Madrid O3S-DQA Homogenization Report

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1 Madrid Metadata timeseries

Madrid ozonesonde data is taken from WOUDC data-server and the metadata is provided by the station PI. The timeseries starts from 1992, but the homogenization can be done for the period starting from 1994, since before 1994 there are no background current values which does not allow the conversion from ozone partial pressure values to ozone raw currents.

There are also missing metadata which are temperature (TLab), pressure (PLab) vaues of the laboratory conditions before 2006-02-26, and humidity (ULab) of the laborotart before 2020-11-18. For the TLab, ULab and PLab the climatological means are calculated for each month and these values are used for the missing metadata.

2 O3S corrections

The recommended and applied O3S-DQA corrections are summarized below.

1. Conversion efficiency
2. Background current
3. Pump temperature measurement
4. Pump flow rate, moistening effect
5. Pump flow efficiency at low pressures
6. Total ozone normalization: in O3S-DQA guide this correction factor is recommended to added in the data-set, but this is not extracted yet.
7. Radiosonde changes: RS80 radiosonde correction is tested but not applied yet.

2.0.1 Conversion efficiency

The stoichiometry correction is not needed since SPC $1.0\% - 0.1$B ECC's have always been launched.

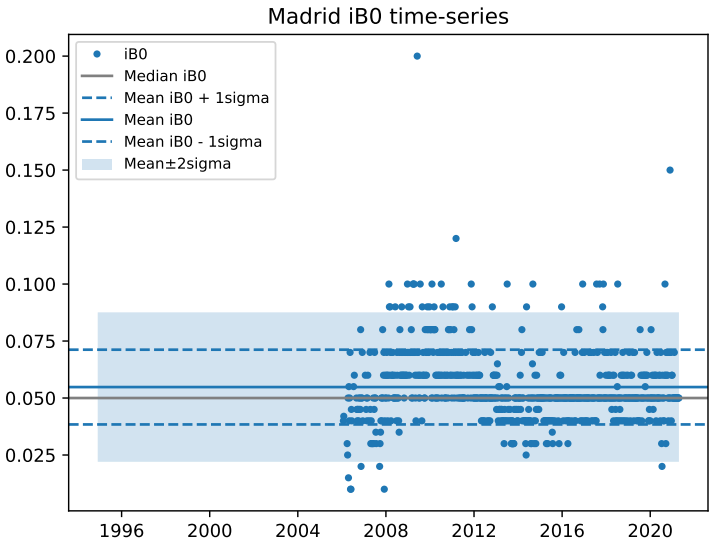


Figure 1: Madrid iB0 timeseries

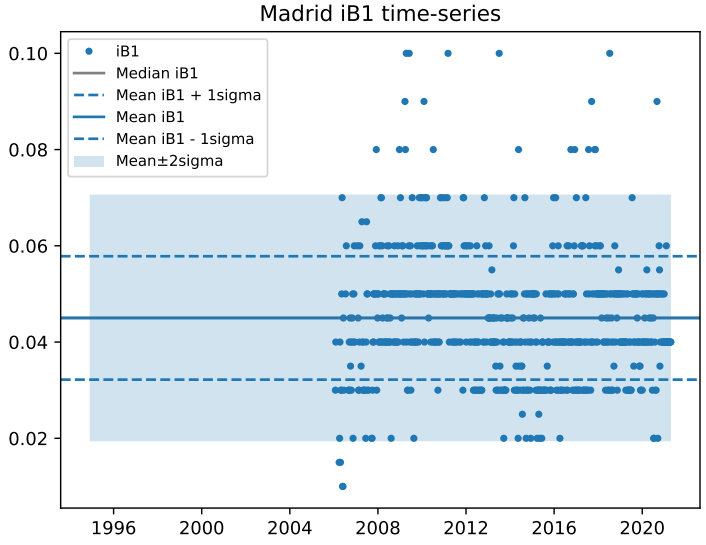


Figure 2: Madrid iB1 timeseries

