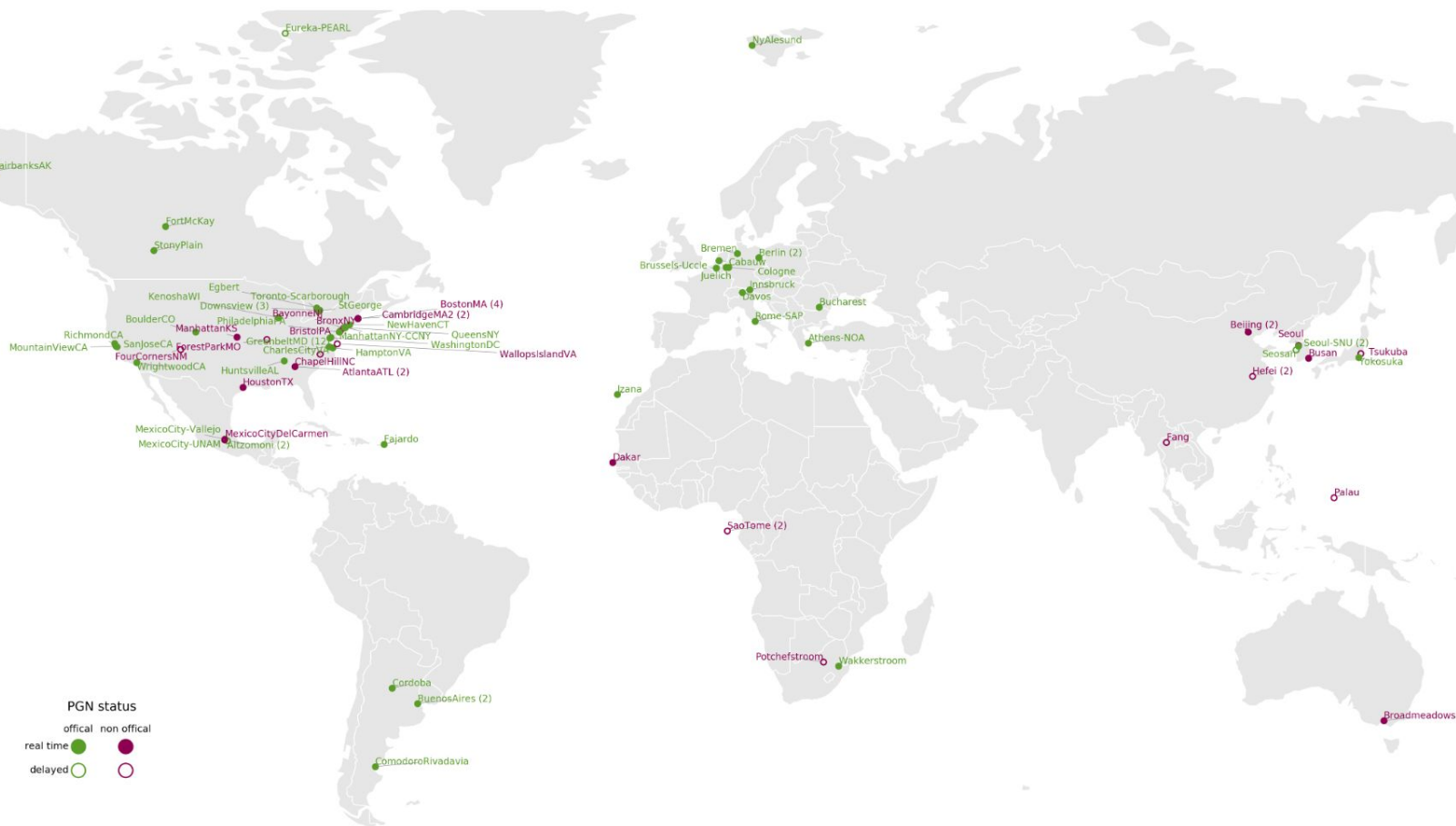
¹LuftBlick, Innsbruck, Austria. ²NASA Goddard Space Flight Center, Greenbelt, MD, USA. ³Department of Atmospheric and Cryospheric Sciences, University of Innsbruck, Innsbruck, Austria. ⁴Earth Observation Ground Segment Department, ESA / ESRI, Frascati, Italy. ⁵NASA Headquarters, Washington D.C., USA. ⁶Office of Research & Development, US Environmental Protection Agency, Durham, NC, USA. ⁷Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium. ⁸Koninklijk Nederlands Meteorologisch Instituut (KNMI), De Bilt, The Netherlands. ⁹German Aerospace Center (DLR), Oberpfaffenhofen, Germany

Additional material

EGU General
Assembly 2021
EGU21-13302



PGN instrument distribution Apr 2021



Tot = Total column amount based on direct sun observations

Prof = Tropospheric column amount, surface concentration and profile information based on sky observations (MAXDOAS type)

Product	Changes compared to v1.7
NO ₂ Tot	Improved fitting settings, inclusion of stratospheric climatology, more comprehensive uncertainty, improved field calibration
NO ₂ Prof	Added profile information (tropospheric column and surface concentration existed)
O ₃ Tot	Improved fitting settings, fitting effective temperature, more comprehensive uncertainty, new field calibration technique
SO ₂ Tot	New product
HCHO Tot	New product
HCHO Prof	Added profile information (tropospheric column and surface concentration existed)

