

Revision of the RBCC-E Reference Triad

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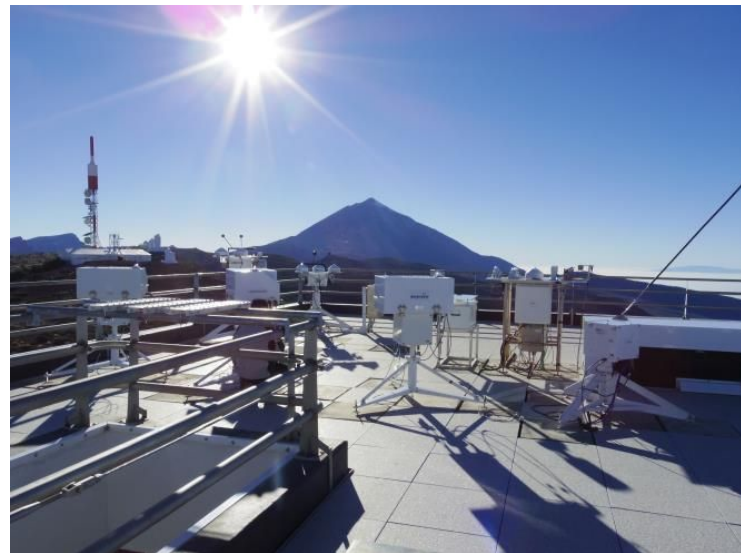
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RBCC-E Instruments

Total ozone column (TOC) measurements began at the Izaña observatory in 1991 using the Brewer **B#033**, being replaced in 1998 by the Brewer **B#157**.

In November 2003 the WMO/GAW Regional Brewer Calibration Center for Europe (RA-VI region) (RBCC-E) was established at IZO with two new instruments (**B#183** and **B#185**). The RBCC-E reference is based on three double Mark-III Brewer spectrophotometers (the IZO triad): a Regional Primary Reference (B#157), a Regional Secondary Reference (B#183) and a Regional Travelling Reference (B#85).

In 2022 three new instruments join the RBCC-E, the Brewers **B#256**, **B#257** and **B#258** to support the campaigns in which the RBCC-E participates and to have spare parts in case of failure of the original Brewers.



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RBCC-E Objectives: Campaigns

- To perform periodical calibration campaigns using the Regional Primary Reference B157 during intercomparisons held at IZO and the Regional Travelling Reference B185 spectrophotometer in continental campaigns.

- IZO WR Calibration campaign (Spain) 2023
- El Arenosillo (Spain) 2023
- Santa Maria (Brazil) 2024
- CINDI3 (Netherlands) 2024
- Davos (Swiss) 2024
- IZO WR Calibration campaign (Spain) 2024



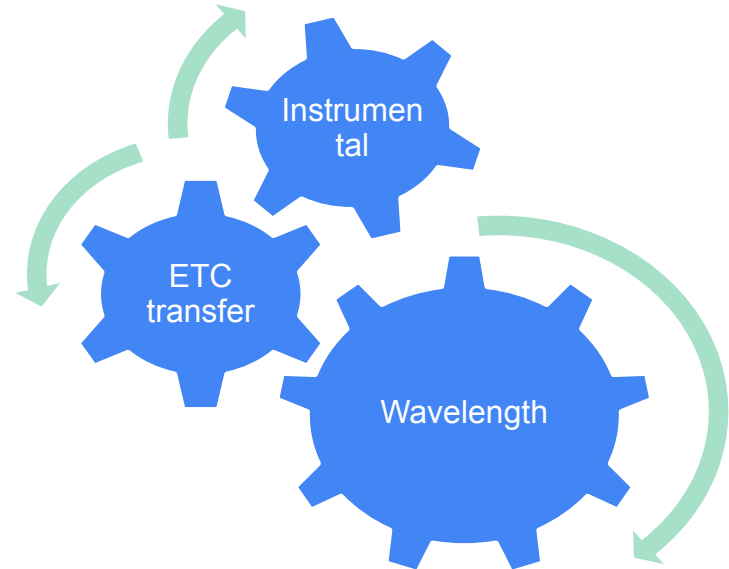
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RBCC-E Objectives: Triad Calibration

- To implement a system for routine absolute calibrations of the European Brewer regional reference instruments at IZO, fully compatible with absolute calibrations of the world reference triad at MLO.

CALIBRATION CYCLE

- 1: Instrument Calibration (F)
 - 2: Wavelength Calibration (α)
 - 3: ETC transfer.
- Continuous calibration
 - Independent calibration



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Report Triad 2023

https://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/latex/triada2023.pdf

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/informe_langley.m

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/configs/icf157.xls

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/configs/icf183.xls

...

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/html/Inst_WI157.html

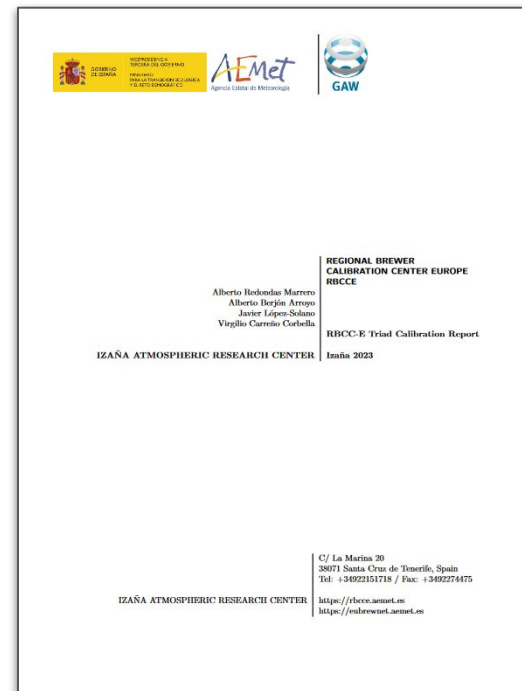
http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/html/Inst_WI183.html

...