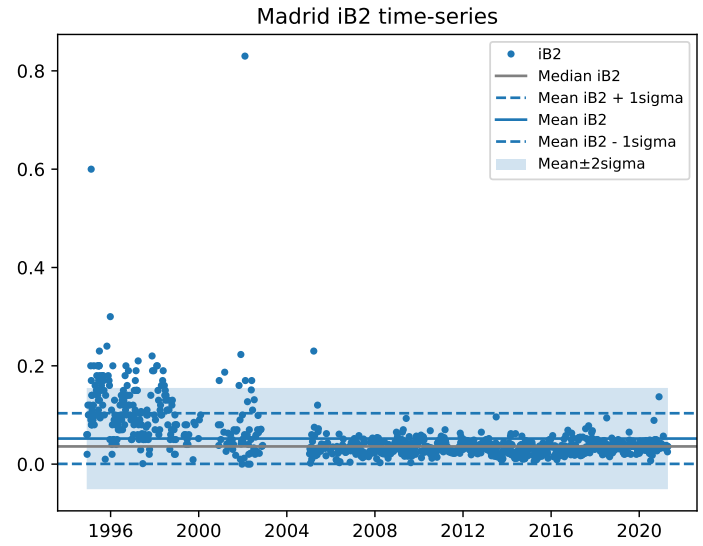


Figure 3: Madrid iB2 timeseries

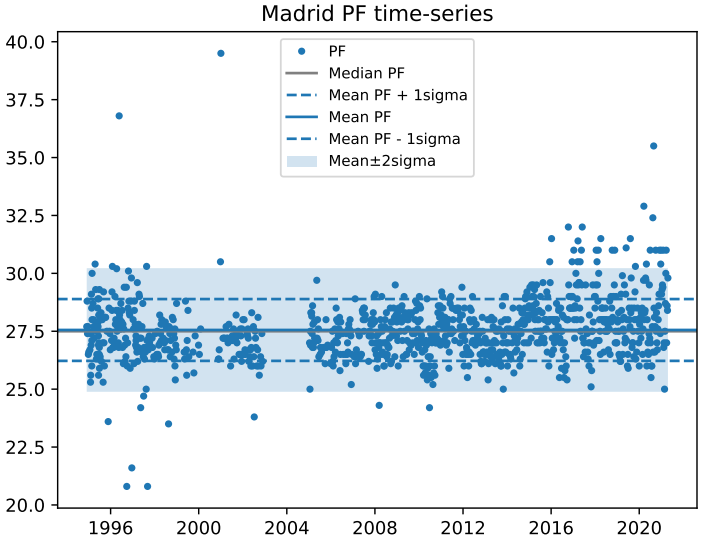


Figure 4: Madrid pump flow rate timeseries

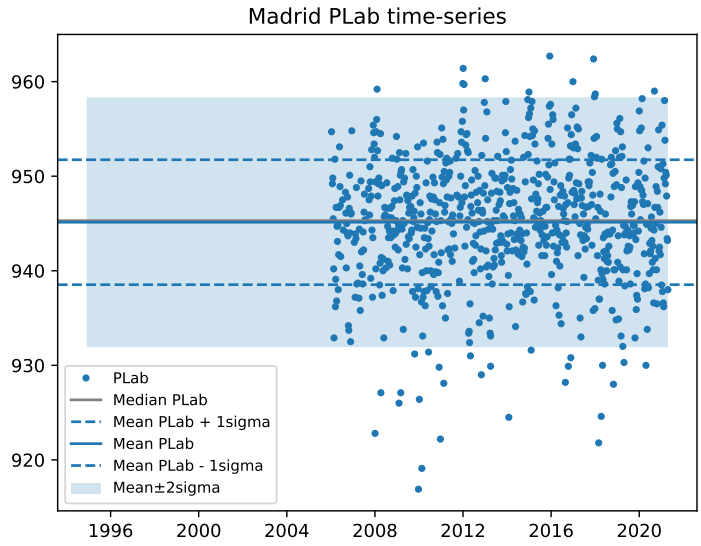


Figure 5: Madrid laboratory pressure timeseries

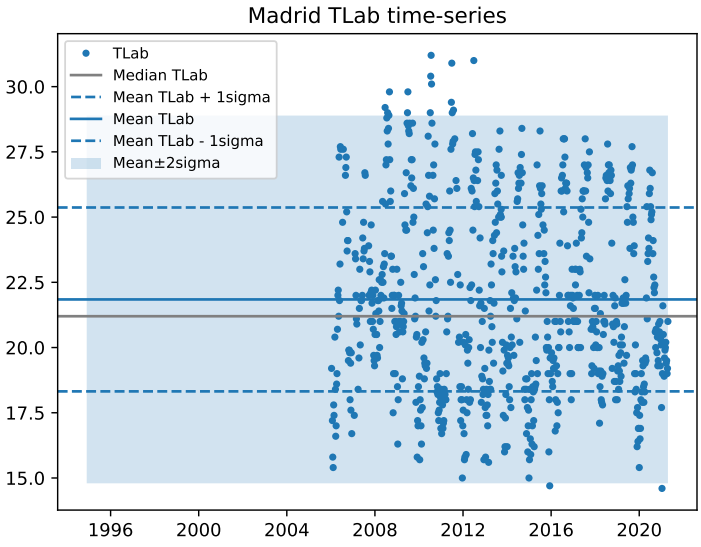


Figure 6: Madrid laboratory temperature timeseries

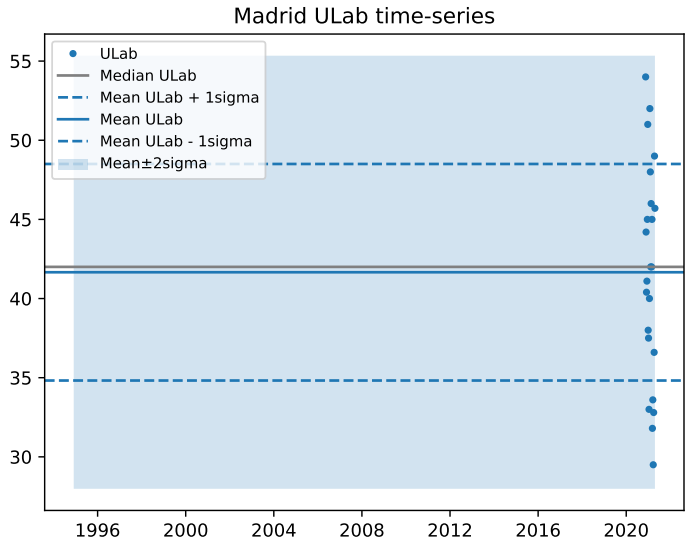


Figure 7: Madrid laboratory humidity timeseries

2.0.2 Background current

Background correction, using iB2, applied Madrid data is shown in Fig 9. If I_B exceeds $I_{B,\text{Mean}}+2\sigma_{IB}$ then I_B, it should be replaced by the more representative climatological value of $I_{B,\text{Mean}}$, however with larger uncertainty of $2\sigma_{IB}$. For the background correction the mean of I_B is calculated in the range of $I_B < 0.1$. Therefore to the I_B values falling above $I_{B,\text{Mean}}+2\sigma_{IB}$ in Fig 8, the background correction is applied.

This effect can be seen in Fig 9.

2.0.3 Pump temperature measurement

Truest pump temperature correction is applied according to Eq.13 of the O3S-DQA Guidelines. At 1998-12-02 the pump location changed from being in the box to the inside the pump. Therefore Case-III correction is applied to SPC-5A sondes and case-V correction to SPC-6A sondes. The effect of the temperature correction is shown in Fig 10.

2.0.4 Pump flow rate (moistening effect)

This correction, Eq.15 of the O3S-DQA Guidelines, is applied and shown in Fig 11. The details of the values used for correction is explained in Sec 1.