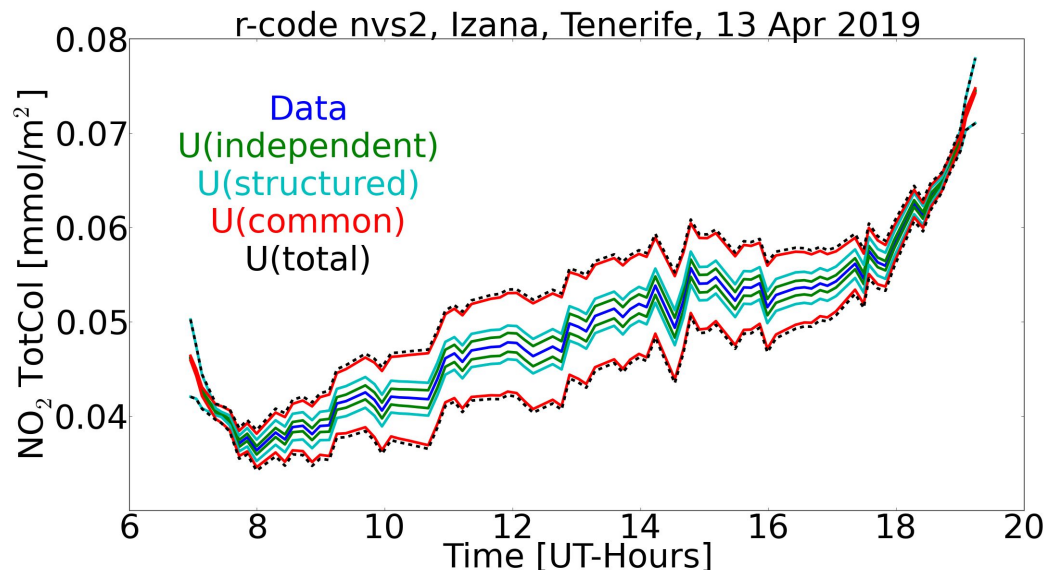
Tot = Total column amount based on direct sun observations

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Product	Changes compared to v1.7
NO₂ Tot	Improved fitting settings, inclusion of stratospheric climatology, more comprehensive uncertainty, improved field calibration
NO ₂ Prof	Added profile information (tropospheric column and surface concentration existed)
O₃ Tot	Improved fitting settings, fitting effective temperature (=useful output!), more comprehensive uncertainty, new field calibration technique
SO₂ Tot	New product
HCHO Tot	New product
HCHO Prof	Added profile information (tropospheric column and surface concentration existed)

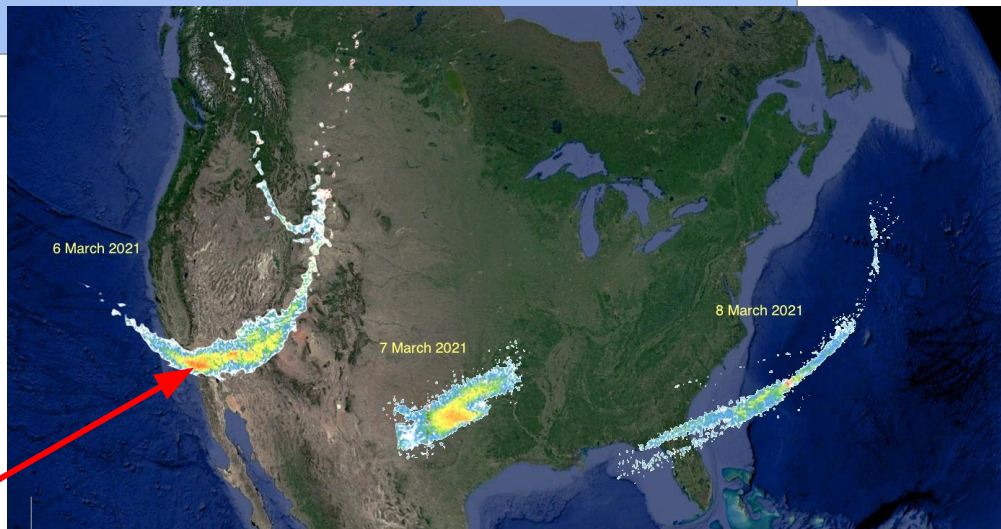
Some appetizers for these products are shown in this presentation

- PGN v1.8 data uncertainty extensively restructured and updated
- Use newest nomenclature and usage based on core principles of metrological traceability (done under guidance of UK National Physics Laboratory, NPL).
- Error sources not “captured” by the uncertainty are included in the data quality flags:
DQ0=high quality, DQ1=medium quality, DQ2=low quality
DQ10, DQ11, DQ12: as above but data still not quality assured



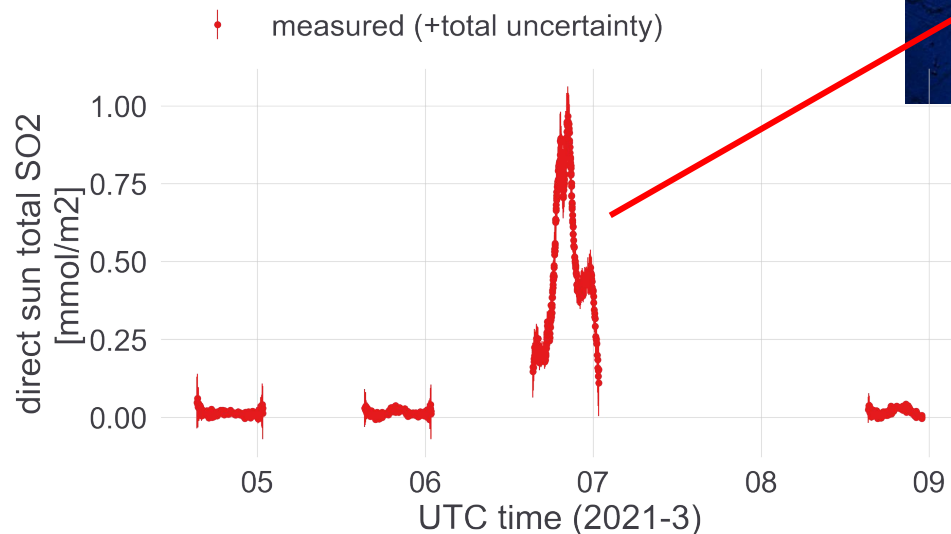
Product	Changes compared to v1.7
SO₂ Tot	New product

SO₂-greetings from Mount Etna



TROPOMI data (tweet from Pepijn Veeffkind)

