

# Pandonia Global Network Update 2023

Alexander Cede for the PGN team



# PGN & Pandora manufacturing teams by July 2023

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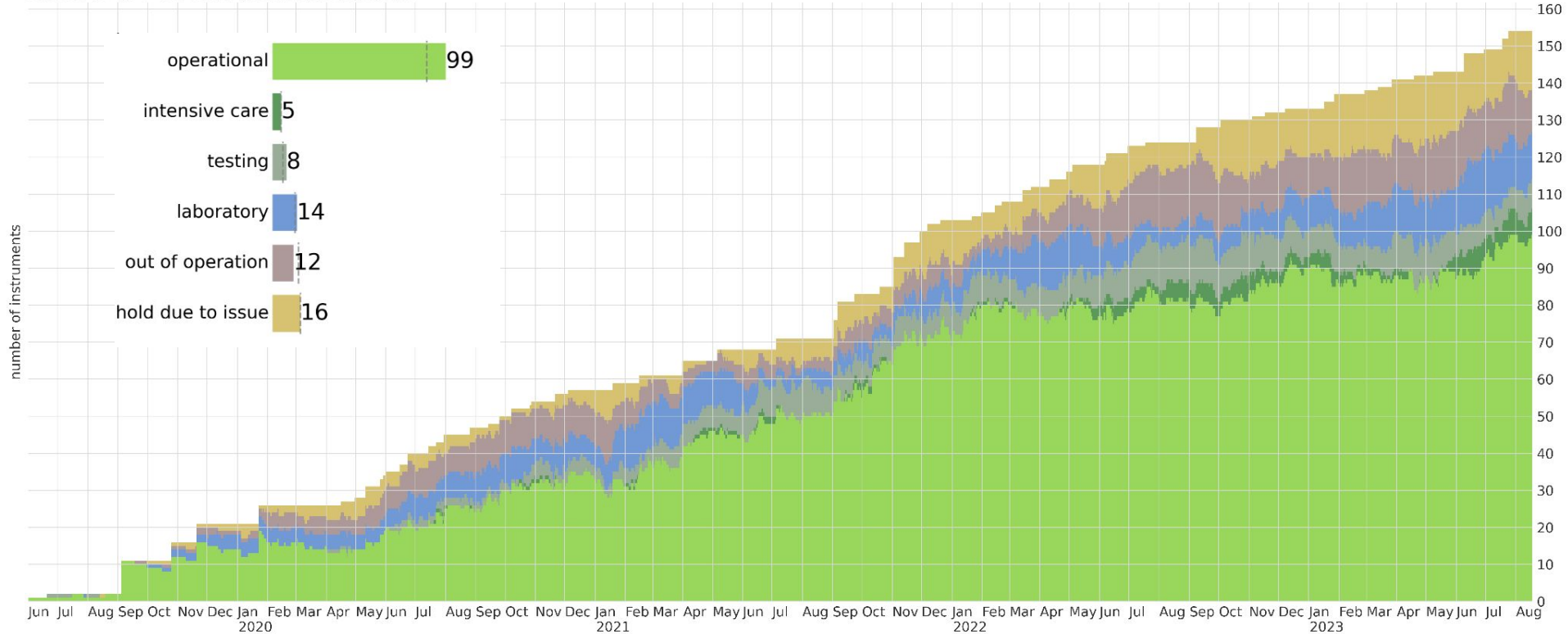