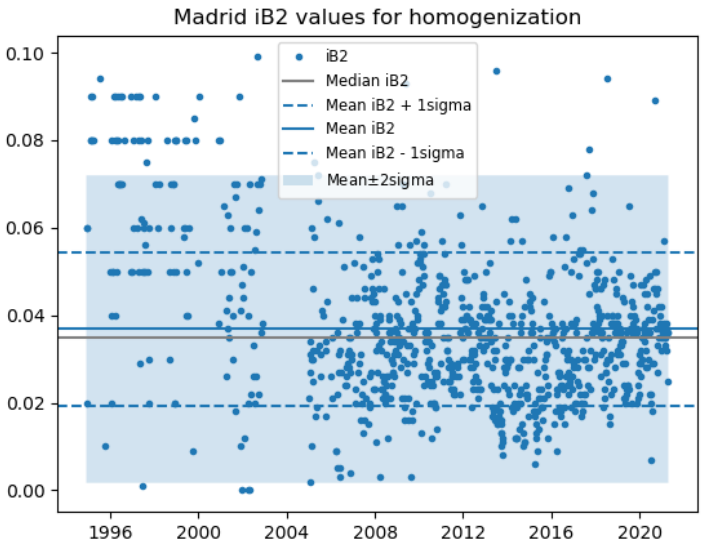


Figure 8: Background current values used for DQA background correction

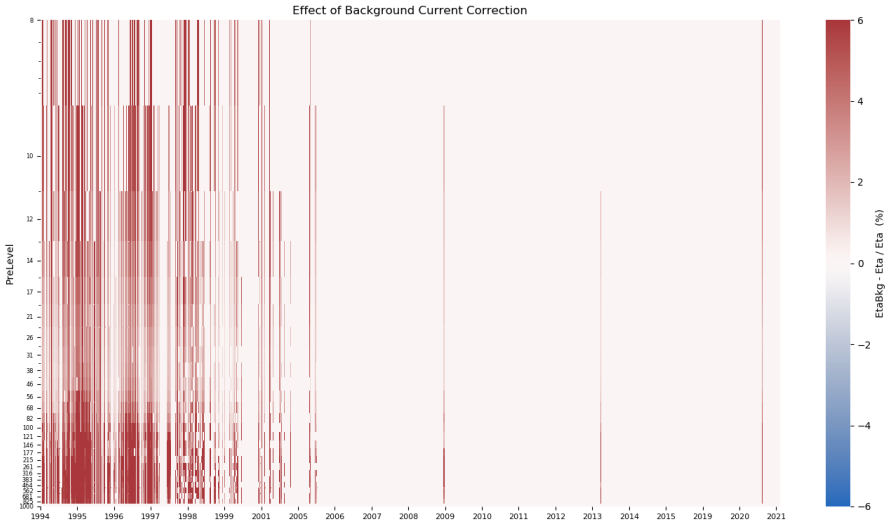


Figure 9: Background current correction

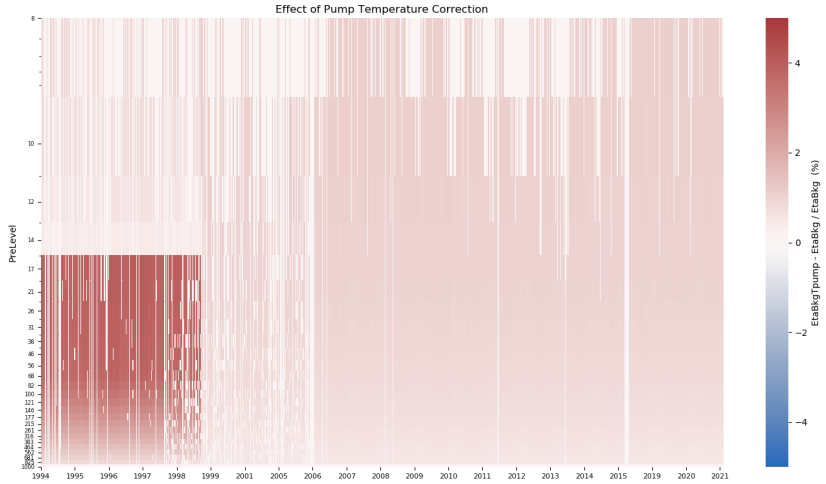


Figure 10: Pump temperature correction applied

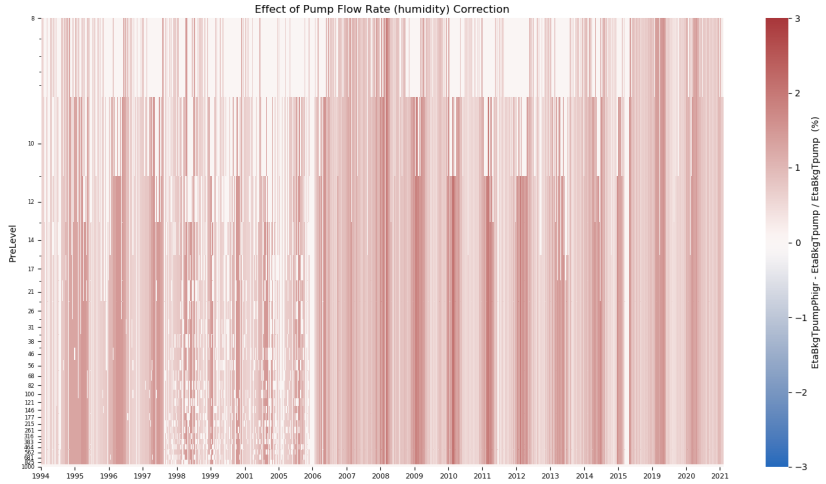


Figure 11: Pump flow rate correction applied

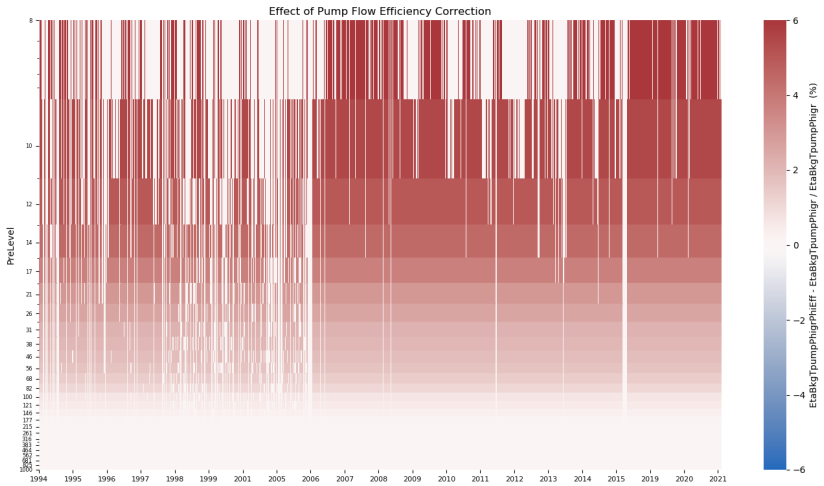


Figure 12: Pump flow rate correction applied

2.0.5 Pump flow efficiency

This correction, Eq.22 of the O3S-DQA Guidelines, is applied using Table 6 of the O3S-DQA Guidelines and shown in Fig 12. The interpolation of the correction factors are made using the pressure. This method gives the same result as doing the interpolation using the logarithm of pressure and polynomial fit with an error of less than 0.03%. The effect of this correction is shown in Fig 12.

2.0.6 Radiosonde correction