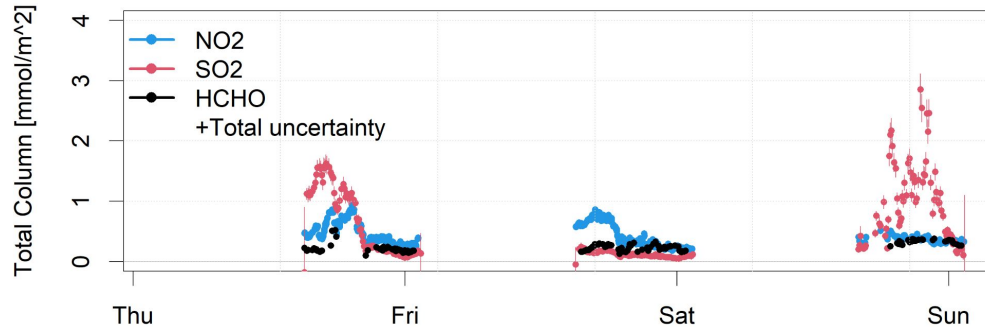
Pandora 68 SO₂ @ Wrightwood CA (JPL Table Mountain), Station PI Thierry Leblanc



PGN v1.8 total SO₂, NO₂, HCHO columns at Mexico City (Station PI Michel de Grutter) and Wakkerstroom (Station PI Bob Scholes)



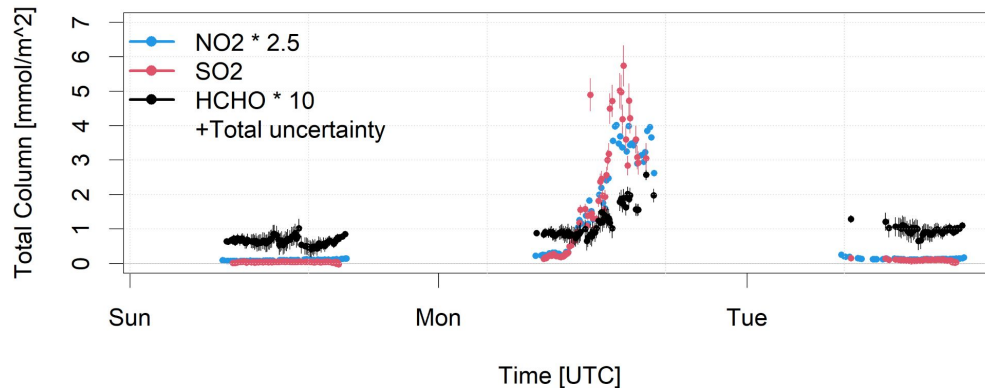
2020-10-01 - 2020-10-04



Mexico City, P157

Frequent volcanic activities from nearby Popocatépetl (“smoking mountain”).

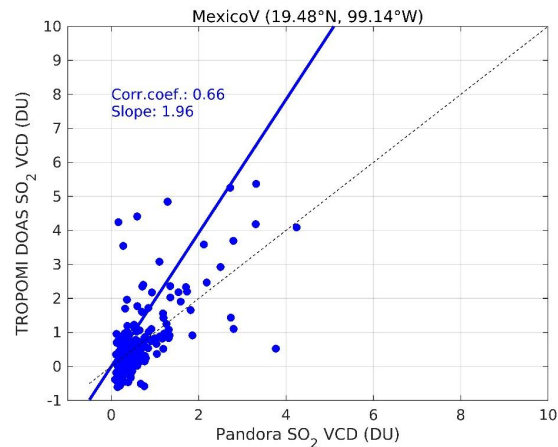
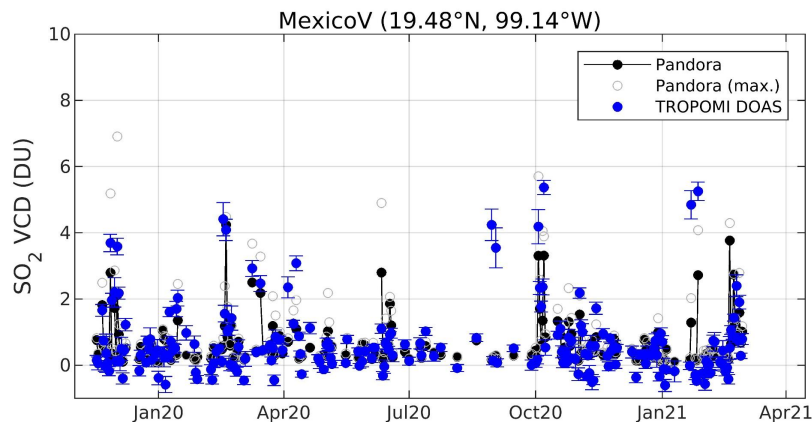
2020-07-05 - 2020-07-08



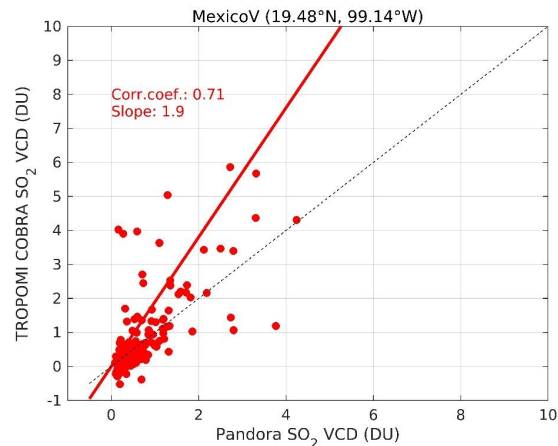
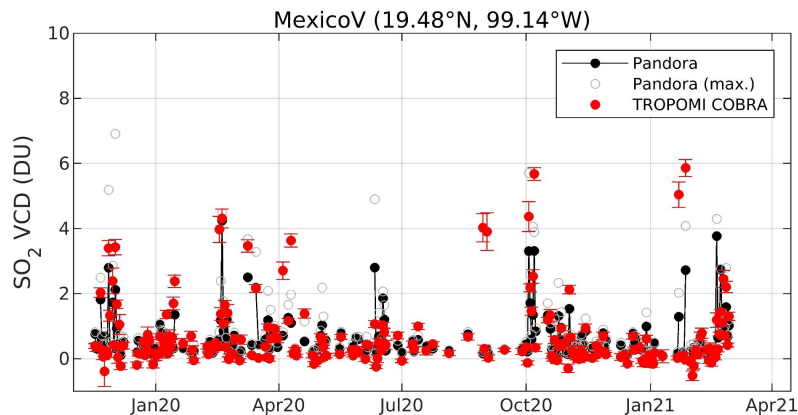
Wakkerstroom (South Africa), P159

Events of SO₂ from coal industry in the region. Plumes contain other pollution gases as well.
Note: NO₂ and HCHO data are scaled!

