Valentia O3S-DQA Homogenization Report

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1 Valentia Metadata Timeseries

Valentia data is dowloaded from WOUDC data server and processed by RMI. The timeseries starts at 1994/01. The temperature (TLab), humidity (ULab) and pressure (PLab) of the laboratory measurements are missing before 2003. For the missing values, monthly climatological means are calculated with the available data and these values are used for the corresponding missing metadata. TLab, PLab and ULab are used for pump flow rate humidity correction. For the background correction, iB2 is used. The related plots are shown in Figs 1 - 6.

2 O3S Corrections

Assumptions made for homogenization are indicated in blue, to be confirmed by the station PI
Unusual behaviours are indicated in red The recommended and applied O3S-DQA corrections are summarized below.

1. Conversion efficiency
   (Transfer functions are not applied since always SPC 1.0%-1.0B sondes have been used. 3ml of cathode solution is used during the entire period that the absorption efficiency is taken as 1.)

2. Background current
   (iB2 is used through entire time-series)

3. Pump temperature measurement
   (For 5A SPC sondes, pump temperature thermistor was taped externally and for 6A and ENSCI sondes was taped internally.)

4. Pump flow rate, moistening effect
   (Humidty correction is not applied in the Vaisala software that the WOUDC

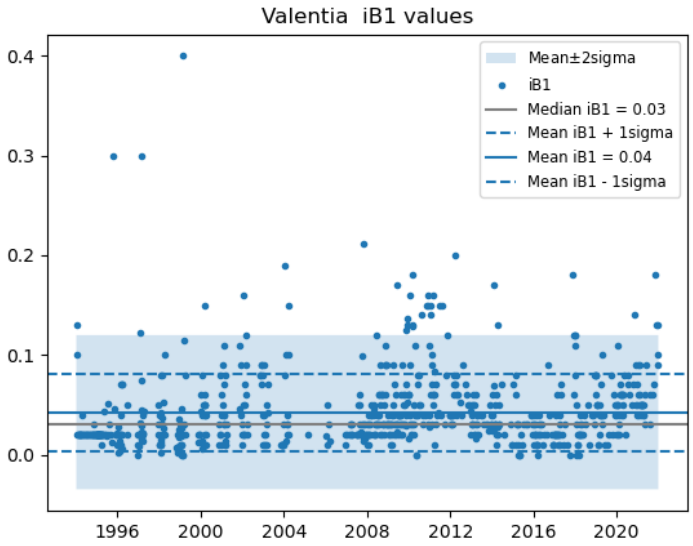

Figure 1: Valentia iB1 timeseries

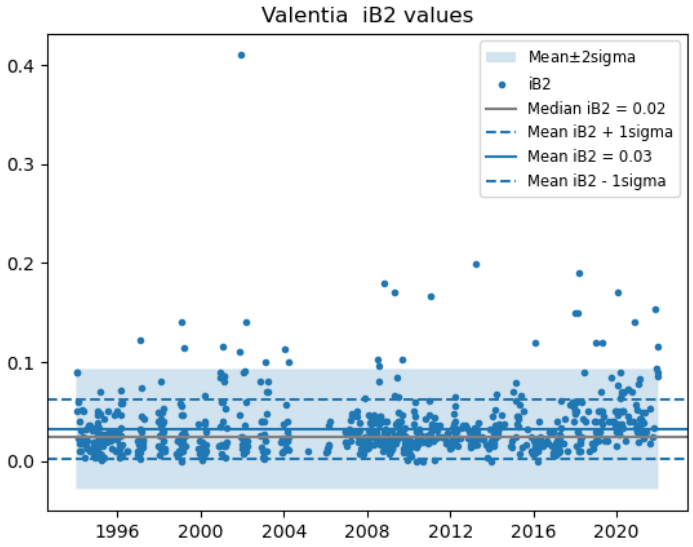

Figure 2: Valentia iB2 timeseries

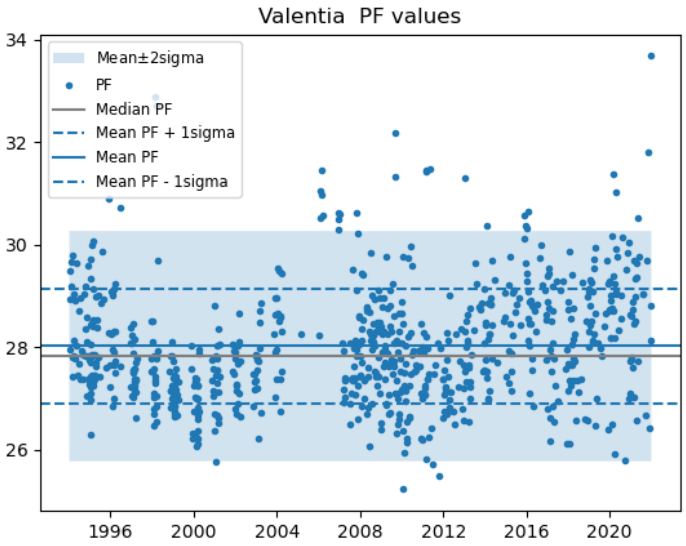

Figure 3: Valentia pump flow rate timeseries

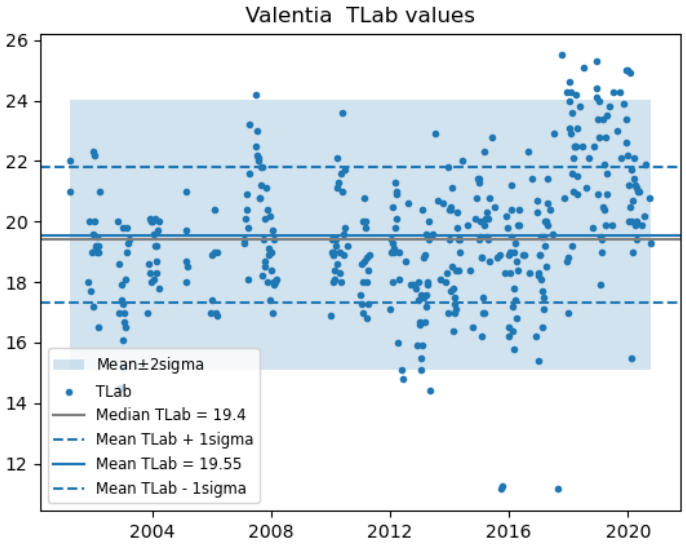

Figure 4: Valentia laboratory temperature timeseries

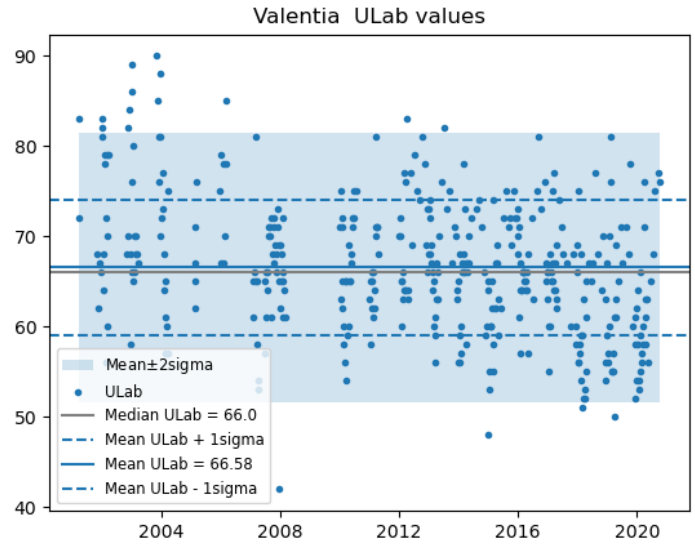

Figure 5: Valentia laboratory humidity timeseries

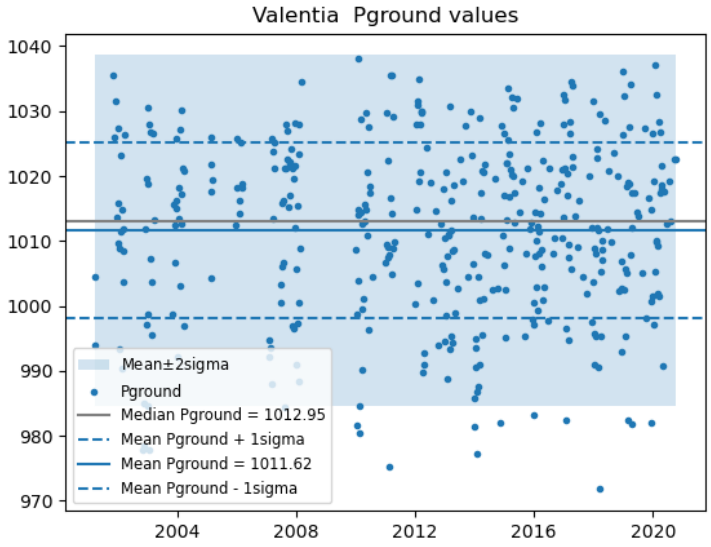

Figure 6: Valentia laboratory humidity timeseries

O3 values are not corrected for humidity.)

