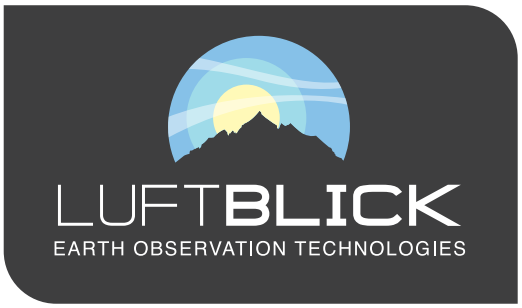

LuftBlick Report 2016007

OMI validation support

Pandora-OMI O_3 validation report

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Contents

Document Change Record

Issue	Date	Section	Observations
0.1	30 June 2016	All	First draft version

Acronyms and Abbreviations

$TotO_3$	Total column ozone
AVDC	Aura Validation Data Center
CC	Correlation coefficient
ClimCor	Climatological footprint correction
dLAT	Latitudinal distance of the footprint center to Pandora.
dLON	Longitudinal distance of the footprint center to Pandora.
DQ0	Pandora High Quality Data
EffLoc	Effective validation location
GeoFilt	OMI pixel geolocation filters
GSFC	Goddard Space Flight Center
MEDD	Median difference = Median$TotO_3$(OMI - Pandora)
NASA	National Aeronautics and Space Administration
OMI	Ozone Monitoring Instrument
OMI	Ozone monitoring instrument
PanAVG	Pandora data averaging time around the OMI overpass time.
RMS	Root mean square error to a linear fit
SatCF	Satellite footprint cloud fraction
SatFPT	Satellite footprint size
SLP	Slope of linear fit Pandora vs. OMI
SZA	Solar Zenith Anlge
TempO3	Effective ozone temperature
ValPars	Validation parameters
ValSite	Validation site

1 Introduction

This report is deliverable TD3370-1.4 of the contract "OMI validation support" [1] within Task 3 of the ESA IDEAS+ project, addressing the validation of total column ozone ($TotO_3$) from the ozone monitoring instrument (OMI) with Pandora direct-sun retrievals.

The outcome of this study and the conclusion we draw from it are condensed in the next section (number 2). Two methods which are applied to try to enhance the representativeness of the different footprints for OMI and Pandora are explained in section 3. In section 4 we introduce both data sets and how the data are prepared and processed to be used in this validation. Section 5 finally, presents the validation results for each validation site part of this study.

1.1 Applicable Documents

[1] OMI Validation Support - Contract Description, Contract Number: 4000111304/14/I-AM, LuftBlick Proposal 201504A, 2015.

[2] A. Cede. *Manual for Blick Software Suite Version 4*, 2016. URL `http://pandonia.net/docs/BlickSoftwareSuite_Manual_v4.pdf`.

1.2 Reference Documents

[3] M. Tiefengraber and A. Cede. Inter-calibration of ground-based spectrometers and Lidars – Minispectrometer Intercalibration and Satellite Validation, LuftBlick Report 2013004: Minispectrometer Data Quality Report, 2013.

[4] M. Tiefengraber and M. Müller. OMI validation support, LuftBlick Report 2015010: Pandora validation data, 2015.

2 Summary, Results and Conclusions

This report presents the validation results of the TotO3 product of OMI (OMTO3 v8.5, Collection 3) to the direct-sun TotO3 of Pandora (v002). The validation period covers a maximum time range of more than 6 years (2009 to 2015) and considers a maximum possible number of 81 validation sites (ValSite).
We chose a set of parameters where the validation quality is assessed on (ValPars). These are:

Validation parameter	**Abbreviation**
Correlation coefficient between OMI and Pandora data	CC
Root mean square error to a linear fit for Pandora vs. OMI data	RMS
Slope of a linear fit in Pandora vs. OMI	SLP
Median difference (= median$TotO_3$(OMI - Pandora)) between OMI and Pandora data	MEDD

Table 1: Validation parameters used in this study to assess the validation quality.

CC (relative units) and RMS (absolute units) give us an estimate about the linear correlation or "scattering" between OMI and Pandora data points. Beside the standard SLP, MEDD is a parameter to express the disagreement between both data sets in a very tangible way.

To ensure that only data of high quality are included in the validation study, data filtering is utilized (details see section 4.1). For Pandora we allowed only data passing the highest quality criteria. The impact of OMI pixel filtering on the validation outcome is estimated in a sensitivity study. By this means we assessed the impact of the pixel location and size (geolocation filters, GeoFilt) as well as the cloud fraction on the ValPars in Table 1. In addition to that the Pandora data averaging time around the overpass time is assessed.

Beside the data filtering two further correction steps are tested on the data. For Pandora the validation geolocation of the instruments are shifted to take into account the effective absorber height of O_3 for direct-sun data (details see section 3.1). We denote this coordinates effective validation location (EffLoc). OMI pixels are further corrected based on a high resolution, time averaged climatological footprint map (ClimCor) of $TotO_3$ (details see section 3.2). By this the varying position of the footprint pixels for different overpasses can be taken into account for sites exhibiting significant TotO3 gradients across a common OMI pixel.

OMI data showing cloud fractions < 0.1 turned out to be best suitable for the validation. Pandora data are averaged $\pm$ 90 minutes around the OMI overpass time to mitigate the footprint difference between OMI and Pandora. Applying cloud fraction filtering to OMI data and filtering Pandora data reduce the number of available ValSites to 57. The sensitivity study reveals also a significant improvement in the validation quality when applying GeoFilt to the OMI pixels. Since this strongly drops the number of data points, the available number of ValSites drops to 41. This emphasizes the necessity of long, continuous time series of ground based validation data.

2.1 Validation overview

Figure 1 essentially comprises the overall validation outcome, expressed in box plots for different scenarios and the ValPars mentioned earlier. Each box plot contains the information of all ValSites. The median value of each ValPar is depicted as red bar, the black box comprises the 25 to 75 percentile range and the black bars define the 5 to 95 percentile range. The blue dots indicate ValSites lying outside this range. Each column in the figure represents a different scenario which is a combination of

- **E1 or E0** means EffLoc considered or not, and
- **C1 or C0** means ClimCor applied or not, and
- **G1 or G0** means GeoFilt applied or not.

The differences between the individual scenarios for the ValPars is not very pronounced, however we can still distill down three findings: First, applying GeoFilt reduces the spread in the ValPars between all ValLocs. In particular the number of "outliers" dropped. Second, utilizing EffLoc instead of the actual location for the validation further narrows

the spread in the ValPars between all ValLocs. Especially high latitude ValLocs during mid latitude winter experience the mismatch between EffLoc and the actual position. Third, whether ClimCor is applied or not does not have any significant impact on the validation outcome. This seems reasonably, since usually no strong TotO3 gradients are expected across an OMI pixel.

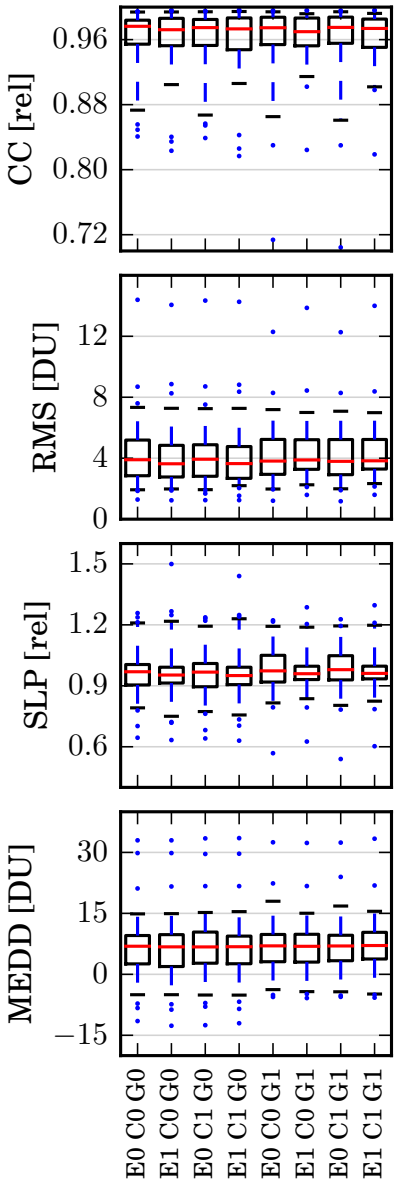


Figure 1: Overall validation result expressed by ValPars for different validation scenarios (explained in the text). The box plots include the entire data base. The median values are depicted by the red bar, 25 to 75 percentiles are embraced by the black box. The 5 to 95 percentile is marked by the black bars. Values outside this range are given as blue dots.

The results for each ValSite are shown in Figure 2 (3) for data with no (with) GeoFilt applied. The different scenarios, the same abbreviations as in Figure 1 are used, are now depicted as horizontal bar (circle) for C1 (0) and color coded in green (red) for E1 (0). The stronger influence on the ValPars by EffLoc compared to ClimCor is also visible in these figures, since the "colors" deviate more than the "symbols".

ValSites like Doi Ang Khang (Thailand), Galveston (TX, USA) or RockyFlasts (CO, USA) benefit in particular from utilizing EffLoc. Interestingly enough, the improvement is even better when also GeoFilt is applied.

The major driver for the differences in the ValPars for the individual location is the influence on the effective O_3

temperature (TempO3). Whereas both systems, OMI and Pandora, are sensitive to TempO3, it is taken into account for the OMI retrieval but not for Pandora. The Pandora standard TotO3 retrieval assumes a constant TempO3 of 225 K. This value is a compromise in latitude and season. Thus largest deviations are expected in winter and summer for high and low latitudes. This temperature error is a constant relative error in the slant columns meaning a not constant error in the vertical columns (=TotO3). This leads to a seasonal bias and change in the slope for TotO3 comparison. Hence we see the strongest effect in mid latitude summer (winter) with a common underestimation (overestimation) for Pandora and slopes > (<) 1.

This effect has two major implications for the validation study. First if a data set at a ValSite spans at least a year, that is it includes all seasons, an enhanced RMS can be observed. But since the different seasons counteract, small MEDD and a SLP close to 1 is observed. Examples beside others are Busan (South Kora), GSFC (MD, USA) or Seoul (South Korea), all shown in section 5. Second if a data set at a ValSite only covers a shorter time period, e.g. only one season, it depends on the season in which "direction" the comparison is biased or tilted (in terms of MEDD and SLP). Examples for this seasonal effect are beside others Lauder (New Zealand), Baengnyeongdo (South Korea) and Golden (TX, USA) for summer differences and Hanford (CA, USA), Parlier (CA, USA) and Madera (CA, USA) for winter differences (again shown in section 5).

In addition to this seasonal effect there are shortcomings in the Pandora data processing from which we can assume to have an effect on MEDD and probably also on SLP. Each instrument has a different spectral response and spectral stray light susceptibility. Since we currently do not correct for theses effects (that is absolute calibration and stray light correction, which is commonly not considered in DOAS applications), different impacts on MEDD for different Pandoras can be expected and are seen.

To quantify the final validation result, we utilize the scenario yielding the best overall validation quality (compare Figure 1). This is scenario E1 C0 G1. The 25, 50 and 75 percentile values for the ValPars are given in Table 2.

ValPar	**Value: 25 perc - 50 perc - 75 perc**
CC	0.95 - 0.97 - 0.99
RMS [DU]	3.27 - 3.89 - 5.21
SLP	0.93 - 0.96 - 1.00
MEDD [DU]	3.01 - 6.90 - 9.85

Table 2: ValPars for validation scenario E1 C0 G1. Shown are the 25, 50 and 75 percentiles.

Rather high CC can be expected for TotO3 validation. 75 percent of all ValSites show a better CC than 0.95. Expressed in an absolute number, the median RMS is near 4 DU. The vast majority of the data show SLP < 1, which would assume an underestimation of the OMI TotO3 data compared to Pandora. However, since different seasons show different SLP values (as mentioned before) and we have included all kind of time periods, we can not extract a conclusion from that.

Rather surprisingly though, MEDD is positive with a median value of about 7 DU. This would suggest Pandora underestimating TotO3 compared to OMI. This is at a first glance counterintuitive, considering that OMI TotO3 is always an average over the pixel area. Our first guess is that the missing absolute calibration and stray light correction have the potential to explain this bias.

2.2 Conclusions

Based on this study we come to the following conclusions:

- Long, continues time series are of great value for TotO3 satellite validation. Strict data filter criteria can be applied to the data, still offering good statistics. By this also seasonal dependencies as well as long term trends can be investigated.
- The concept of utilizing the effective rather than the geolocation of a validation site turned out to be a useful tool to enhances the representativeness of TotO3 from the satellite and Pandora.
- The overall uncertainty in the validation is driven by two topics: first, seasonality in the TotO3 differences due to changing effective O_3 temperature. Seasonal subsets show different slopes and median differences, which makes it

difficult to interpret short validation time periods but also enhances the "data scattering" for longer validation time periods. Second, neglecting the instruments spectral response and spectral stray light seem to introduce a negative bias, underestimating TotO3 compared to OMI. This effect is different in magnitude for each Pandora but tends to go into the same direction.

- To reduce systematic differences in the satellite validation we want to
  - include the retrieval of the effective O_3 temperature in the spectral fitting algorithm operationally (see *Cede* [2] for algorithm details).
  - include the correction of the instruments spectral response into the L1 processing.
  - include the spectral stray light correction in the L1 processing.

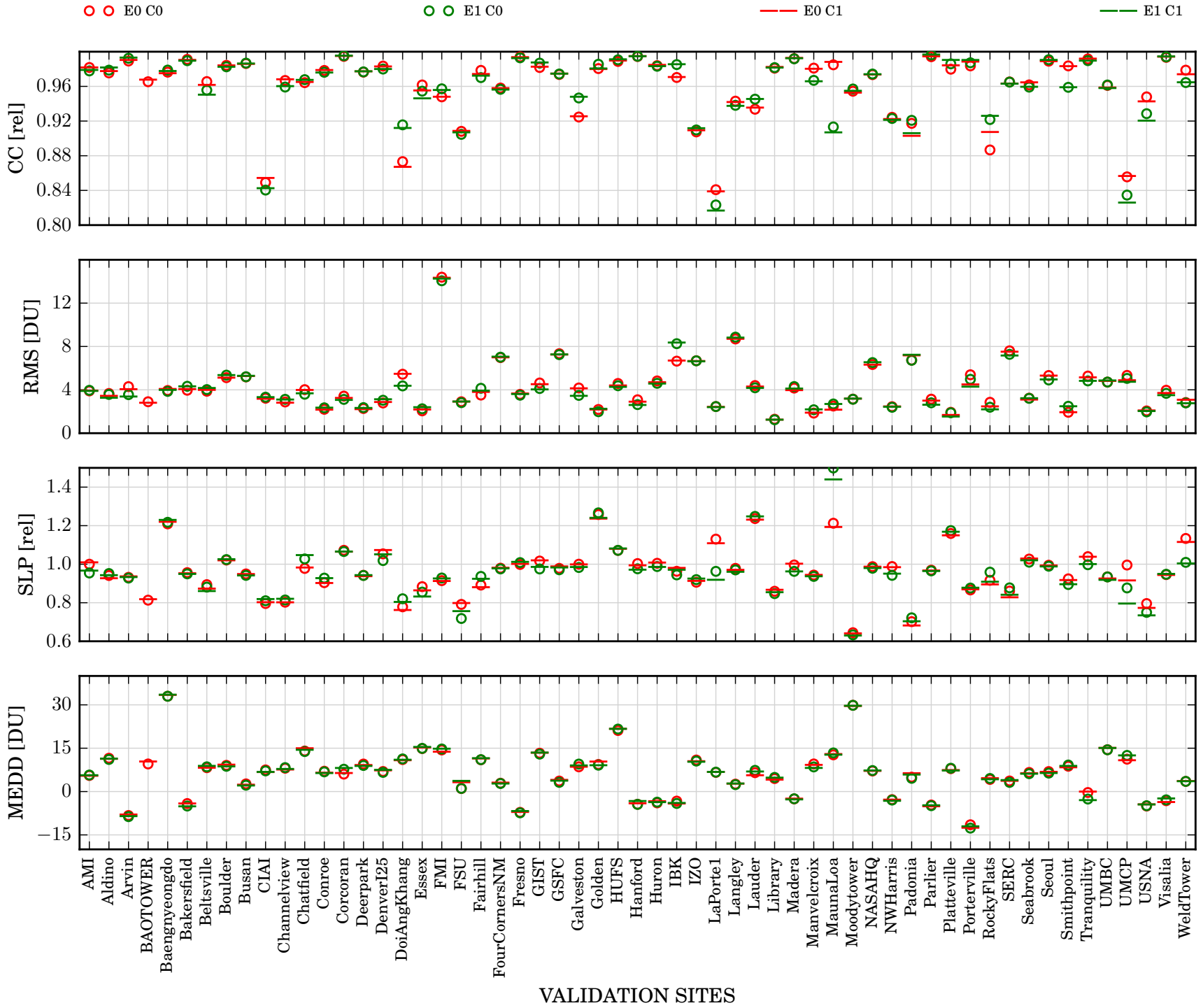


Figure 2: Validation results expressed by ValPars for all ValSites for all validation scenarios excluding GeoFilt. Applied (not applied) EffLoc is indicated by green (red) colors and applied (not applied) ClimCor is seen by bars (circles).

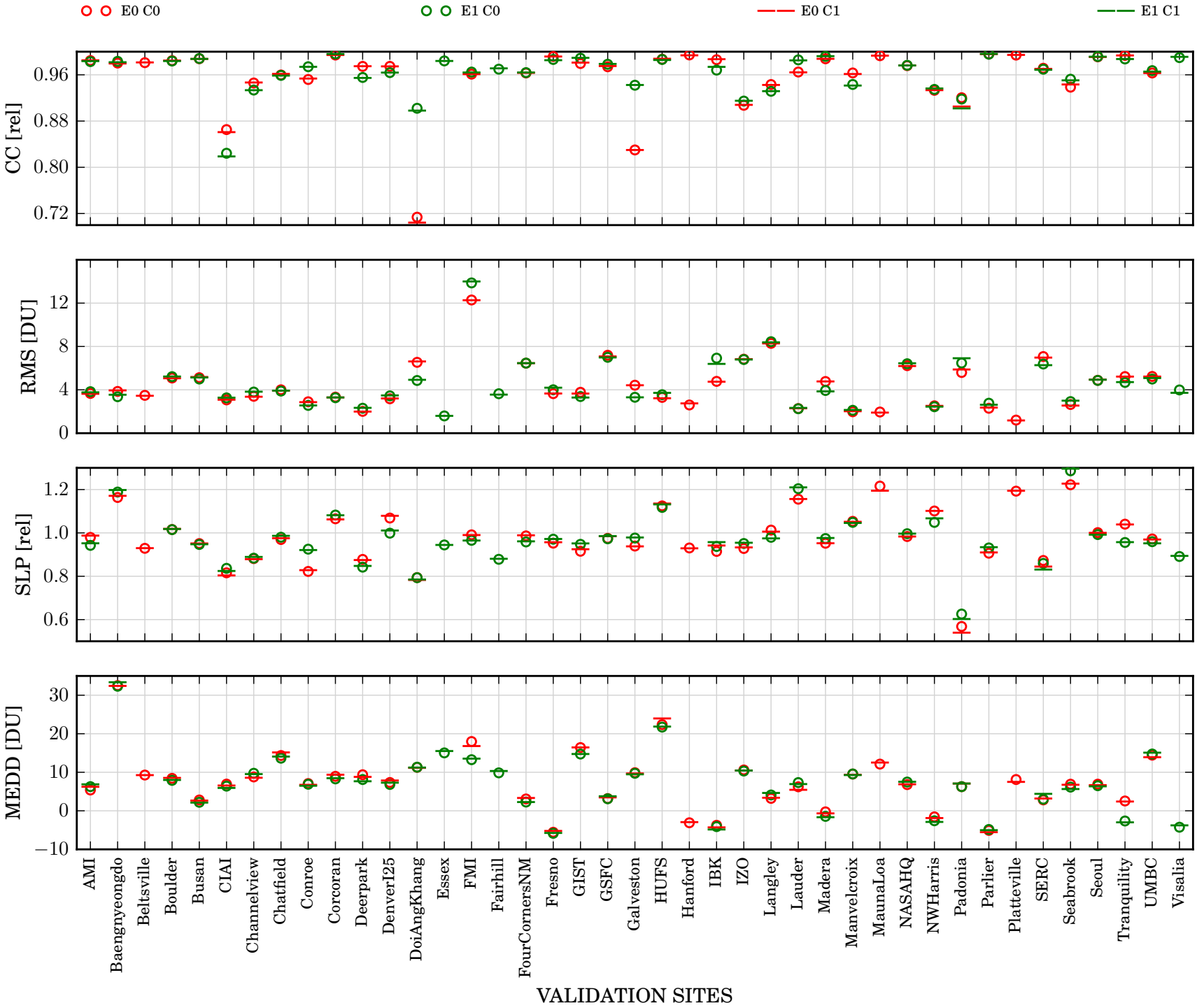


Figure 3: Similar to Figure 2 but including GeoFilt.

3 Validation Support

Satellite retrievals and ground-based direct sun data sample different air masses. This difference in the footprint poses a central difficulty in satellite validation. In this section we present two methods which may help to enhance the representativeness of both data sets.

3.1 Effective Validation Location

The SZA changes with the ValSite and the overpass time of the Aura satellite, which carries the OMI. In the morning hours for example, the direct-sun data from Pandora are measured at moderate to high SZA. We assume the effective absorption layer height of O_3 to be at 21.0 km, so the effective validation location is not the ground geolocation itself. Instead, the effective location on the Northern Hemisphere is shifted towards the South-East direction. This displacement can be taken into account in the validation by using the effective validation location instead of the geolocation. Off course, the unknown exact position of the effective gas height is an error source, but should be small for O_3.

3.2 Climatological Footprint Correction

If a ValSite is located within an area of significant O_3 gradients, the measured $TotO_3$ by OMI is different for each overpass, since the actual position of the footprint pixel varies for each overpass. For illustration lets assume a O_3 hot spot North-East of the ValSite. If the footprint pixel covers the ValSite only just with its bottom left (top right) corner the data would be biased high (low) compared to an average. We take this into account by compiling a significantly large number of overpass data to a high resolution climatological footprint map (with a grid resolution of 0.05°). Significant means to have good statistics for each subgrid pixel in the high resolution map. The ClimCor is finally carried out by subtracting the mean value of a footprint pixel in the high resolution map from the value in the high resolution map where the Pandora is located.

We decided to calculate high resolution climatological footprint maps for each year from 2009 to 2015 to be able to take into account potential drifts between the years. The value used for the footprint correction is utilized on a yearly basis which means that a weighted average between the considered high resolution maps is calculated. For example, if the footprint has been measured at March the 1st 2014, we take 25 % of the 2014 map and 75 % of the 2013 map, for July the 1st we take 100 % of the 2014 map, for October the 1st 2014 we take 25 % of the 2014 map and 75 % of 2015 map, and so on.

We are at the very beginning in utilizing this ClimCor method and therefore have not yet quantified the influence of changing the resolution and the time slices of the high resolution map. We are sure that the impact of this method could be further improved. For example, increasing the resolution (finer) and/or considering seasonal high resolution maps rather than yearly maps may be advantageous.

4 Data

The OMI overpass data are provided by the Aura Validation Data Center (AVDC) hosted by the National Aeronautics and Space Administration (NASA) and has been extracted by Michael M. Yan for each ValSite in Figure 4. The O_3 data product used for the validation is OMTO3 v8.5, Collection 3.

The extracted OMTO3 data set contains all overpass pixels where the center of the pixel does not exceed a radius of 100 km around each ValSite. The additional OMI pixels, although not directly overlapping the ValSite, are used to process the climatological footprint correction maps mentioned in the previous section.

The OMI dataset is validated against the entire direct-sun Pandora dataset, which has recently been extended and refined from version 001 [3] to version 002 [4]. The maximum time periods covered for each dataset are given in Table 3. Whereas OMI data are continues, Pandora data include a lot of campaign data and hence also include rather short time periods for some ValSites.

Data set	Version Number	Maximum time period	Data format
OMI	EOS Aura OMI OMTO3 v8.5, Collection 3	2009-01-01 to 2015-09-30	GEOMS H5
Pandora	v002	2009-01-01 to 2015-09-30	GEOMS H5

Table 3: Details on OMI and Pandora data sets.

Figure 4 shows a global map depicting all possible ValSites. ValSites are represented by an empty circle when the site has to be omitted due to lack of data after filtering. ValSites with a dotted circle are accepted ValSites and those showing a filled circle are accepted ValSites within the strongest filter criteria.