PGN v1.8 total SO₂ columns vc. TROPOMI at Mexico City (Station PI Michel de Gutter)

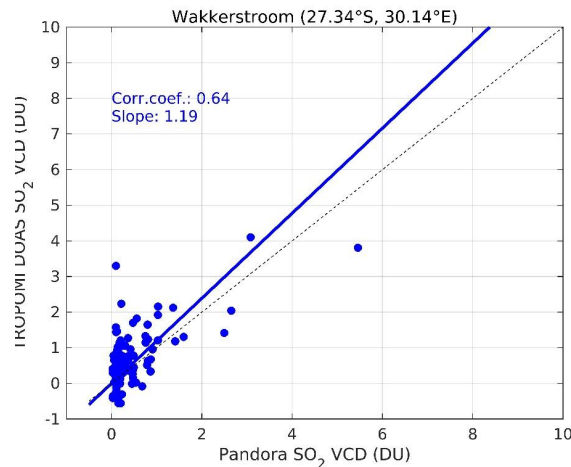
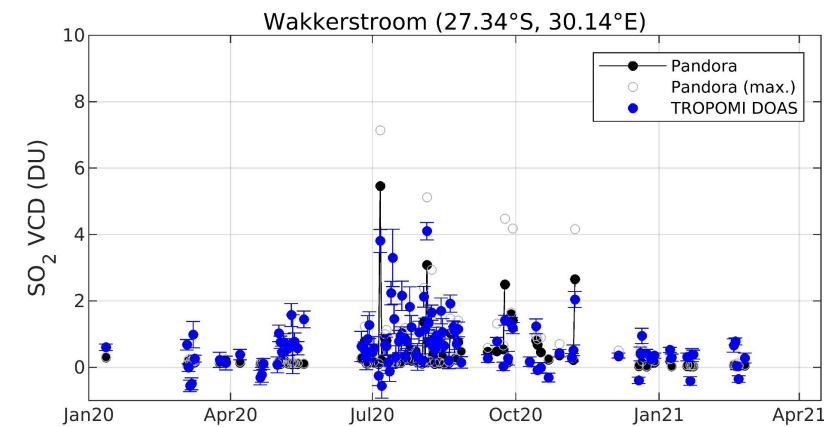


PGN v1.8 data used to validate TROPOMI SO₂ and to test new retrieval method “COBRA”

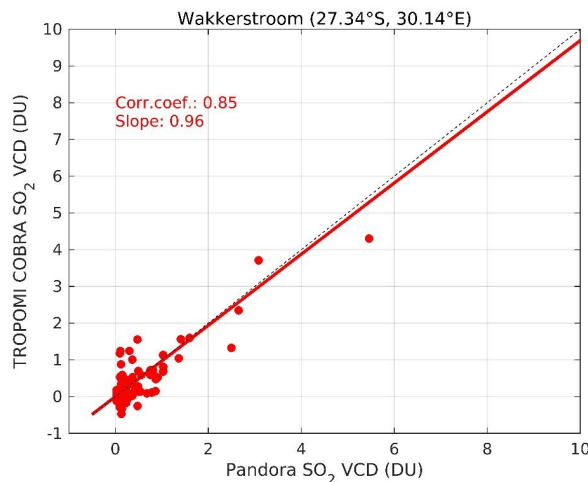
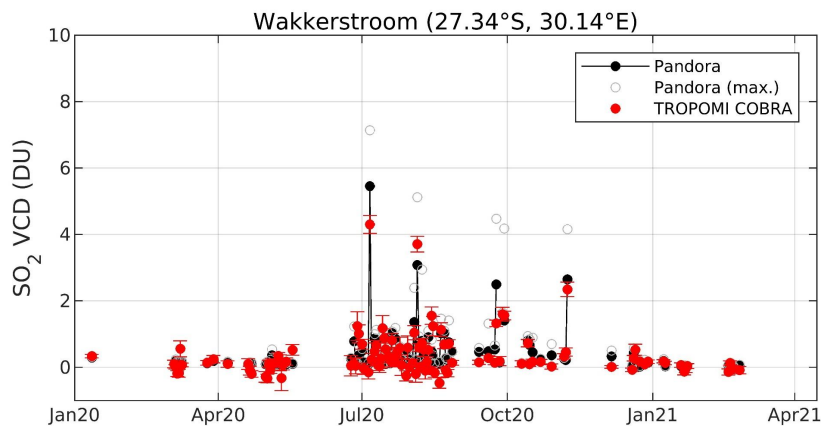


Mexico City
Frequent volcanic activities from nearby Popocatepetl (“smoking mountain”).

PGN v1.8 total SO₂ columns vc. TROPOMI at Wakkerstrom (Station PI Bob Scholes)