5. Pump flow efficiency at low pressures
   (PF efficiency tables are applied as in the Vaisala software. These are:
   SPC Table = [1.171, 1.171, 1.131, 1.092, 1.055, 1.032, 1.022, 1.015, 1.011, 1.008, 1.006, 1.004, 1, 1]
   for Pressure = [0, 2, 3, 5, 10, 20, 30, 50, 100, 200, 300, 500, 1000, 1100] values and ENSCI Table = [1.24, 1.24, 1.124, 1.087, 1.066, 1.048, 1.041, 1.029, 1.018, 1.013, 1.007, 1.002, 1, 1]
   for Pressure = [0, 3, 5, 7, 10, 15, 20, 30, 50, 70, 100, 150, 200, 1100] values.)

6. Total ozone normalization: in O3S-DQA guide this correction factor is recommended to be added in the data-set, but the normalization factor is not applied.

   • TO values from Dobson/Brewer spectrophotometers are taken from the WOUDC data-server.

The O3S-DQA corrections are applied to the raw current measured by the ECC's. The raw current values are determined from converting partial ozone values that are in the WOUDC files to current. Knowing pump temperature values, pump flow rate and background values (iB2) is essential to obtain the raw current values. The corrections that were applied to have the WOUDC ozone partial pressure values, are un-corrected to get the raw current values. These un-corrections correspond to the corrections applied in the Vaisala software, which are: pressure dependent background correction for SPC sondes and pump flow efficiency correction. The pump flow efficiency correction table used at this stage is slightly different than the table used for O3S-DQA pump efficiency corrections. The correction applied for uncorrecting the WOUDC pump flow efficiency can be seen in Ozone Sounding with Vaisala Radiosonde RS41 User's Guide M211486EN, page 74 and the correction table used for O3S-DQA can be seen in O3S-DQA Activity: Guide Lines for Homogenization of Ozone Sonde Data (Version 2.0) at page 34.

The ozone partial pressure values converted from raw current wihout applying any correction are denoted as 'Raw' or 'No correction', the O3 values from WOUDC files are denoted by 'WOUDC' and the ozone partial values that have all the DQA corrections are denoted by 'DQA' in the rest of the manuscript.

2.0.1 Conversion efficiency

3ml of cathode solution is used all entire period that the absorption efficiency is taken as 1. Since SPC 1.0%-1.0B sondes have been used, stoichmetry correction

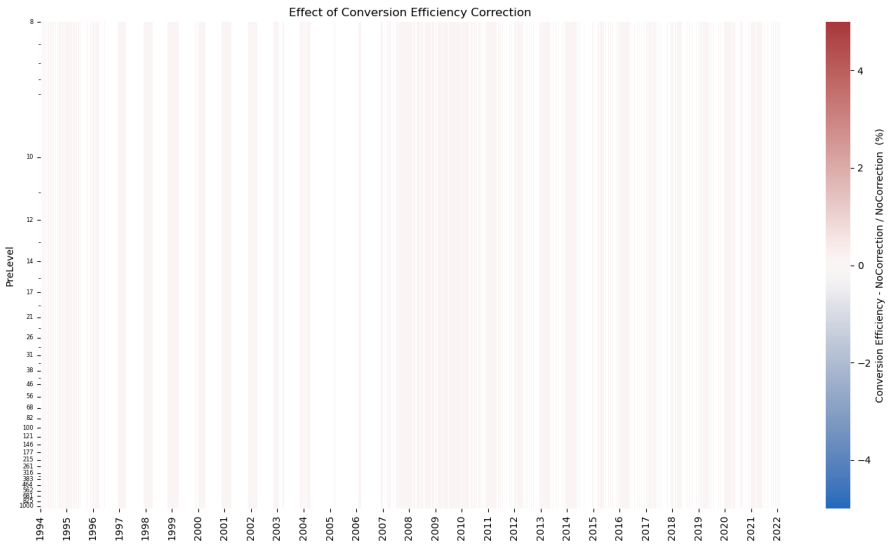

Figure 7: Conversion efficiency correction

is not needed. Therefore, the conversion efficiency is taken 1 and this correction do not have an effect on the data-set, Fig 7

2.0.2 Background current

Background correction, iB2, applied to Valentia time-series is shown in Fig 2. If I_B exceeds $I_{B,\mathrm{Mean}} + 2\sigma_{IB}$ then I_B, it should be replaced by the more representative climatological value of $I_{B,\mathrm{Mean}}$, however with larger uncertainty of $2\sigma_{IB}$. Therefore if I_B values are falling above $I_{B,\mathrm{Mean}} + 2\sigma_{IB}$ in Fig 2, the background correction is applied.