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/html/Langley_report.html

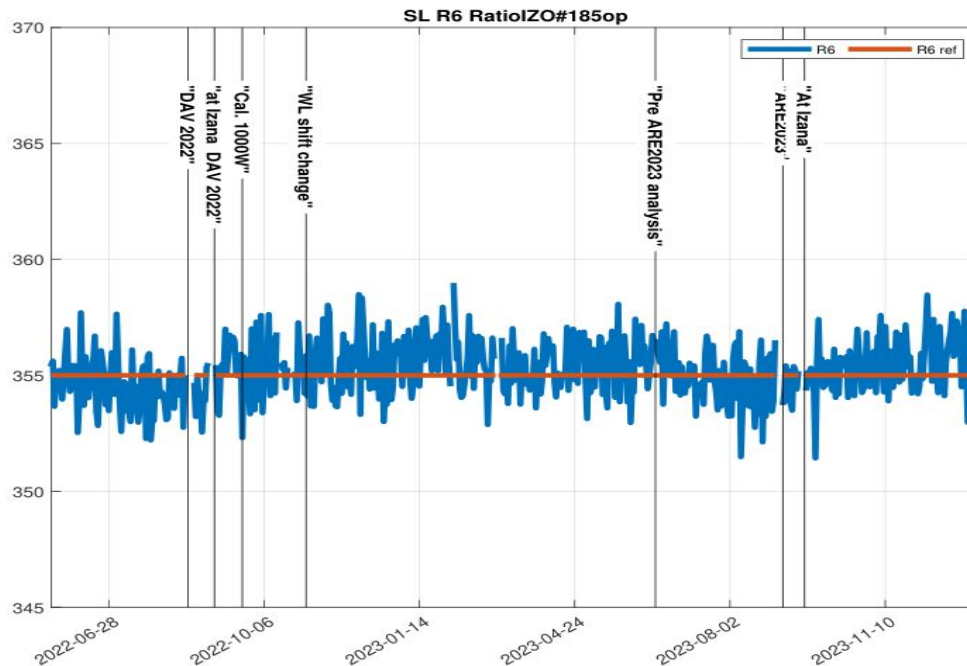
http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/html/comp_data_brewer.html

http://rbcce.aemet.es/svn/iberonesia/RBCC_E/2023/Triad/html/report_ARE2023_comp_pre_pos.html



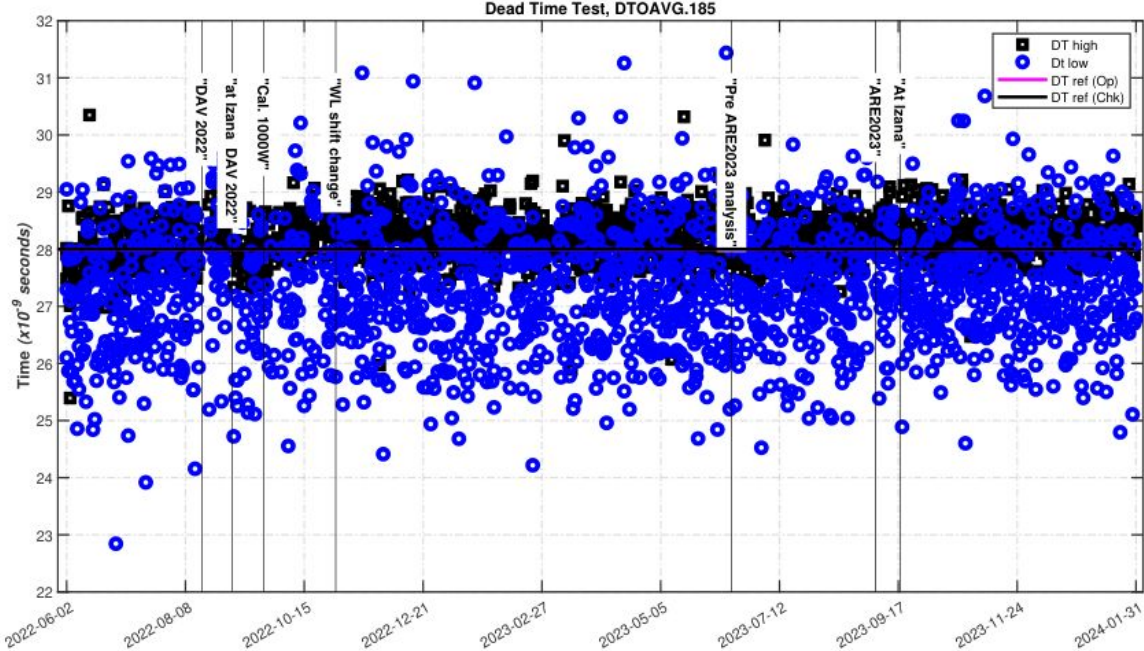
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Report Triad 2023: B#185 SL R6



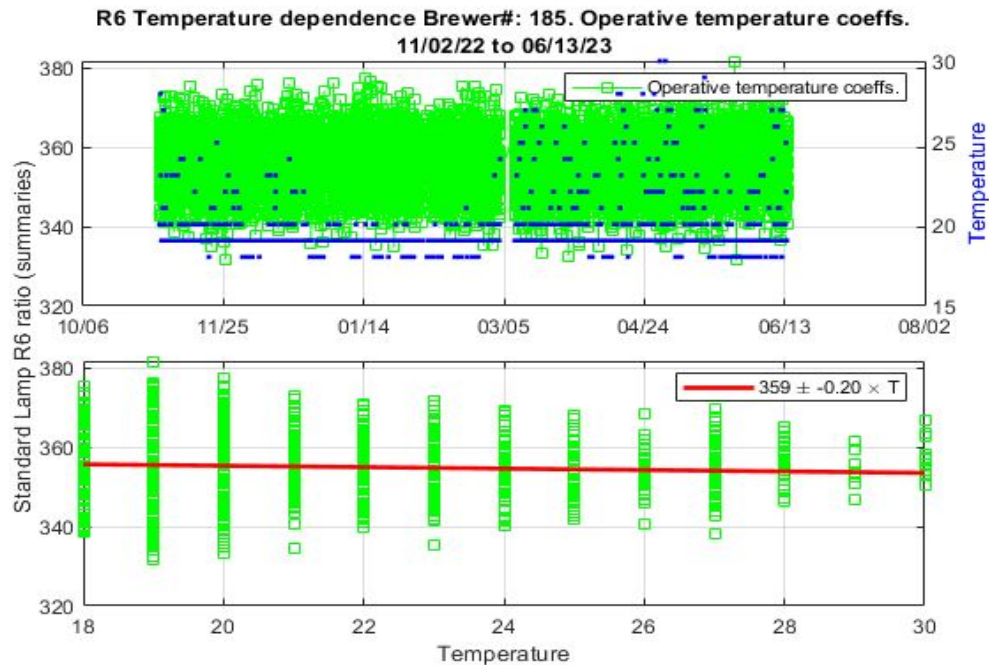
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Report Triad 2023: B#185 Dead Time