This correction (give a reference to the paper) is applied to correct the pressure offset difference. It's uncertainity is not implemented in the total uncertainity of the ozone partial pressure. The effect of RS80 correction is shown in Fig 13.

The effect of all DQA correction with respect to no correction is shown in Fig 14 and the comparison of DQA corrected and WOUDC O3S values is shown in Fig 15.

3 Effect of each DQA correction to ozone profiles

In order to see the effect of each DQA correction, explained in Sec.2, the ozone profiles after and before each correction have been explored. The RS80 and

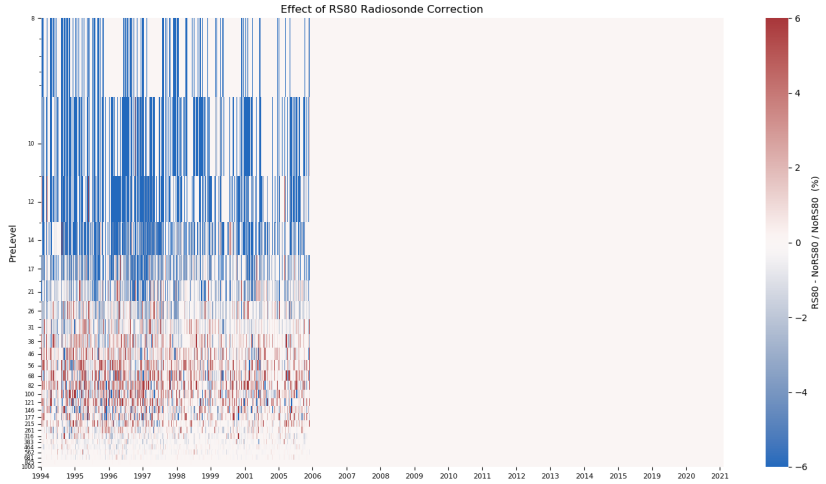


Figure 13: RS80 correction applied

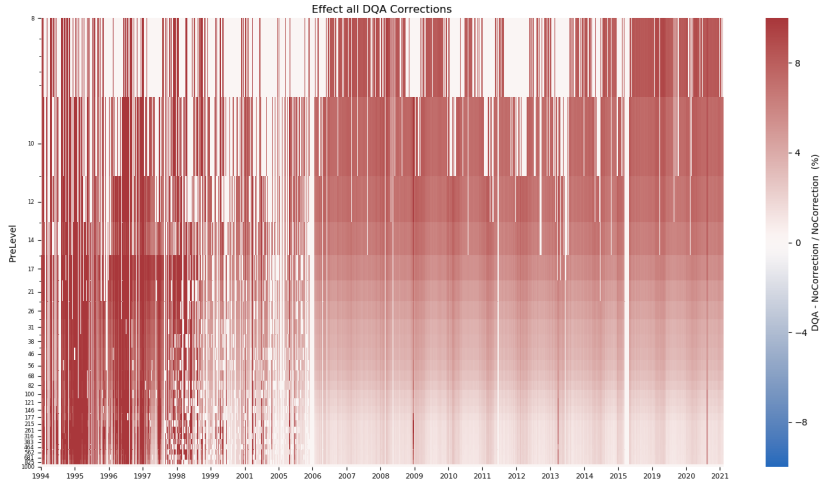


Figure 14: Effect of all DQA corrections

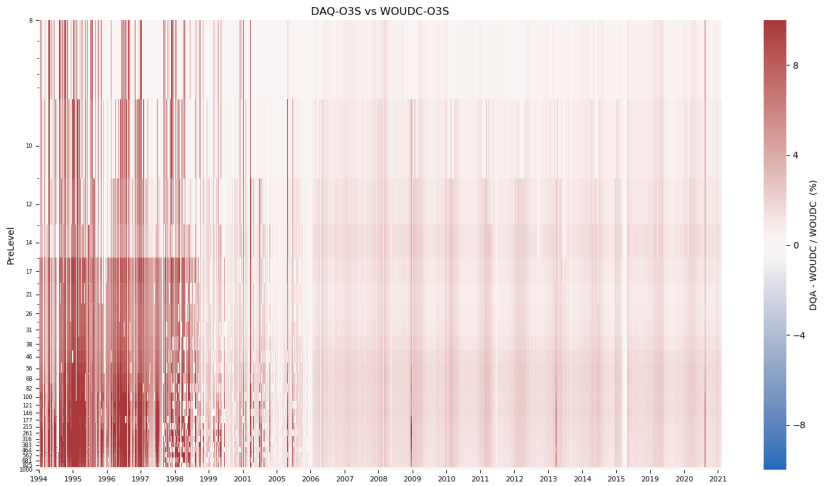


Figure 15: Comparison of DQA and WOUDC O3S values

pump temperatuure location corrections are applied for the srelevant specific period. All the plots are summarized between Fig.16 to Fig.24.