# PGN Evolution

Number of PGN instrument and status

total number: 154





# Data products overview - NO<sub>2</sub>, O<sub>3</sub>, SO<sub>2</sub>, HCHO (status 17 Aug 2023)



Product	Version	Planned	Develop			Release	EVDC	# PGN	# EVDC	Validation type	Uncertainty maturity	Key aspects / remarks	Literature
			Dates of first accomplishment										
<b>NO<sub>2</sub></b>													
Direct Sun Total Column	rnvs1p1-7				Dec-2019	Feb-2020	17	17	ExtPub	HLL	short fitting window, fixed effective parameters (temperature, height)	<a href="#">Wang et al. 2010, Diemoz et al., 2021</a>	
	rnvs3p1-8	Jul-2019			Sep-2021	May-2022	103	46	Intern	HMH	long fitting window, climatological effective parameters (temperature, height)	<a href="#">Section 3.3 of D11-1</a>	
Direct Moon Total Column	rnvm0p1-8	Jan-2021	Jul-2017						Unval	HLL	short fitting window, fixed effective parameters (temperature, height), reference spectrum from solar measurements	<a href="#">Section 3.4 of D11-1</a>	
	rnms0p1-8	Nov-2020	Sep-2021	Dec-2021					Intern	HMM	long fitting window, climatological effective parameters (temperature, height), reference spectrum from solar measurements	<a href="#">Section 3.4 QA4EO deliverable, Section 3.4 of D11-1</a>	
TropCol, SurfConc, Profile	rnvh3p1-8	Jul-2019	May-2020	May-2020	Sep-2021		119	0	ExtPub	HLM	V-shaped measurement geometry, parameterized algorithm using look-up tables, sequential reference spectrum used; EVDC-GEOMS template still missing	<a href="#">Roscoe et al. 2010, Kreher et al. 2020, Tirpitz et al. 2021, Section 3.15 of D11-1</a>	
<b>O<sub>3</sub></b>													
Direct Sun Total Column	rout0p1-7			Aug-2012	Dec-2019		17	0	ExtPub	HLL	no spectral straylight correction, fixed effective parameters (temperature, height)	<a href="#">Tzortziou et al 2012, Herman et al. 2015, Zhao et al. 2016, Robinson et al. 2020, Zhao et al. 2021</a>	
	rout2p1-8	Jul-2019	Jan-2020	Jan-2021	Sep-2021	May-2022	121	30	ExtLB	HML	no spectral straylight correction, climatological effective parameters (temperature, height)	<a href="#">Section 3.5 of D11-1</a>	
	rous1p1-8	Jul-2019	Jun-2020	Jan-2021	Sep-2021				ExtLB	HMH	with spectral straylight correction, effective O <sub>3</sub> temperature retrieved, climatological effective height	<a href="#">Section 3.5 of D11-1</a>	
Direct Moon Total Column	roms0p1-8	Nov-2020	Sep-2021	Dec-2021					Intern	HMH	Chappuis band from VIS Pandora channel	<a href="#">Section 3.4 QA4EO deliverable</a>	
TropCol, SurfConc, Profile											Ongoing O <sub>3</sub> profile algorithm project	<a href="#">Kreher et al. 2020</a>	
<b>SO<sub>2</sub></b>													
Direct Sun Total Column	rsus1p1-8	Jul-2019	Jun-2020	Jan-2021	Sep-2021	May-2022	103	42	Intern	HMH	O <sub>3</sub> effective temperature is fitted, reference spectrum is O <sub>3</sub> absorption free	<a href="#">Section 3.6 of D11-1</a>	
Direct Moon Total Column													
TropCol, SurfConc, Profile													
<b>HCHO</b>													
Direct Sun Total Column	rfus5p1-8	Jul-2019	Jul-2019	Jan-2021	Sep-2021	May-2022	103	37	ExtPub	HMH	extended-MLE used for calibration	<a href="#">Spinei et al. 2018, Spinei et al. 2021, Section 3.7 of D11-1</a>	
Direct Moon Total Column													
TropCol, SurfConc, Profile	rfuh5p1-8	Jul-2019	May-2020	May-2020	May-2021		119	0	Unval	HML	V-shaped measurement geometry, parameterized algorithm using look-up tables, sequential reference spectrum used	<a href="#">Pinardi et al. 2013, Kreher et al. 2020, Section 3.17 of D11-1</a>	

# PGN NO<sub>2</sub>

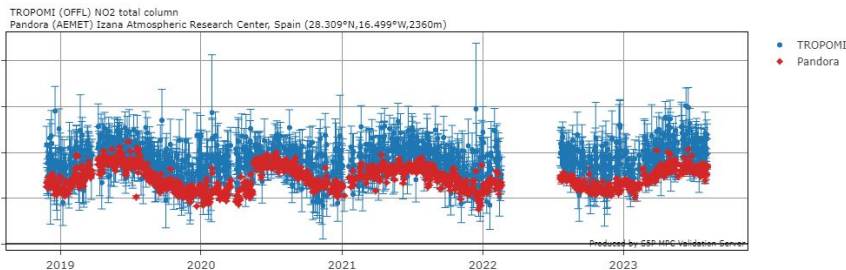


## Total columns (from direct sun)

- High frequency direct sun total columns also used for flux studies
- NO<sub>2</sub> effective temperature and height determined using a stratospheric climatology