2.0.3 Pump temperature measurement

Truest pump temperature correction is applied according to Eq.13 of the O3S-DQA Guidelines. Until 2003 SPC-5A sondes, and SPC 6A sondes have been launched. After 2003, 6A sondes have been used. 5A and 6A sonde periods need different corrections and their effects are shown in Fig 9 as dark and light red respectively.

2.0.4 Pump flow rate (moistening effect)

This correction, Eq.15 of the O3S-DQA Guidelines, is applied and shown in Fig 10. The details of the values used for correction is explained in Sec 1.

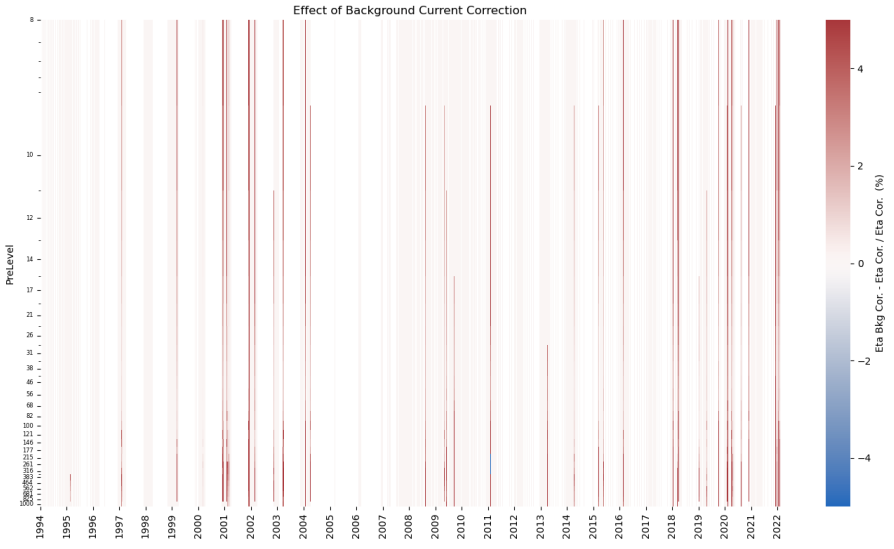

Figure 8: Background current correction

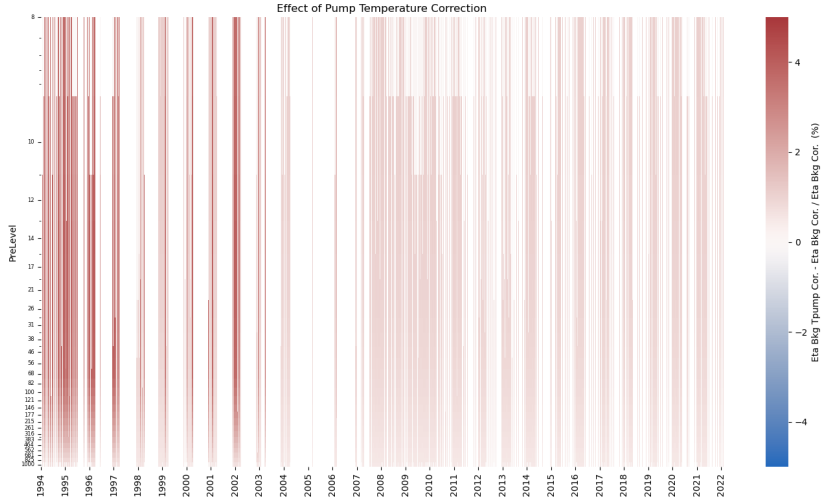

Figure 9: Pump temperature correction

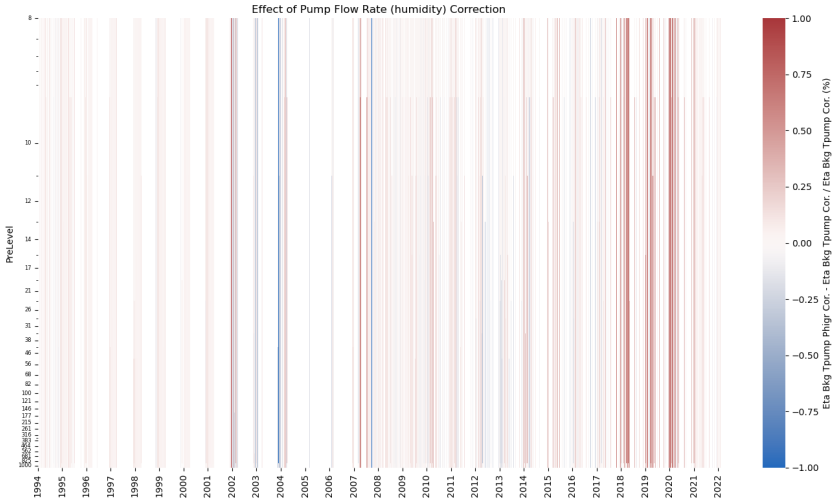

Figure 10: Pump flow rate humidity correction applied

Considering that the humidity values of the laboratorty is very high, the effect of this correction is not very significant.