4 Total Ozone Normalization before and after homogenization.

The Total Ozone Normalization (TON) factors have been calculated with and without DQA corrections. For the TON the ratio of the TO from Brewer to the TO from the sonde is taken. For the TO from the sonde, the TO is integrated until 10hPa and the residuals, calculated from climatological means, are added. The corresponding plots are shown between Fig.**??** and Fig.**??**.

5 Comparison plots to AURA MLS v04 and v05

The homogenized and non-homogenized Madrid data is compared with AURA-MLS data using v04 and v05. Among these two a small difference can be seen in the pressure levels between 45 and 215 hPa. This difference is due to the differences in the AURA MLS data. The not-corrected, homogenized and WOUDC O3S data sets are compared and shown in figures between 25 and 27.

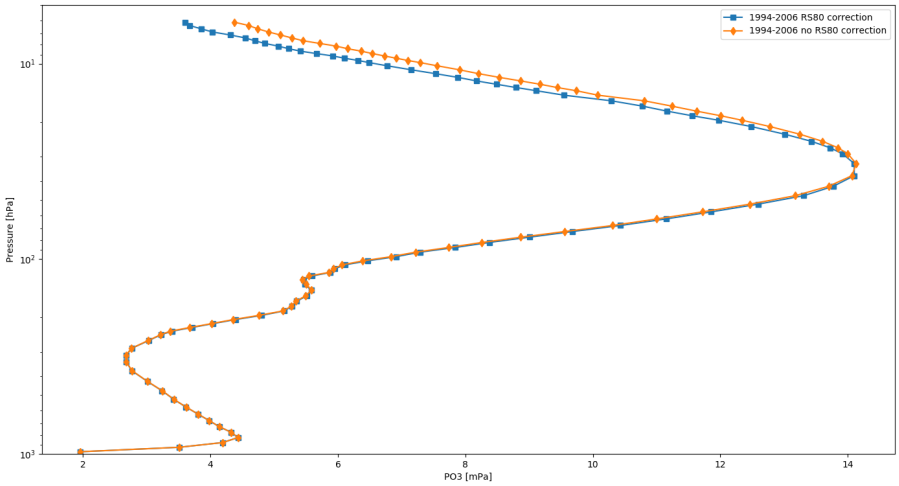


Figure 16: RS80 correction between 1994-2006

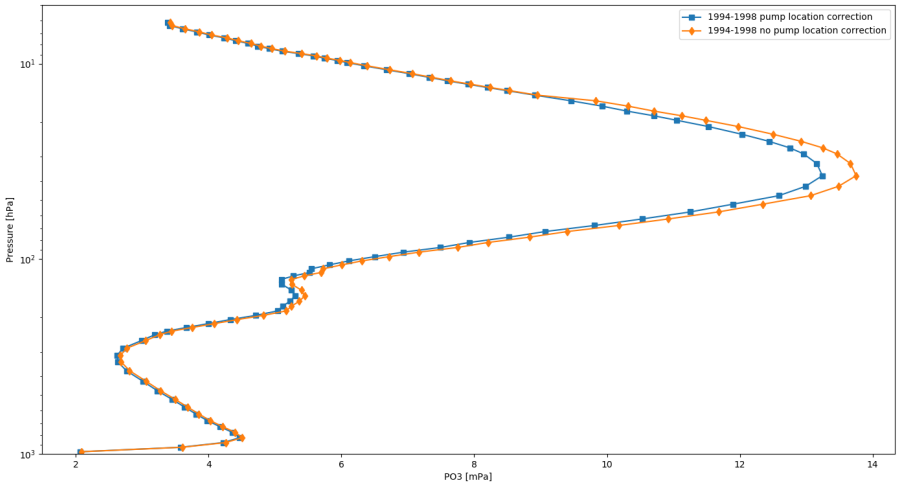


Figure 17: Pump temperature location between 1994-1998

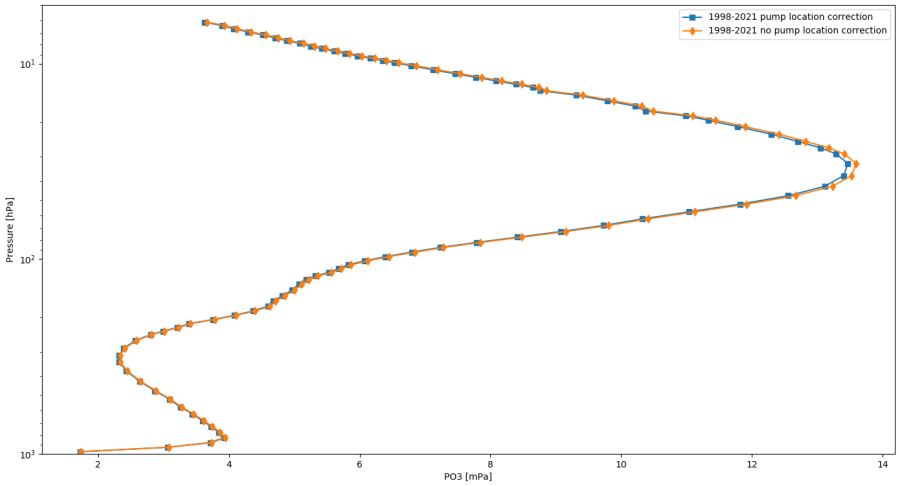


Figure 18: Pump temperature location between 1998-2021