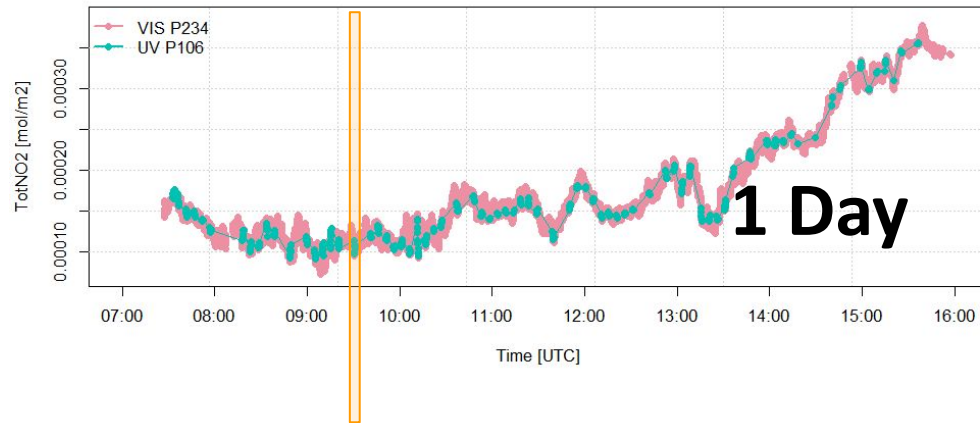
## Tropospheric columns, surface concentrations and vertical profiles (from MAXDOAS)