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 11. The effect of this correction is shown in Fig 11.

The effect of all DQA correction with respect to no correction is shown in Fig 12 and the comparison of DQA corrected and WOUDC O3S values is shown in Fig 13.

3 Effect DQA corrections on vertical ozone profiles

In order to see the effect of DQA corrections, explained in Sec.2, on the ozone profiles the ozone profiles have been explored with and without DQA corrections. In Fig14, the ozone profiles with DQA and WOUDC corrections are shown.

4 Comparison plots to AURA MLS v04

The homogenized and non-homogenized Valentia data is compared with AURA-MLS data using v04. The WOUDC and DQA homogenized O3 data sets are

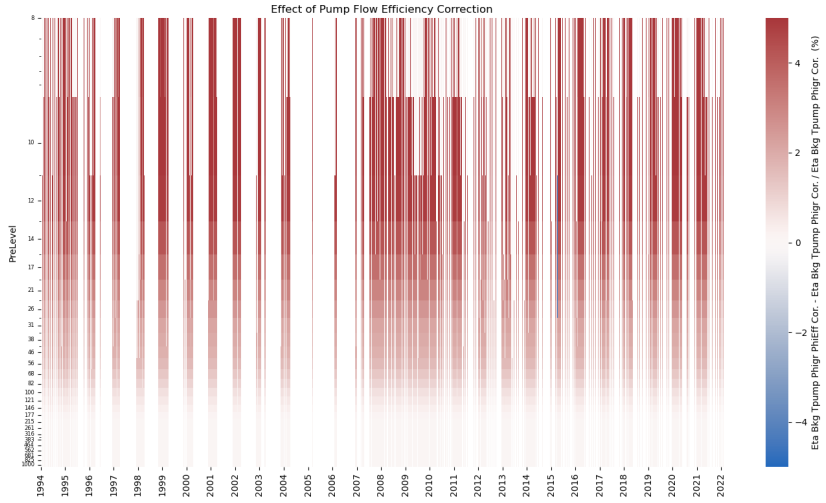

Figure 11: Pump flow rate correction applied

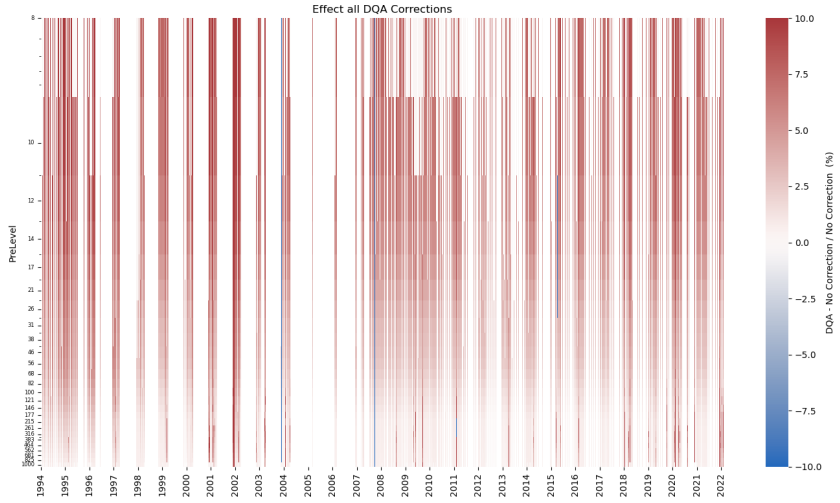

Figure 12: Effect of all DQA corrections