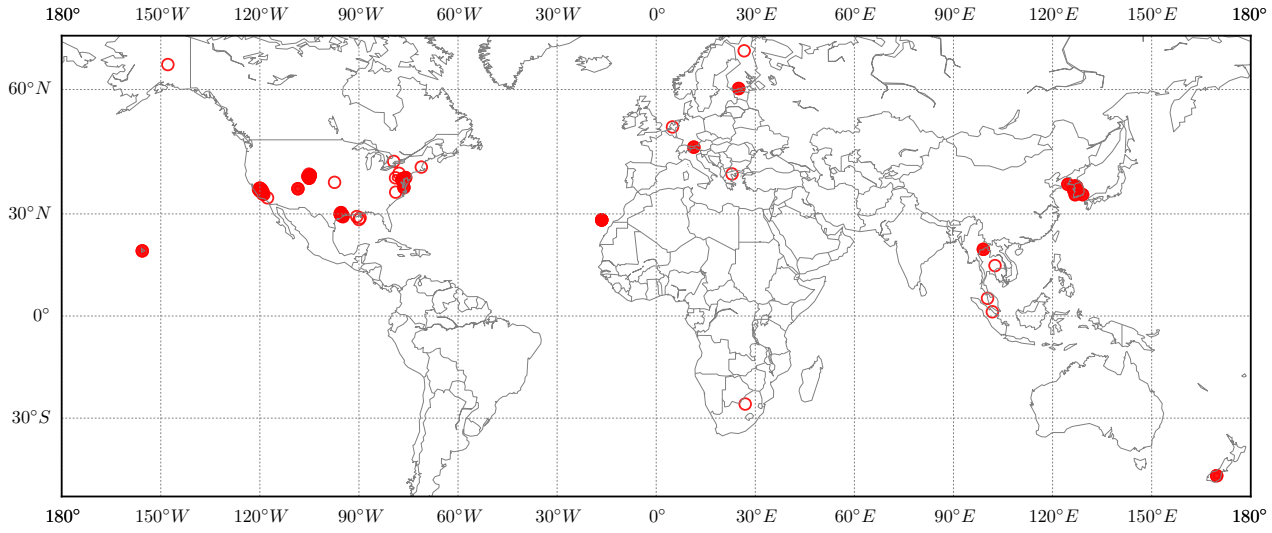


Figure 4: Validation locations. Explanation in the text.

4.1 Data Filtering

To ensure reliable data in the validation study proper data filtering has to be applied. For estimating the influence of a filter parameter threshold we carried out a simple sensitivity study. Pandora data filter parameters are not further tested, since we only accept data passing the strictest quality flag DQ0. This flagging procedure is explained in detail in *Tiefengraber and Müller* [4] and the values are summarized in Table 4. For Pandora, we only tested for the effect of averaging the Pandora data around the overpass time (PanAVG). PanAVG is given as PanAVG/2 $\pm$ before the OMI overpass time.

Parameter	Abbreviation	Threshold
Pandora (DQ0)		
$TotO_3$ uncertainty	PanUQ	1 DU
normalized rms of spectral fitting residual	PanWRMS	2.0×10^{-2}
wavelength shift	PanWVL	2.0×10^{-1} nm
direct sun air mass factor	PanAMF	5
enhanced data scatter	PanSCAT	1.0×10^{-2}

Table 4: Filter criteria applied for the Pandora quality flag DQ0.

For OMI data we selected two groups of filter parameters. From the first group (GeoFilts) we tested for the longitudinal (latitudinal) distance of the footprint center to the Pandora location (dLON (dLAT)) and the footprint size (SatFPT). Theses filters hence indirectly include a cross track position filtering. Beside that, as a quality filter, we tested for the cloud fraction (SatCF) assumed in the OMI pixel.

The sensitivity of the selection of the filter parameter thresholds is validated against the ValPars listed in Table 1. Since we are interested in the relative change of the test parameters when altering the filter parameter thresholds, we express the test parameters as relative changes with respect to an initial guess (dCC, dRMS, dSLP, dMEDD). The initial guesses are given in the third column in Table 5. The values are estimated from the know average OMI footprint geometry and experience from former studies.

The sensitivity test is carried out by varying only one of the filter parameter thresholds at the same time and leave the others at the initial guesses. We applied the sensitivity tests on four locations with long time series (even strong filter thresholds keep good statistics), but with different characteristics. Langley (Fairfax, Virginia, USA) as a location considered to be rural and with the longest Pandora time series available, Los Alamos (Four Corners, USA) as a second rural site but with high O_3 variability (nearby power plant), GSFC (Greenbelt, Maryland, USA) as an urban location and as the Pandora "headquarter" with the densest time series of Pandoras and finally Seoul (South Korea) due to its very high air pollution.

Figure is 5 showing the results of the sensitivity study for different ValSites in different colors. The mean over all ValSites is shown in black. The rows in the plot refer to the filter parameters and the columns to the ValPars. Each subplot is visualized in a way to show 4 quarters (divided by the vertical and horizontal bar in gray) to give an immediate information about the improvement or deterioration of a test parameter by varying a selected filter parameter threshold. Improvement means, that positive values for e.g. dCC mean higher CC and positive values for dMEDD mean lower MEDD, since it is preferable. Hence the upper (lower) left quarter means improvement (deterioration) by reducing the filter parameter threshold and the upper (lower) right quarter means improvement (deterioration) by enhancing the threshold. Please not the different scales for each subplot.

The geolocation filter parameters (dLAT, dLON, SatFPT) are especially dependent on the surroundings of the location. Hence different sensitivities can be seen for remote and urban ValSites. Having in mind the pixel shape of OMI the stronger sensitivity of dLAT than dLON is plausible. We select a dLAT threshold values of 0.08 deg, since below remote and urban locations are affected very differently. The selection of dLON and SatFPT thresholds have no clear tendency on the ValPars. We shift the initial guess for dLON of 0.3 deg to 0.2 deg and for SatFPT form 0.3 to 0.35 deg^2. The geolocation filters can only be applied to ValSites with long time series, since it strongly reduces the available number of footprints. Rather intuitively is the improvement of the ValPars with smaller SatCF thresholds. Again ValSites react differently. Urban ValSites benefit in particular when adjusting the initial value of 0.3 to 0.1. We decided to increase the PanAVG from 90 min to 120 min because dCC increases for remote sites and does not decrease for urban sites. The overall effect is rather small though.

The final selection of the filter parameter thresholds applied for this validation study are summarized in Table 5 in the fourth column. The asterisks highlight filter parameters which can only be applied to ValSites with long time series.

Sensitivity parameter	Abbreviation	Initial threshold	Best threshold
OMI geolocation filter (GeoFilt)			
lon. footprint center distance to Pandora *	dLON	0.3 °	0.2 °
lat. footprint center distance to Pandora *	dLAT	0.1 °	0.08 °
footprint area *	SatFPT	0.3 °x°	0.35 °x°
OMI quality filter			
cloud fraction	SatCF	0.3	0.1
Pandora data averaging time			
data averaging time	PanAVG	90 min	120 min

Table 5: Optimized filter parameter thresholds applied for TotO3 validation. The best guess thresholds are the conclusion from the sensitivity test.

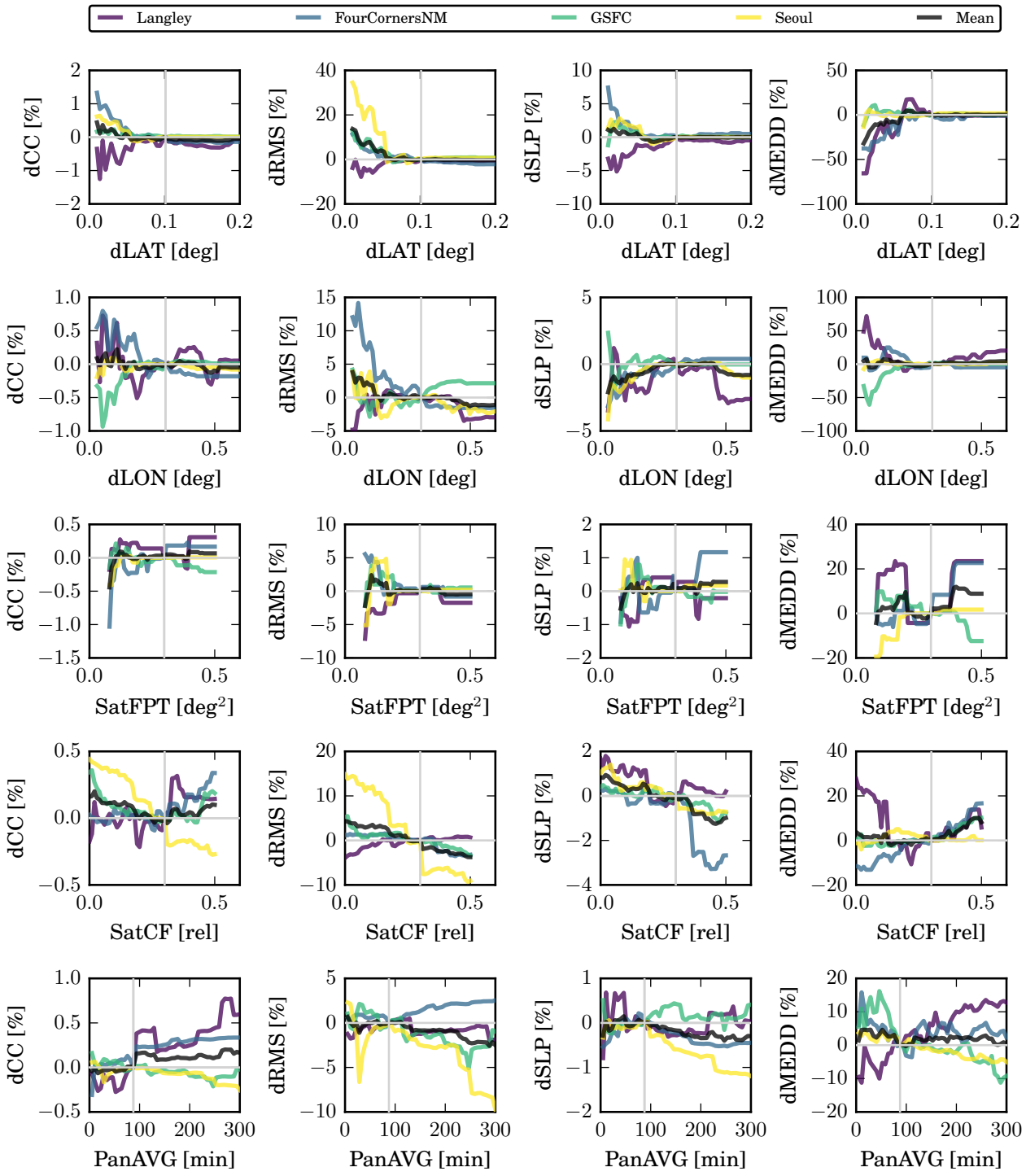


Figure 5: Filter parameter threshold sensitivity test for four validation locations: GSFC, Langley, FourCornersNM and Seoul. The four different test parameters dCC, dRMS, dSLP and dMEDD are constant for each column and the filter parameters (dLat, dLon, SatFPT, SatCF and PanAVG) are constant in each row.

4.2 Data Preparation and Validation Procedure

- OMI data preparation

1. ClimCor maps are produced and EffLocs are calculated.

2. A thinned out OMI dataset is compiled only containing pixels overlapping the geo -and/or effective Pandora location. This data set is given in the same format as the Pandora data and contains also information about ClimCor and EffLoc.
   → SV0 data.
3. Data quality filtering according to Table 5 and ClimCor is applied to the SV0 data.
   → SV1 data.

- Pandora data preparation

4. Temporally overlapping Pandoras are identified and combined for each footprint in SV1. By this noise and potential systematic errors of one Pandora can be reduced.
   → PV0 data.
5. Data quality filtering according to Table 5 and EffLoc correction is applied to PV0.
   → PV1 data.

- Validation procedure

6. PV1 data points are averaged around SV1 footprint measurement times. The averaging time is PanAVG from Table 4.
   → PV2 data.
7. SV1 is validated against PV2 for the desired scenario (introduced in section 2.1). If less than 10 data points are available the ValSite is not considered. Scatter plots are generated and statistics are calculated.

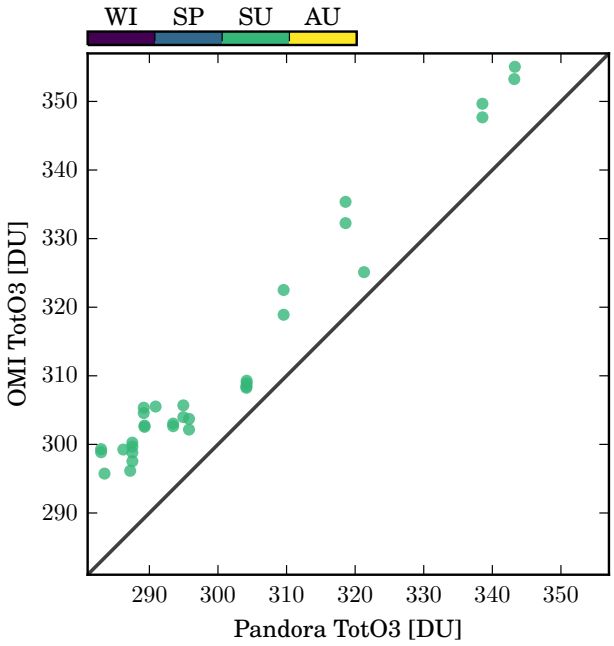
5 Individual Validation Results

In the following pages we present scatter plots and statistics for each ValSite for TotO3 validation based on scenario E1 C0 G0 and E1 C0 G1 (marked with an asterisk). The statistics are described in Table 6. The scatter plots are color coded to highlight data points which are collected in different seasons: purple for winter, blue for spring, green for summer and yellow for autumn.

Short Description	**Long Description**
longitude, latitude	ground geolocation of the Pandora unit (not its effective location)
num data points	number of data points passing the filter criteria
max Pan. (Pans.)	maximum number of Pandora units involved (Pandora ID(s) operating at this location)
CC	correlation coefficient between OMI and Pandora TotO3
RMS	root mean squre error to a linear fit in Pandora minus OMI
SLP	slope term in the linear fit including OMI uncertainty (Pandora uncertainty is omitted due to the large number of points)
mean	arithmetic mean of the difference OMI minus Pandora
MEDD	median value for OMI minus Pandora difference
25-75 percentile range	25 to 75 percentile range for OMI minus Pandora difference
10-90 percentile range	10 to 90 percentile range for OMI minus Pandora difference
min-max range	minimum value to maximum value range for OMI minus Pandora difference
OMI CF	percentage of OMI data passing the OMI CF filter
Pandora DQ0	percentage of Pandora data passing the DQ0 filter

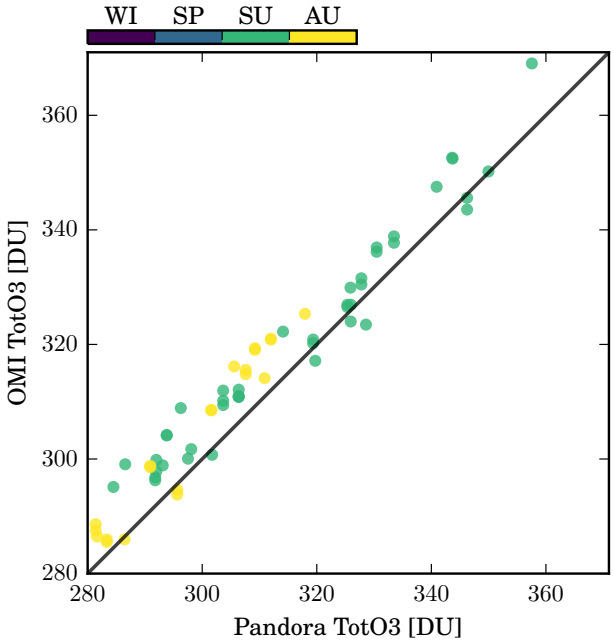
Table 6: Description on the additional information and statistics given for each ValSite.

Aldino



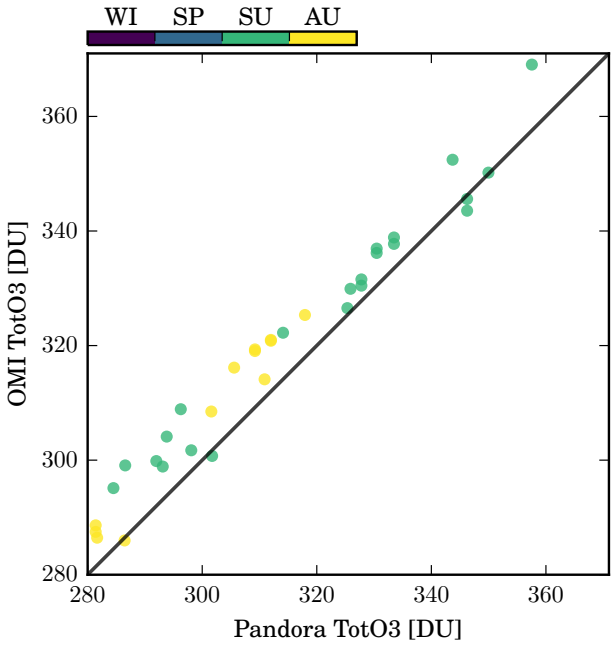
longitude, latitude	-76.203889, 39.563333
num data points	33
max Pan. (Pans.)	1 (23)
CC	0.98
RMS	3.58 DU
SLP	0.95 ± 0.04
mean	10.76 DU
MEDD	11.10 DU
25-75 percentile range	9.02 DU to 13.27 DU
10-90 percentile range	4.79 DU to 15.80 DU
min-max range	3.82 DU to 16.76 DU
OMI CF	50.75 %
Pandora DQ0	61.08 %

AMI



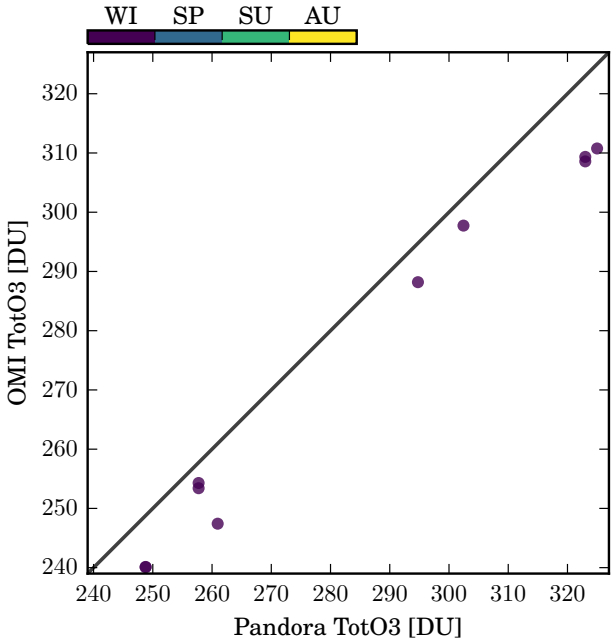
longitude, latitude	126.33, 36.538
num data points	64
max Pan. (Pans.)	1 (21)
CC	0.98
RMS	3.96 DU
SLP	0.95 ± 0.03
mean	5.05 DU
MEDD	5.72 DU
25-75 percentile range	2.45 DU to 7.91 DU
10-90 percentile range	-0.89 DU to 10.25 DU
min-max range	-5.13 DU to 12.63 DU
OMI CF	40.19 %
Pandora DQ0	26.62 %

AMI*



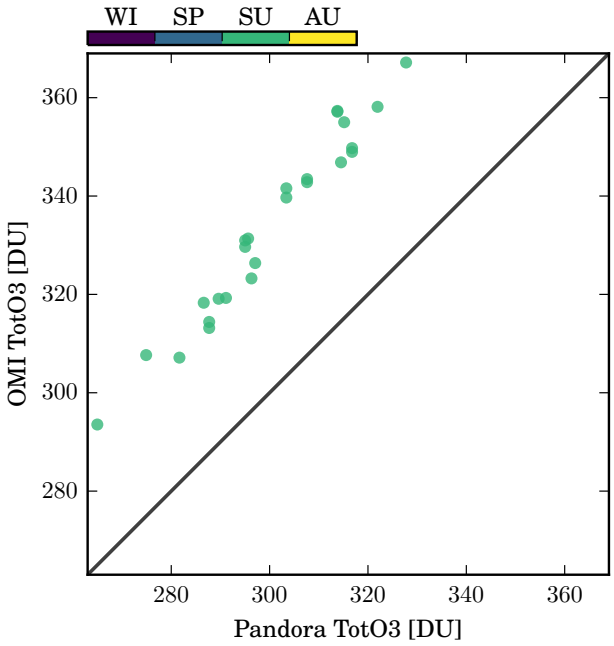
longitude, latitude	126.33, 36.538
num data points	34
max Pan. (Pans.)	1 (21)
CC	0.98
RMS	3.83 DU
SLP	0.94 ± 0.03
mean	6.02 DU
MEDD	6.28 DU
25-75 percentile range	3.66 DU to 8.96 DU
10-90 percentile range	-0.26 DU to 10.61 DU
min-max range	-2.70 DU to 12.63 DU
OMI CF	40.19 %
Pandora DQ0	26.62 %

Arvin



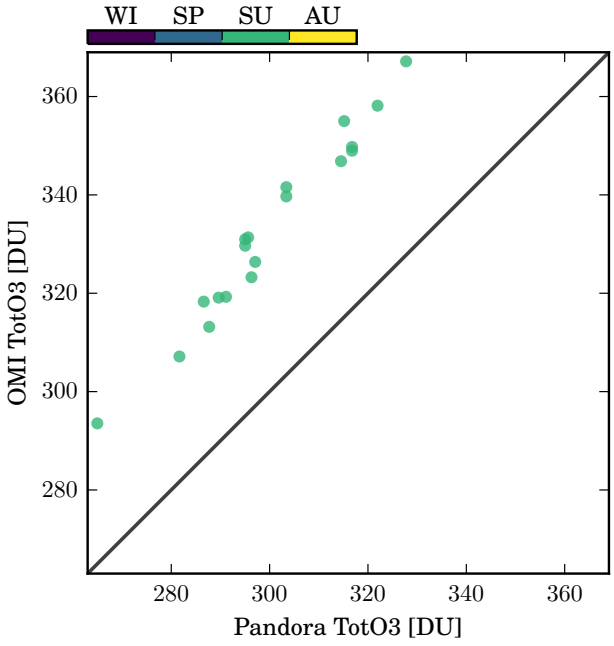
longitude, latitude	-118.7887, 35.291
num data points	10
max Pan. (Pans.)	1 (35)
CC	0.99
RMS	3.56 DU
SLP	0.93 ± 0.04
mean	-9.23 DU
MEDD	-8.69 DU
25-75 percentile range	-13.63 DU to -5.17 DU
10-90 percentile range	-14.26 DU to -4.23 DU
min-max range	-14.43 DU to -3.44 DU
OMI CF	55.65 %
Pandora DQ0	27.57 %

Baengnyeongdo



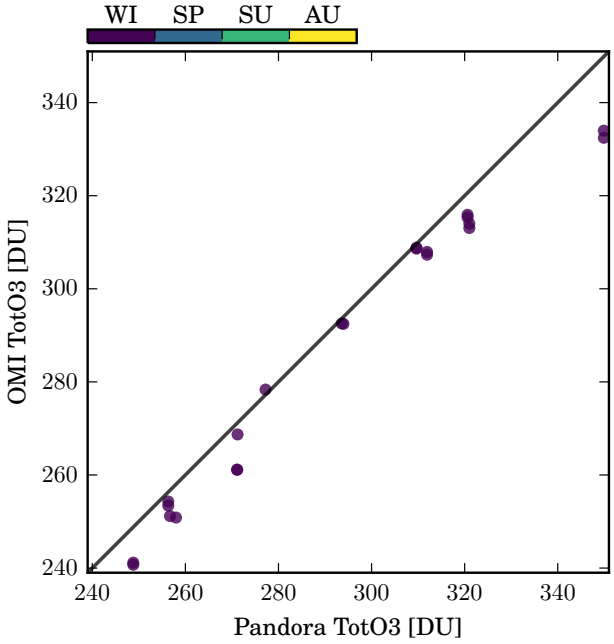
longitude, latitude	124.631, 37.965
num data points	25
max Pan. (Pans.)	1 (35)
CC	0.98
SLP	1.22 ± 0.05
OFFS	-31.85 DU ± 15.97 DU
RMS	3.86 DU
mean	33.45 DU
MEDD	32.97 DU
25-75 percentile range	29.30 DU to 36.19 DU
10-90 percentile range	26.79 DU to 39.67 DU
min-max range	25.45 DU to 43.52 DU
OMI CF	44.26 %
Pandora DQ0	19.24 %