NO<sub>2</sub> total column at Izana Atmospheric Research Center, Spain

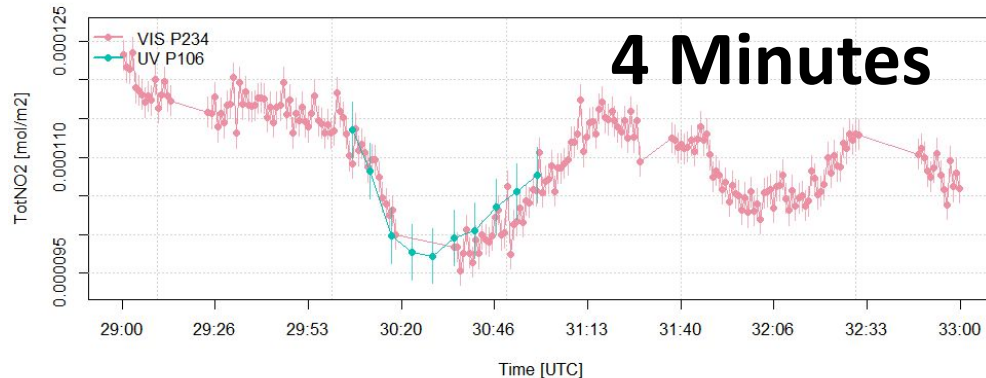


From <http://mpc-vdaf-server.tropomi.eu/no2/no2-offl-pandora>

Innsbruck 2023-02-13 07:00:00 to 2023-02-13 16:00:00



Innsbruck 2023-02-13 09:29:00 to 2023-02-13 09:33:00



# PGN O<sub>3</sub>

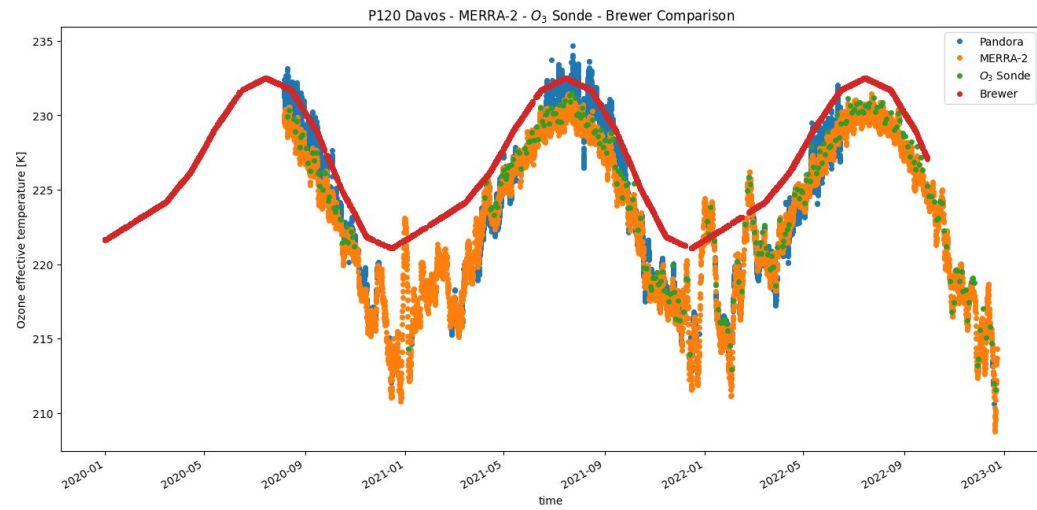
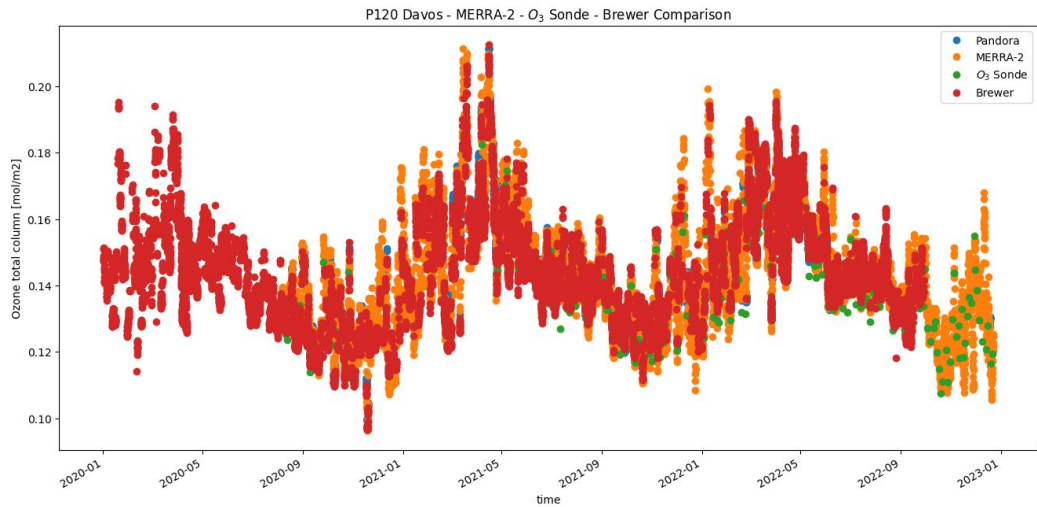
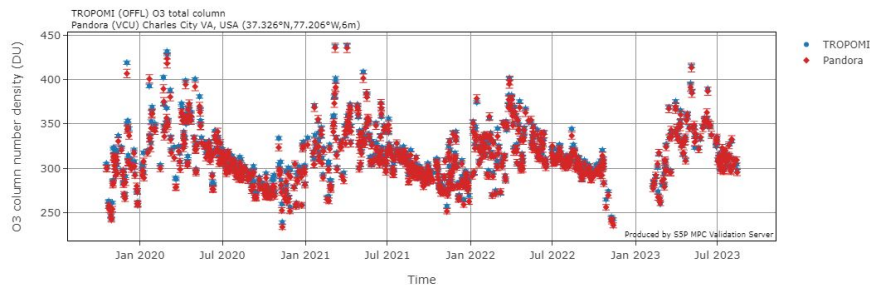
## Total columns (from direct sun)

- Version “ous1” fits effective temperature (see figures); it requires stray light calibration and additional field calibration analysis, which is currently in the process on an instrument-per-instrument base (→ figures)

