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Atmospheric Measurement Techniques Discussions
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Interactive comment on "Sulphur dioxide (SO_2) vertical column density measurements by Pandora spectrometer over the Canadian oil sands" *by* Vitali E. Fioletov et al.

Anonymous Referee #1

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The paper describes first measurements of vertical column density of sulfur dioxide (SO2) in Canadian Oil sands region using ground-based PANDORA instrument in direct sun mode applying DOAS retrieval technique. The paper is particularly suitable for publication in AMT because it introduces new and practical method of measuring column amounts of important criteria pollutant SO2 gas, which is precursor for sulfate aerosols. The paper is well written and discusses in sufficient details important aspects of the measurement technique, including the instruments, installation, operations, DOAS retrieval algorithm (comparison of different spectral fitting windows), modified calibration procedure for SO2 (SCD reference), VCD conversion, data filtering and error estimates. References to the previous work are adequate and comprehensive.

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Discussion paper

The paper further discusses important relationship between SO2 surface concentrations and columns as well as their dependence on wind direction relative to the SO2 emission point sources. The paper further compares ground-based measurements with aircraft in-situ measurements (spirals) as well as with satellite OMI retrievals. The paper will be of great interest for a broad audience including DOAS community, atmospheric scientists, air quality decision makers and satellite retrieval community.

The paper can be accepted for publication with only minor suggestions:

General comments:

I suggest changing spelling of “suphur” to “sulfur” throughout the paper to make it consistent with previous papers on SO2 measurements.

Technical comments:

1, 17: I suggest removing sentence about spectral fitting uncertainty (0.05DU) from the abstract, because it is only part of the total error.

1,30: with [the] oil sands operations

2,9: remove, add: Many satellite . . .provide total column value[s] [once a day]

2,10: Add: [Time resolved] ground-based measurements. . .

2,31: add reference for MAX-DOAS SO2 measurements: [Theys et al., JGR, 2015]

3,2 add comma: ,which

5,10 add parenthesis: (Fig.3c)

7,30: explain how PANDORA measures ozone and how ozone absorption could interfere with the SO2 retrieval?

8,6: colors

9,17: suggest additional scenario for calculating aircraft in-situ integral linearly extrap-

olating aircraft measured mixing ratio below the lowest altitude. This scenario typically produce larger estimate of the SO2 column and would improve comparison with ground measurements on August 24 (Fig 11b) and Sep 3 (Fig.11d).

9,31: the recent version [of the operational OMI SO2 data] based . . .

10,3: . . . and [this] is not surprising

12,28: change to Netherlands Space Agency (NSO).

19, Figure 1 caption, 1: Pandora instrument . . . the instrument's [optical] head . . .

20, Figure 2 caption, 1: Explain how the measured slant column optical depths (red curves) for O3, NO2 and HCHO were obtained?

24, Figure 24 caption, 1: colors

27, Figure 9: caption: Explain that azimuth 0 correspond to Northern wind direction, 180 – from the south, etc.

27, Figure 9 caption, 2: data show . . .

27, Figure 9 caption, 5: based on simultaneous PANDORA and in situ measurements . . .

28, Figure 10 caption, 2: flight[s]

28, Figure 10 caption, 5: are located and [to] the south-southeast . . .

29, Figure 11 caption, 4: missing ratio -> mixing ratio

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