Baengnyeongdo*



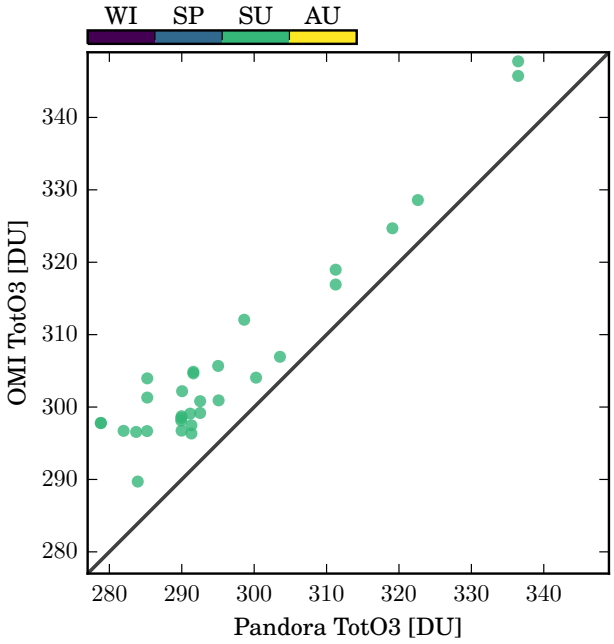
longitude, latitude	124.631, 37.965
num data points	19
max Pan. (Pans.)	1 (35)
CC	0.98
RMS	3.37 DU
SLP	1.19 ± 0.05
mean	32.57 DU
MEDD	32.33 DU
25-75 percentile range	28.94 DU to 36.07 DU
10-90 percentile range	26.64 DU to 38.41 DU
min-max range	25.45 DU to 39.85 DU
OMI CF	44.26 %
Pandora DQ0	19.24 %

Bakersfield



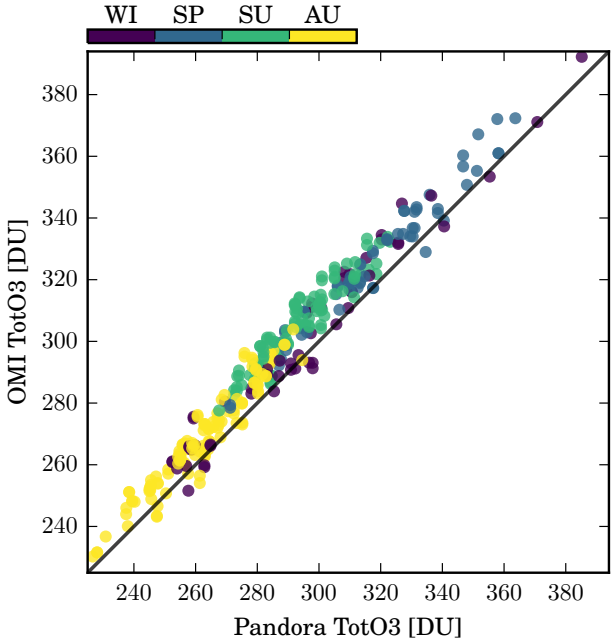
longitude, latitude	-118.9976, 35.3246
num data points	22
max Pan. (Pans.)	2 (33, 36)
CC	0.99
RMS	4.33 DU
SLP	0.95 ± 0.03
mean	-5.73 DU
MEDD	-5.01 DU
25-75 percentile range	-7.87 DU to -2.15 DU
10-90 percentile range	-10.00 DU to -1.03 DU
min-max range	-17.46 DU to 1.13 DU
OMI CF	48.89 %
Pandora DQ0	49.04 %

Beltsville



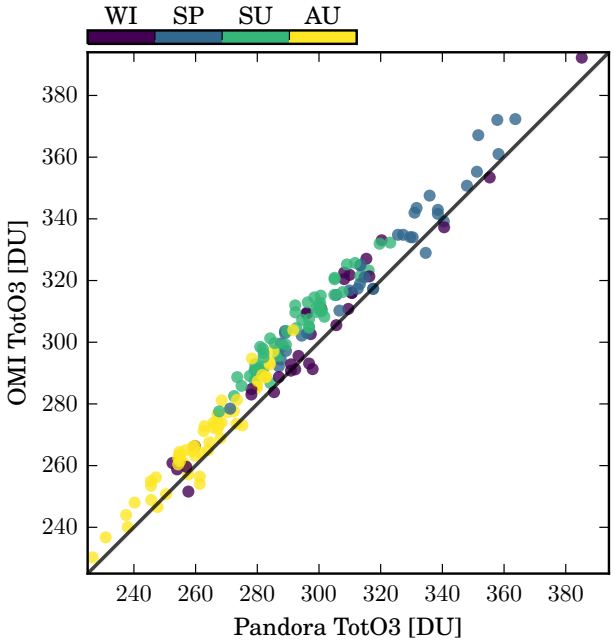
longitude, latitude	-76.878333, 39.055277
num data points	31
max Pan. (Pans.)	1 (20)
CC	0.96
RMS	4.02 DU
SLP	0.88 ± 0.05
mean	9.84 DU
MEDD	8.55 DU
25-75 percentile range	6.07 DU to 12.96 DU
10-90 percentile range	5.60 DU to 16.08 DU
min-max range	3.38 DU to 18.99 DU
OMI CF	54.84 %
Pandora DQ0	70.56 %

Boulder



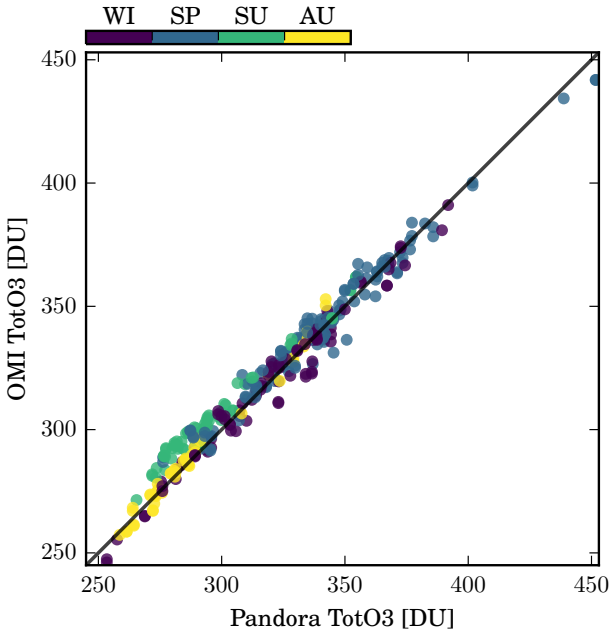
longitude, latitude	-105.26067, 39.99093
num data points	346
max Pan. (Pans.)	1 (34)
CC	0.98
RMS	5.36 DU
SLP	1.02 ± 0.01
mean	8.49 DU
MEDD	8.74 DU
25-75 percentile range	5.37 DU to 11.91 DU
10-90 percentile range	1.49 DU to 15.38 DU
min-max range	-7.29 DU to 20.60 DU
OMI CF	34.41 %
Pandora DQ0	48.08 %

Boulder*



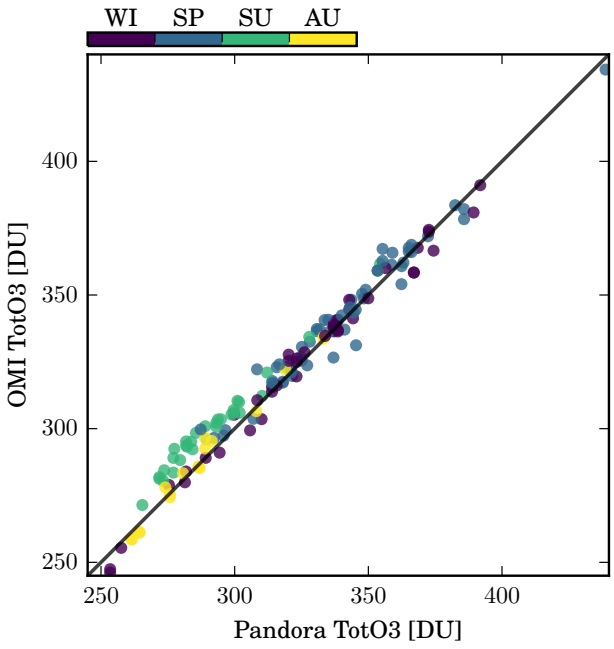
longitude, latitude	-105.26067, 39.99093
num data points	181
max Pan. (Pans.)	1 (34)
CC	0.98
RMS	5.21 DU
SLP	1.02 ± 0.01
mean	7.58 DU
MEDD	7.90 DU
25-75 percentile range	4.84 DU to 11.58 DU
10-90 percentile range	0.25 DU to 14.14 DU
min-max range	-7.29 DU to 19.67 DU
OMI CF	34.41 %
Pandora DQ0	48.08 %

Busan



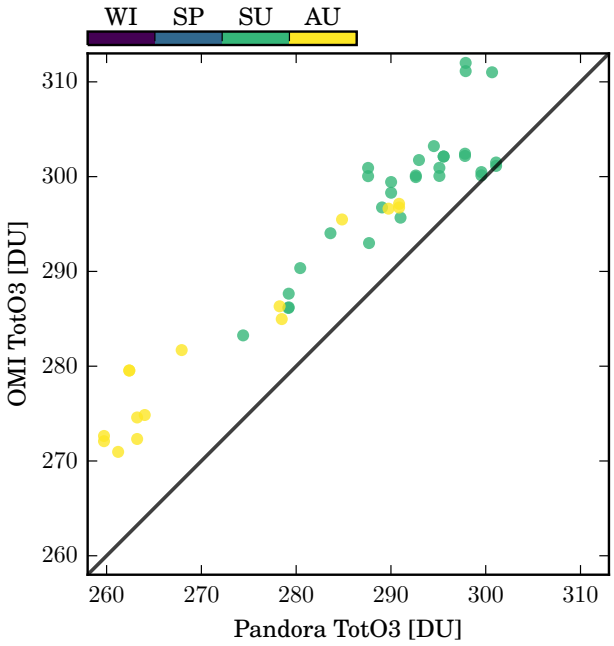
longitude, latitude	129.0825, 35.2353
num data points	351
max Pan. (Pans.)	2 (20, 36)
CC	0.99
RMS	5.21 DU
SLP	0.94 ± 0.01
mean	2.23 DU
MEDD	2.20 DU
25-75 percentile range	-0.84 DU to 5.87 DU
10-90 percentile range	-4.20 DU to 9.12 DU
min-max range	-14.29 DU to 15.06 DU
OMI CF	44.60 %
Pandora DQ0	44.18 %

Busan*



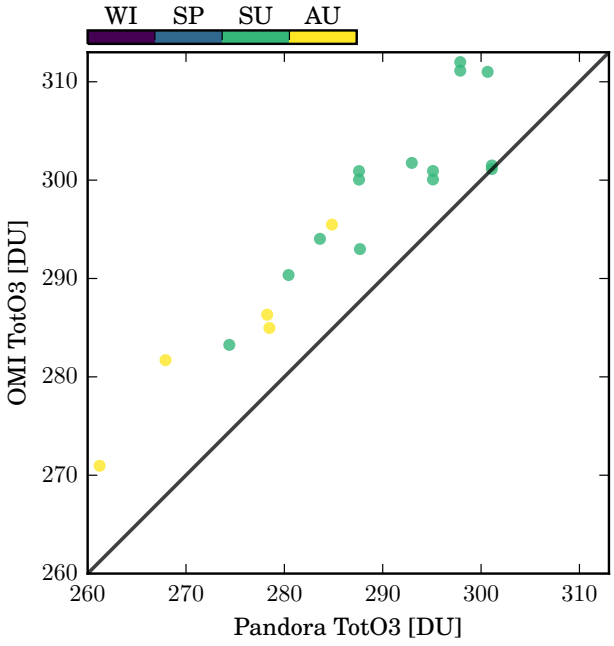
longitude, latitude	129.0825, 35.2353
num data points	154
max Pan. (Pans.)	2 (20, 36)
CC	0.99
RMS	5.00 DU
SLP	0.95 ± 0.01
mean	2.40 DU
MEDD	2.21 DU
25-75 percentile range	-0.80 DU to 6.30 DU
10-90 percentile range	-3.55 DU to 9.27 DU
min-max range	-14.19 DU to 15.06 DU
OMI CF	44.60 %
Pandora DQ0	44.18 %

Channelview



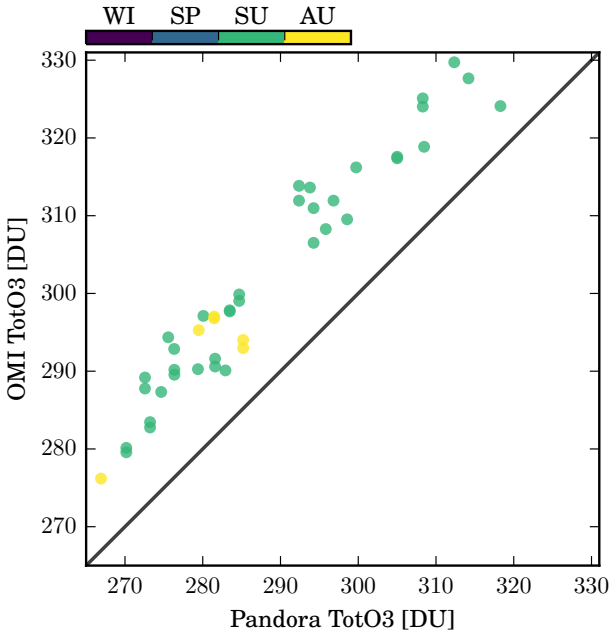
longitude, latitude	-95.1255, 29.8025
num data points	45
max Pan. (Pans.)	1 (26)
CC	0.96
RMS	3.12 DU
SLP	0.81 ± 0.04
mean	8.36 DU
MEDD	8.28 DU
25-75 percentile range	6.27 DU to 10.64 DU
10-90 percentile range	4.46 DU to 13.30 DU
min-max range	0.04 DU to 17.16 DU
OMI CF	52.27 %
Pandora DQ0	53.12 %

Channelview*



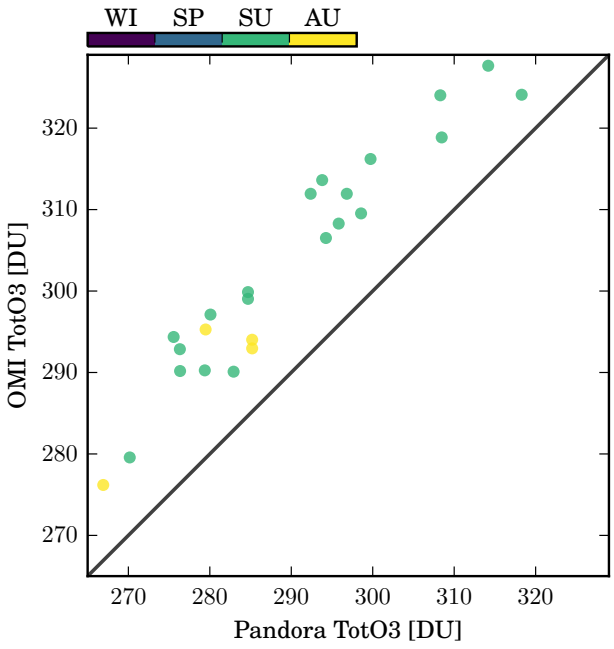
longitude, latitude	-95.1255, 29.8025
num data points	19
max Pan. (Pans.)	1 (26)
CC	0.93
RMS	3.80 DU
SLP	0.88 ± 0.08
mean	8.77 DU
MEDD	9.74 DU
25-75 percentile range	6.16 DU to 11.55 DU
10-90 percentile range	4.05 DU to 13.42 DU
min-max range	0.04 DU to 14.12 DU
OMI CF	52.27 %
Pandora DQ0	53.12 %

Chatfield



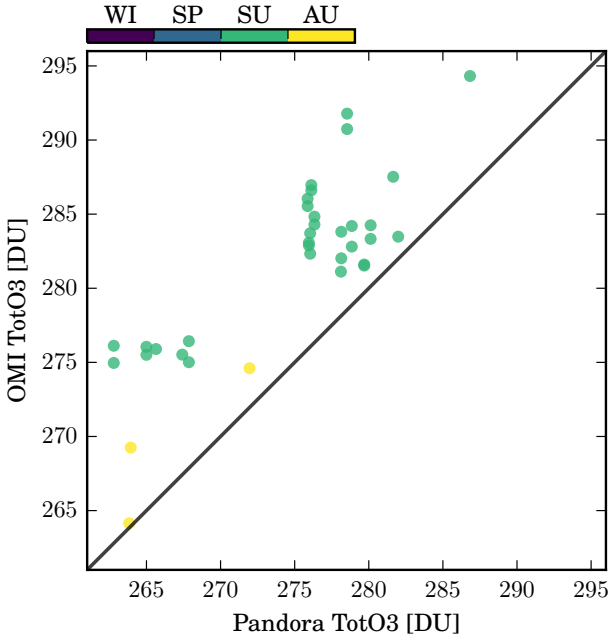
longitude, latitude	-105.07, 39.53
num data points	43
max Pan. (Pans.)	1 (26)
CC	0.97
RMS	3.59 DU
SLP	1.03 ± 0.04
mean	13.49 DU
MEDD	13.83 DU
25-75 percentile range	10.31 DU to 16.14 DU
10-90 percentile range	9.07 DU to 17.31 DU
min-max range	5.81 DU to 21.46 DU
OMI CF	34.56 %
Pandora DQ0	49.65 %

Chatfield*



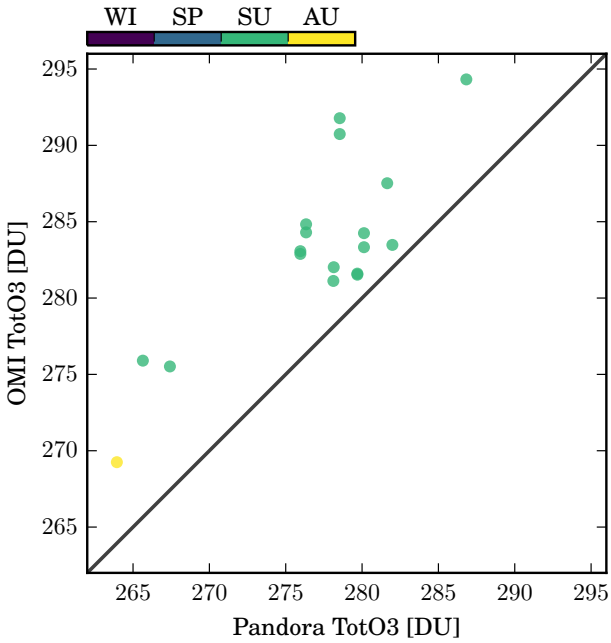
longitude, latitude	-105.07, 39.53
num data points	24
max Pan. (Pans.)	1 (26)
CC	0.96
RMS	3.89 DU
SLP	0.98 ± 0.06
mean	13.21 DU
MEDD	13.66 DU
25-75 percentile range	10.14 DU to 15.97 DU
10-90 percentile range	8.08 DU to 18.27 DU
min-max range	5.81 DU to 19.83 DU
OMI CF	34.56 %
Pandora DQ0	49.65 %

CIAI



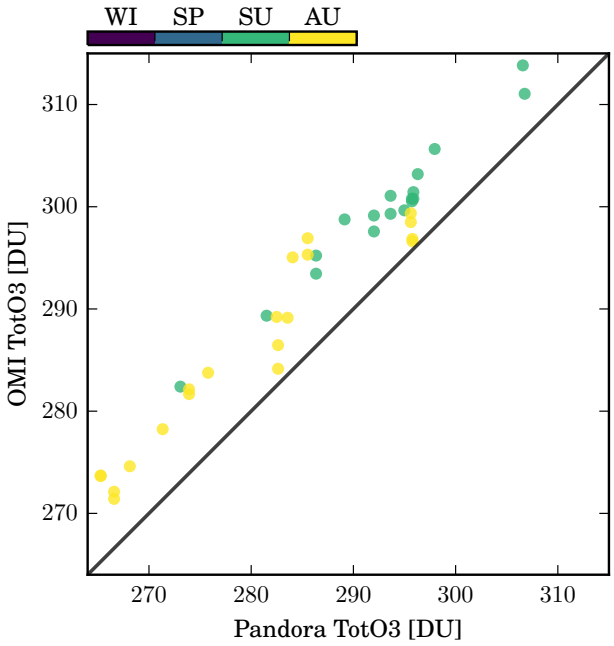
longitude, latitude	-16.4994, 28.309
num data points	35
max Pan. (Pans.)	1 (101)
CC	0.84
RMS	3.32 DU
SLP	0.81 ± 0.09
mean	7.09 DU
MEDD	7.15 DU
25-75 percentile range	4.04 DU to 10.21 DU
10-90 percentile range	2.20 DU to 11.72 DU
min-max range	0.30 DU to 13.32 DU
OMI CF	54.90 %
Pandora DQ0	71.26 %

CIAI*



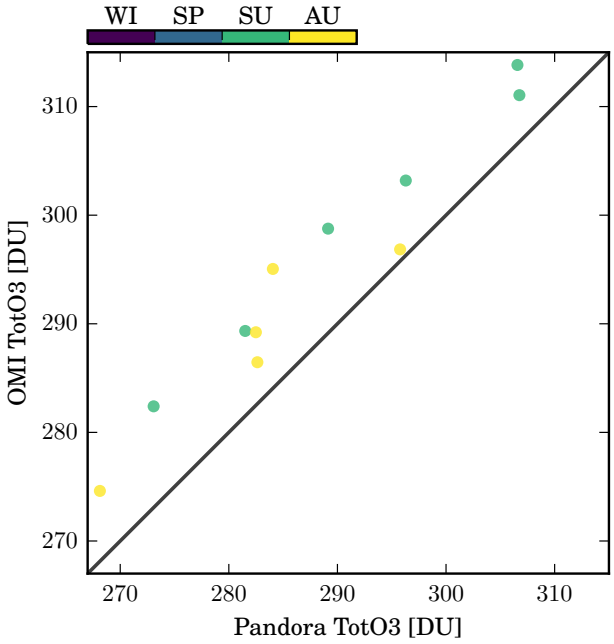
longitude, latitude	-16.4994, 28.309
num data points	18
max Pan. (Pans.)	1 (101)
CC	0.82
RMS	3.26 DU
SLP	0.84 ± 0.14
mean	6.25 DU
MEDD	6.40 DU
25-75 percentile range	3.37 DU to 8.07 DU
10-90 percentile range	1.89 DU to 10.84 DU
min-max range	1.49 DU to 13.24 DU
OMI CF	54.90 %
Pandora DQ0	71.26 %

Conroe



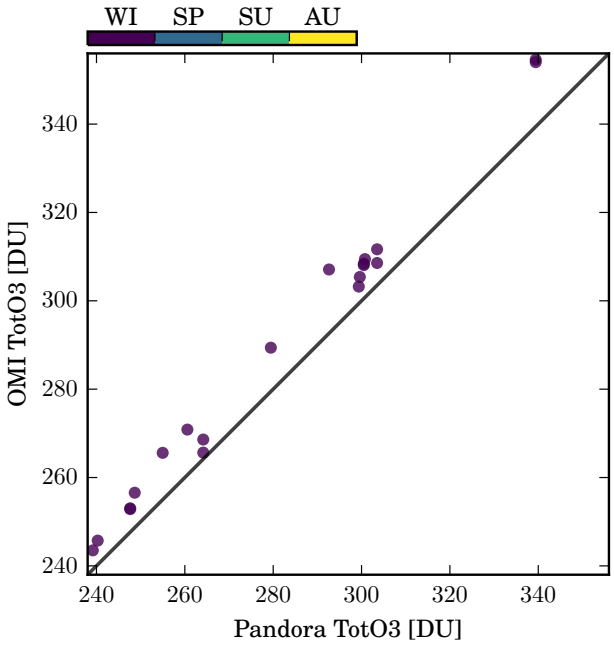
longitude, latitude	-95.425, 30.350
num data points	38
max Pan. (Pans.)	1 (31)
CC	0.98
RMS	2.34 DU
SLP	0.93 ± 0.03
mean	6.38 DU
MEDD	6.81 DU
25-75 percentile range	4.85 DU to 7.94 DU
10-90 percentile range	3.49 DU to 9.41 DU
min-max range	0.85 DU to 11.39 DU
OMI CF	47.87 %
Pandora DQ0	50.16 %

Conroe*



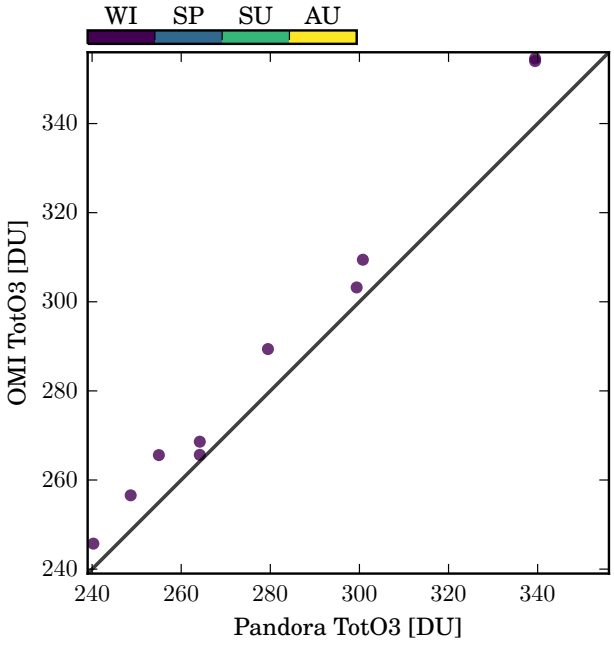
longitude, latitude	-95.425, 30.350
num data points	11
max Pan. (Pans.)	1 (31)
CC	0.97
RMS	2.56 DU
SLP	0.92 ± 0.07
mean	6.76 DU
MEDD	6.90 DU
25-75 percentile range	5.39 DU to 8.58 DU
10-90 percentile range	3.83 DU to 9.62 DU
min-max range	1.08 DU to 10.99 DU
OMI CF	47.87 %
Pandora DQ0	50.16 %