## Vertical profiles (from MAXDOAS)

- Ongoing ozone profile algorithm (OPA) project with BIRA (sponsored by ESA); phase 1 finishes end of 2023

O<sub>3</sub> total column at Charles City VA, USA

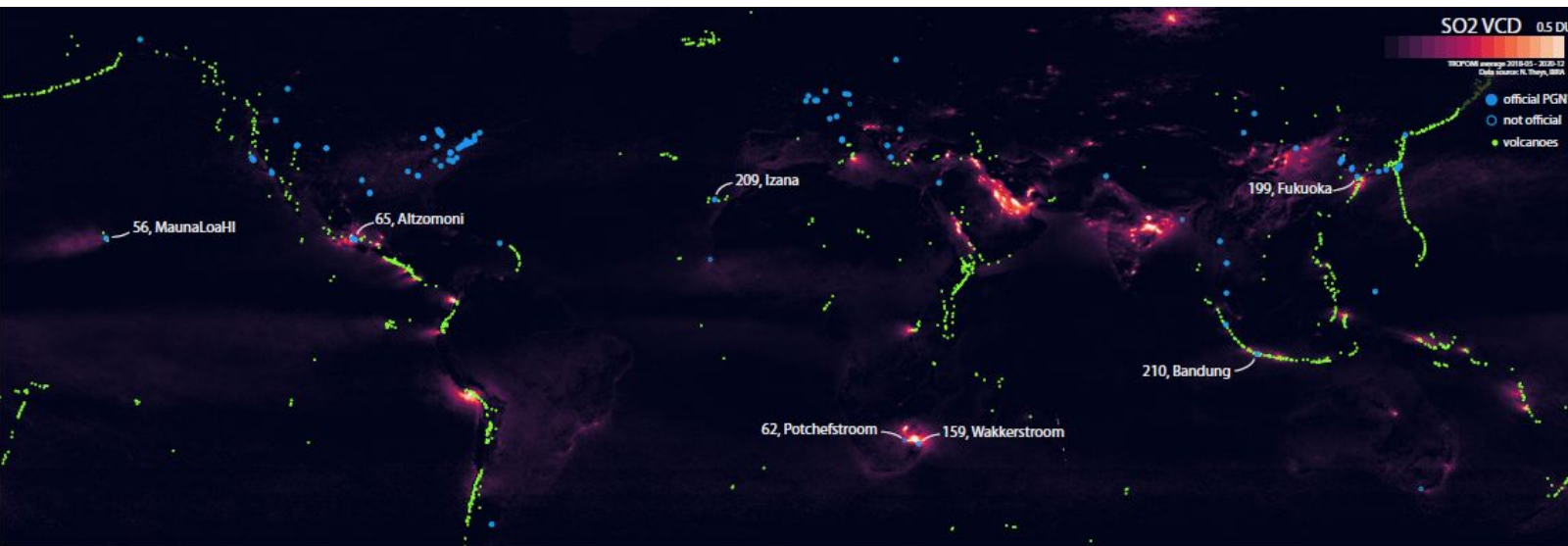
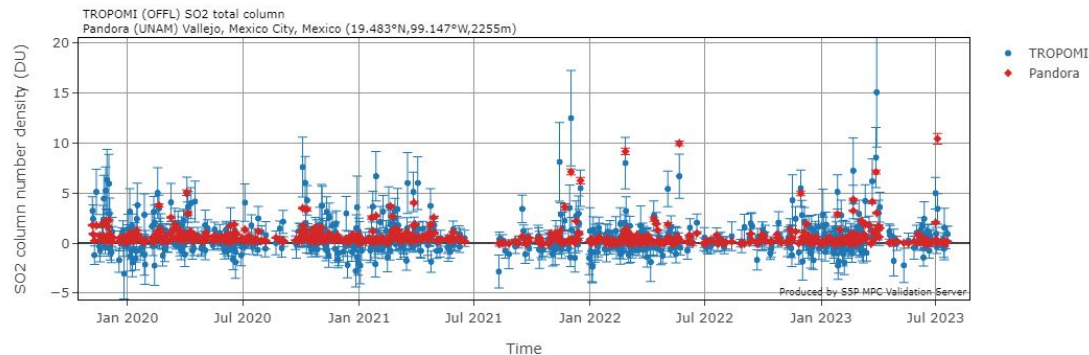