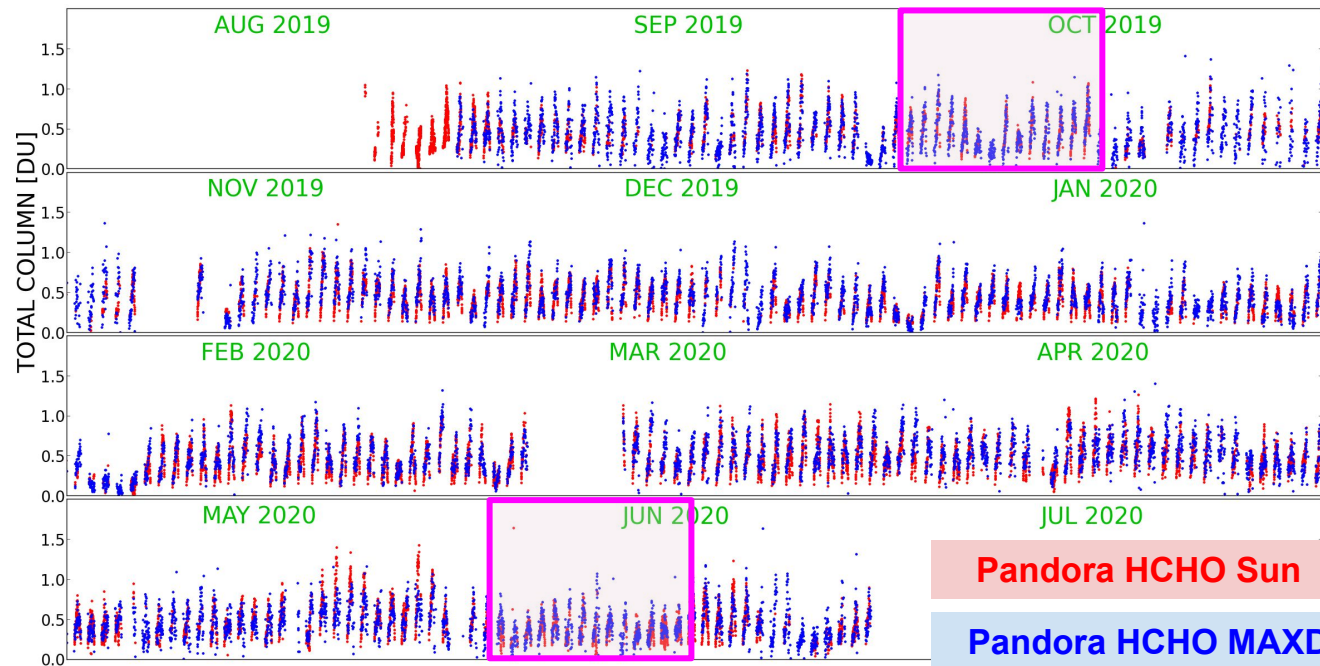


PGN v1.8 data used to validate TROPOMI SO₂ and to test new retrieval method “COBRA”



Wakkerstrom (South Africa)
Events of SO₂ from coal industry in the region.

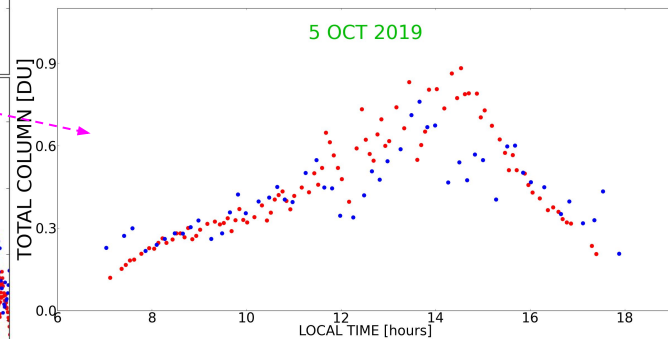
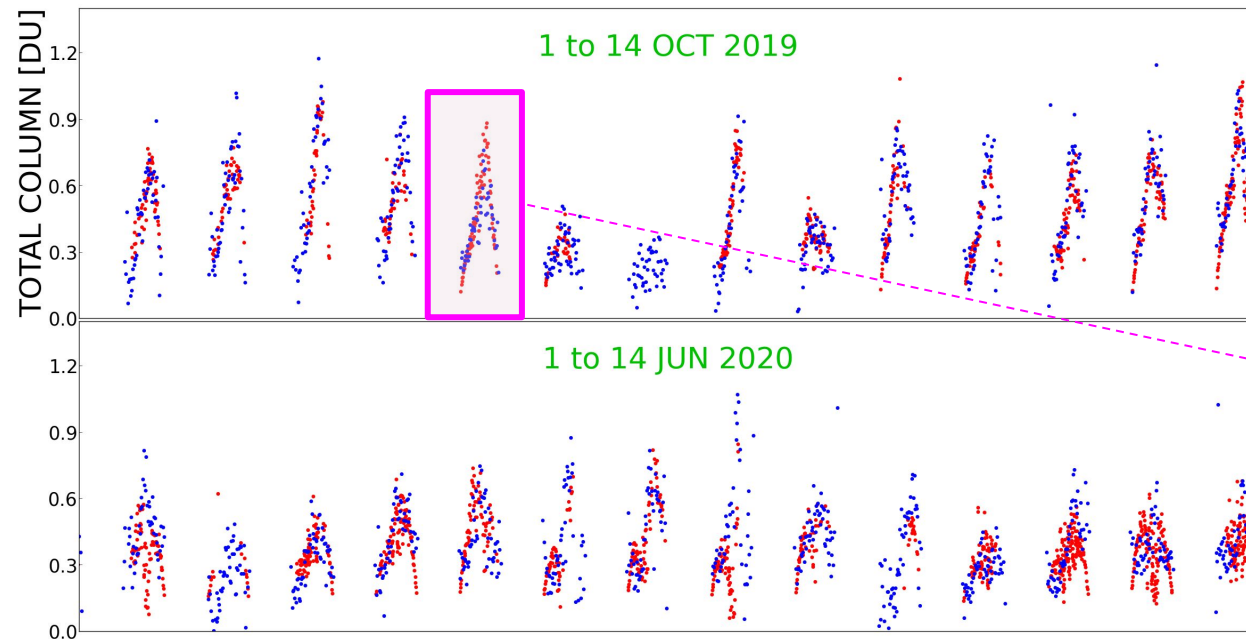
Product	Changes compared to v1.7
HCHO Tot	New product
HCHO Prof	Added profile information (tropospheric column and surface concentration existed)