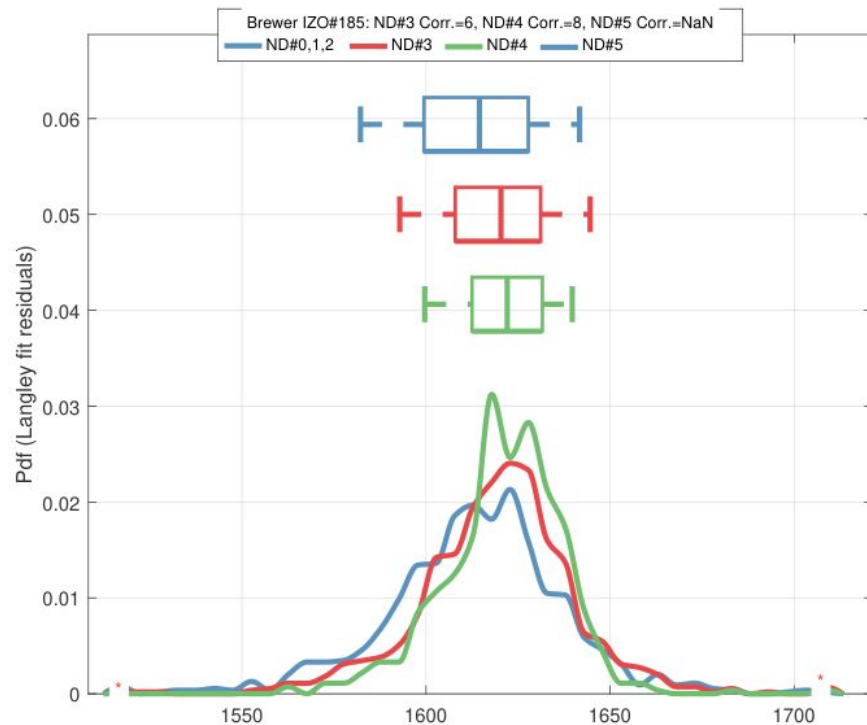
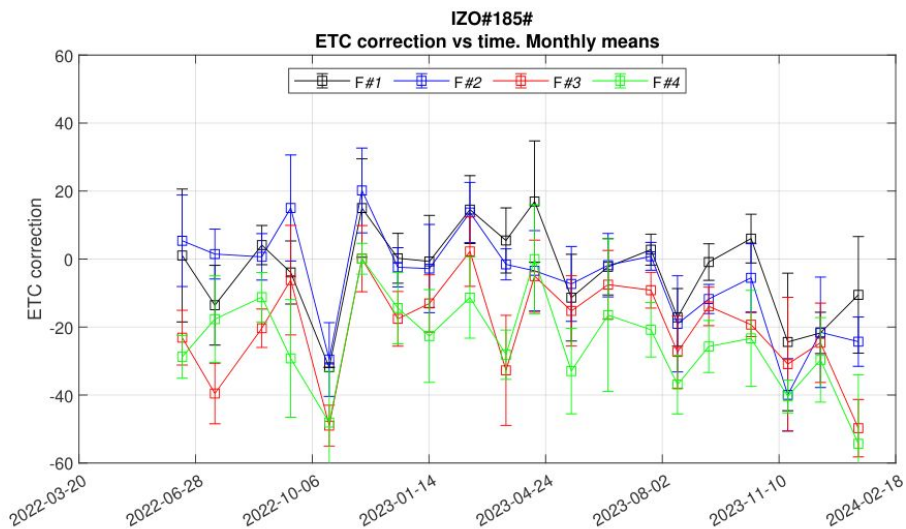
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Report Triad 2023: B#185 Temperature dependence



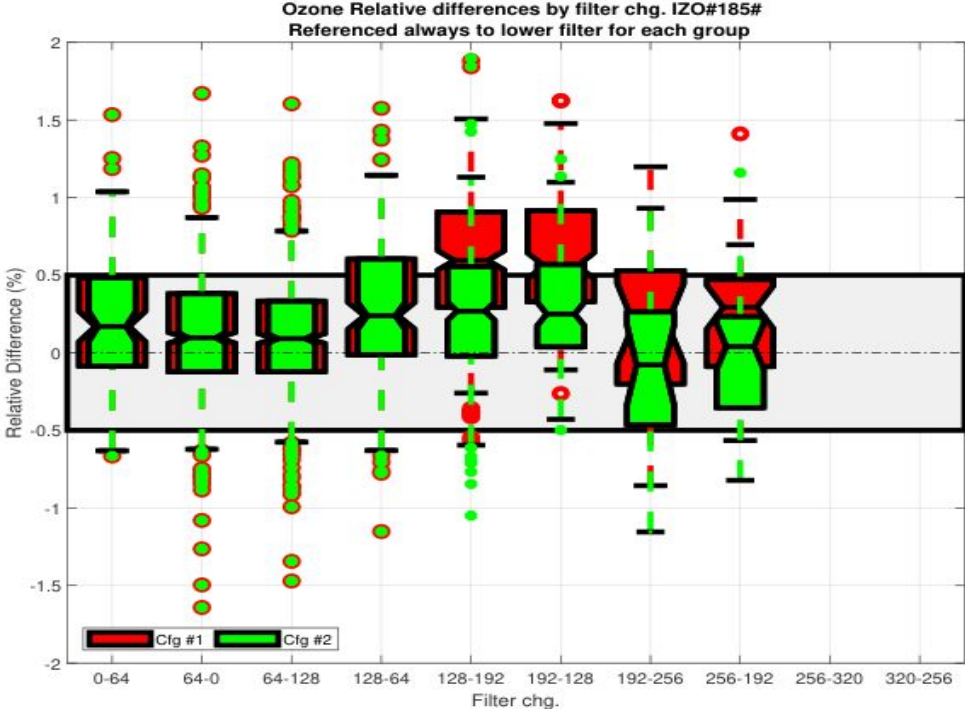
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Report Triad 2023: B#185 Filters