Corcoran



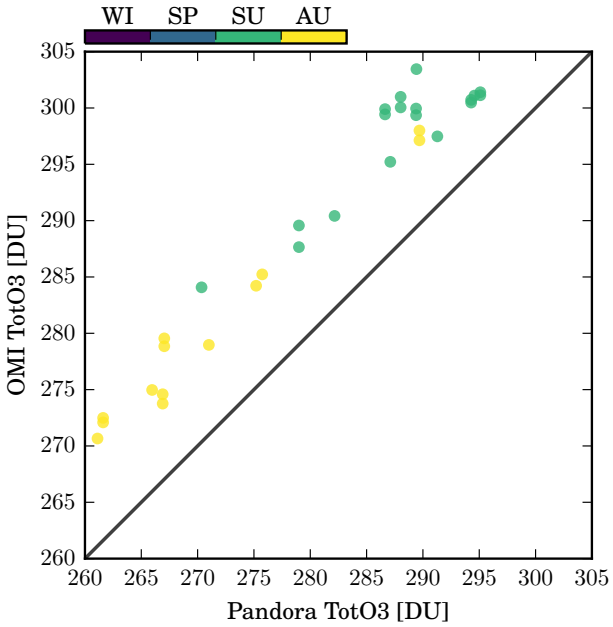
longitude, latitude	-119.5656, 36.1022
num data points	20
max Pan. (Pans.)	1 (34)
CC	1.00
RMS	3.12 DU
SLP	1.07 $\pm$ 0.02
mean	7.81 DU
MEDD	7.73 DU
25-75 percentile range	5.17 DU to 10.01 DU
10-90 percentile range	4.29 DU to 14.47 DU
min-max range	1.47 DU to 15.17 DU
OMI CF	58.54 %
Pandora DQ0	57.48 %

Corcoran*



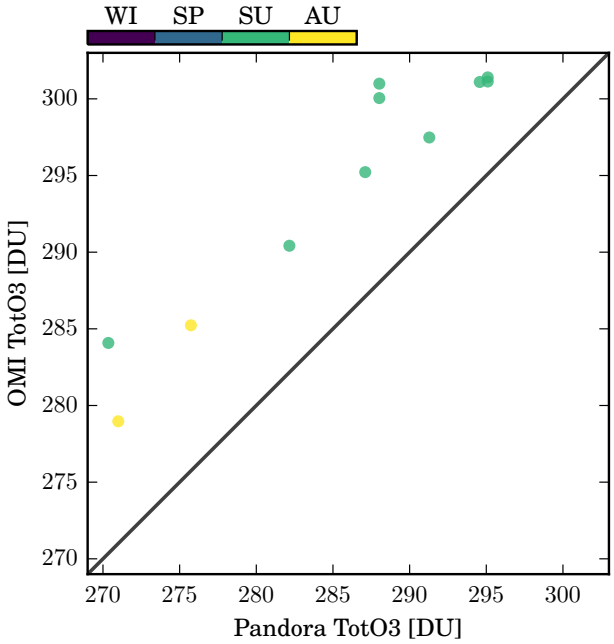
longitude, latitude	-119.5656, 36.1022
num data points	10
max Pan. (Pans.)	1 (34)
CC	1.00
RMS	3.27 DU
SLP	1.08 $\pm$ 0.03
mean	8.20 DU
MEDD	8.28 DU
25-75 percentile range	4.68 DU to 10.43 DU
10-90 percentile range	3.61 DU to 14.65 DU
min-max range	1.47 DU to 15.17 DU
OMI CF	58.54 %
Pandora DQ0	57.48 %

Deerpark



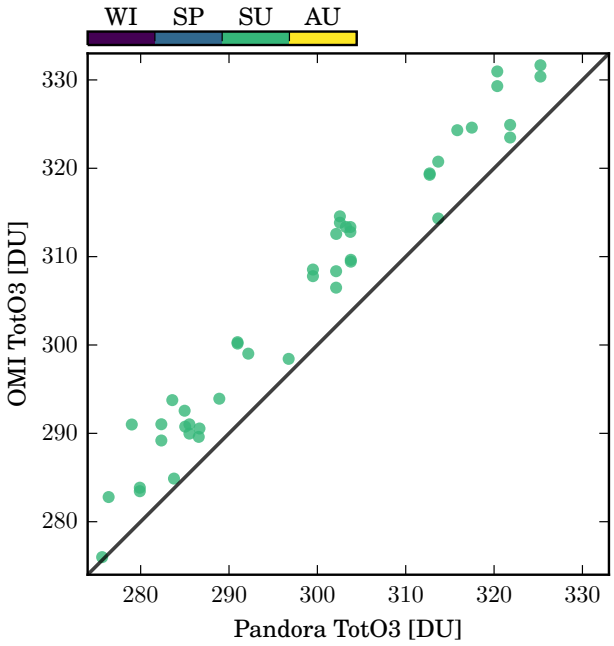
longitude, latitude	-95.1283, 29.6700
num data points	31
max Pan. (Pans.)	1 (32)
CC	0.98
RMS	2.36 DU
SLP	0.94 ± 0.04
mean	9.47 DU
MEDD	9.03 DU
25-75 percentile range	7.56 DU to 11.34 DU
10-90 percentile range	6.30 DU to 12.97 DU
min-max range	6.03 DU to 14.03 DU
OMI CF	40.00 %
Pandora DQ0	44.32 %

Deerpark*



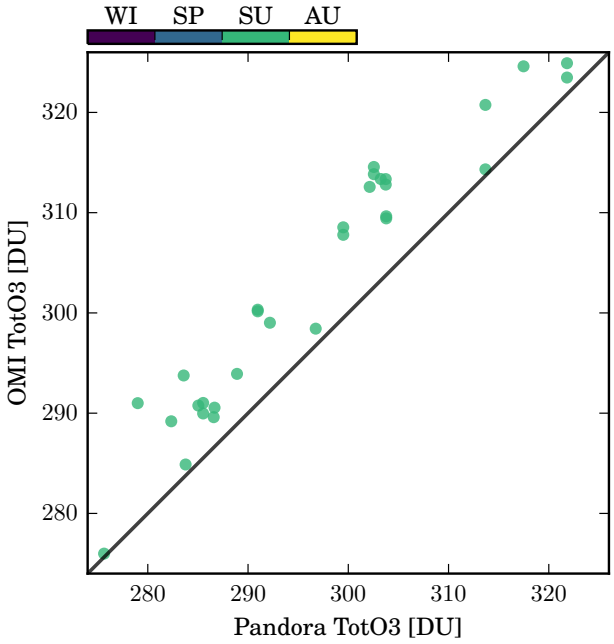
longitude, latitude	-95.1283, 29.6700
num data points	11
max Pan. (Pans.)	1 (32)
CC	0.96
RMS	2.30 DU
SLP	0.84 ± 0.09
mean	8.88 DU
MEDD	8.12 DU
25-75 percentile range	6.42 DU to 10.76 DU
10-90 percentile range	6.20 DU to 12.97 DU
min-max range	6.03 DU to 13.73 DU
OMI CF	40.00 %
Pandora DQ0	44.32 %

DenverI25



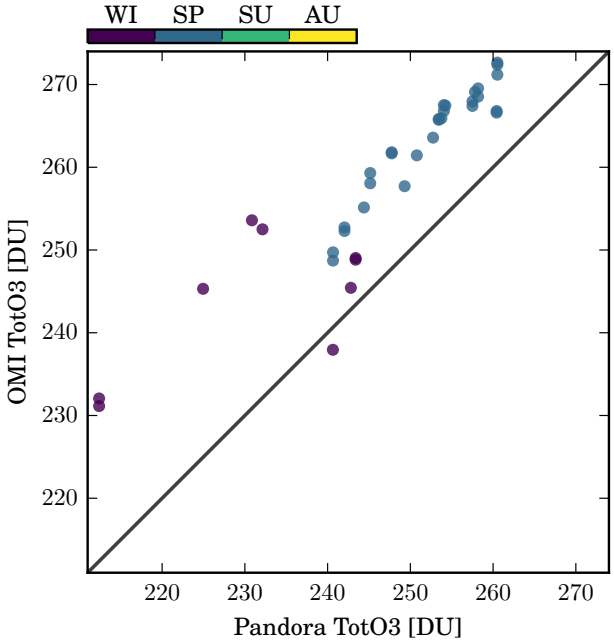
longitude, latitude	-105.015, 39.732
num data points	44
max Pan. (Pans.)	1 (27)
CC	0.98
RMS	3.04 DU
SLP	1.02 ± 0.03
mean	6.58 DU
MEDD	6.63 DU
25-75 percentile range	4.43 DU to 9.05 DU
10-90 percentile range	2.08 DU to 10.36 DU
min-max range	0.35 DU to 12.01 DU
OMI CF	40.48 %
Pandora DQ0	43.27 %

DenverI25*



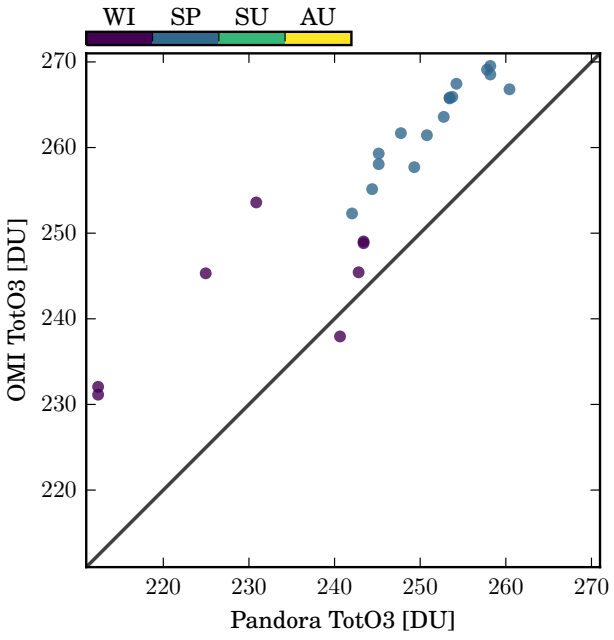
longitude, latitude	-105.015, 39.732
num data points	30
max Pan. (Pans.)	1 (27)
CC	0.96
RMS	3.44 DU
SLP	1.00 ± 0.05
mean	6.54 DU
MEDD	6.84 DU
25-75 percentile range	4.03 DU to 9.31 DU
10-90 percentile range	1.61 DU to 10.52 DU
min-max range	0.35 DU to 12.01 DU
OMI CF	40.48 %
Pandora DQ0	43.27 %

DoiAngKhang



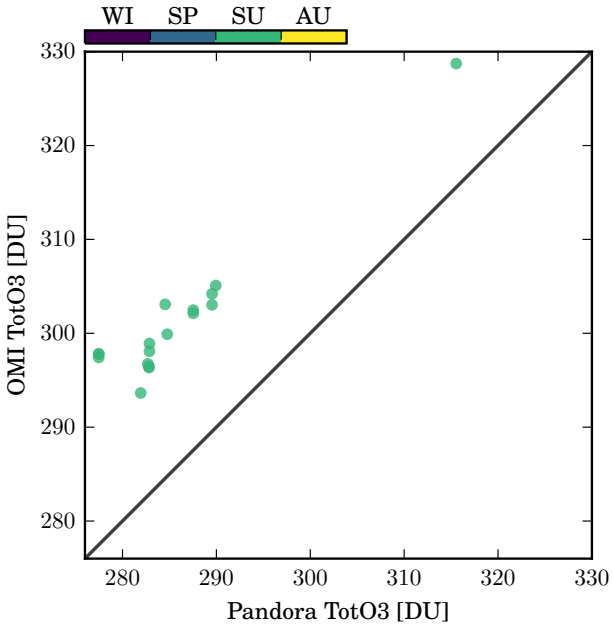
longitude, latitude	99.04526, 19.9332
num data points	37
max Pan. (Pans.)	2 (16, 42)
CC	0.92
RMS	4.36 DU
SLP	0.82 ± 0.06
mean	11.45 DU
MEDD	11.30 DU
25-75 percentile range	9.91 DU to 13.22 DU
10-90 percentile range	5.96 DU to 19.12 DU
min-max range	-2.70 DU to 22.74 DU
OMI CF	36.46 %
Pandora DQ0	47.22 %

DoiAngKhang*



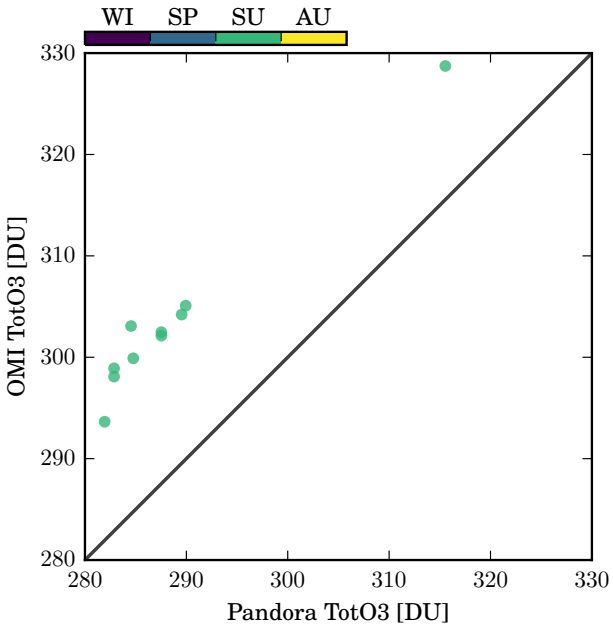
longitude, latitude	99.04526, 19.9332
num data points	24
max Pan. (Pans.)	2 (16, 42)
CC	0.90
RMS	4.86 DU
SLP	0.79 ± 0.08
mean	11.41 DU
MEDD	11.32 DU
25-75 percentile range	9.80 DU to 13.40 DU
10-90 percentile range	5.50 DU to 19.40 DU
min-max range	-2.70 DU to 22.74 DU
OMI CF	36.46 %
Pandora DQ0	47.22 %

Essex



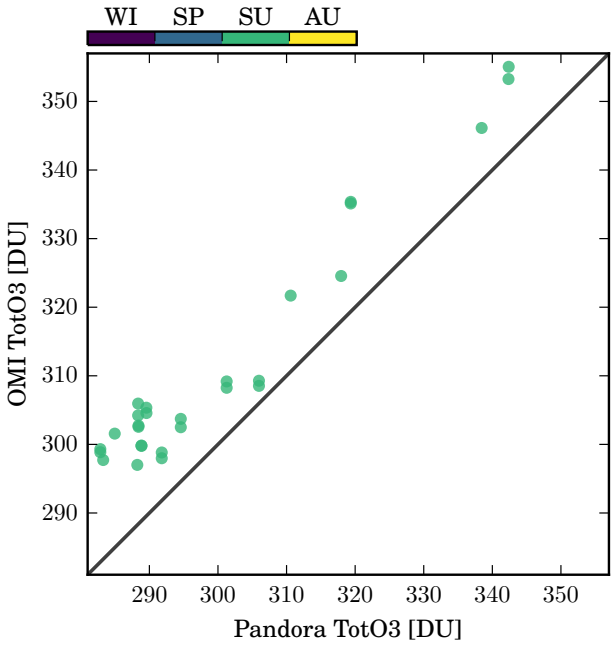
longitude, latitude	-76.474444, 39.310833
num data points	17
max Pan. (Pans.)	1 (19)
CC	0.95
RMS	2.25 DU
SLP	0.86 ± 0.07
mean	15.56 DU
MEDD	14.93 DU
25-75 percentile range	13.64 DU to 16.04 DU
10-90 percentile range	13.37 DU to 20.10 DU
min-max range	11.70 DU to 20.34 DU
OMI CF	48.39 %
Pandora DQ0	54.50 %

Essex*



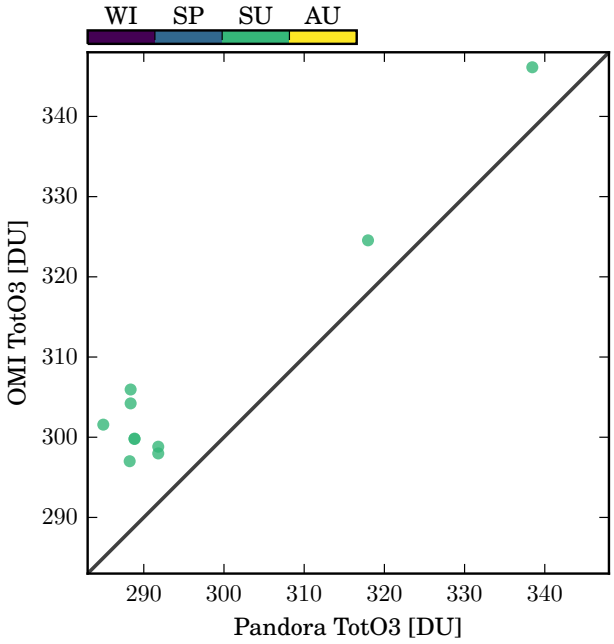
longitude, latitude	-76.474444, 39.310833
num data points	10
max Pan. (Pans.)	1 (19)
CC	0.98
RMS	1.59 DU
SLP	0.94 ± 0.06
mean	14.92 DU
MEDD	15.03 DU
25-75 percentile range	14.61 DU to 15.20 DU
10-90 percentile range	13.04 DU to 16.29 DU
min-max range	11.70 DU to 18.53 DU
OMI CF	48.39 %
Pandora DQ0	54.50 %

Fairhill



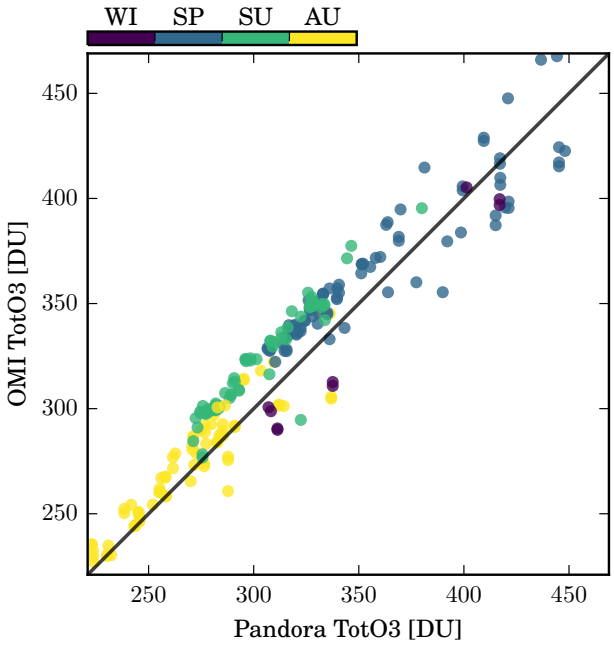
longitude, latitude	-75.868, 39.701111
num data points	28
max Pan. (Pans.)	1 (16)
CC	0.97
RMS	4.14 DU
SLP	0.94 ± 0.05
mean	11.38 DU
MEDD	11.04 DU
25-75 percentile range	7.86 DU to 15.77 DU
10-90 percentile range	6.47 DU to 16.15 DU
min-max range	2.55 DU to 17.59 DU
OMI CF	39.44 %
Pandora DQ0	53.69 %

Fairhill*



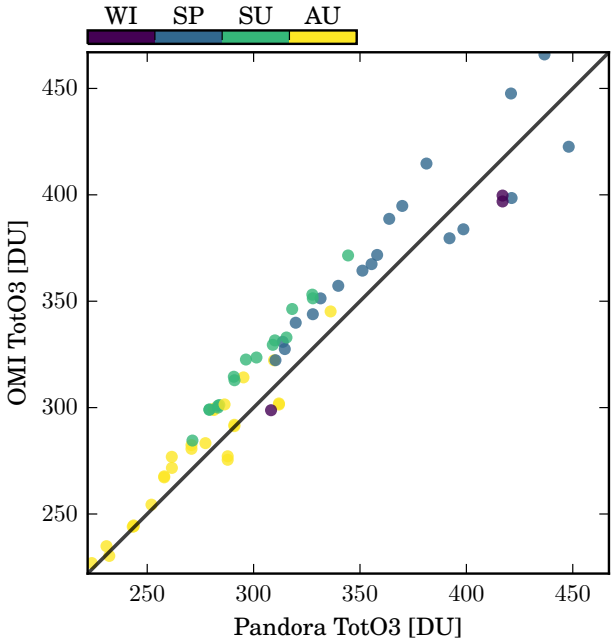
longitude, latitude	-75.868, 39.701111
num data points	10
max Pan. (Pans.)	1 (16)
CC	0.97
RMS	3.64 DU
SLP	0.88 ± 0.08
mean	10.82 DU
MEDD	9.85 DU
25-75 percentile range	7.18 DU to 14.64 DU
10-90 percentile range	6.55 DU to 16.72 DU
min-max range	6.18 DU to 17.59 DU
OMI CF	39.44 %
Pandora DQ0	53.69 %

FMI



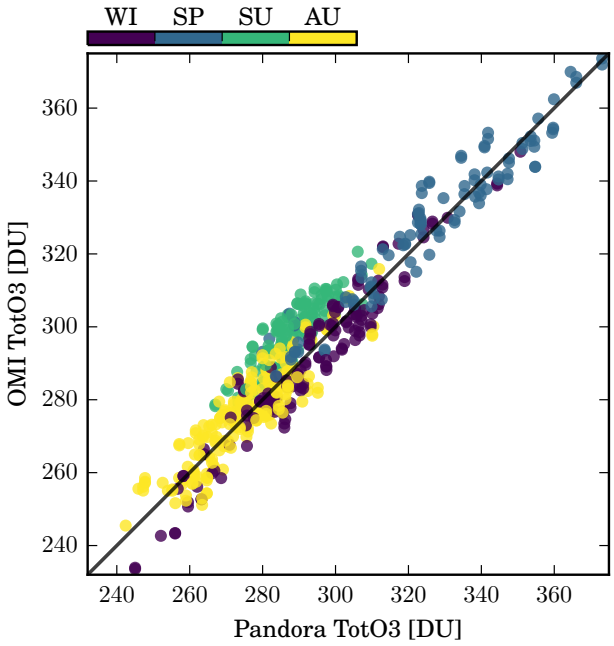
longitude, latitude	24.9612, 60.2037
num data points	235
max Pan. (Pans.)	1 (21)
CC	0.96
RMS	14.06 DU
SLP	0.93 ± 0.02
mean	9.80 DU
MEDD	14.73 DU
25-75 percentile range	2.53 DU to 20.04 DU
10-90 percentile range	-12.43 DU to 23.34 DU
min-max range	-34.53 DU to 33.46 DU
OMI CF	43.86 %
Pandora DQ0	30.23 %

FMI*



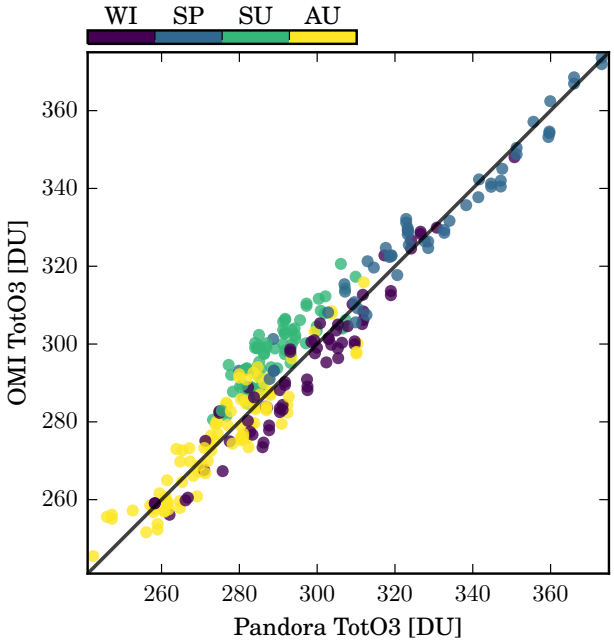
longitude, latitude	24.9612, 60.2037
num data points	65
max Pan. (Pans.)	1 (21)
CC	0.96
RMS	13.86 DU
SLP	0.97 ± 0.03
mean	10.23 DU
MEDD	13.27 DU
25-75 percentile range	0.98 DU to 19.94 DU
10-90 percentile range	-11.68 DU to 25.29 DU
min-max range	-25.50 DU to 33.46 DU
OMI CF	43.86 %
Pandora DQ0	30.23 %