# PGN SO<sub>2</sub>

## Total columns (from direct sun)

- PGN data a rather unique source for total SO<sub>2</sub> columns
- High precision allows also to monitor the “non-volcanic cases”

SO<sub>2</sub> total column at Vallejo, Mexico City, Mexico



Global average SO<sub>2</sub> distribution from TROPOMI. Data courtesy N.Theys, BIRA. Also shown are PGN locations and volcanoes

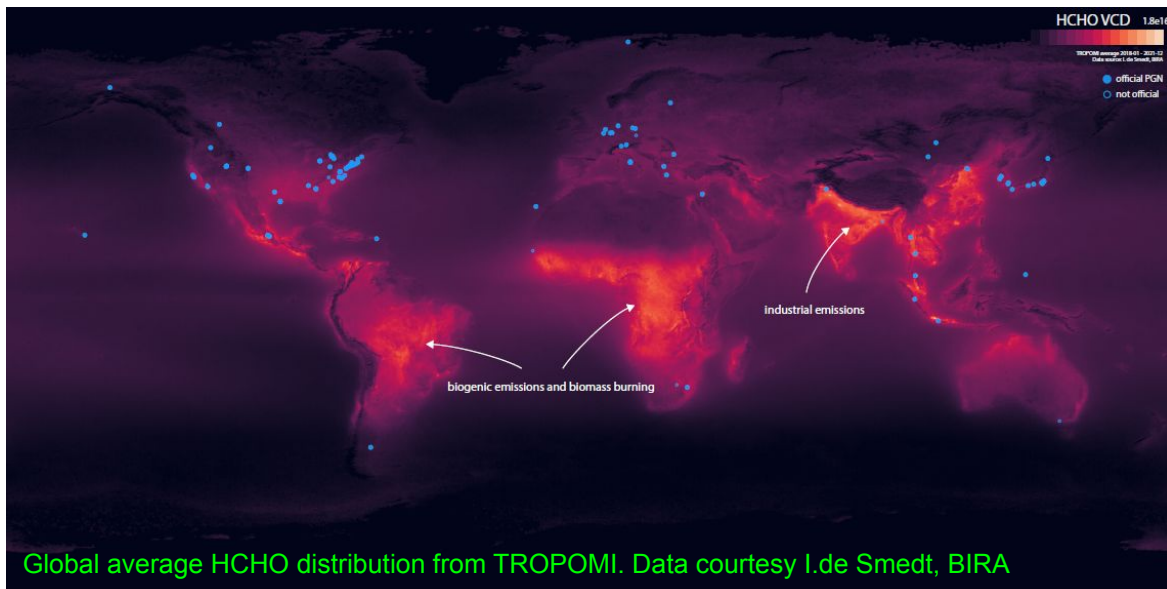
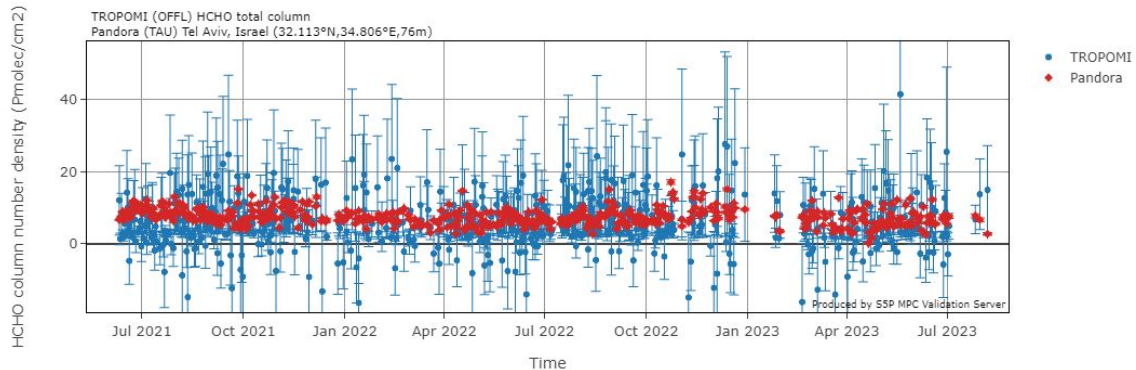