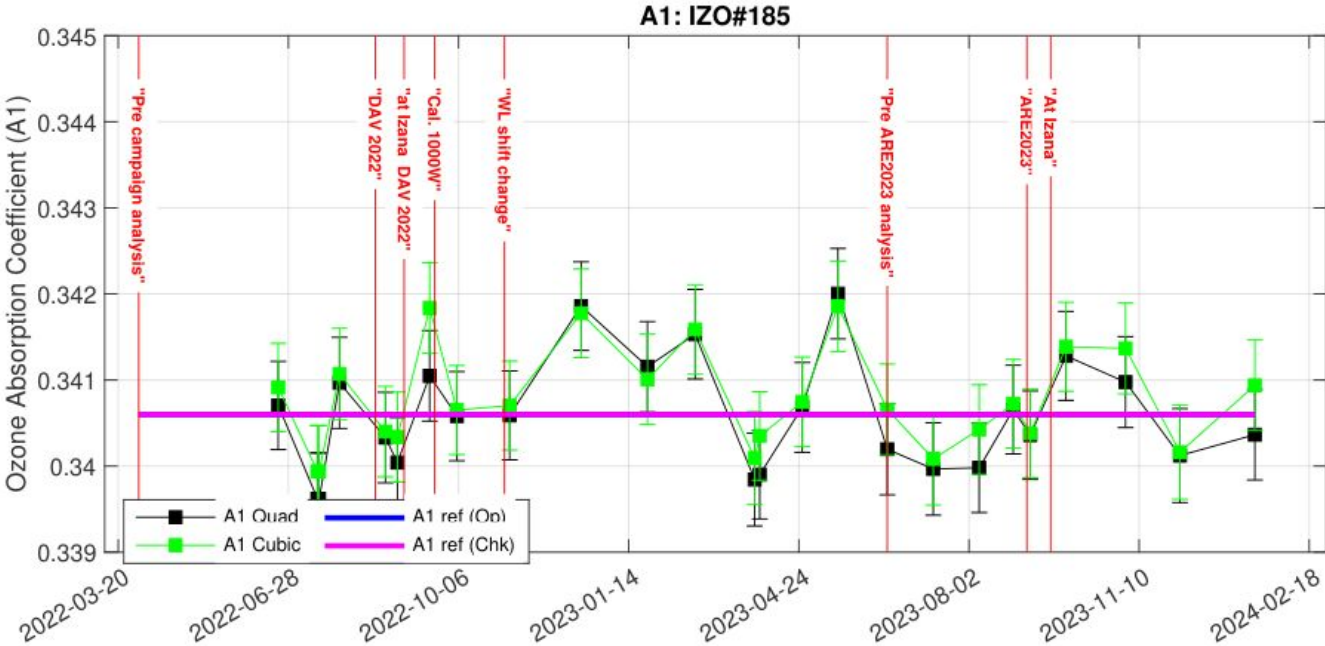
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Report Triad 2023: B#185 Filters



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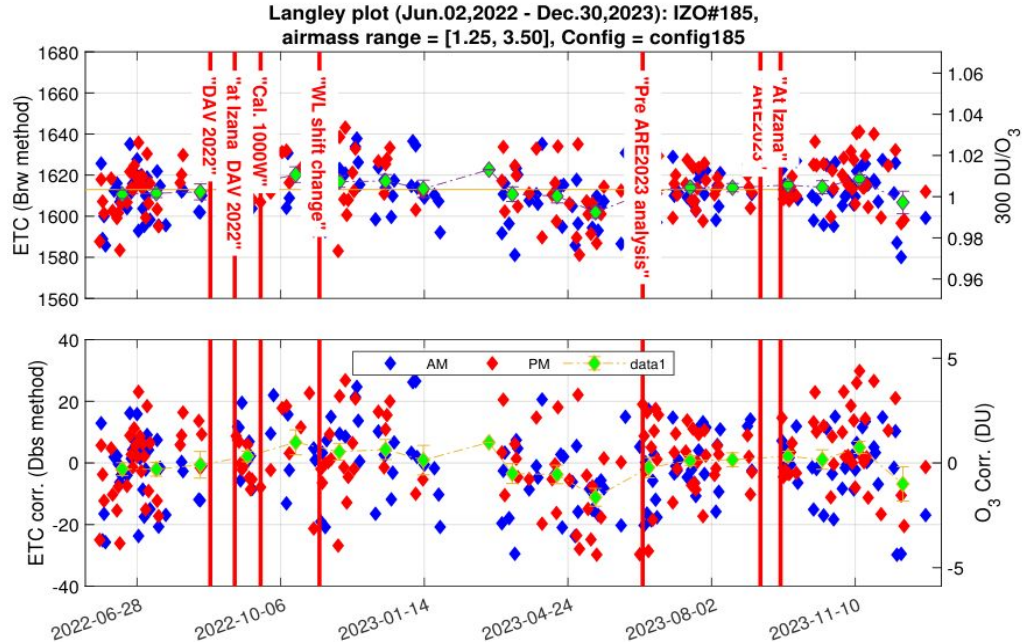
Report Triad 2023: B#185 O₃ Absorption coefficient