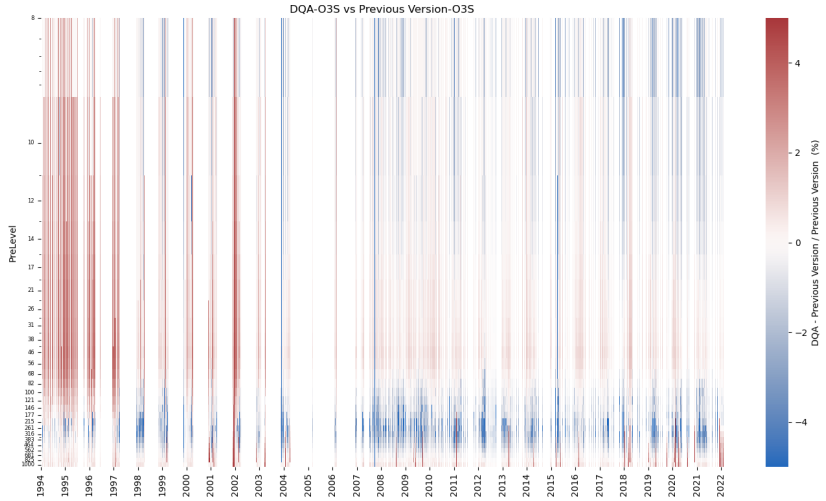

Figure 13: Comparison of DQA and WOUDC O3S values

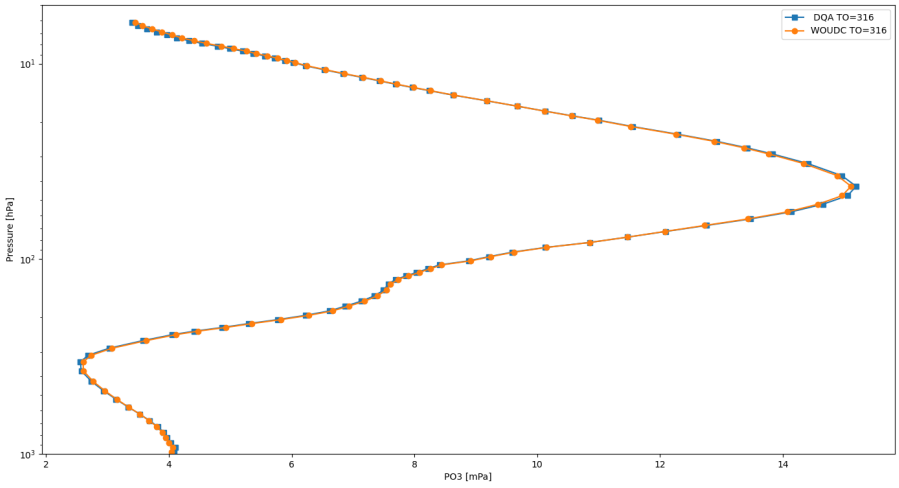

Figure 14: DQA corrections and WOUDC corrections

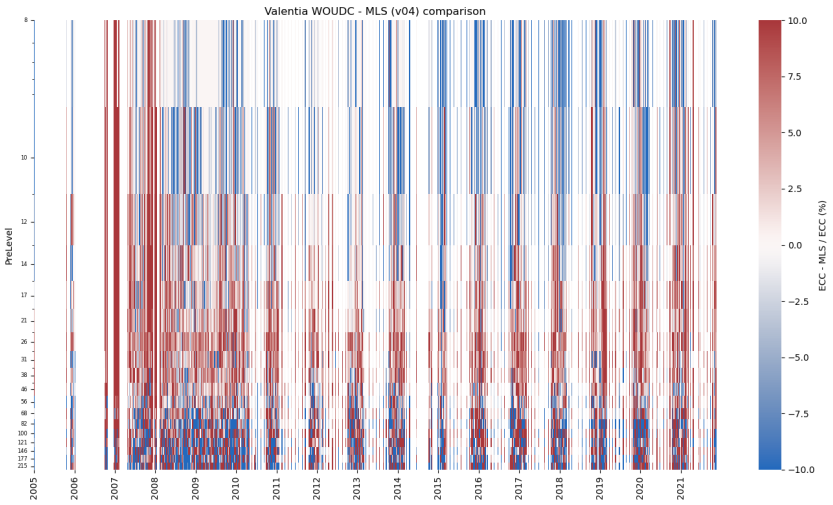

Figure 15: WOUDC Valentia O3S vs AURA MLS v04

compared and shown in figures between 15 and 16.

5 Total Ozone and Total Ozone Normalization Factors

The Total Ozone Normalization (TON) factors have been calculated with and without DQA corrections. For the TON the ratio of TO from the sonde to the TO from satellites are taken. For the TO from the sonde, the TO is integrated until burst (max. 10hPa) and the residuals, calculated from climatological means, are added. The corresponding plots are shown in Fig.17 and Fig.19.

6 Pump Temperature Profiles

The pump temperature values are investigated to check if there are any anamolies during the entire time series. The related plots are shown in Fig.20-23.