FourCornersNM



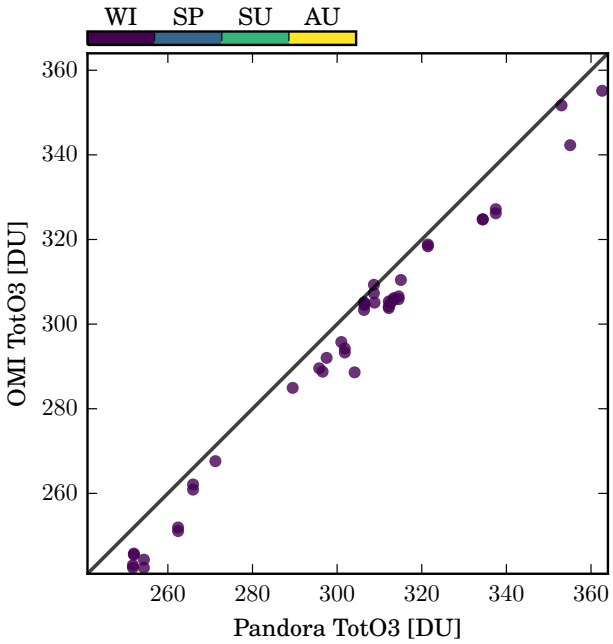
longitude, latitude	-108.480, 36.797
num data points	597
max Pan. (Pans.)	1 (23)
CC	0.96
RMS	7.01 DU
SLP	0.98 ± 0.01
mean	2.58 DU
MEDD	2.79 DU
25-75 percentile range	-2.68 DU to 7.64 DU
10-90 percentile range	-6.41 DU to 11.92 DU
min-max range	-13.61 DU to 19.52 DU
OMI CF	60.10 %
Pandora DQ0	50.47 %

FourCornersNM*



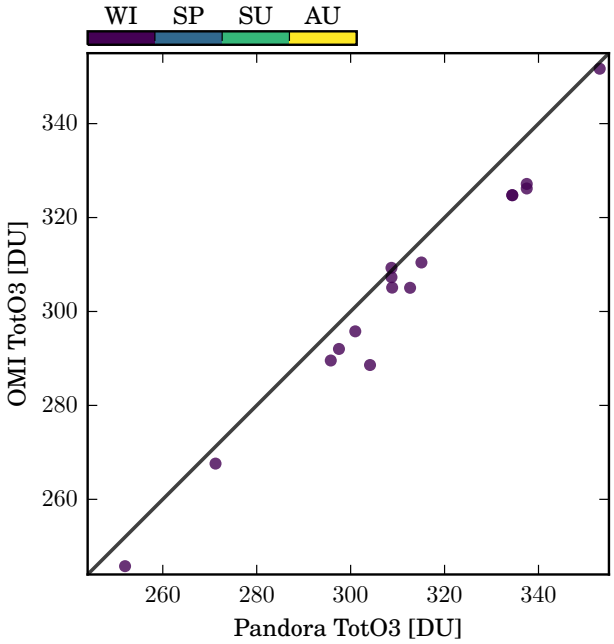
longitude, latitude	-108.480, 36.797
num data points	290
max Pan. (Pans.)	1 (23)
CC	0.96
RMS	6.47 DU
SLP	0.96 ± 0.02
mean	1.85 DU
MEDD	2.28 DU
25-75 percentile range	-3.38 DU to 6.50 DU
10-90 percentile range	-6.40 DU to 10.97 DU
min-max range	-12.52 DU to 17.39 DU
OMI CF	60.10 %
Pandora DQ0	50.47 %

Fresno



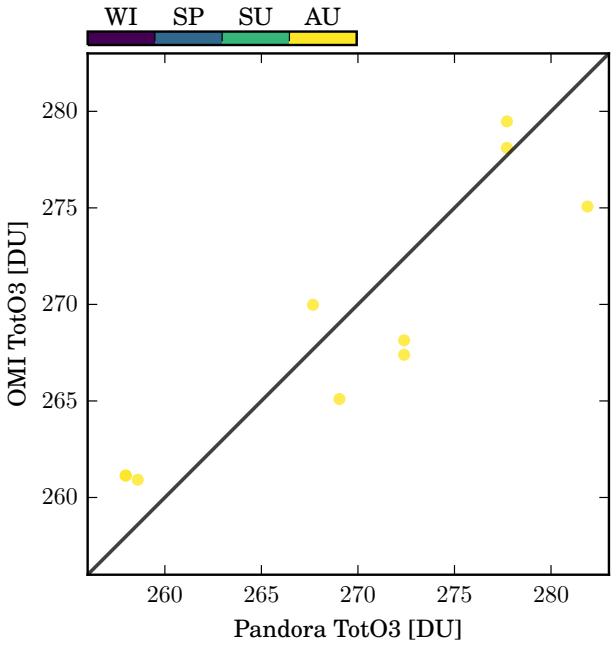
longitude, latitude	-119.7731, 36.7854
num data points	44
max Pan. (Pans.)	2 (30, 31)
CC	0.99
RMS	3.50 DU
SLP	1.01 $\pm$ 0.02
mean	-6.72 DU
MEDD	-7.37 DU
25-75 percentile range	-8.85 DU to -3.83 DU
10-90 percentile range	-11.06 DU to -1.76 DU
min-max range	-15.53 DU to 0.60 DU
OMI CF	45.10 %
Pandora DQ0	36.52 %

Fresno*



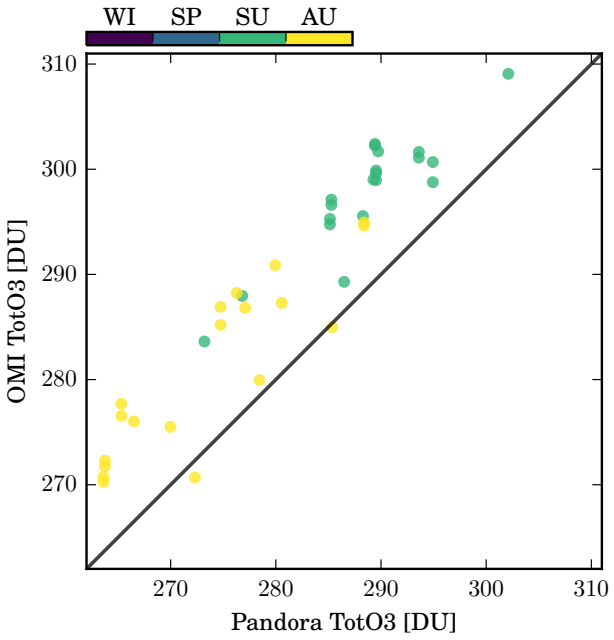
longitude, latitude	-119.7731, 36.7854
num data points	16
max Pan. (Pans.)	2 (30, 31)
CC	0.99
RMS	4.01 DU
SLP	0.97 $\pm$ 0.04
mean	-6.34 DU
MEDD	-5.84 DU
25-75 percentile range	-9.65 DU to -3.72 DU
10-90 percentile range	-10.82 DU to -1.37 DU
min-max range	-15.53 DU to 0.60 DU
OMI CF	45.10 %
Pandora DQ0	36.52 %

FSU



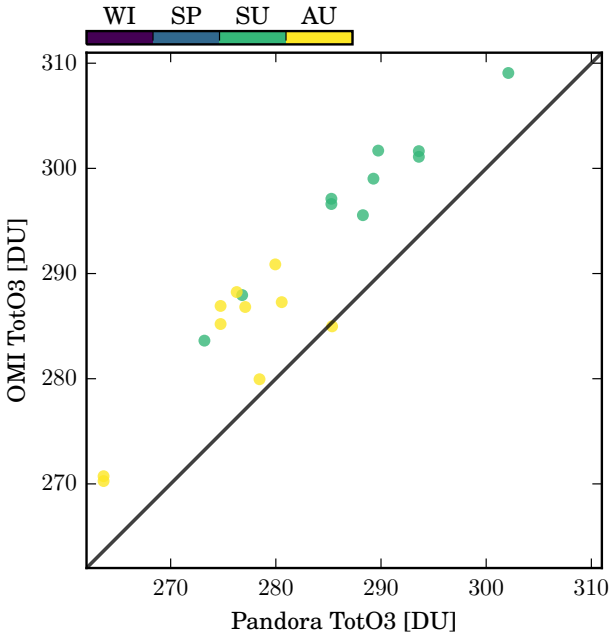
longitude, latitude	-78.9329, 39.6511
num data points	10
max Pan. (Pans.)	3 (2, 3, 9)
CC	0.90
RMS	2.82 DU
SLP	0.72 ± 0.12
mean	-0.69 DU
MEDD	1.08 DU
25-75 percentile range	-4.17 DU to 2.32 DU
10-90 percentile range	-5.18 DU to 3.16 DU
min-max range	-6.82 DU to 3.17 DU
OMI CF	81.82 %
Pandora DQ0	26.10 %

Galveston



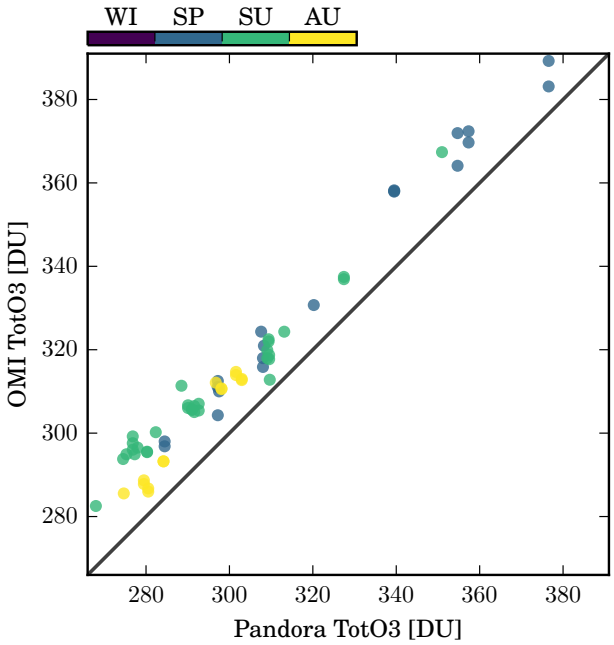
longitude, latitude	-94.8612, 29.2544
num data points	39
max Pan. (Pans.)	1 (34)
CC	0.95
RMS	3.49 DU
SLP	0.98 ± 0.06
mean	8.39 DU
MEDD	9.51 DU
25-75 percentile range	6.69 DU to 11.04 DU
10-90 percentile range	3.63 DU to 12.00 DU
min-max range	-1.62 DU to 12.98 DU
OMI CF	51.28 %
Pandora DQ0	55.86 %

Galveston*



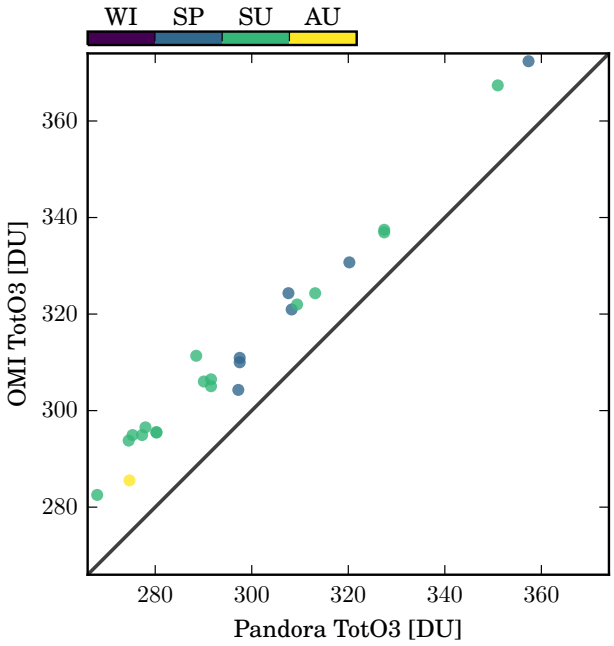
longitude, latitude	-94.8612, 29.2544
num data points	20
max Pan. (Pans.)	1 (34)
CC	0.94
RMS	3.31 DU
SLP	0.98 ± 0.08
mean	8.65 DU
MEDD	9.74 DU
25-75 percentile range	7.07 DU to 11.20 DU
10-90 percentile range	6.13 DU to 11.96 DU
min-max range	-0.37 DU to 12.17 DU
OMI CF	51.28 %
Pandora DQ0	55.86 %

GIST



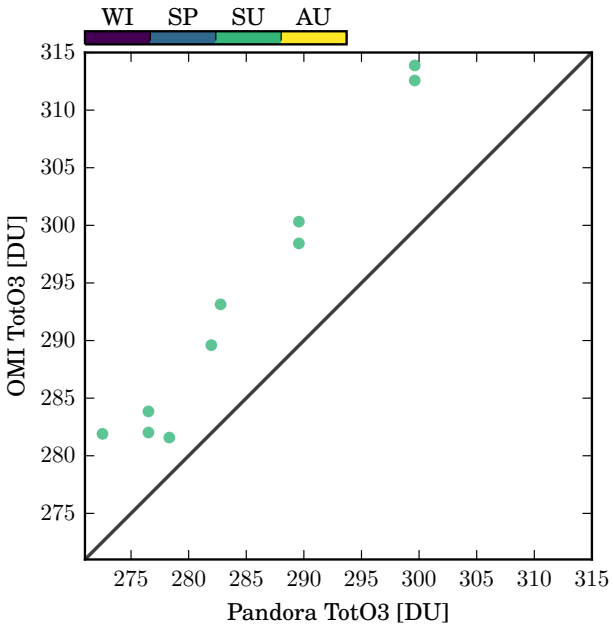
longitude, latitude	126.843, 35.226
num data points	66
max Pan. (Pans.)	1 (26)
CC	0.99
RMS	4.12 DU
SLP	0.98 ± 0.02
mean	13.22 DU
MEDD	12.95 DU
25-75 percentile range	9.97 DU to 15.81 DU
10-90 percentile range	8.27 DU to 18.64 DU
min-max range	3.13 DU to 22.87 DU
OMI CF	38.68 %
Pandora DQ0	32.58 %

GIST*



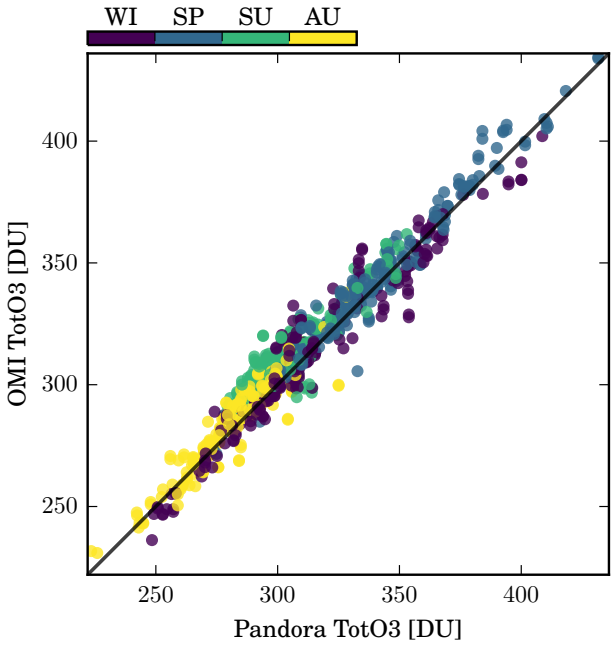
longitude, latitude	126.843, 35.226
num data points	24
max Pan. (Pans.)	1 (26)
CC	0.99
RMS	3.38 DU
SLP	0.95 ± 0.03
mean	14.41 DU
MEDD	14.73 DU
25-75 percentile range	12.17 DU to 16.49 DU
10-90 percentile range	10.16 DU to 19.07 DU
min-max range	7.08 DU to 22.87 DU
OMI CF	38.68 %
Pandora DQ0	32.58 %

Golden



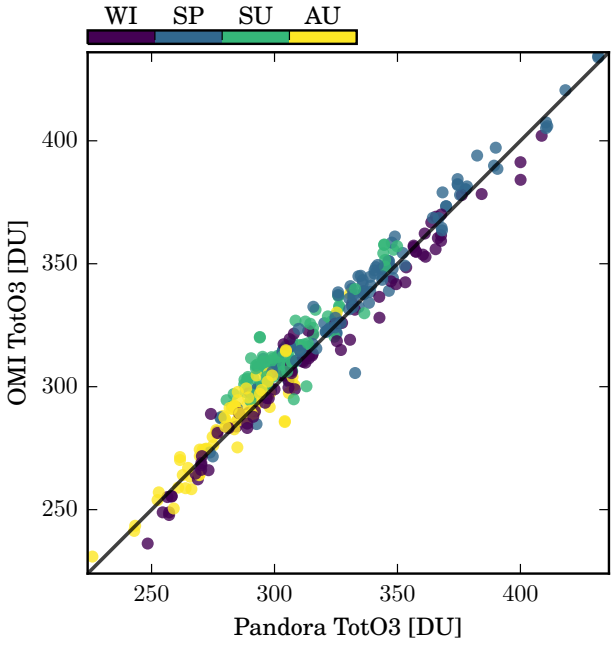
longitude, latitude	-105.1779, 39.7437
num data points	10
max Pan. (Pans.)	1 (38)
CC	0.99
RMS	1.98 DU
SLP	1.27 ± 0.08
mean	9.03 DU
MEDD	9.12 DU
25-75 percentile range	7.41 DU to 10.66 DU
10-90 percentile range	5.28 DU to 13.08 DU
min-max range	3.26 DU to 14.26 DU
OMI CF	21.57 %
Pandora DQ0	40.63 %

GSFC



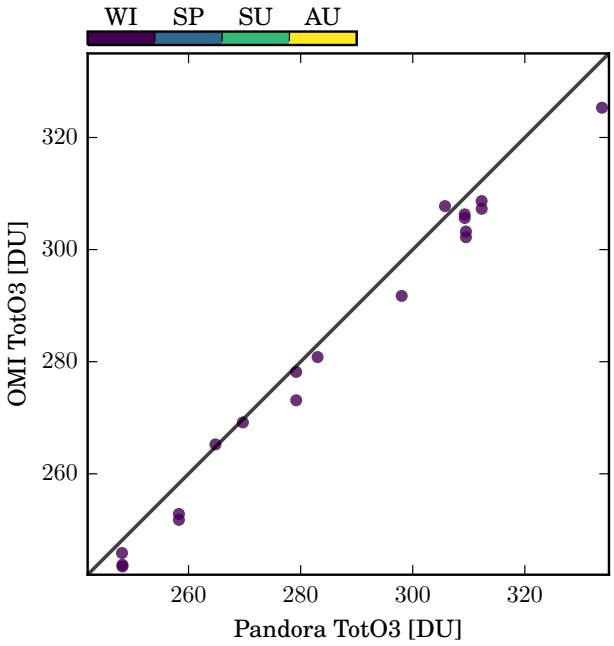
longitude, latitude	-76.8396, 38.9926
num data points	867
max Pan. (Pans.)	11 (18, 19, 21, 25, 26, 28, 2, 3, 43, 7, 9)
CC	0.97
RMS	7.25 DU
SLP	0.97 ± 0.01
mean	3.31 DU
MEDD	3.18 DU
25-75 percentile range	-1.00 DU to 8.23 DU
10-90 percentile range	-5.45 DU to 12.12 DU
min-max range	-27.21 DU to 26.18 DU
OMI CF	41.42 %
Pandora DQ0	26.89 %

GSFC*



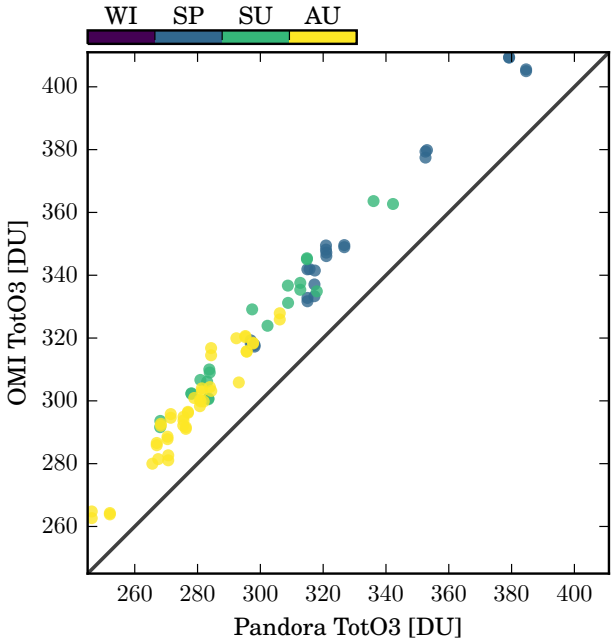
longitude, latitude	-76.8396, 38.9926
num data points	378
max Pan. (Pans.)	11 (18, 19, 21, 25, 26, 28, 2, 3, 43, 7, 9)
CC	0.98
RMS	7.00 DU
SLP	0.97 ± 0.01
mean	3.16 DU
MEDD	3.13 DU
25-75 percentile range	-1.29 DU to 7.93 DU
10-90 percentile range	-5.77 DU to 11.72 DU
min-max range	-27.21 DU to 26.18 DU
OMI CF	41.42 %
Pandora DQ0	26.89 %

Hanford



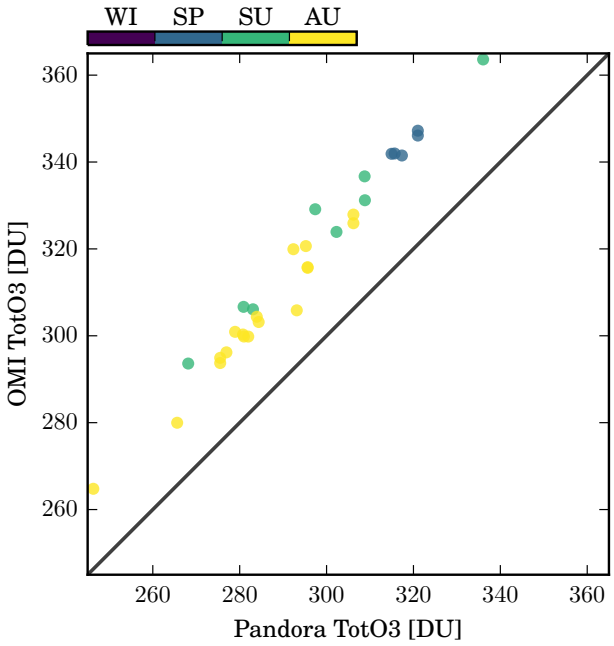
longitude, latitude	-119.6433, 36.3193
num data points	19
max Pan. (Pans.)	2 (18, 32)
CC	0.99
RMS	2.64 DU
SLP	0.98 ± 0.02
mean	-3.91 DU
MEDD	-4.44 DU
25-75 percentile range	-6.17 DU to -2.23 DU
10-90 percentile range	-6.65 DU to -0.33 DU
min-max range	-8.45 DU to 2.01 DU
OMI CF	46.88 %
Pandora DQ0	51.57 %

HUFS



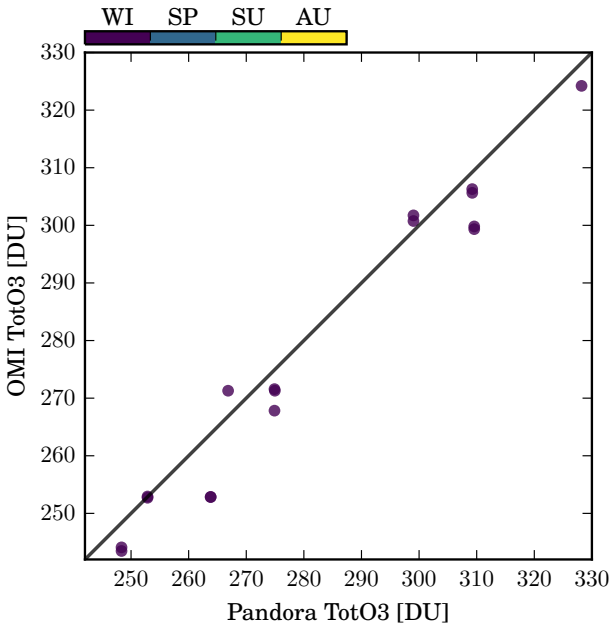
longitude, latitude	127.265, 37.338
num data points	89
max Pan. (Pans.)	1 (18)
CC	0.99
RMS	4.38 DU
SLP	1.07 ± 0.02
mean	21.68 DU
MEDD	21.62 DU
25-75 percentile range	18.47 DU to 25.08 DU
10-90 percentile range	15.96 DU to 27.65 DU
min-max range	10.41 DU to 32.49 DU
OMI CF	38.55 %
Pandora DQ0	30.33 %