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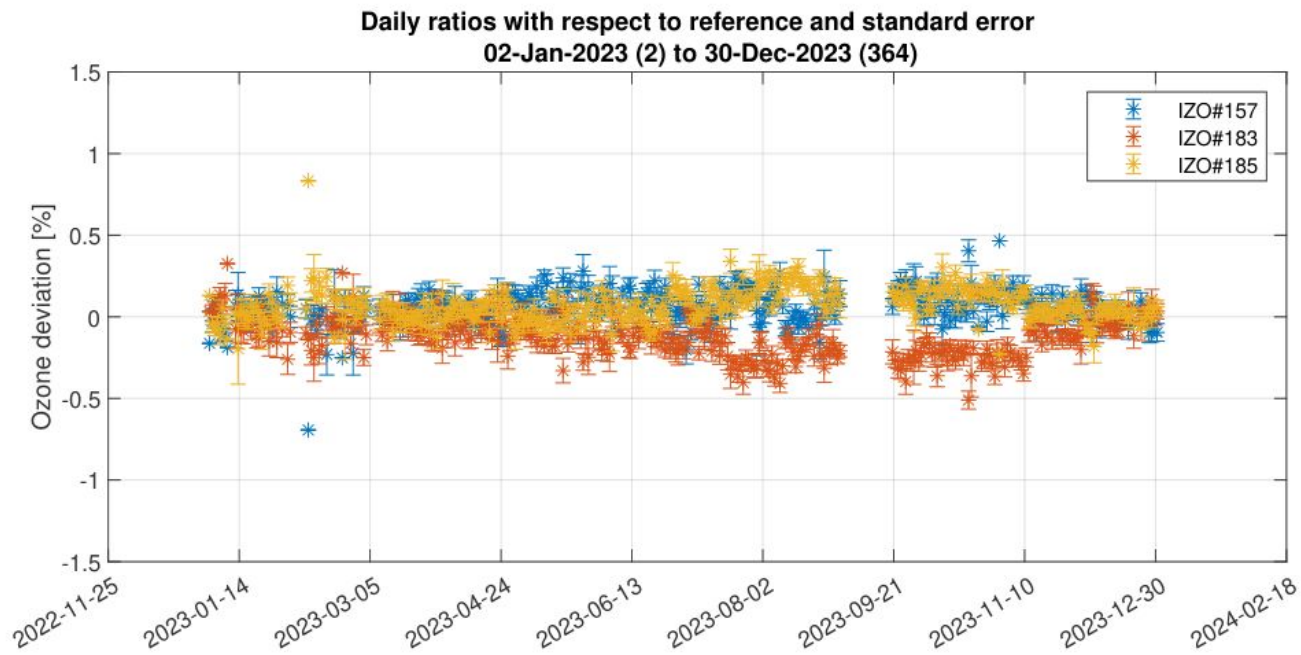
Report Triad 2023: B#185 Langley ETC

	ETC	brw	sem.brw	db	sem.db	N	Uetc
04-Sep-2022	1613	1615	1.8	3	1.8	18	1.9
22-Sep-2022	1613	1619	3.2	5	3.4	15	3.3
02-Nov-2022	1613	1612	1.4	-2	1.4	104	1.4
15-Jun-2023	1613	1613	1.4	0	1.4	65	1.4
19-Sep-2023	1613	1615	1.4	2	1.4	73	1.4



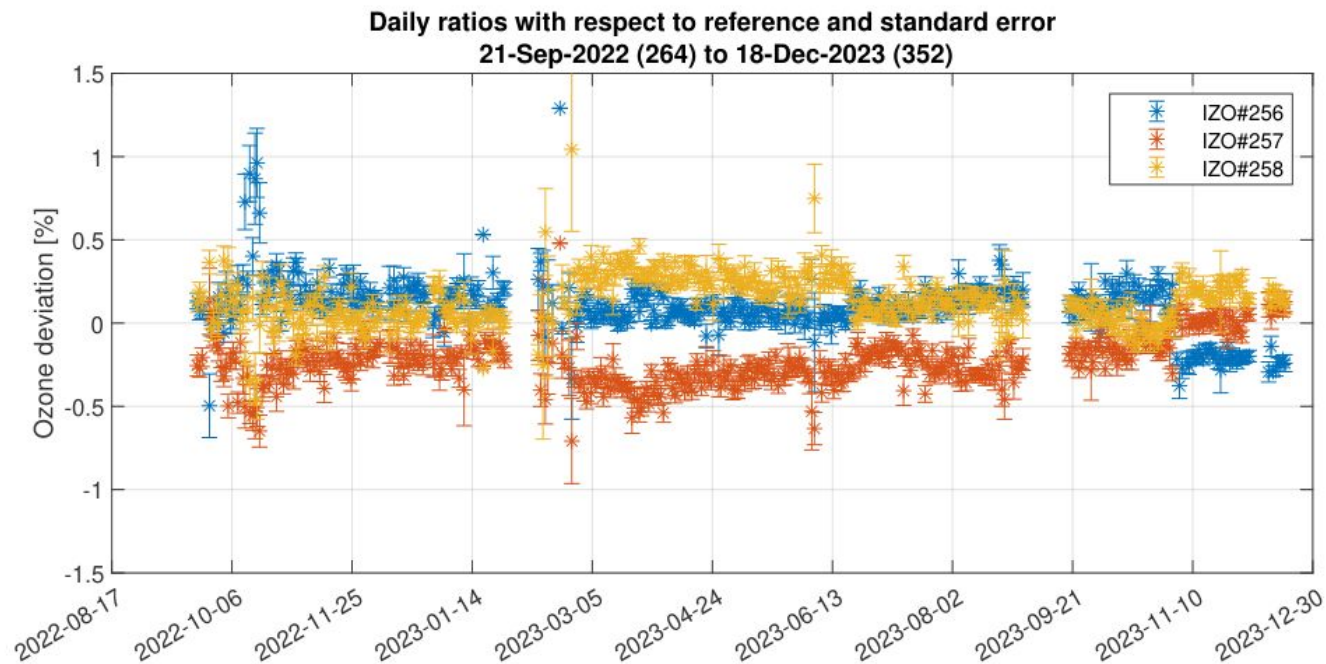
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Report Triad 2023: Triad comparison