**Pandora 142
HCHO @ Mexico
City, Station PI
Michel de Grutter**

Pandora HCHO Sun

Pandora HCHO MAXDOAS

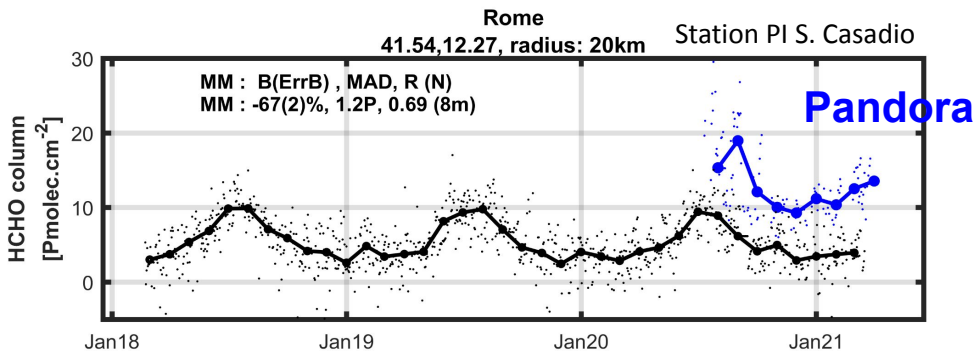


**Pandora 142 HCHO @ Mexico
City, Station PI Michel de
Grutter**

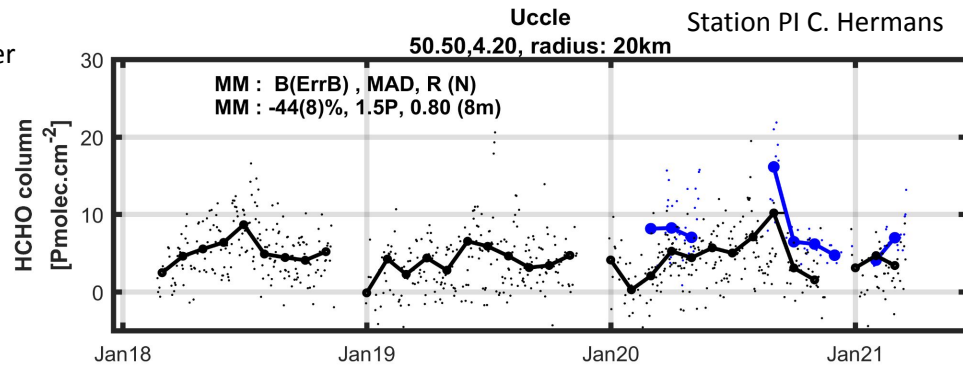
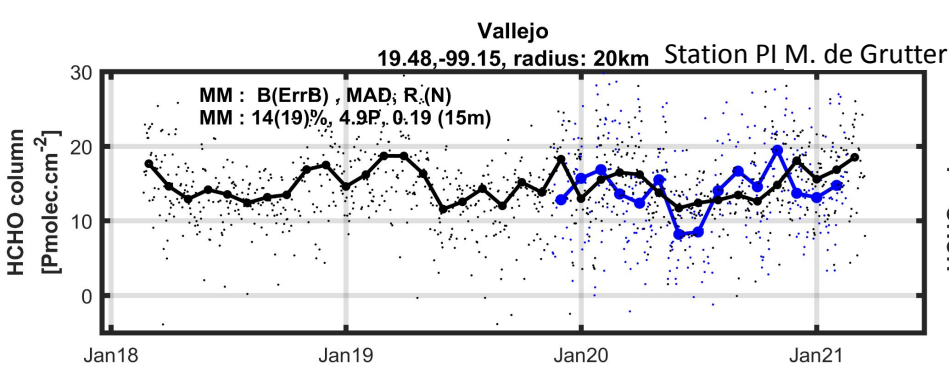
Pandora HCHO Sun

Pandora HCHO MAXDOAS

Initial comparisons of PGN v1.8 data with TROPOMI HCHO retrievals: daily means (small dots) and monthly means (large dots and lines)



- **B=Bias:** median of column relative differences (TROPOMI - Pandora)/Pandora.
- **ErrB:** estimated error on B
- **MAD:** median absolute deviation of the differences (TROPOMI - Pandora)
- **R:** Correlation Coefficient
- **N:** number of coincident months.

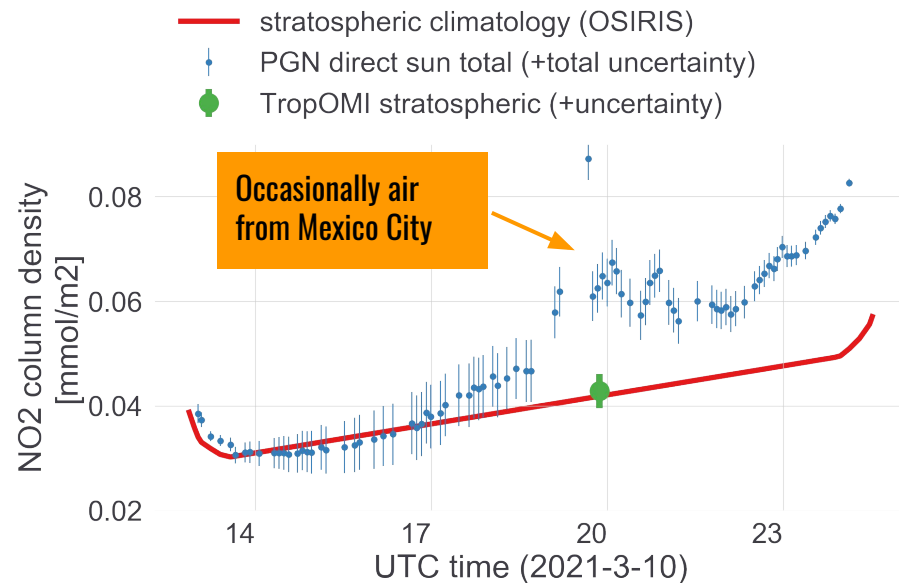
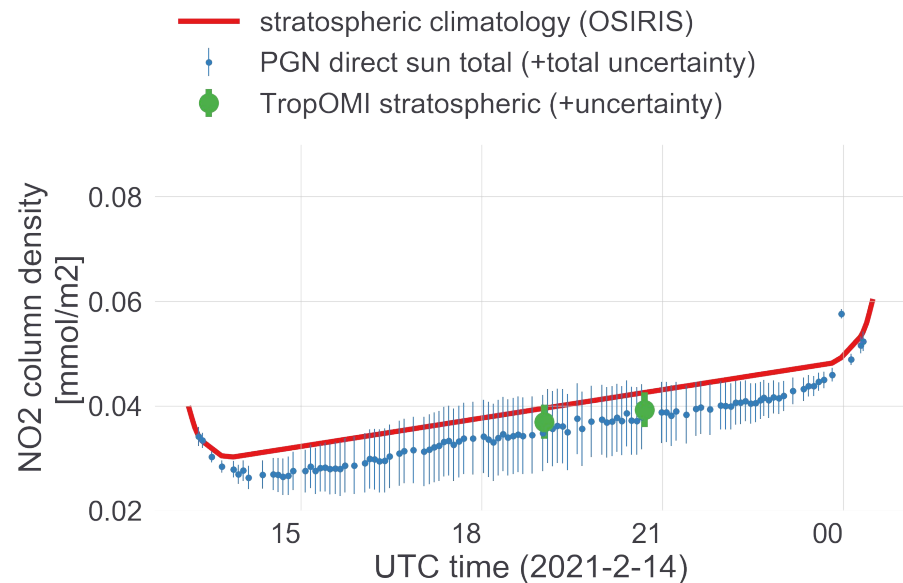