HUFS*



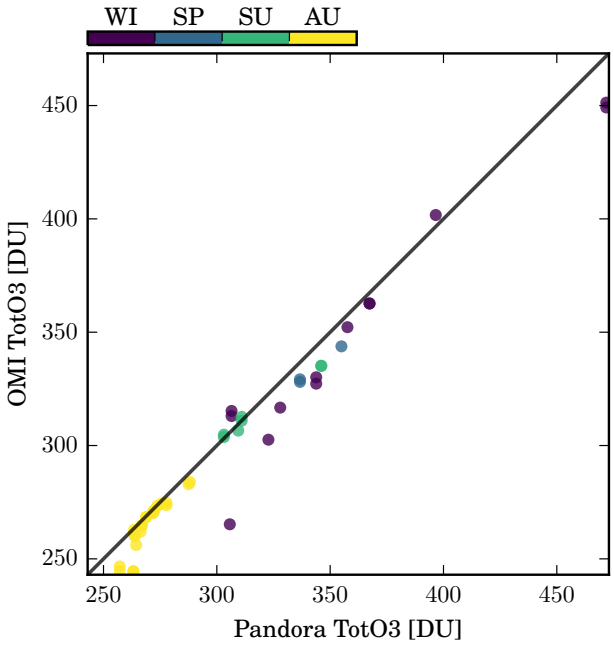
longitude, latitude	127.265, 37.338
num data points	31
max Pan. (Pans.)	1 (18)
CC	0.99
RMS	3.55 DU
SLP	1.12 ± 0.03
mean	22.22 DU
MEDD	21.72 DU
25-75 percentile range	19.33 DU to 25.61 DU
10-90 percentile range	18.22 DU to 27.57 DU
min-max range	12.72 DU to 31.74 DU
OMI CF	38.55 %
Pandora DQ0	30.33 %

Huron



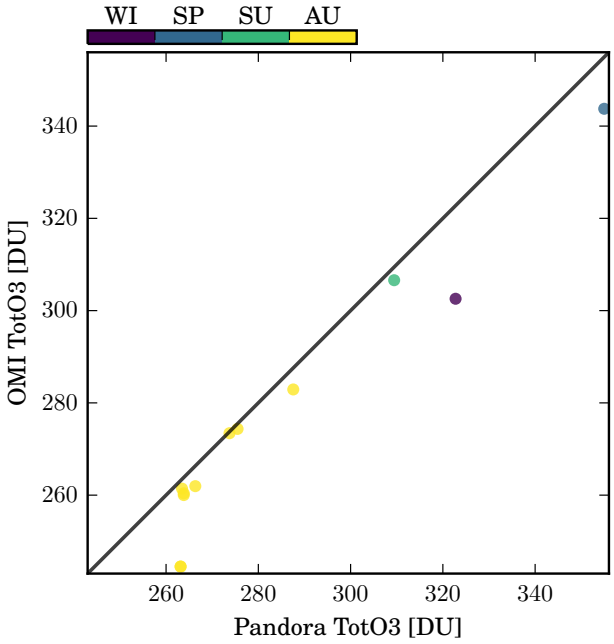
longitude, latitude	-120.105, 36.206
num data points	17
max Pan. (Pans.)	1 (2)
CC	0.98
RMS	4.60 DU
SLP	0.99 ± 0.05
mean	-3.93 DU
MEDD	-3.67 DU
25-75 percentile range	-7.07 DU to -0.15 DU
10-90 percentile range	-10.53 DU to 2.12 DU
min-max range	-10.98 DU to 4.44 DU
OMI CF	66.67 %
Pandora DQ0	62.34 %

IBK



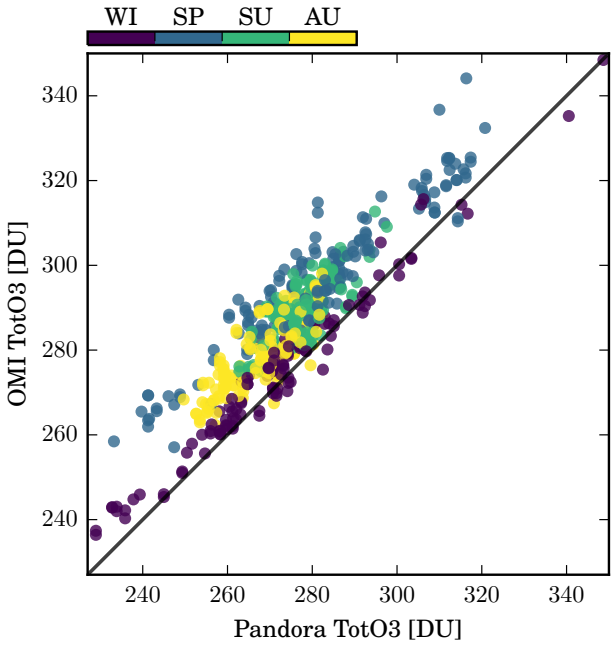
longitude, latitude	11.3852, 47.2643
num data points	47
max Pan. (Pans.)	1 (106)
CC	0.99
RMS	8.26 DU
SLP	0.94 ± 0.02
mean	-6.35 DU
MEDD	-4.12 DU
25-75 percentile range	-10.92 DU to -0.96 DU
10-90 percentile range	-18.63 DU to 1.05 DU
min-max range	-40.46 DU to 8.75 DU
OMI CF	16.29 %
Pandora DQ0	38.06 %

IBK*



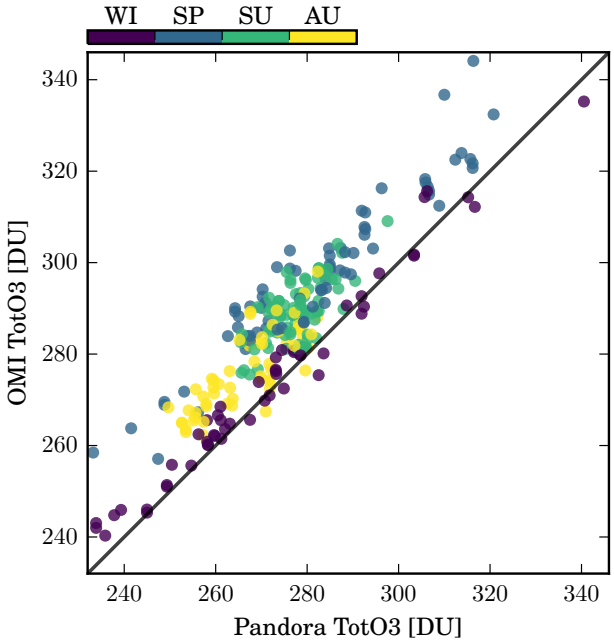
longitude, latitude	11.3852, 47.2643
num data points	12
max Pan. (Pans.)	1 (106)
CC	0.97
RMS	6.92 DU
SLP	0.94 ± 0.08
mean	-7.61 DU
MEDD	-4.10 DU
25-75 percentile range	-13.07 DU to -2.65 DU
10-90 percentile range	-18.65 DU to -1.23 DU
min-max range	-20.19 DU to -0.32 DU
OMI CF	16.09 %
Pandora DQ0	38.06 %

IZO



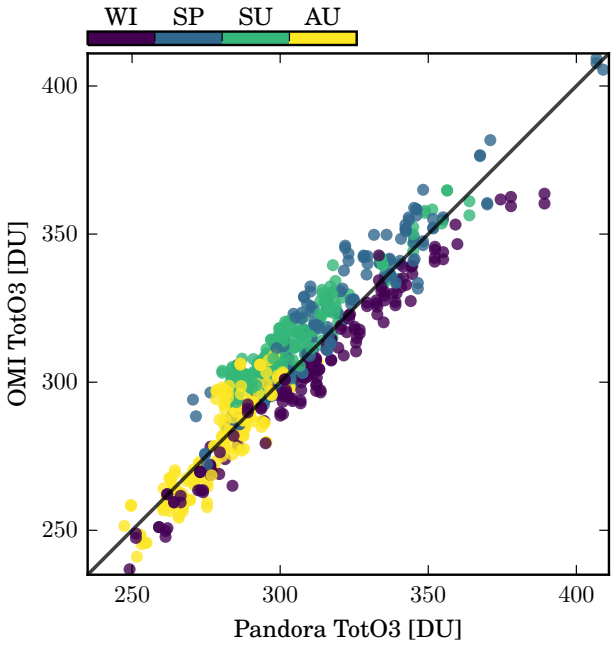
longitude, latitude	-16.4994, 28.309
num data points	575
max Pan. (Pans.)	1 (101)
CC	0.91
RMS	6.68 DU
SLP	0.92 ± 0.02
mean	10.83 DU
MEDD	10.54 DU
25-75 percentile range	6.16 DU to 14.72 DU
10-90 percentile range	2.02 DU to 20.01 DU
min-max range	-7.13 DU to 33.52 DU
OMI CF	53.94 %
Pandora DQ0	69.59 %

IZO*



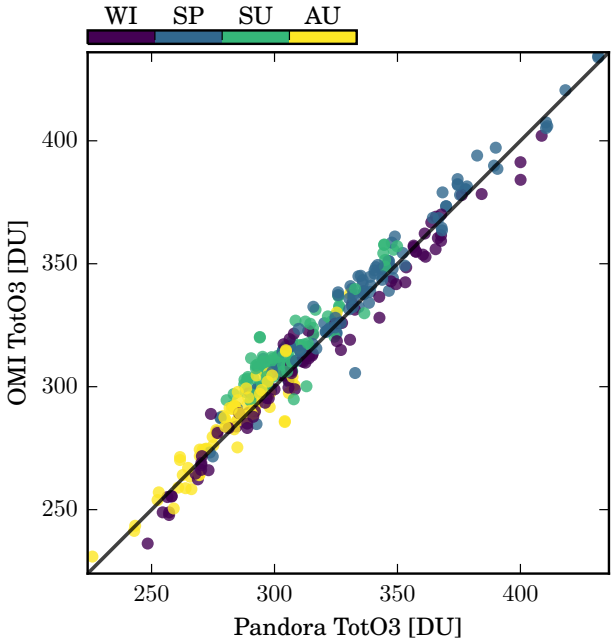
longitude, latitude	-16.4994, 28.309
num data points	269
max Pan. (Pans.)	1 (101)
CC	0.91
RMS	6.80 DU
SLP	0.95 ± 0.03
mean	10.36 DU
MEDD	10.32 DU
25-75 percentile range	5.49 DU to 14.62 DU
10-90 percentile range	1.69 DU to 19.51 DU
min-max range	-7.13 DU to 27.77 DU
OMI CF	54.04 %
Pandora DQ0	69.59 %

Langley



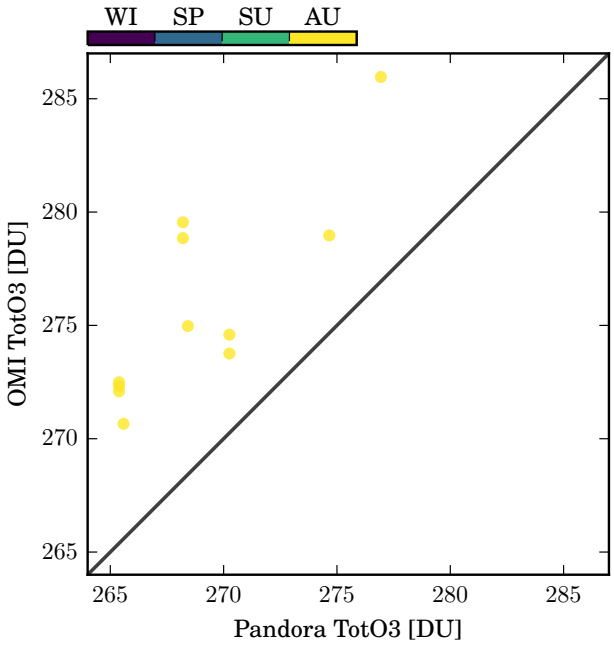
longitude, latitude	-76.3868, 37.1036
num data points	754
max Pan. (Pans.)	3 (37, 39, 6)
CC	0.94
RMS	8.86 DU
SLP	0.97 $\pm$ 0.01
mean	2.88 DU
MEDD	2.39 DU
25-75 percentile range	-3.68 DU to 9.75 DU
10-90 percentile range	-8.54 DU to 14.21 DU
min-max range	-28.92 DU to 24.15 DU
OMI CF	51.36 %
Pandora DQ0	23.56 %

Langley*



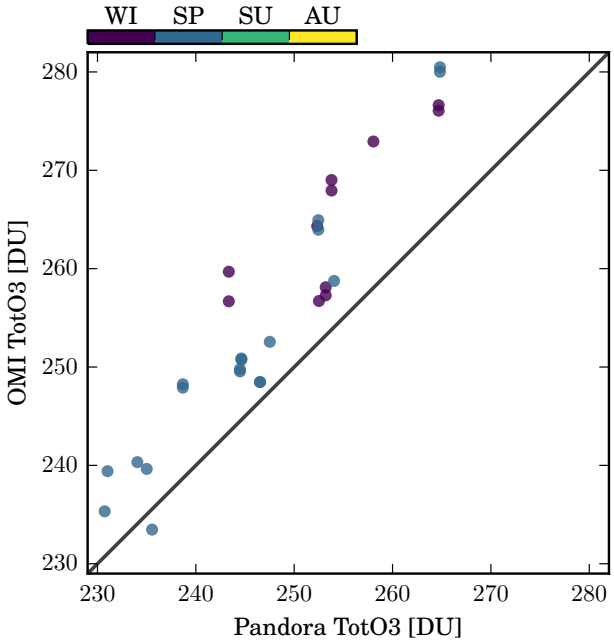
longitude, latitude	-76.3868, 37.1036
num data points	307
max Pan. (Pans.)	3 (37, 39, 6)
CC	0.93
RMS	8.44 DU
SLP	0.98 $\pm$ 0.02
mean	3.76 DU
MEDD	4.11 DU
25-75 percentile range	-2.96 DU to 10.27 DU
10-90 percentile range	-7.41 DU to 13.97 DU
min-max range	-18.87 DU to 23.55 DU
OMI CF	51.39 %
Pandora DQ0	23.56 %

LaPorte1



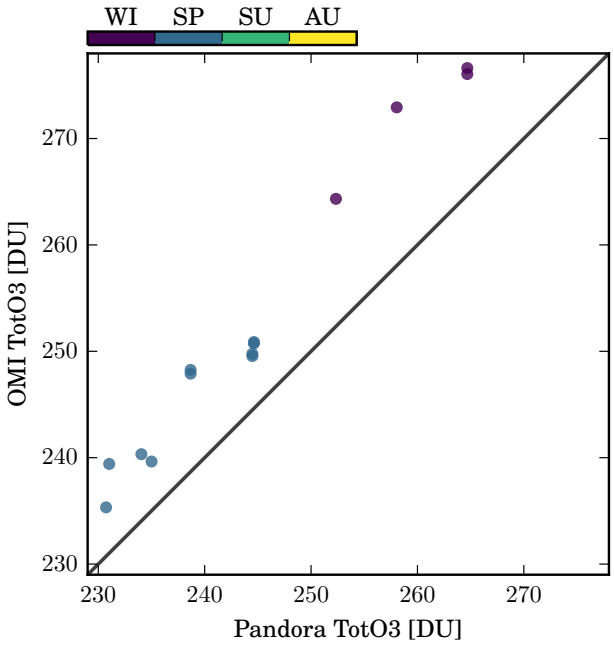
longitude, latitude	-95.0647, 29.672
num data points	11
max Pan. (Pans.)	1 (38)
CC	0.82
RMS	2.46 DU
SLP	0.96 ± 0.22
mean	6.87 DU
MEDD	6.71 DU
25-75 percentile range	4.71 DU to 8.06 DU
10-90 percentile range	4.31 DU to 10.65 DU
min-max range	3.51 DU to 11.35 DU
OMI CF	32.35 %
Pandora DQ0	49.54 %

Lauder



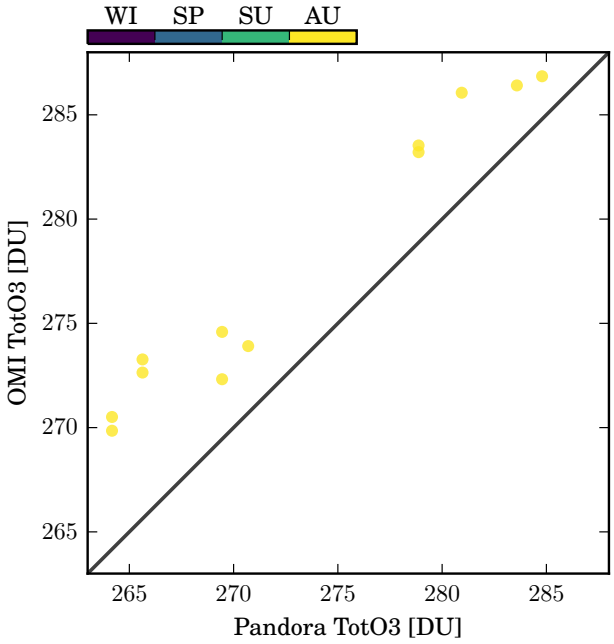
longitude, latitude	169.684, -45.038
num data points	30
max Pan. (Pans.)	1 (37)
CC	0.95
RMS	4.19 DU
SLP	1.25 ± 0.08
mean	8.47 DU
MEDD	7.33 DU
25-75 percentile range	4.75 DU to 12.36 DU
10-90 percentile range	3.87 DU to 15.19 DU
min-max range	-2.08 DU to 16.34 DU
OMI CF	66.67 %
Pandora DQ0	47.49 %

Lauder*



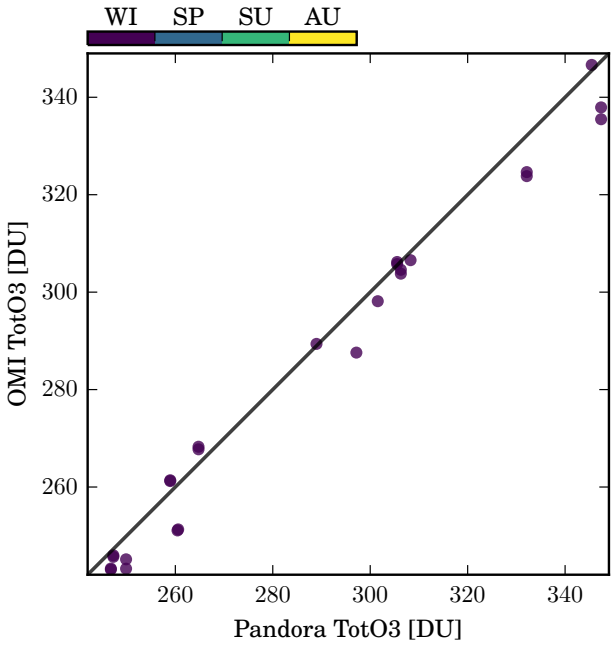
longitude, latitude	169.684, -45.038
num data points	14
max Pan. (Pans.)	1 (37)
CC	0.99
RMS	2.26 DU
SLP	1.20 ± 0.06
mean	8.25 DU
MEDD	7.33 DU
25-75 percentile range	5.49 DU to 10.92 DU
10-90 percentile range	4.76 DU to 11.97 DU
min-max range	4.60 DU to 14.88 DU
OMI CF	66.67 %
Pandora DQ0	47.49 %

Library



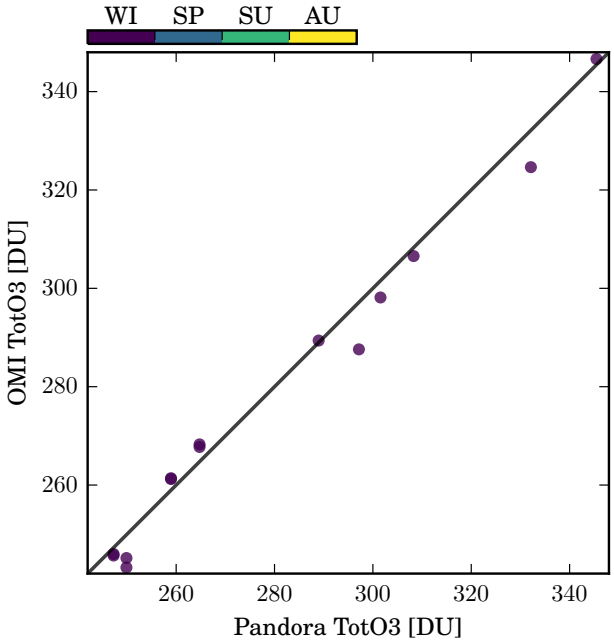
longitude, latitude	-95.657, 29.8334
num data points	12
max Pan. (Pans.)	1 (18)
CC	0.98
RMS	1.24 DU
SLP	0.85 ± 0.05
mean	4.74 DU
MEDD	4.89 DU
25-75 percentile range	3.13 DU to 5.85 DU
10-90 percentile range	2.83 DU to 6.94 DU
min-max range	2.06 DU to 7.64 DU
OMI CF	39.02 %
Pandora DQ0	28.49 %

Madera



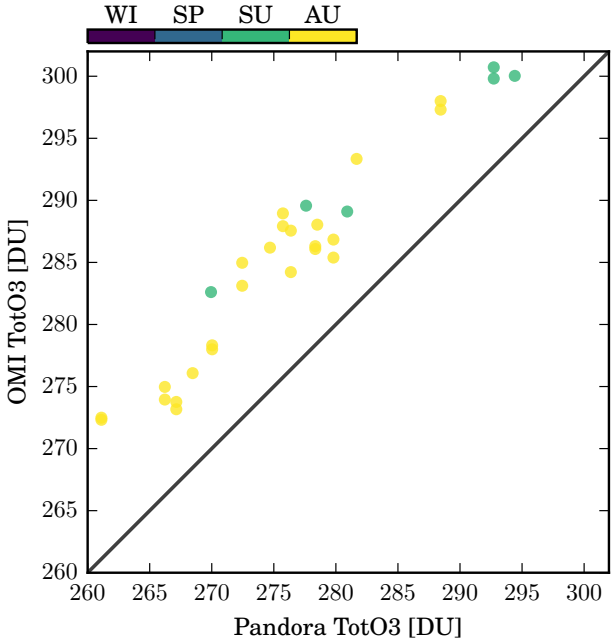
longitude, latitude	-120.0342, 36.9533
num data points	25
max Pan. (Pans.)	1 (29)
CC	0.99
RMS	4.30 DU
SLP	0.96 ± 0.03
mean	-3.30 DU
MEDD	-2.50 DU
25-75 percentile range	-7.49 DU to 0.41 DU
10-90 percentile range	-9.43 DU to 2.37 DU
min-max range	-11.90 DU to 3.51 DU
OMI CF	48.31 %
Pandora DQ0	40.77 %

Madera*



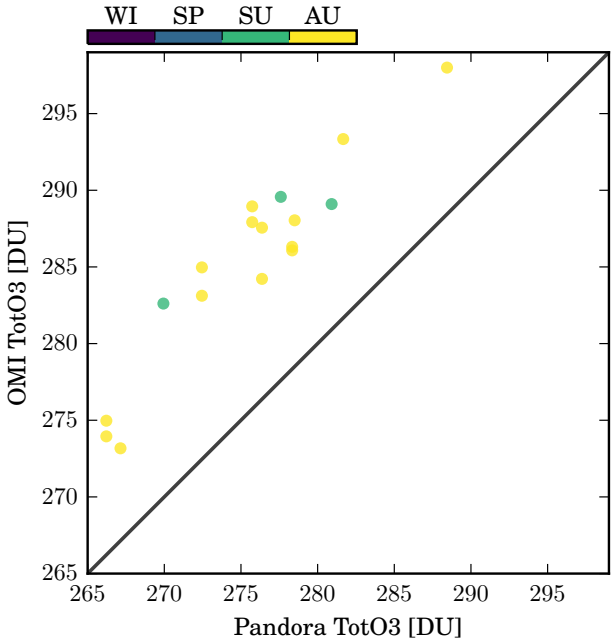
longitude, latitude	-120.0342, 36.9533
num data points	14
max Pan. (Pans.)	1 (29)
CC	0.99
RMS	3.94 DU
SLP	0.97 ± 0.04
mean	-1.69 DU
MEDD	-1.45 DU
25-75 percentile range	-4.40 DU to 2.00 DU
10-90 percentile range	-7.24 DU to 2.82 DU
min-max range	-9.57 DU to 3.51 DU
OMI CF	48.31 %
Pandora DQ0	40.77 %

Manvelcroix



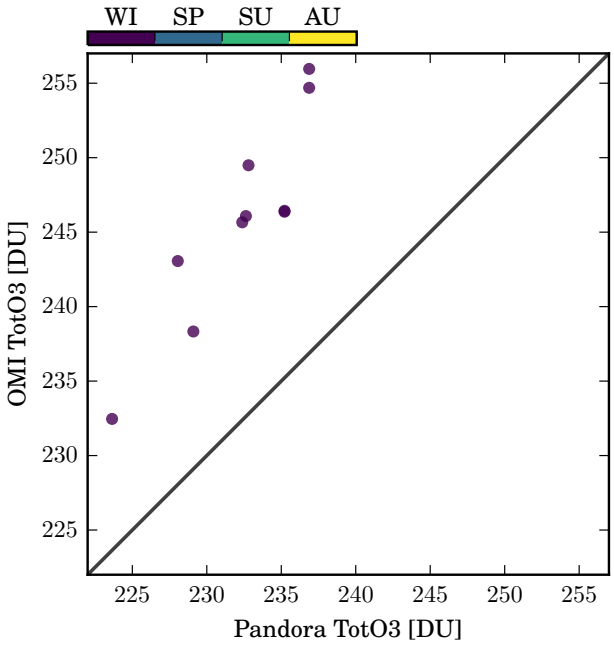
longitude, latitude	-95.392, 29.520
num data points	30
max Pan. (Pans.)	1 (33)
CC	0.97
RMS	2.16 DU
SLP	0.94 ± 0.05
mean	9.21 DU
MEDD	8.52 DU
25-75 percentile range	7.73 DU to 11.34 DU
10-90 percentile range	6.56 DU to 12.22 DU
min-max range	5.59 DU to 13.22 DU
OMI CF	48.45 %
Pandora DQ0	41.67 %