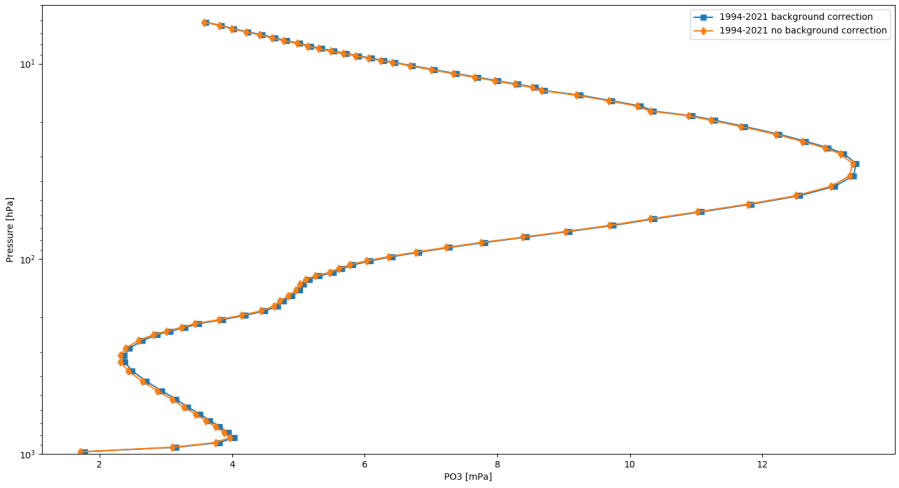


Figure 19: Effect of background correction

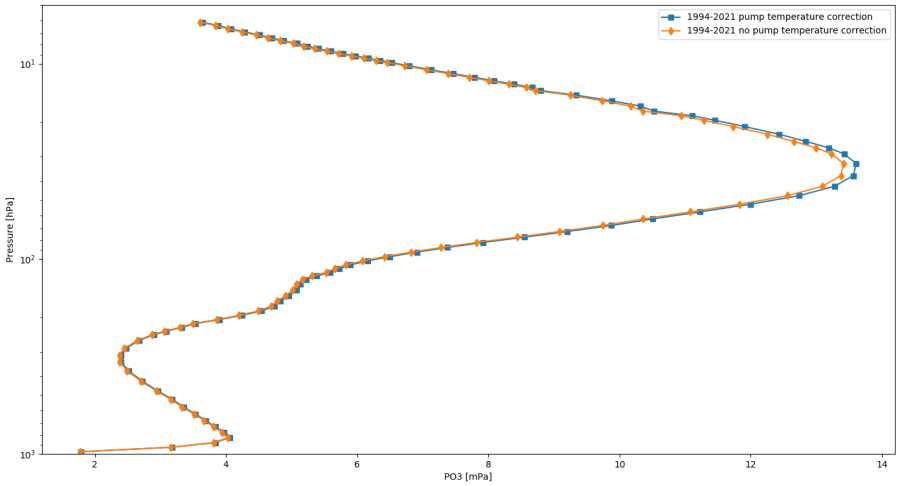


Figure 20: Pump temperature location between 1994-2021

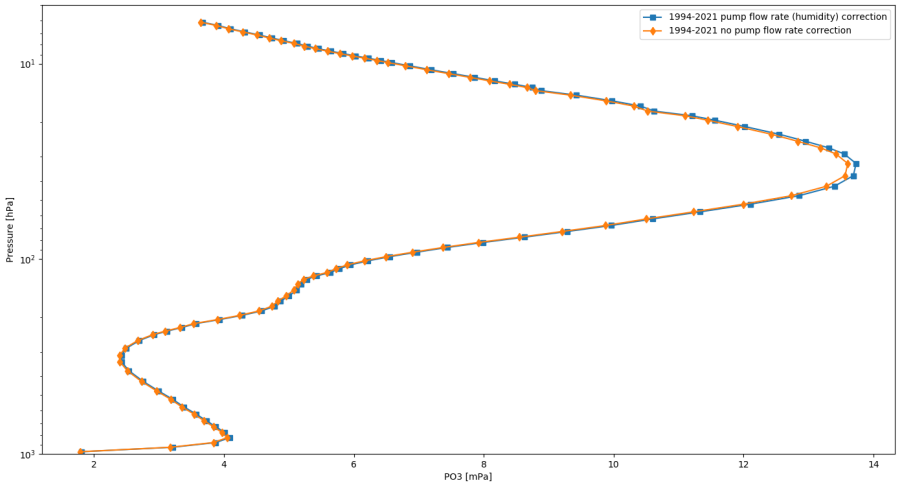


Figure 21: Pump flow rate (humidity) correction

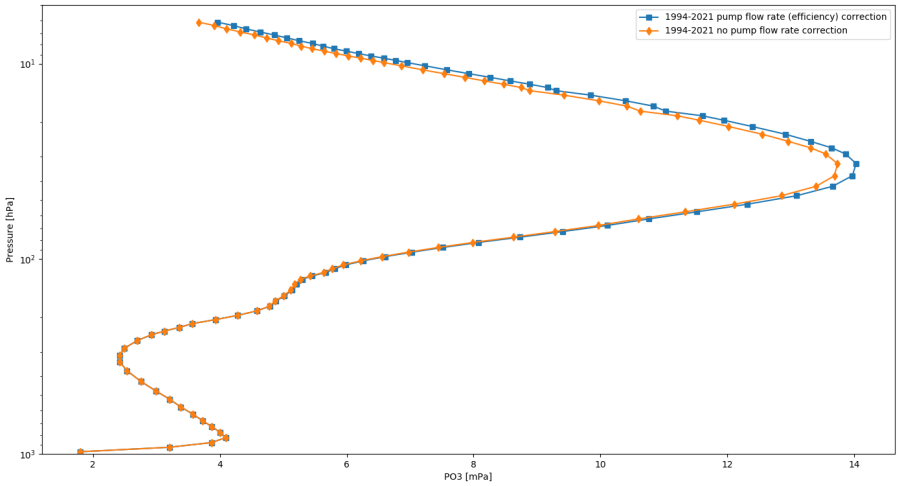


Figure 22: Pump flow efficiency correction

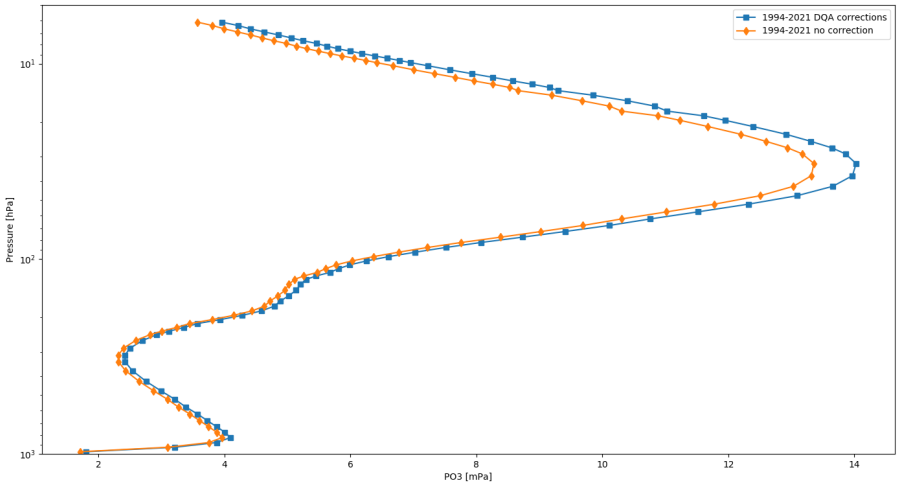


Figure 23: Effect of all DQA corrections

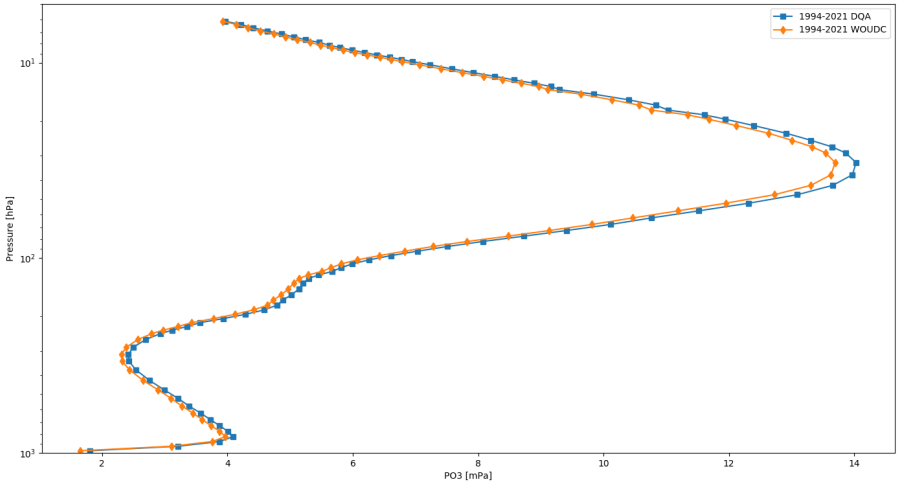
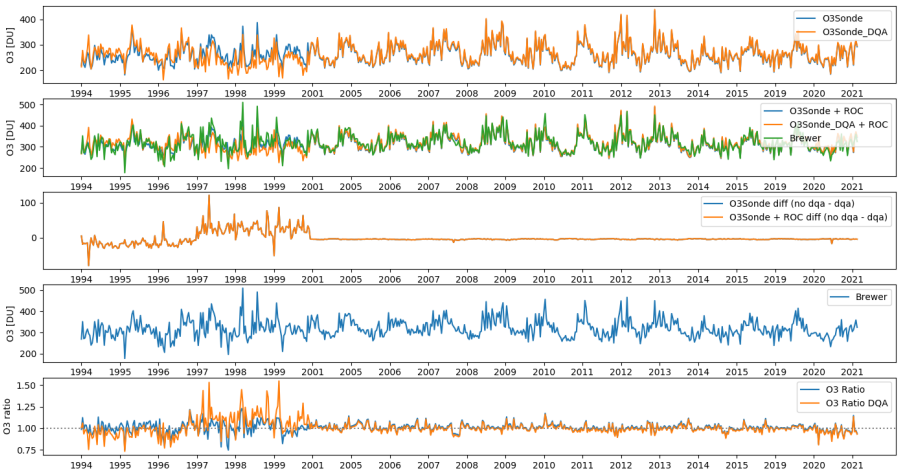
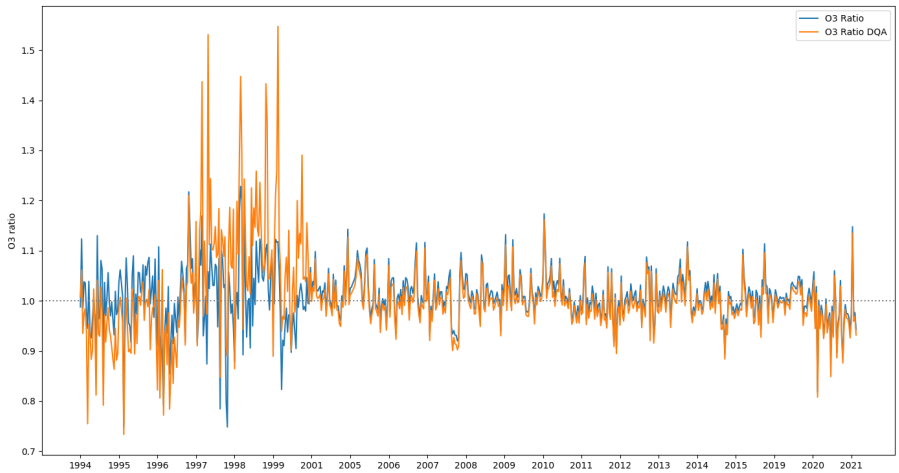