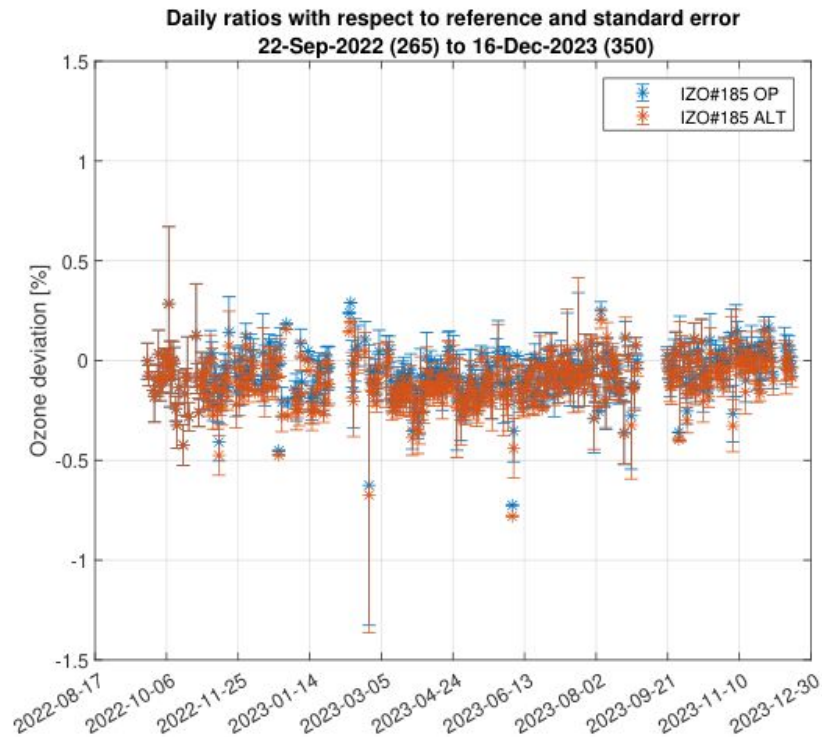
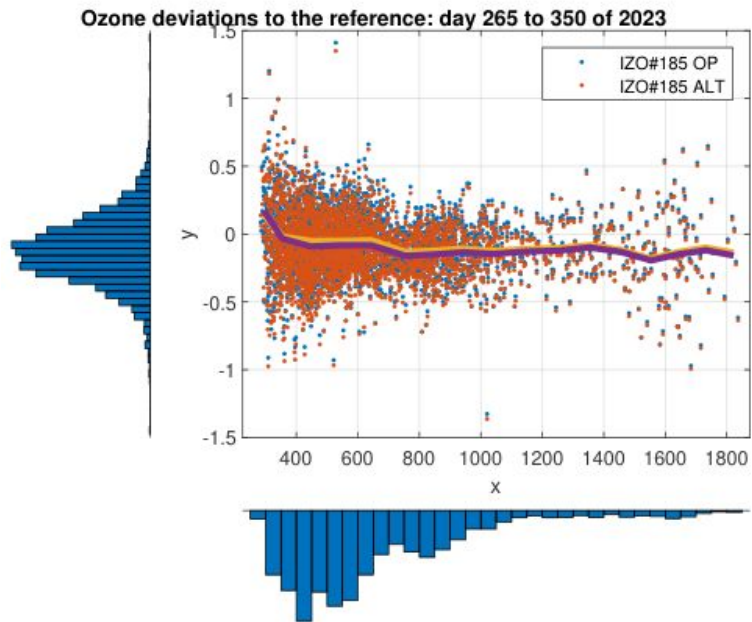
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Report Triad 2023: Triad comparison



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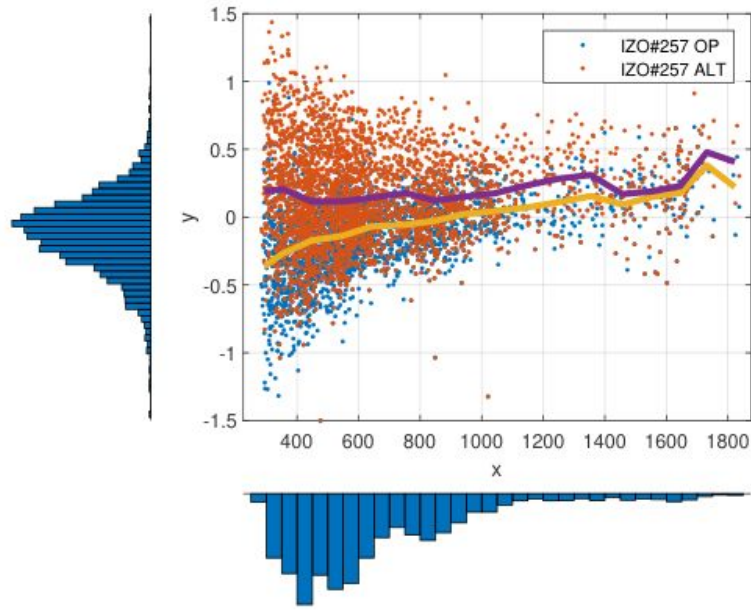
Report Triad 2023: Triad comparison (B#185)



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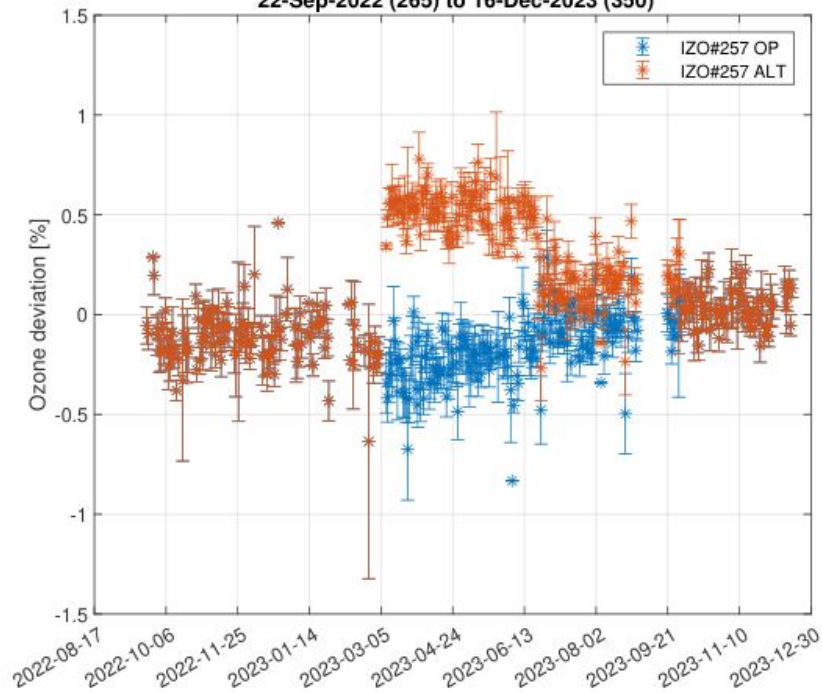
Report Triad 2023: Triad comparison (B#257)