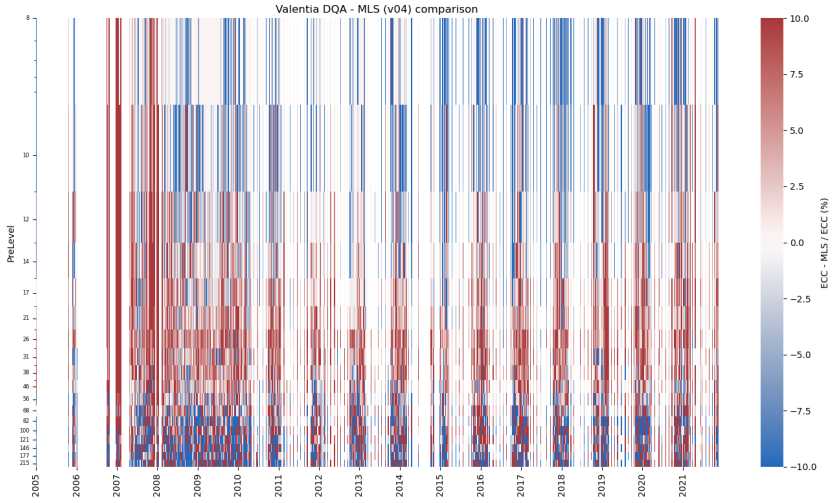

Figure 16: DQA Valentia O3S vs AURA MLS v04

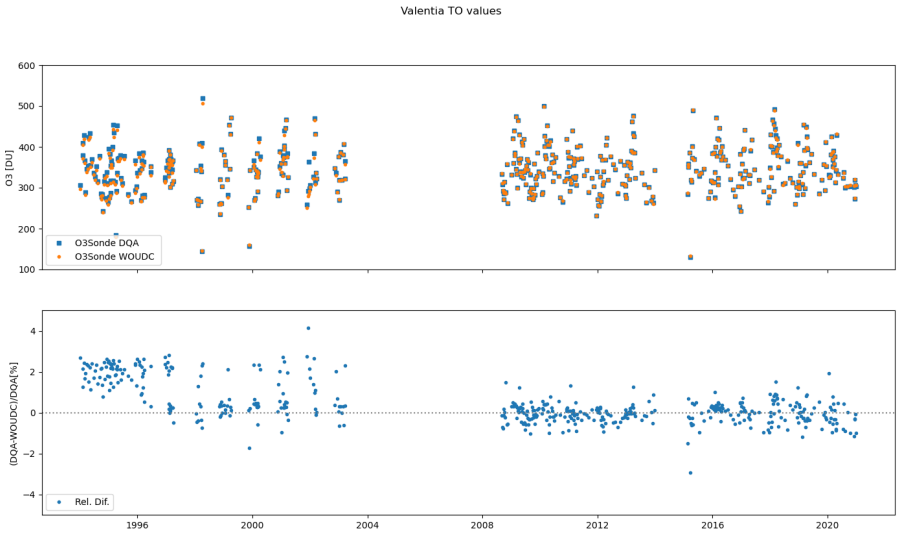

Figure 17: TO values calculated with WOUDC and DQA corrected ozonesonde data

Figure 18: TO from Brewer and Relative differences of TO values with respect to Brewer calculated with WOUDC and DQA corrected ozonesonde data

Figure 19: Relative differences of TON values with respect to satellite data calculated with WOUDC and DQA corrected ozonesonde data

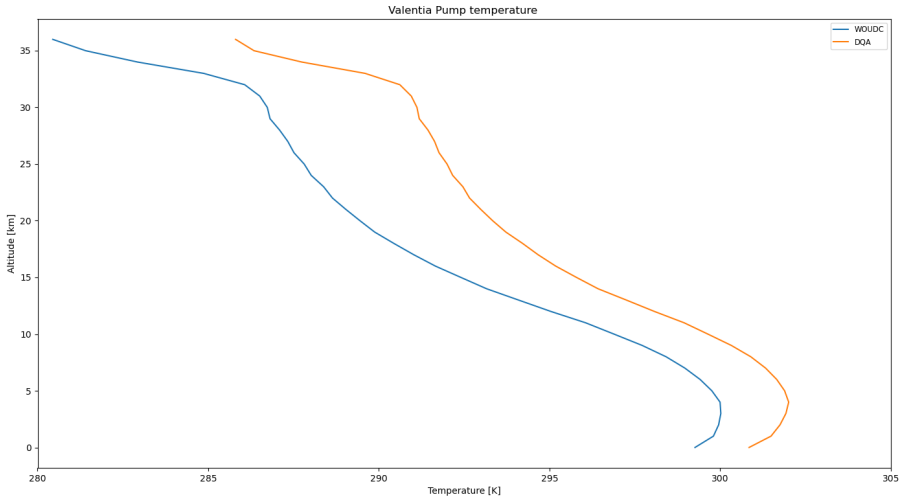

Figure 20: Pump temperature profiles as a function of altitude with and without DQA corrections