Manvelcroix*



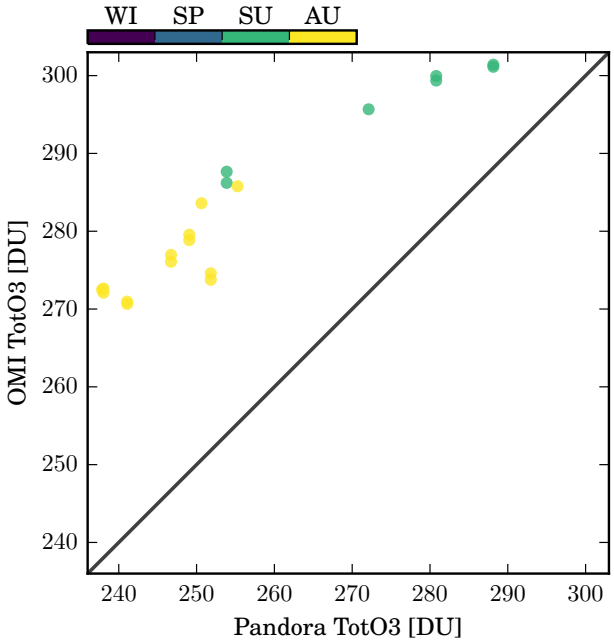
longitude, latitude	-95.392, 29.520
num data points	17
max Pan. (Pans.)	1 (33)
CC	0.94
RMS	2.11 DU
SLP	1.05 ± 0.10
mean	9.97 DU
MEDD	9.56 DU
25-75 percentile range	7.97 DU to 11.97 DU
10-90 percentile range	7.74 DU to 12.58 DU
min-max range	6.03 DU to 13.22 DU
OMI CF	48.45 %
Pandora DQ0	41.67 %

MaunaLoa



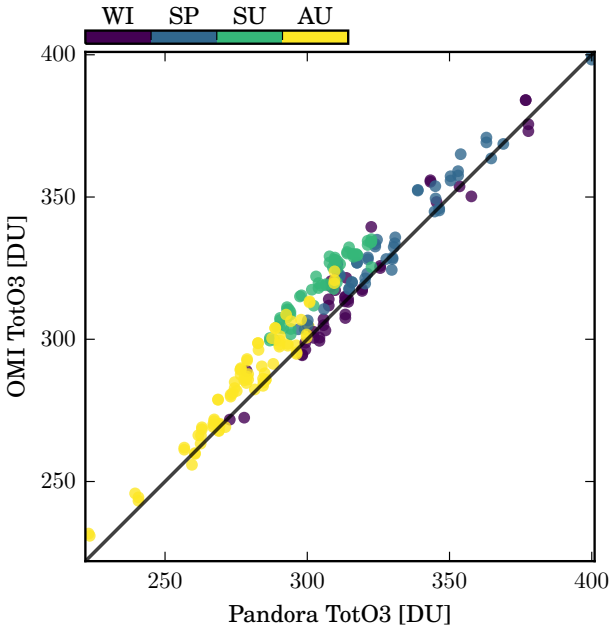
longitude, latitude	-155.6027, 19.4795
num data points	10
max Pan. (Pans.)	1 (31)
CC	0.91
RMS	2.70 DU
SLP	1.50 ± 0.24
mean	13.57 DU
MEDD	13.37 DU
25-75 percentile range	11.17 DU to 16.27 DU
10-90 percentile range	9.19 DU to 17.94 DU
min-max range	8.82 DU to 19.09 DU
OMI CF	18.29 %
Pandora DQ0	58.29 %

Moodytower



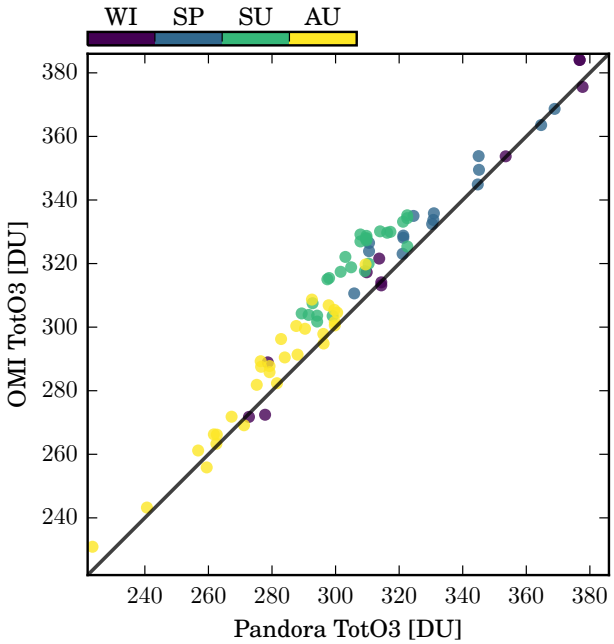
longitude, latitude	-95.3413, 29.7175
num data points	20
max Pan. (Pans.)	1 (35)
CC	0.96
RMS	3.13 DU
SLP	0.63 ± 0.05
mean	27.22 DU
MEDD	29.84 DU
25-75 percentile range	22.56 DU to 32.50 DU
10-90 percentile range	18.03 DU to 34.10 DU
min-max range	12.99 DU to 34.63 DU
OMI CF	39.56 %
Pandora DQ0	27.76 %

NASAHQ



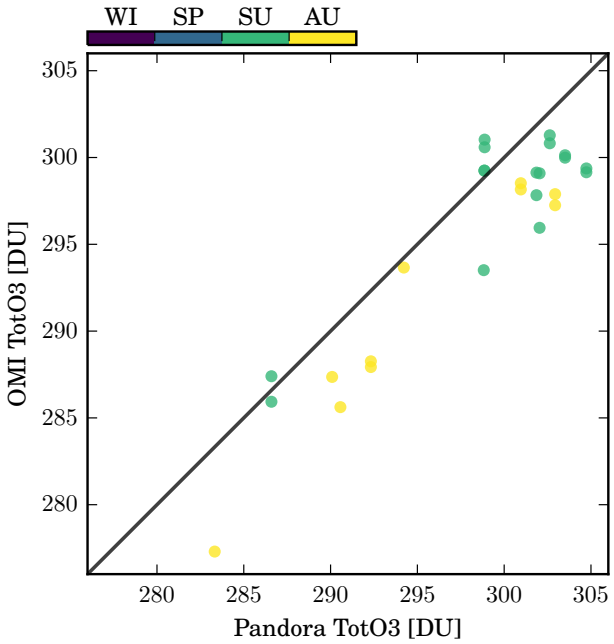
longitude, latitude	-76.8396, 38.9926
num data points	225
max Pan. (Pans.)	2 (17, 33)
CC	0.97
RMS	6.52 DU
SLP	0.98 ± 0.02
mean	7.12 DU
MEDD	7.27 DU
25-75 percentile range	1.38 DU to 12.71 DU
10-90 percentile range	-1.20 DU to 15.97 DU
min-max range	-7.46 DU to 21.33 DU
OMI CF	42.33 %
Pandora DQ0	37.15 %

NASAHQ*



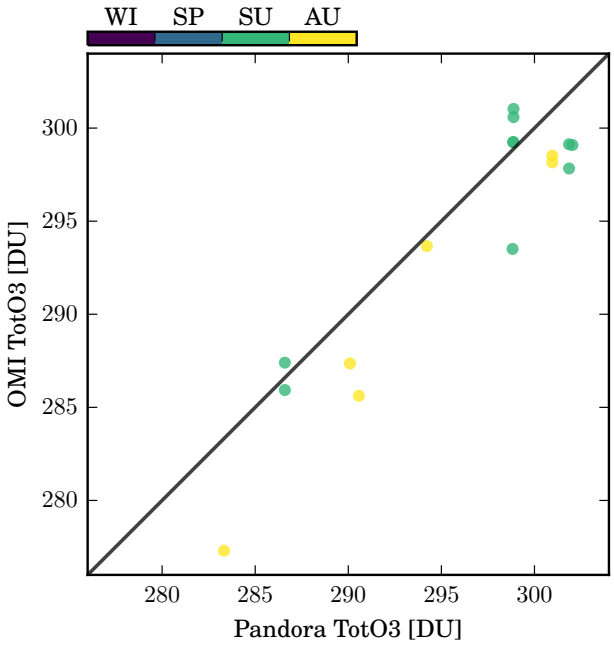
longitude, latitude	-76.8396, 38.9926
num data points	81
max Pan. (Pans.)	2 (17, 33)
CC	0.98
RMS	6.41 DU
SLP	1.00 ± 0.02
mean	7.85 DU
MEDD	7.47 DU
25-75 percentile range	2.78 DU to 12.74 DU
10-90 percentile range	-0.28 DU to 17.49 DU
min-max range	-5.39 DU to 21.33 DU
OMI CF	42.33 %
Pandora DQ0	37.15 %

NWHarris



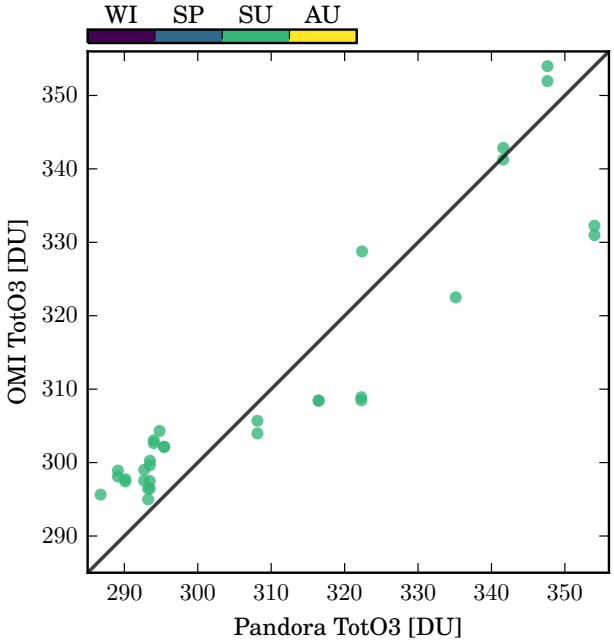
longitude, latitude	-95.6738, 30.0394
num data points	27
max Pan. (Pans.)	1 (30)
CC	0.92
RMS	2.39 DU
SLP	0.94 ± 0.08
mean	-2.82 DU
MEDD	-2.95 DU
25-75 percentile range	-5.00 DU to -1.00 DU
10-90 percentile range	-5.63 DU to 0.56 DU
min-max range	-6.09 DU to 2.16 DU
OMI CF	45.33 %
Pandora DQ0	46.10 %

NWHarris*



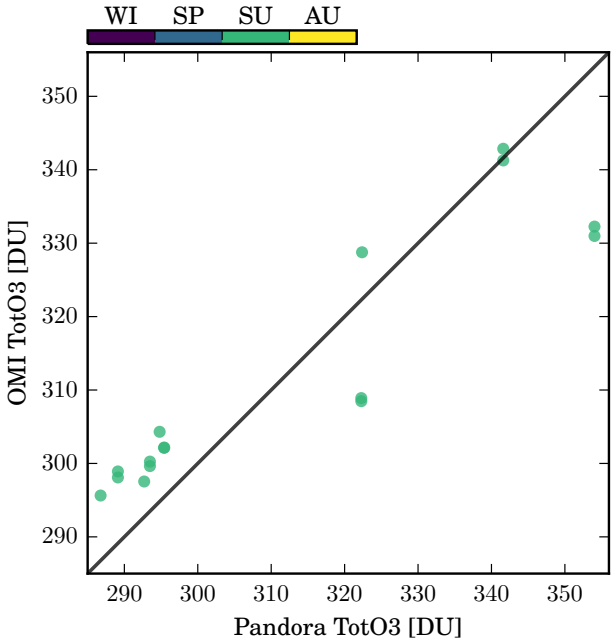
longitude, latitude	-95.6738, 30.0394
num data points	16
max Pan. (Pans.)	1 (30)
CC	0.93
RMS	2.44 DU
SLP	1.05 ± 0.11
mean	-1.86 DU
MEDD	-2.58 DU
25-75 percentile range	-3.22 DU to 0.38 DU
10-90 percentile range	-5.13 DU to 1.26 DU
min-max range	-6.03 DU to 2.16 DU
OMI CF	45.33 %
Pandora DQ0	46.10 %

Padonia



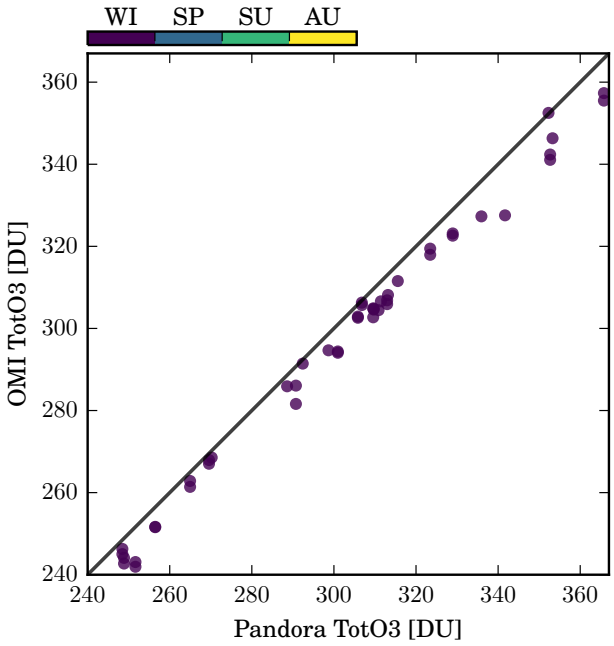
longitude, latitude	-76.631111, 39.460833
num data points	32
max Pan. (Pans.)	1 (17)
CC	0.92
RMS	6.73 DU
SLP	0.72 ± 0.06
mean	0.94 DU
MEDD	4.58 DU
25-75 percentile range	-2.86 DU to 6.90 DU
10-90 percentile range	-13.30 DU to 8.96 DU
min-max range	-23.05 DU to 9.79 DU
OMI CF	55.17 %
Pandora DQ0	62.62 %

Padonia*



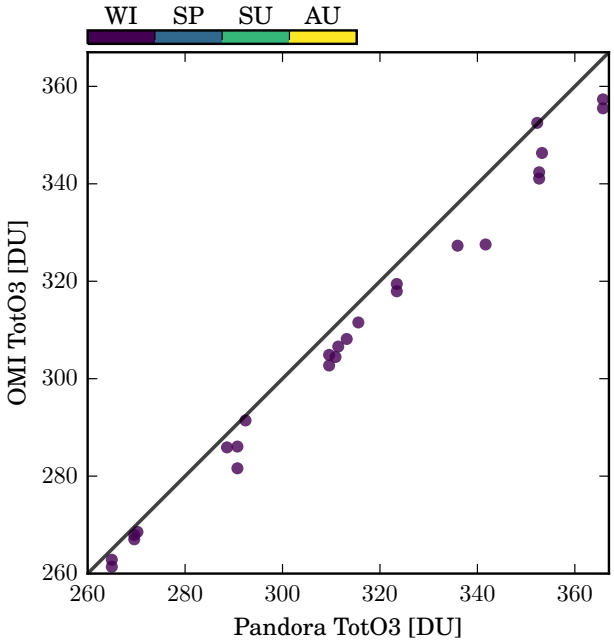
longitude, latitude	-76.631111, 39.460833
num data points	16
max Pan. (Pans.)	1 (17)
CC	0.92
RMS	6.48 DU
SLP	0.63 ± 0.07
mean	0.23 DU
MEDD	6.27 DU
25-75 percentile range	-3.59 DU to 7.29 DU
10-90 percentile range	-17.78 DU to 9.24 DU
min-max range	-23.05 DU to 9.79 DU
OMI CF	55.17 %
Pandora DQ0	62.62 %

Parlier



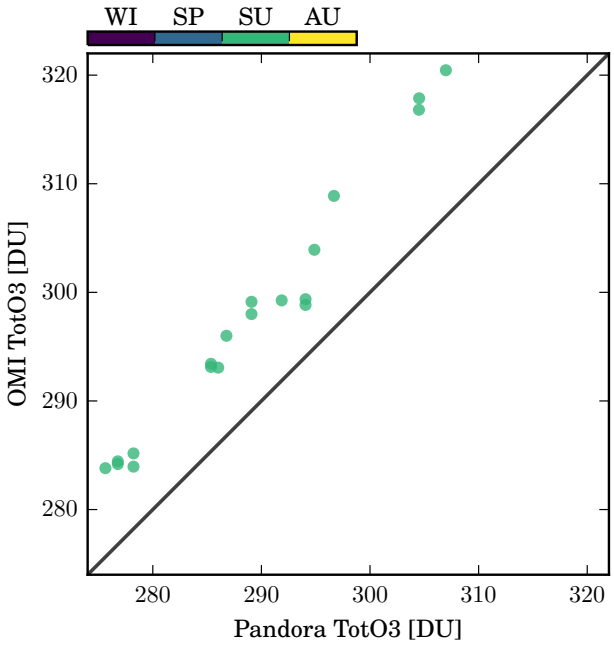
longitude, latitude	-119.5037, 36.5974
num data points	46
max Pan. (Pans.)	1 (28)
CC	1.00
RMS	2.80 DU
SLP	0.97 ± 0.01
mean	-5.34 DU
MEDD	-4.89 DU
25-75 percentile range	-6.88 DU to -3.29 DU
10-90 percentile range	-9.42 DU to -1.66 DU
min-max range	-14.13 DU to 0.23 DU
OMI CF	42.20 %
Pandora DQ0	44.04 %

Parlier*



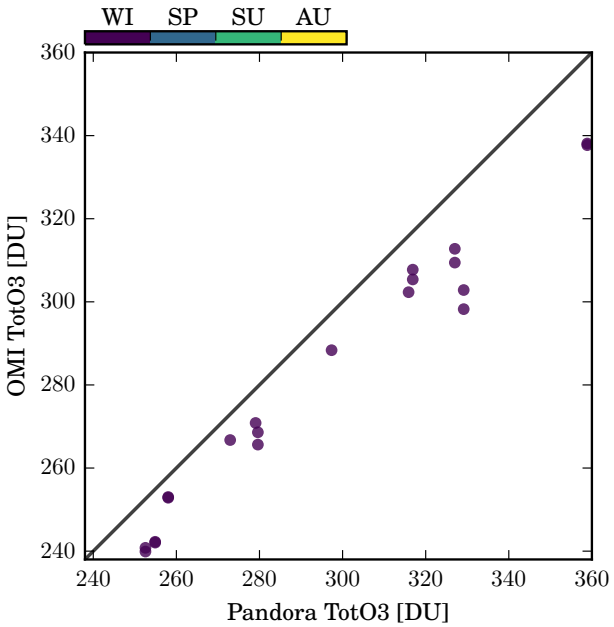
longitude, latitude	-119.5037, 36.5974
num data points	25
max Pan. (Pans.)	1 (28)
CC	1.00
RMS	2.77 DU
SLP	0.93 ± 0.02
mean	-5.62 DU
MEDD	-4.84 DU
25-75 percentile range	-8.45 DU to -2.70 DU
10-90 percentile range	-10.29 DU to -1.65 DU
min-max range	-14.13 DU to 0.23 DU
OMI CF	42.20 %
Pandora DQ0	44.04 %

Platteville



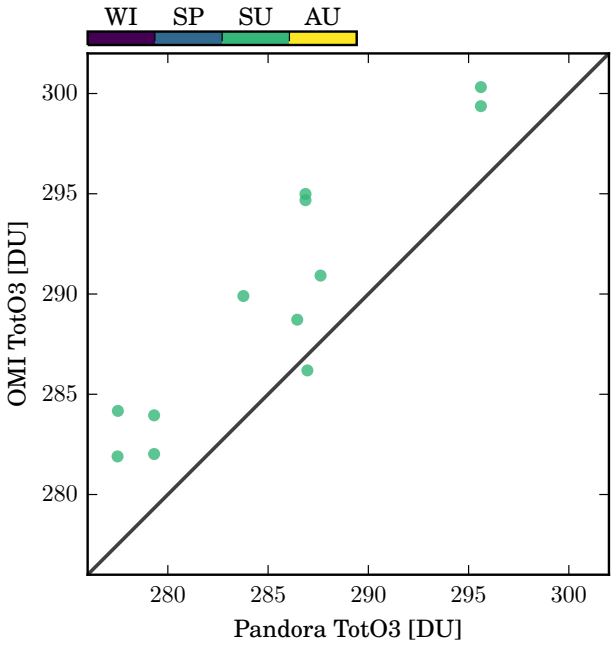
longitude, latitude	-104.726, 40.181
num data points	19
max Pan. (Pans.)	2 (30, 8)
CC	0.99
RMS	1.88 DU
SLP	1.17 ± 0.05
mean	8.67 DU
MEDD	8.06 DU
25-75 percentile range	7.22 DU to 9.63 DU
10-90 percentile range	5.64 DU to 12.51 DU
min-max range	4.78 DU to 13.47 DU
OMI CF	41.30 %
Pandora DQ0	25.85 %

Porterville



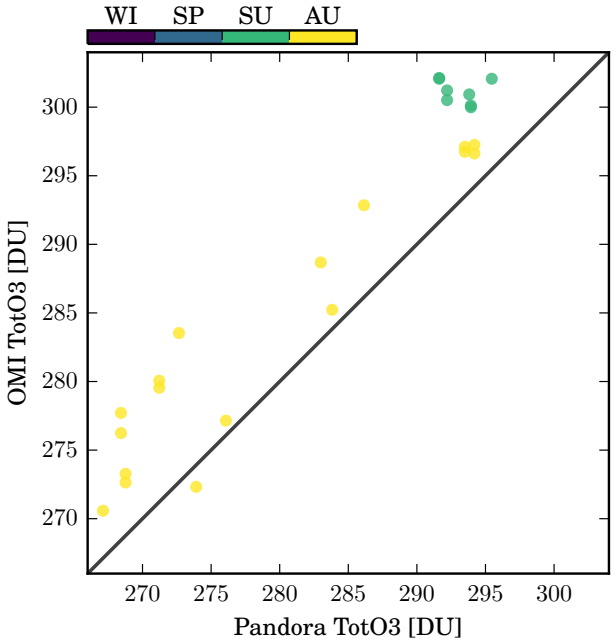
longitude, latitude	-119.055, 36.03179
num data points	20
max Pan. (Pans.)	2 (27, 8)
CC	0.99
RMS	4.97 DU
SLP	0.88 ± 0.03
mean	-13.69 DU
MEDD	-12.65 DU
25-75 percentile range	-15.08 DU to -9.11 DU
10-90 percentile range	-21.69 DU to -6.11 DU
min-max range	-30.91 DU to -5.00 DU
OMI CF	48.84 %
Pandora DQ0	31.81 %

RockyFlats



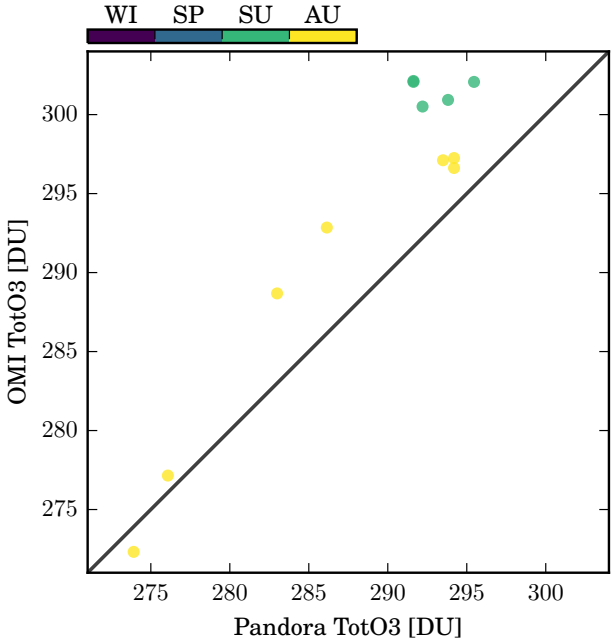
longitude, latitude	-105.19, 39.92
num data points	12
max Pan. (Pans.)	1 (31)
CC	0.92
RMS	2.39 DU
SLP	0.96 ± 0.13
mean	4.48 DU
MEDD	4.52 DU
25-75 percentile range	3.15 DU to 6.26 DU
10-90 percentile range	2.31 DU to 7.70 DU
min-max range	-0.77 DU to 8.12 DU
OMI CF	35.29 %
Pandora DQ0	18.36 %