Ozone deviations to the reference: day 265 to 350 of 2023



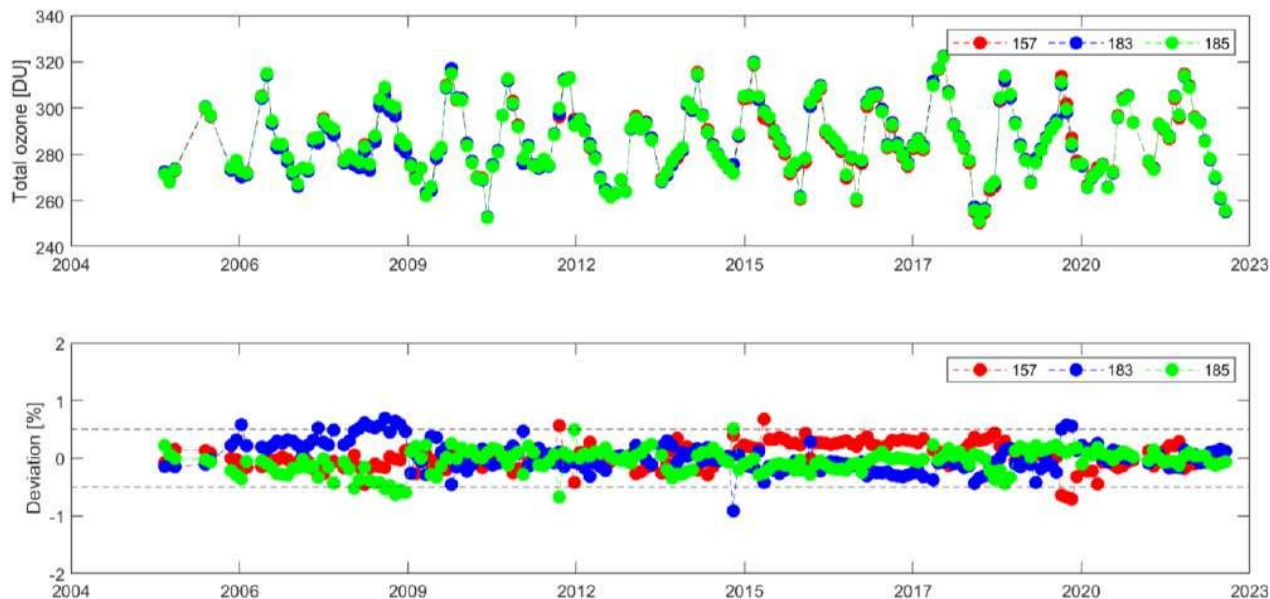
Daily ratios with respect to reference and standard error

22-Sep-2022 (265) to 16-Dec-2023 (350)



Revision of the RBCC-E Reference Triad

Monthly mean Total Ozone Column values measured at Izaña Observatory by the RBCC-E Triad and Relative deviation of each Brewer from the monthly mean of the RBCC-E Triad during the 2005-2022 period.



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RBCC-E Objectives: Uncertainty

- To study the sources of errors of the absolute calibrations and to determine the accuracy of total ozone measurement achievable by this method under different atmospheric conditions or instrumental characteristics.

Documents:

- [Eubrewnet Uncertainty Budget-WP1 Instrumental parameters](#)
- [Eubrewnet Uncertainty Budget-WP2 Atmospheric parameters](#)
- [Eubrewnet Uncertainty Budget-WP3 EVDC GEOMS - Total Ozone Brewer Forma](#)
- [Eubrewnet Uncertainty Budget-WP4 Error implementation on total ozone Eubrewnet products](#)



<https://eubrewnet.aemet.es/dokuwiki/doku.php?id=codes:errorbudget>

Revision of the RBCC-E Reference Triad

RBCC-E Objectives: Uncertainty

O3 SO2 Umkehr Data and Metadata NO2

Setup Algorithm Instrumental Constants O3 V2 Algorithm **O3 Uncertainty**

O3 Uncertainty Values

Bass and Paur	Err. Abs. temp b0 B&P	Err. Abs. temp b1 B&P	Err. Abs. temp b2 B&P	Err. Abs. temp b3 B&P	Err. Abs. temp b4 B&P	Abs. gradient with Step B&P
	0.008808808964E	-2.21067182807e	9.7436474494e-07	6.5900298563e-0E	7.18450672913e-1	-0.0010493187570C
Bremen	Err. Abs. temp b0 Bremen	Err. Abs. temp b1 Bremen	Err. Abs. temp b2 Bremen	Err. Abs. temp b3 Bremen	Err. Abs. temp b4 Bremen	Abs. gradient with Step Bremen
	0.004642983701C	4.46266575883e-	6.91839537731e-07	2.00959821734e-C	1.69190220191e-1	-0.0010217236462
Rayleigh Coefficients	BE0	BE2	BE3	BE4	BE5	BE6
	5049	4831	4584	4370	4178	4001
ETC	Err. ETC v1	Err. ETC v2				
	0.672566512511	0.687539577692				
Sun Scan	SC linear coeff.	Err. SC linear coeff.				
	-0.005581537875	0.007657695842C				
Other	Err. Stray light k	Err. Stray light s	Err. Rayleigh	Err. Rayleigh Bodhaine	Err. Deadtime	
	0.0	0.0	0.01	2e-05	1e-09	
	Err. R5 temp. Coeff.	Err. R6 temp. Coeff.	Err. Temperature	Err. Time	Err. Filter linearity	
	0.041988069217E	0.0236850300677	1.0	1.0	3.0	