PGN v1.8 improved total NO₂ columns



Product	Changes compared to v1.7
NO₂ Tot	Improved fitting settings, inclusion of stratospheric climatology, more comprehensive uncertainty, improved field calibration

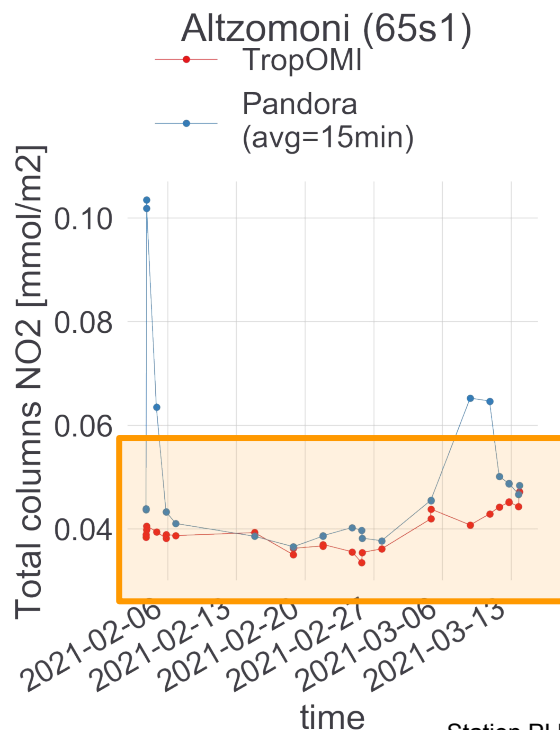
Difference v1.8 to 1.7 mainly seen in rural stations with mostly stratospheric NO₂ (→ new treatment of effective NO₂-temperature).



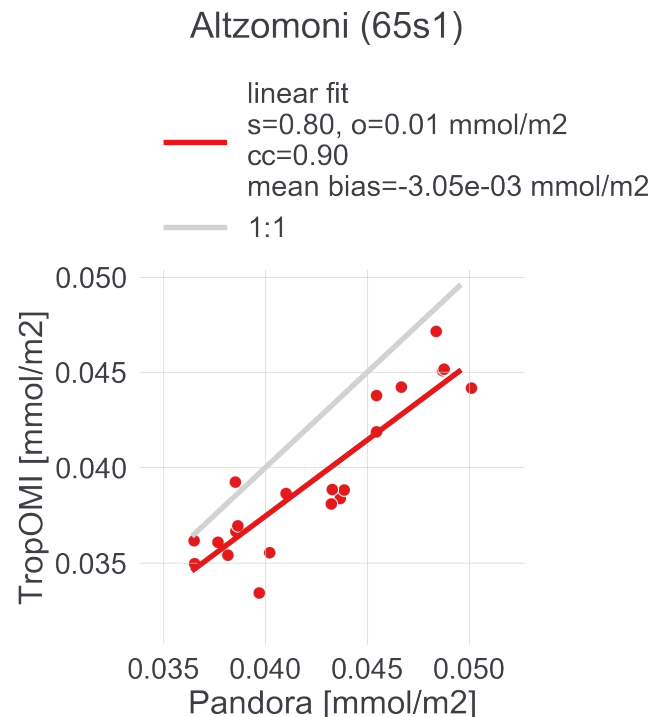
PGN v1.8 improved total NO₂ columns comparison to TROPOMI stratospheric NO₂



High altitude remote sites have been used to validate TROPOMI stratospheric NO₂. Here a scatterplot using only the days without polluted air from Mexico City. Such comparison will be redone using PGN v1.8 data.