# PGN HCHO

## Total columns (from direct sun) TropCol, SurfConc & Profiles (from MAXDOAS)

- Version 1.8 total column data improved (polished diffuser, resolution change fitting), therefore HCHO are now official!
- Still HCHO is not “fiducial” for all Pandoras, only about 1/3 of them
- Ongoing HW and SW improvements to increase this number

HCHO total column at Tel Aviv, Israel



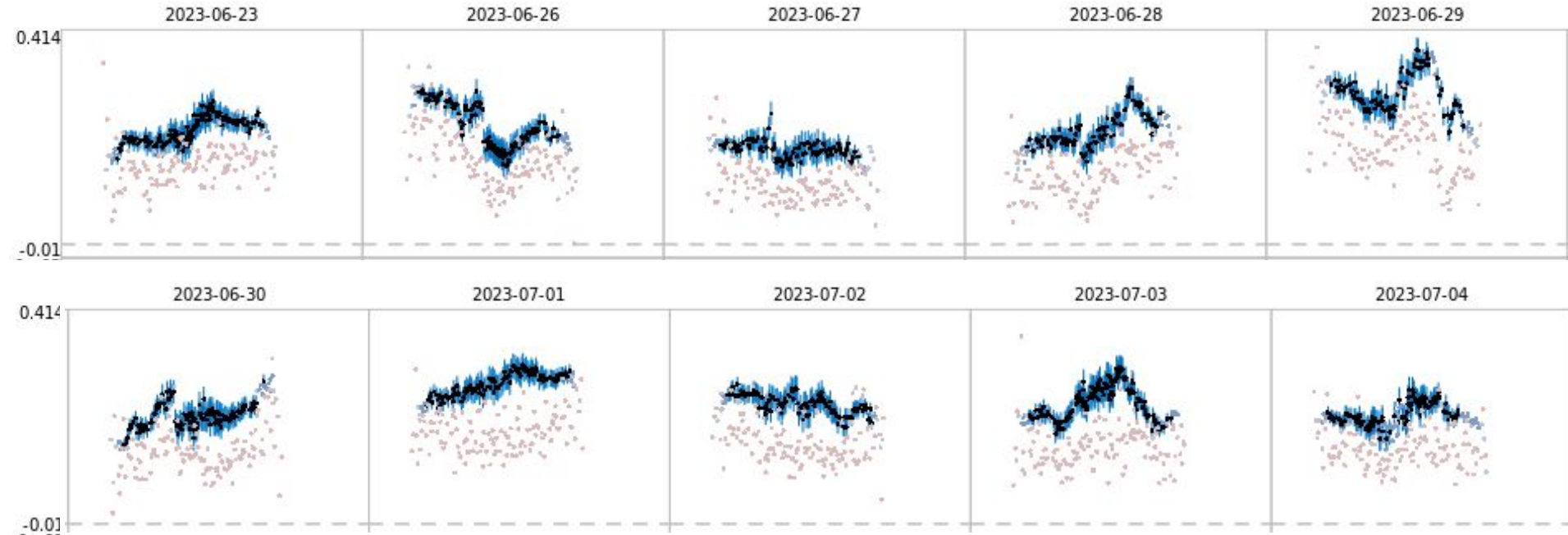
Global average HCHO distribution from TROPOMI. Data courtesy I. de Smedt, BIRA

# HCHO Direct Sun versus MAXDOAS



- Data from **Pandora 238 at Granada, Spain**, station PI Daniel Ramirez (all in  $\text{mmol}/\text{m}^2$ )
- Total columns from direct sun in black **with uncertainties in blue**
- **Tropospheric columns from MAXDOAS in light red**

For most sites we see a difference between the total and tropospheric columns  
(here by about  $0.1 \text{ mmol}/\text{m}^2 = 0.2 \text{ DU} = 6 \times 10^{15} \text{ mol}/\text{cm}^2$ )





PGN Workshop, Howard Univ., Washington DC, 3 to 5 Oct 2023



Thank you