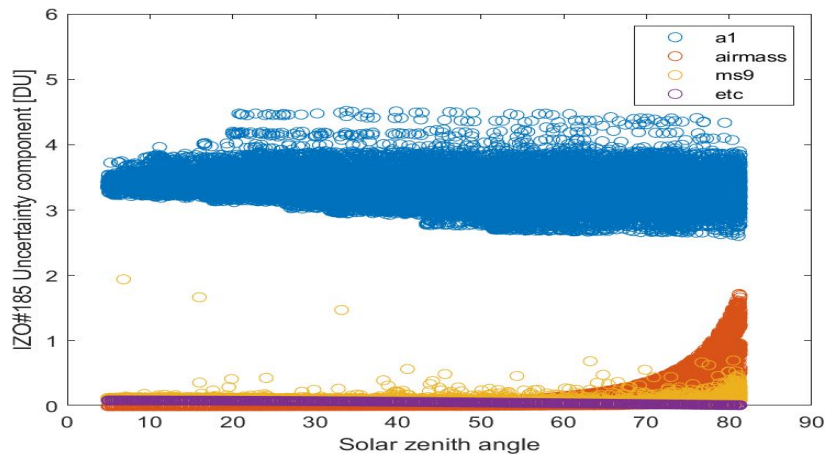
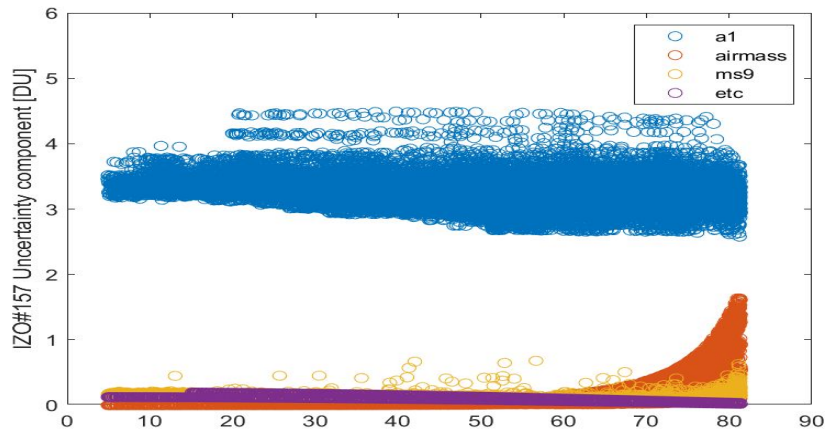
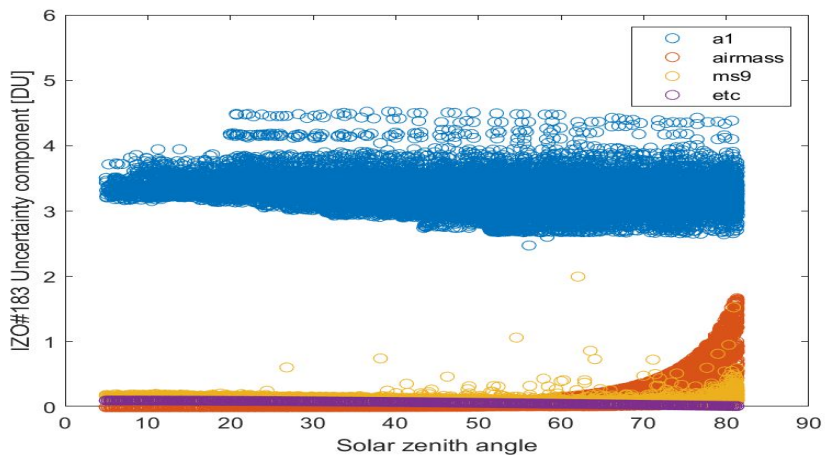
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RBCC-E Objectives: Uncertainty

	B#157 (31/07/2023)	B#183 (28/08/2023)	B#185 (19/09/2023)	Default
e_deadtime [sec]	1.00E-09	1.00E-09	1.00E-09	1.00E-09
e_r6_temp_coeff [1/°C]	0.037	0.037	0.024	0.094
ms9_step [%]	-0.014	0.040	-0.006	0.023
e_ms9_step [%]	0.0049	0.0055	0.008	0.1413
astep_bp [atm cm-1/step]	-0.00105	-0.00106	-0.00105	-0.00102
gradt_bp [atm cm-1/K]	0.00026	0.00026	0.00025	0.00025
be2	4832	4833	4831	4870
be3	4585	4586	4584	4620
be4	4371	4372	4371	4410
be5	4178	4179	4178	4220
be6	4002	4002	4002	4040
e_etco3rate_v1	0.95	0.79	0.67	0.00
e_rayleigh	0.01	0.01	0.01	0.01
e_temperature [°C]	1	1	1	1
e_t0 [sec]	1	1	1	1
hglimit [steps]	1	1	1	3
absorption temp coef c0 bp [1/cm]	3.448E-01	3.463E-01	3.451E-01	--
absorption temp coef c1 pb [1/cm/K]	2.580E-05	1.993E-05	2.376E-05	--
absorption temp coef c2 pb [1/cm/K ²]	-1.314E-07	-1.487E-07	-1.132E-07	--
e absorption temp coef b0 bp [1/cm]	4.640E-03	4.655E-03	4.643E-03	--
e absorption temp coef b1 bp[1/cm/K]	4.480E-06	4.377E-06	4.463E-06	--
e absorption temp coef b2 bp [1/cm/K ²]	6.903E-07	6.900E-07	6.918E-07	--
e absorption temp coef b3 bp [1/cm/K ³]	2.005E-08	2.005E-08	2.010E-08	--
e absorption temp coef b4 bp [1/cm/K ⁴]	1.688E-10	1.688E-10	1.692E-10	--
e_filter_linearity	5	3	3	Yes/No (L1.5)
e_stray_light_a	0	0	0	Yes/No (L1.5)
e_stray_light_b	0	0	0	Yes/No (L1.5)

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Uncertainty (main components)



Revision of the RBCC-E Reference Triad

Uncertainty (sys. and ran.)