Seabrook



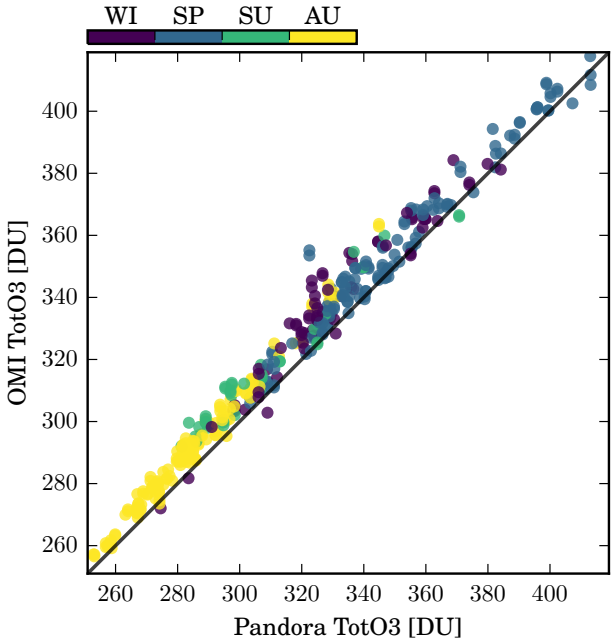
longitude, latitude	-95.3261, 29.9010
num data points	25
max Pan. (Pans.)	1 (27)
CC	0.96
RMS	3.21 DU
SLP	1.01 ± 0.06
mean	5.87 DU
MEDD	6.18 DU
25-75 percentile range	3.46 DU to 8.32 DU
10-90 percentile range	1.81 DU to 9.98 DU
min-max range	-1.59 DU to 10.87 DU
OMI CF	44.68 %
Pandora DQ0	27.56 %

Seabrook*



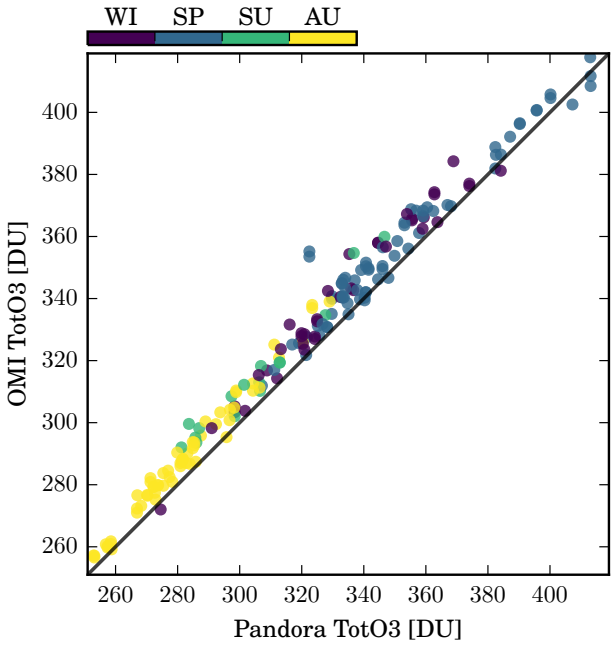
longitude, latitude	-95.3261, 29.9010
num data points	12
max Pan. (Pans.)	1 (27)
CC	0.95
RMS	2.92 DU
SLP	1.29 ± 0.13
mean	5.33 DU
MEDD	6.15 DU
25-75 percentile range	2.90 DU to 7.41 DU
10-90 percentile range	1.21 DU to 10.23 DU
min-max range	-1.59 DU to 10.50 DU
OMI CF	44.68 %
Pandora DQ0	27.56 %

Seoul



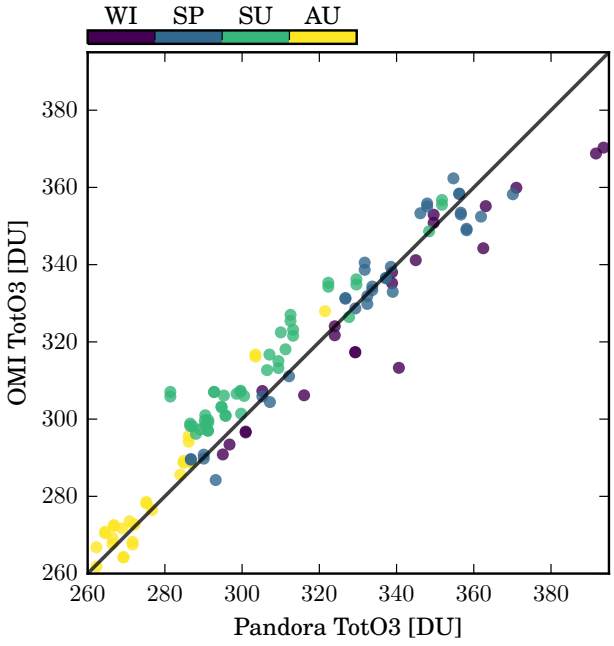
longitude, latitude	126.934, 37.5644
num data points	391
max Pan. (Pans.)	2 (17, 19)
CC	0.99
RMS	4.91 DU
SLP	0.99 ± 0.01
mean	6.78 DU
MEDD	6.38 DU
25-75 percentile range	3.58 DU to 9.69 DU
10-90 percentile range	0.90 DU to 12.66 DU
min-max range	-6.12 DU to 32.72 DU
OMI CF	42.13 %
Pandora DQ0	46.83 %

Seoul*



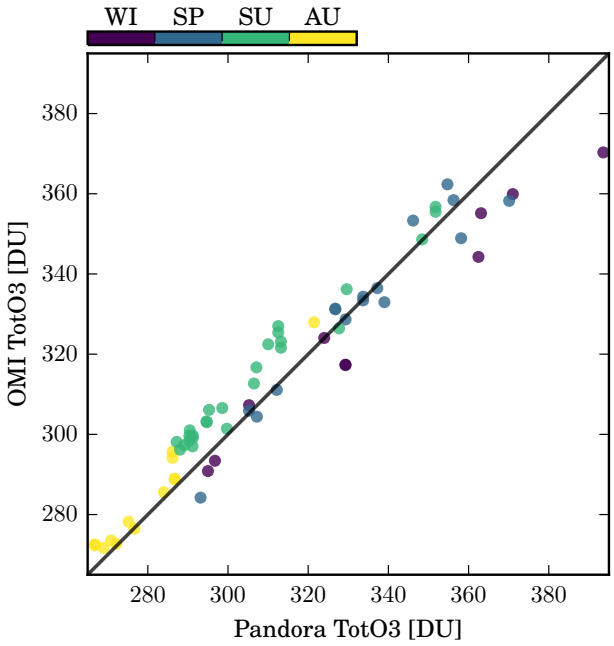
longitude, latitude	126.934, 37.5644
num data points	190
max Pan. (Pans.)	2 (17, 19)
CC	0.99
RMS	4.87 DU
SLP	0.99 ± 0.01
mean	6.87 DU
MEDD	6.51 DU
25-75 percentile range	3.78 DU to 9.60 DU
10-90 percentile range	1.65 DU to 11.92 DU
min-max range	-4.71 DU to 32.72 DU
OMI CF	42.13 %
Pandora DQ0	46.83 %

SERC



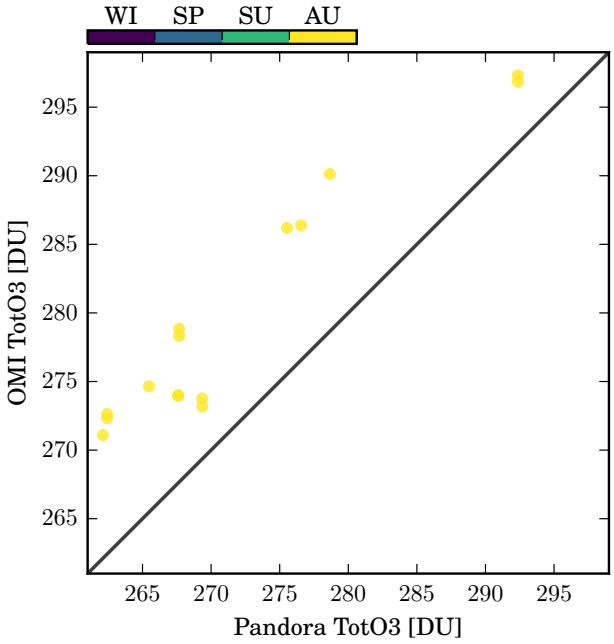
longitude, latitude	-76.55, 38.88
num data points	126
max Pan. (Pans.)	2 (24, 7)
CC	0.96
RMS	7.27 DU
SLP	0.88 ± 0.02
mean	2.47 DU
MEDD	3.17 DU
25-75 percentile range	-1.01 DU to 7.87 DU
10-90 percentile range	-8.40 DU to 11.30 DU
min-max range	-27.32 DU to 25.62 DU
OMI CF	44.64 %
Pandora DQ0	10.66 %

SERC*



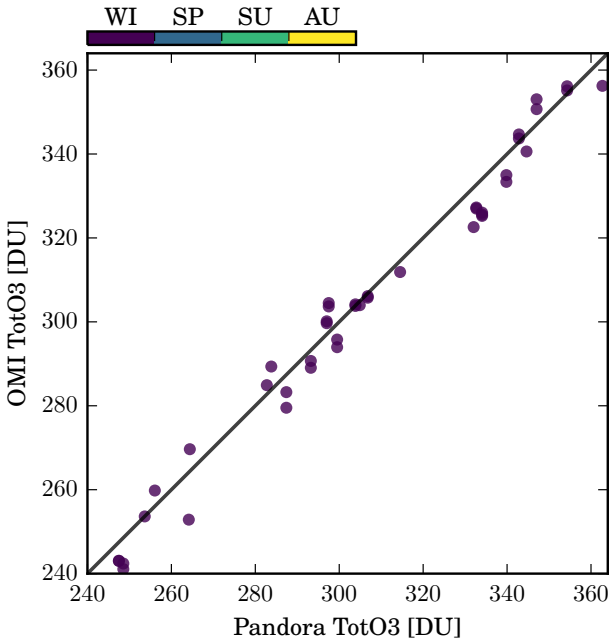
longitude, latitude	-76.55, 38.88
num data points	65
max Pan. (Pans.)	2 (24, 7)
CC	0.97
RMS	6.38 DU
SLP	0.86 ± 0.03
mean	2.28 DU
MEDD	3.01 DU
25-75 percentile range	-0.66 DU to 8.08 DU
10-90 percentile range	-9.11 DU to 9.81 DU
min-max range	-23.29 DU to 14.47 DU
OMI CF	44.64 %
Pandora DQ0	10.66 %

Smithpoint



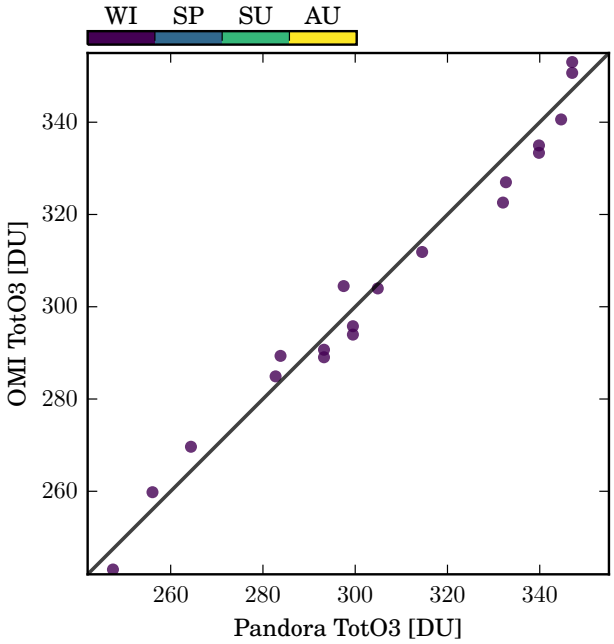
longitude, latitude	-94.7869, 29.5462
num data points	15
max Pan. (Pans.)	3 (29, 36, 8)
CC	0.96
RMS	2.48 DU
SLP	0.89 ± 0.07
mean	8.16 DU
MEDD	9.18 DU
25-75 percentile range	5.65 DU to 10.43 DU
10-90 percentile range	4.44 DU to 10.97 DU
min-max range	3.82 DU to 11.46 DU
OMI CF	40.48 %
Pandora DQ0	38.87 %

Tranquility



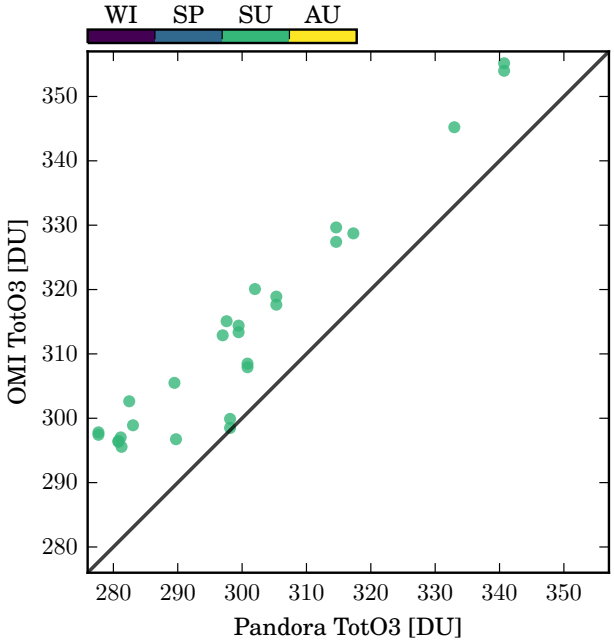
longitude, latitude	-120.3824, 36.6341
num data points	42
max Pan. (Pans.)	1 (26)
CC	0.99
RMS	4.82 DU
SLP	1.00 ± 0.02
mean	-2.00 DU
MEDD	-2.60 DU
25-75 percentile range	-5.65 DU to 1.84 DU
10-90 percentile range	-8.01 DU to 5.10 DU
min-max range	-11.29 DU to 6.98 DU
OMI CF	61.62 %
Pandora DQ0	31.49 %

Tranquility*



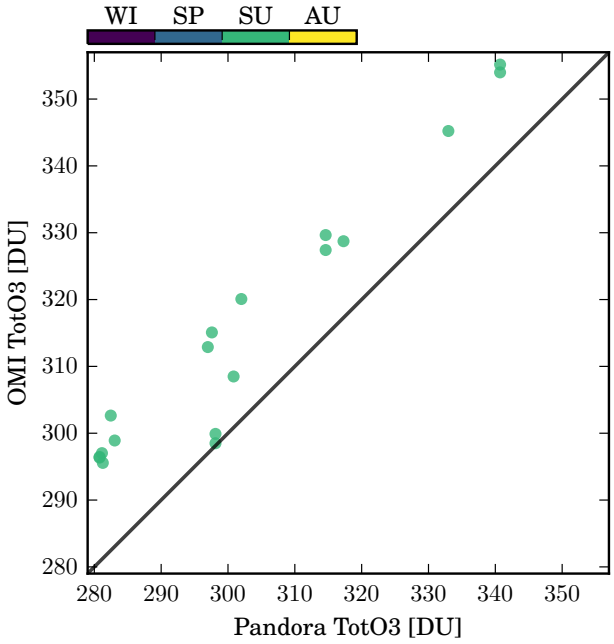
longitude, latitude	-120.3824, 36.6341
num data points	19
max Pan. (Pans.)	1 (26)
CC	0.99
RMS	4.68 DU
SLP	0.96 ± 0.04
mean	-1.11 DU
MEDD	-2.64 DU
25-75 percentile range	-4.65 DU to 3.70 DU
10-90 percentile range	-5.84 DU to 5.63 DU
min-max range	-9.45 DU to 6.98 DU
OMI CF	61.62 %
Pandora DQ0	31.49 %

UMBC



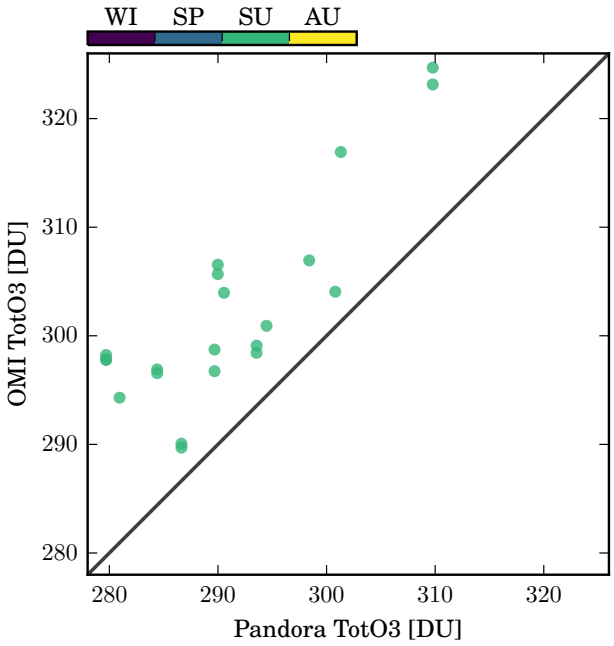
longitude, latitude	-76.709157, 39.2547
num data points	27
max Pan. (Pans.)	1 (2)
CC	0.96
RMS	4.72 DU
SLP	0.93 ± 0.05
mean	13.43 DU
MEDD	14.45 DU
25-75 percentile range	12.29 DU to 15.89 DU
10-90 percentile range	7.06 DU to 18.75 DU
min-max range	0.37 DU to 20.18 DU
OMI CF	53.73 %
Pandora DQ0	55.65 %

UMBC*



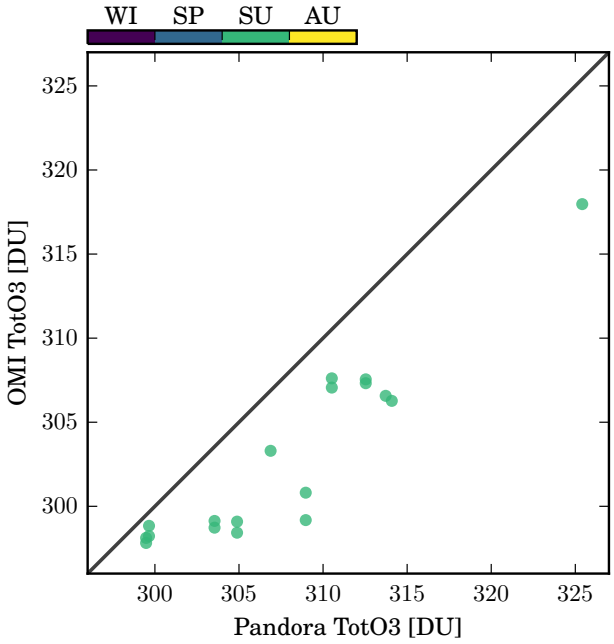
longitude, latitude	-76.709157, 39.2547
num data points	18
max Pan. (Pans.)	1 (2)
CC	0.97
RMS	4.99 DU
SLP	0.96 ± 0.06
mean	13.22 DU
MEDD	14.74 DU
25-75 percentile range	12.38 DU to 15.88 DU
10-90 percentile range	5.89 DU to 17.67 DU
min-max range	0.37 DU to 20.18 DU
OMI CF	53.73 %
Pandora DQ0	55.65 %

UMCP



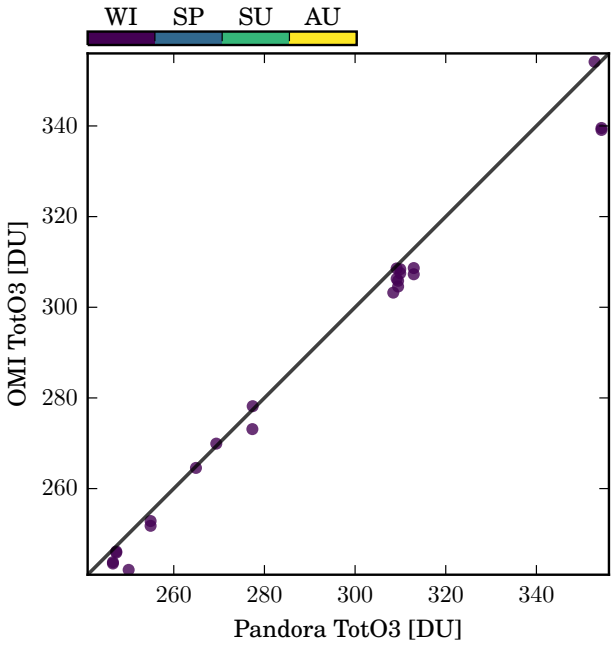
longitude, latitude	-76.942519, 38.990906
num data points	21
max Pan. (Pans.)	1 (21)
CC	0.83
RMS	5.05 DU
SLP	0.88 ± 0.13
mean	11.12 DU
MEDD	12.50 DU
25-75 percentile range	6.45 DU to 15.61 DU
10-90 percentile range	3.42 DU to 18.08 DU
min-max range	3.07 DU to 18.53 DU
OMI CF	56.00 %
Pandora DQ0	58.80 %

USNA



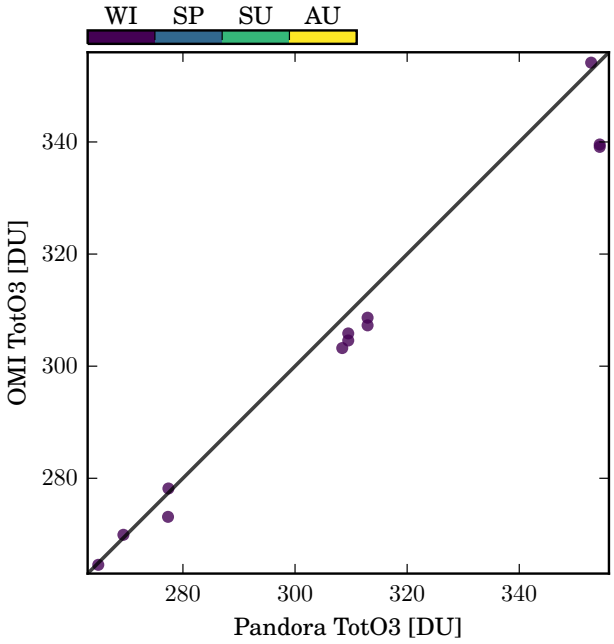
longitude, latitude	-76.479558, 38.983673
num data points	18
max Pan. (Pans.)	1 (25)
CC	0.93
RMS	1.96 DU
SLP	0.75 ± 0.07
mean	-4.85 DU
MEDD	-4.90 DU
25-75 percentile range	-6.98 DU to -3.05 DU
10-90 percentile range	-7.92 DU to -1.40 DU
min-max range	-9.79 DU to -0.81 DU
OMI CF	56.90 %
Pandora DQ0	20.05 %

Visalia



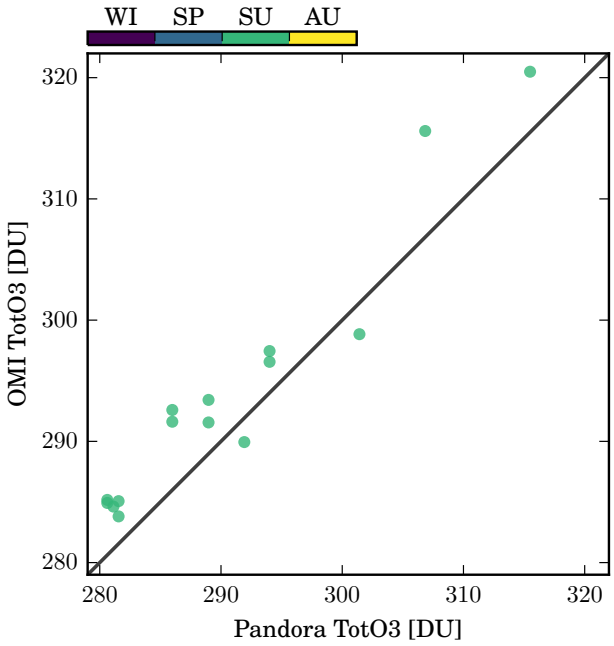
longitude, latitude	-119.3930, 36.3141
num data points	23
max Pan. (Pans.)	1 (18)
CC	0.99
RMS	3.67 DU
SLP	0.95 ± 0.02
mean	-3.69 DU
MEDD	-2.87 DU
25-75 percentile range	-4.60 DU to -1.32 DU
10-90 percentile range	-7.51 DU to 0.37 DU
min-max range	-15.24 DU to 1.32 DU
OMI CF	68.57 %
Pandora DQ0	64.00 %

Visalia*



longitude, latitude	-119.3930, 36.3141
num data points	12
max Pan. (Pans.)	1 (18)
CC	0.99
RMS	3.99 DU
SLP	0.89 ± 0.04
mean	-4.64 DU
MEDD	-4.26 DU
25-75 percentile range	-5.31 DU to -0.12 DU
10-90 percentile range	-13.89 DU to 0.75 DU
min-max range	-15.24 DU to 1.32 DU
OMI CF	68.57 %
Pandora DQ0	64.00 %

WeldTower



longitude, latitude	-104.73, 40.39
num data points	15
max Pan. (Pans.)	1 (21)
CC	0.96
RMS	2.79 DU
SLP	1.01 $\pm$ 0.08
mean	3.51 DU
MEDD	3.52 DU
25-75 percentile range	2.57 DU to 4.77 DU
10-90 percentile range	-0.29 DU to 6.22 DU
min-max range	-2.58 DU to 8.76 DU
OMI CF	39.13 %
Pandora DQ0	37.65 %