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Luzblick
OUTLINE

* Absolute Calibration during ATMOZ-
  introduced in Pandora calibration
* Effect of the Absolute calibration
* Effect of the absorbing gases.
1) Absolute calibration during atmoz
2) Results using the absolute calibration (CF_ABS)
3) Results removing absorbing gases
   a) CF_SO2
   b) CF_SO2_HCHO
4) Results removing absorbing gases and absolute calibration
   a) CF_ABS
   b) CF_ABS_SO2
   c) CF_ABS_SO2_HCLO
Prototype v2: Simple Fiber Optic Guide

FO guide Installed
Pandonia

- Ground-based remote sensing network for air pollution monitoring and satellite validation
- Uses Pandora-2S and Pandora as core instruments

**MOTIVATION:**
Long, uninterrupted, well-maintained, homogeneously calibrated time-series of ground-based remote sensing atmospheric ozone measurements have been and still are the backbone for the validation of ozone columns.
From Pandora to Pandora-2S: head sensor
There is an extensive network calibration plan, which is not fully implemented yet. The key points are:

- Instruments undergo a detailed initial lab-calibration
- Location instruments are visited by mobile reference unit and FCT (Field Calibration Tool) to minimize data interruptions.
ABSOLUTE CALIBRATION:

- PTB Lamp Measurements.
- Determination of the reference plane (-27.3cm).
- Added the Absolute calibration into the P121 CF (FW5).
- Not added yet the absolute calibration for FW6.
PANDORA -ATMOZ- 

- Absolute Calibration
- Stray Light matrix
- New ozone cross section
  (Bremen)

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<th>Std Dev</th>
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Langley Absolute Calibration (no filter)

Example of Langley (up) and $R^2$ of the fit

The UV range 290-325 nm shows more error on the Langley fit a bigger variability.

Ratio to mean langley extrapolation -ATMOZ- campaign
Langey ratio, filter U340 included
Other Improvements at IZO

CF original - FW5 O3vc data respect Brewer Median:

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5, 6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

Rel Diff ((Pandora121_IZO_O3_FW5.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -5.616

O3 Relative Difference [%]

SZA
CF abs - FW5 O3vc data respect Brewer Median:

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5, 6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

Rel Diff ((Pandora121_IZO_O3_FW5.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -6.315
Results using the absolute calibration (CF_ABS)

- The addition of the absolute calibration does not reduce the offset respect the brewers.

- The SZA dependence is worse in the ABS calibrated data. -> Wrong ABS calibration?
Effects of the Gasses in the original CF:
The standard gas retrieval method in the pandora processing software have into account 4 gasses.

- O3
- NO2
- SO2
- HCHO

Some tests were done excluding some of them in the retrieval process.
Filters used in the comparison plots:

- **DQP1**: wavelength shift: O3 < 0.2 nm
- **DQP2**: Stray Light: solar zenith angle < 79
- **DQP2**: Stray Light: Air mass < 5
- **DQP4**: Clouds: Error on the retrieval Noise: < 5 DU(O3)
- **DQP5**: Fitting result index: 1, 2 = no error, >2 = error
CF Original - FW5 comparison

20160901-20160930, Fig06, P121 O3 filtered ftws [5], and Brewers Median [157, 185, 183], O3 Vertical Columns VS Time, [DU]
CF Original - FW5 and FW6 comparison

20160919-20160919, Fig06, P121 O3 filtered ftws [5, 6], and Brewers Median [157, 185, 183], O3 Vertical Columns VS Time, [DU]
CF Original - FW5 comparison

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

- (P121_CF121_v1d20160415_Daumont4TGOME_225K_FW5_gas_vc - Brewers median) % Brewers median, Mean = -5.608
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_withoutHCHO_FW5_gas_vc - Brewers median) % Brewers median, Mean = 0.014
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_withoutSO2HCHO_FW5_gas_vc - Brewers median) % Brewers median, Mean = -0.095
CF Original - FW6 comparison

20160901-20160930, Fig16, ((P121 O3 filtered ftws [6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 ReDiff %]