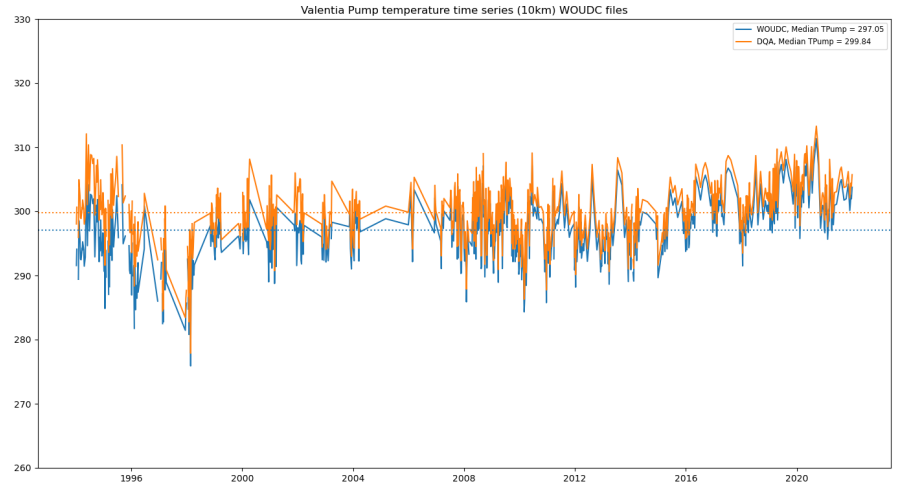

Figure 21: Pump temperature values at 10km with and without DQA corrections

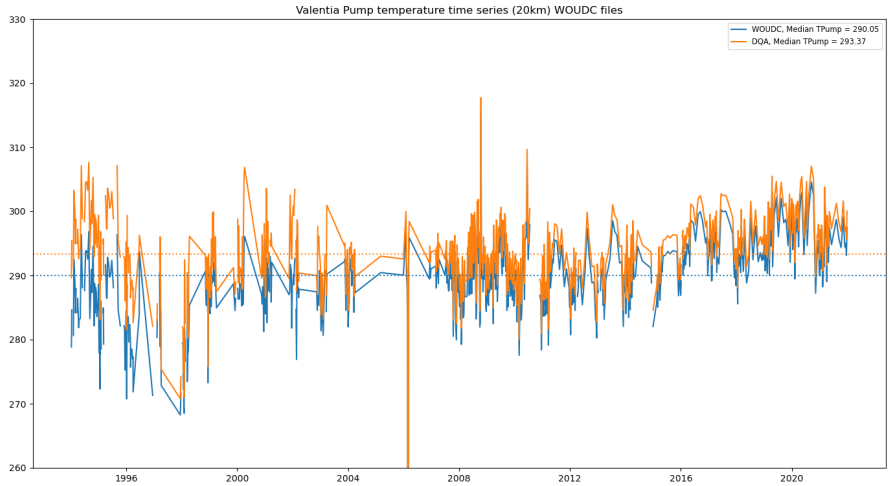

Figure 22: Pump temperature values at 10km with and without DQA corrections

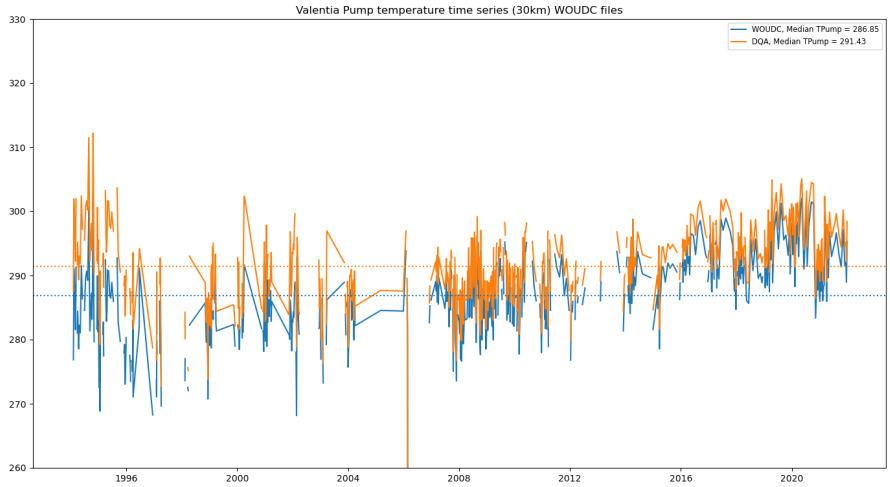

Figure 23: Pump temperature values at 10km with and without DQA corrections