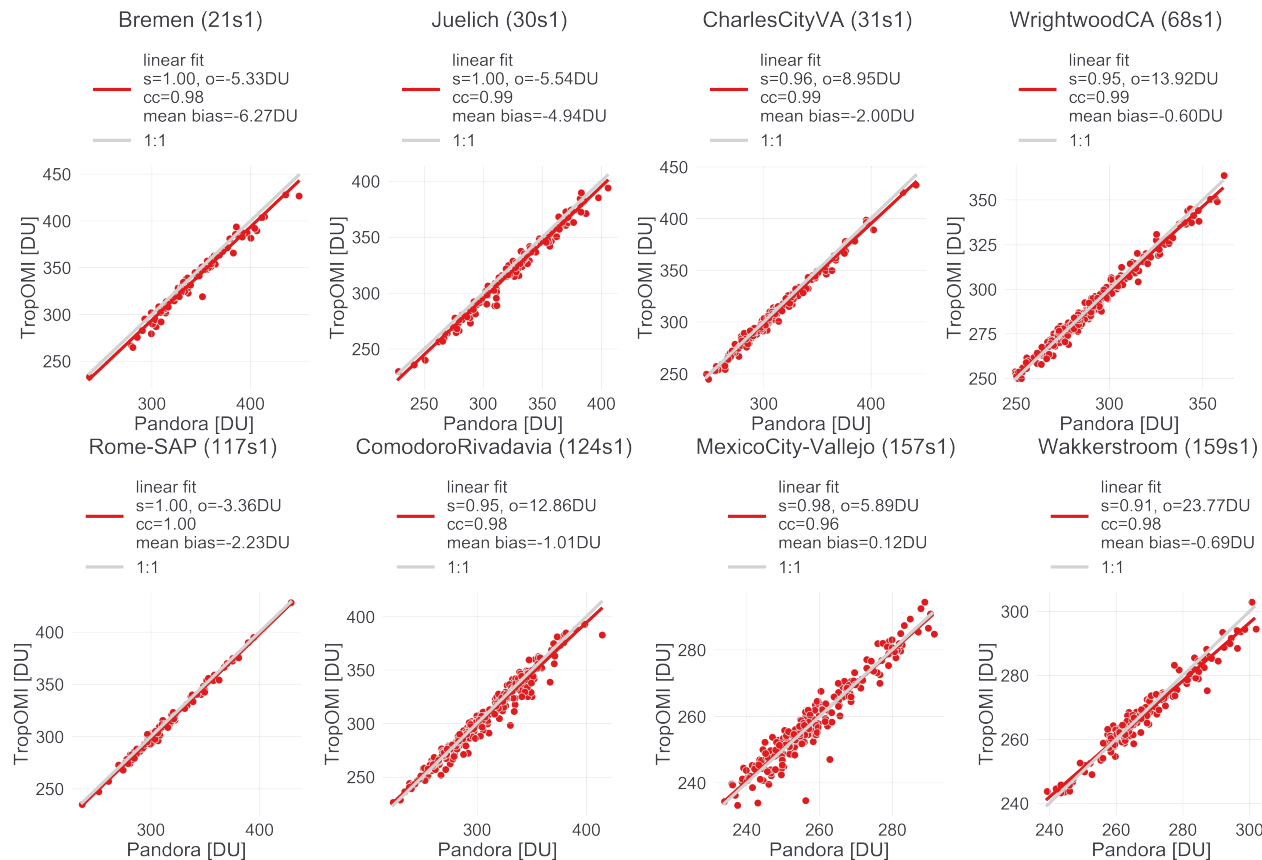
Station PI Michel de Grutter



PGN v1.8 improved total O3 columns

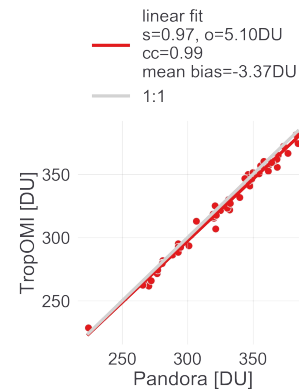


Product	Changes compared to v1.7
O₃ Tot	Improved fitting settings, fitting effective temperature, more comprehensive uncertainty, new field calibration technique



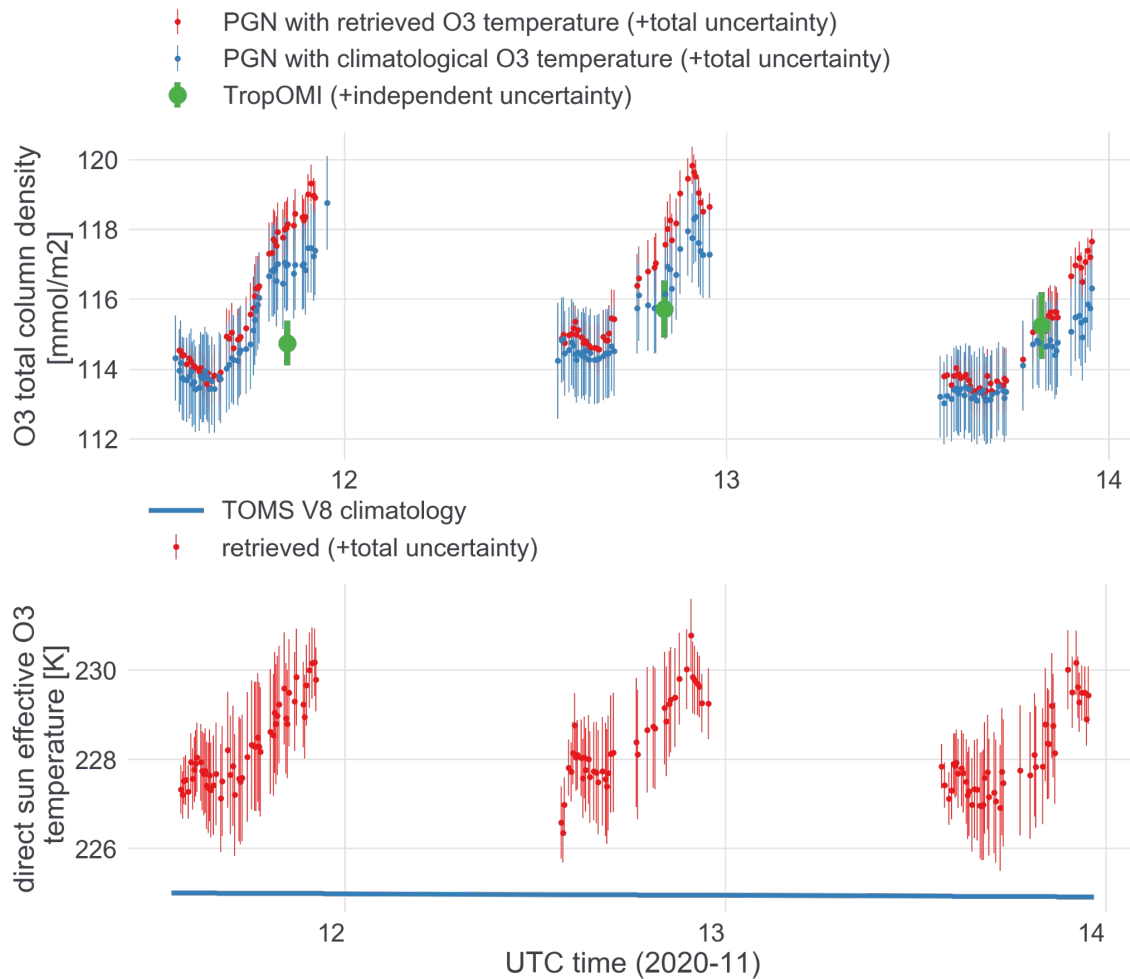
Two versions of PGN v1.8 O₃ columns. This one uses a climatological O₃-effective temperature. It shows excellent comparisons to TROPOMI O₃.

Brussels-Uccle (162s1)



s=Slope
o=Offset
cc=CorrCoef

PGN v1.8 improved total O₃ columns



- **Blue data: PGN O₃ using the climatological O₃-effective temperature.**
- **Red data: PGN O₃ retrieving the O₃-effective temperature.**
- **Green data: TROPOMI O₃.**
- **PGN retrieved O₃-effective temperature allows for future in-depth analysis of possible small biases between PGN and TROPOMI O₃ columns.**

v1.8 data upload to EVDC is starting this week and will be done on an instrument-per-instrument base.