- (P121_CF121_v1d20160415_Daumont4TCOME_225K_FW6_gas_vc - Brewers median) % Brewers median, Mean = -4.630
- (P121_CF121_v1d20160415_Daumont4TCOME_225K_withoutHCHO_FW6_gas_vc - Brewers median) % Brewers median, Mean = -4.652
- (P121_CF121_v1d20160415_Daumont4TCOME_225K_withoutSO2HCHO_FW6_gas_vc - Brewers median) % Brewers median, Mean = -4.685
CF Original - FW5 and FW6

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5, 6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

- Rel Diff ((Pandora121 IZO O3 FW5.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -5.616
- Rel Diff ((Pandora121 IZO O3 FW6.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -4.642
CF Original - FW5 and FW6 Without HCHO

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5, 6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

Rel Diff ((Pandora121_lZO_O3_FW5.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -0.011
Rel Diff ((Pandora121_lZO_O3_FW6.txt_gas_filt - All Brewers median) / All Brewers median [157, 185, 183]), Mean = -4.666
CF Original - FW5 and FW6 Without SO2, HCHO

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5, 6] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]
Results removing absorbing gasses in CF original:

- Removing the HCHO is enough to reduce the [mean] offset until 0.01% in the FW5
- Removing SO2+HCHO is not better than only HCHO.
- In both cases, a SZA dependence appears.
- None of the cases affects to the FW6
Effects of the Gasses with ABS calibration
CF abs - FW5 comparison

20160901-20160930, Fig05, P121 O3 original ftws [5], and Brewers Median [157, 185, 183], O3 Vertical Columns VS Time, [DU]

- P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_FW5_gas_vc, Mean = 260.972[DU]
- P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutHCHO_FW5_gas_vc, Mean = 277.108[DU]
- P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutSO2HCHO_FW5_gas_vc, Mean = 276.405[DU]
- Median O3 of Brewers [157, 185, 183], Mean = 281.825[DU]
CF abs - FW5 comparison

20160919-20160919, Fig06, P121 O3 filtered ftws [5], and Brewers Median [157, 185, 183], O3 Vertical Columns VS Time, [DU]
CF abs - FW5 comparison

20160901-20160930, Fig16, ((P121 O3 filtered ftws [5] - Brewers Median) % Brewers Median [157, 185, 183]), VS SZA, [O3 Diff %]

- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_FW5_gas_vc - Brewers median) % Brewers median, Mean = -6.322
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutHCHO_FW5_gas_vc - Brewers median) % Brewers median, Mean = -0.126
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutSO2HCHO_FW5_gas_vc - Brewers median) % Brewers median, Mean = -0.420
Results removing absorbing gasses in CF abs:

- The conclusions are the same as in the CF orig.
- Removing the HCHO is enough to reduce the [mean] offset until -0.15% in the FW5
- Removing SO2+HCHO is not better than only HCHO.
- In both cases, a SZA dependence appears.
CF Original + CF abs with and without different Gasses

20160901-20160930, Fig18, ((P121 O3 filtered ftws [5] - Brewer 183) % Brewer 183), VS SZA, [O3 Diff %]

- (P121_CF121_v1d20160415_Daumont4TGOME_225K_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -5.734
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_withoutHCHO_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -0.306
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_withoutSO2HCHO_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -0.421
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -6.415
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutHCHO_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -0.443
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_withoutSO2HCHO_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -0.724
- (P121_CF121_v1d20160415_Daumont4TGOME_225K_abs_310_370nm_FW5_gas_vc-Brw183_gas_vc) % Brw183_gas_vc, Mean = -7.454
Brewer - Pandora during ATMOZ

Pandora 121 Total Ozone (Daumont) - Brewer vs SZA

Pandora 121 Total Ozone (Bremen) - Brewer vs SZA

Pandora 121 Total Ozone (Daumont) - Brewer

Pandora 121 Total Ozone (Bremen) - Brewer
The RBCC-E Team

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ATMOZ
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TESTBED
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