Figure 24: Comparison of WOUDC and DQA ozone profiles




O3 Ratio
O3 Ratio DQA
O3 ratio
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
1994
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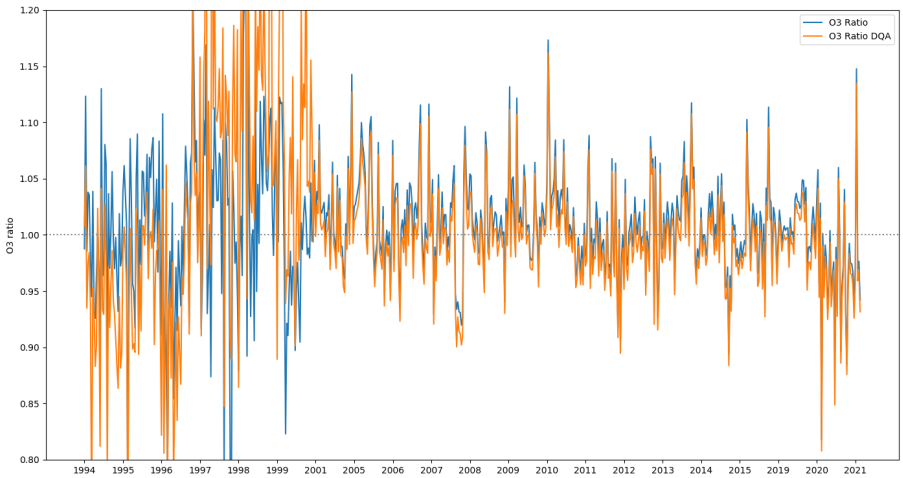
2019
2020
2021


O3 Ratio
O3 Ratio DQA
O3 ratio
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
1994
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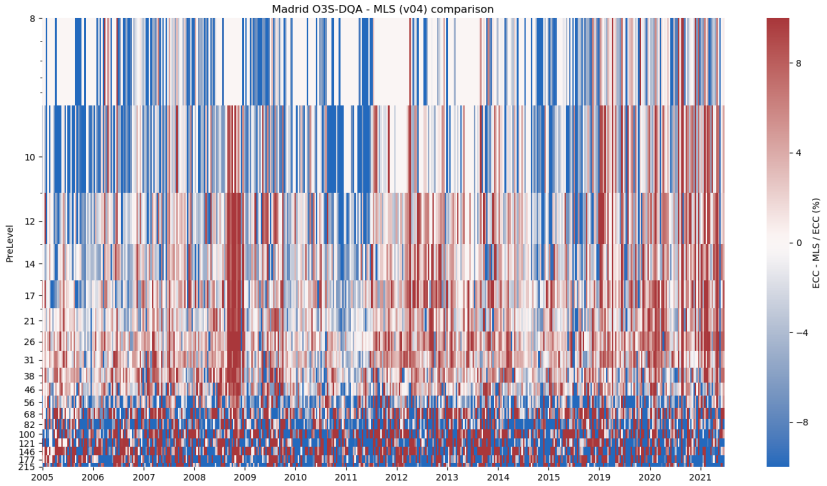

Figure 25: DQA Madrid O3S vs AURA MLS v04

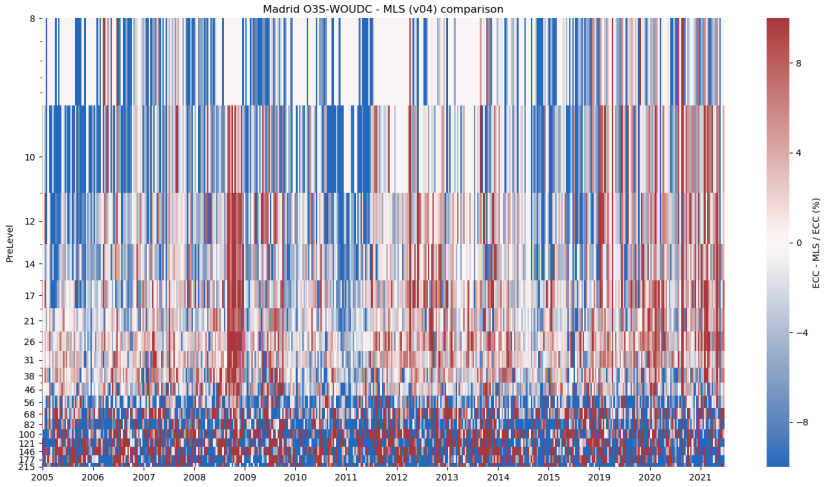

Figure 26: WOUDC Madrid O3S vs AURA MLS v04

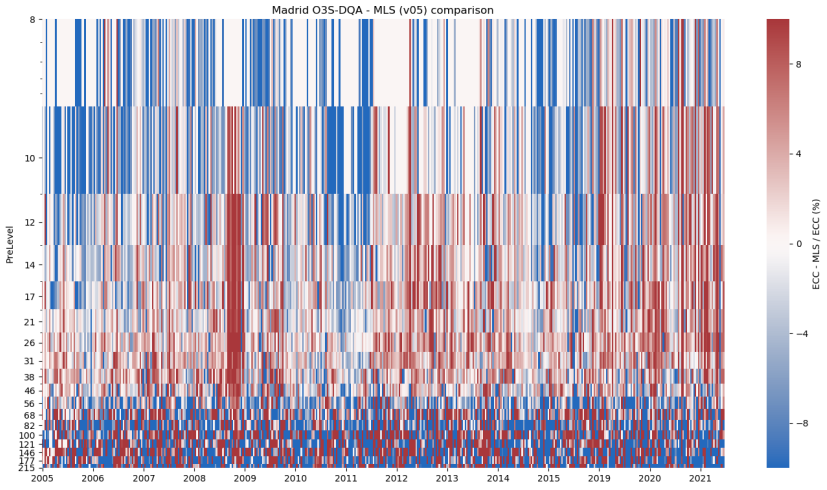

Figure 27: DQA-O3S Madrid vs AURA MLS v05