Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2016-274-RC1, 2016

Atmospheric Measurement Techniques Discussions
Open Access
EGU

Interactive comment on "Plume Propagation Direction Determination with SO_2 Cameras" *by* Angelika Klein et al.

Anonymous Referee #1

Received and published: 26 November 2016

The paper by Klein et al. attempts to clarify geometric considerations when observing volcanic plumes by an SO_2 camera system. If the plume has a velocity component toward or away from the camera, derivation of instantaneous SO_2 fluxes can suffer from severe errors if this velocity component is neglected. The paper estimates the related errors based on geometric considerations and it recommends a method how to correct for it in real measurements. The latter is based on the assumption of a constant mean SO_2 flux over an (undefined) period of time.

The question addressed by the paper is technical and basic. It might be suitable for publication in AMT since it could provide citeable documentation of a methodological problem that could be used by others working in the field. However, the authors should invest in reworking the entire manuscript for clarity. Since the

Printer-friendly version

Discussion paper

main benefit of the study is clarity of documentation, it is essential to use precise and unambiguous language.

Comments:

1. I do not understand the method described in section 3:

- How important is the zenith-looking DOAS instrument? Are there any input variables (e.g. plume center distance) derived from it? If so, this should be made clearer (including the abstract and conclusion) since it implies the necessity to operate a zenith looking DOAS instrument in addition to the camera.

- What is the assumption of "constant SO_2 flux" (L220) and "mean flux" (L192) exactly? Do you mean that "Φ" calculated through equation (1) and then, averaged over a certain period must be the same for all camera pixels? What is the averaging period?

- Is the wording "SO_2 flux" (equation (1), units molec/s) and "SO_2 emission rate" (e.g. Fig. 9, units kg/s) interchangeable for your purposes? The use of different terms for the same quantity might be confusing.

- What is "CD" (acronym never defined)? Is it the column density along the line of sight? Why not use your symbol S or s?

- L238: "This result is nicely comparable with the result from the traverse measurements." Are these traverse measurements shown anywhere? Replace "nicely" by a quantitative measure.

- Doesn't Fig. 11 show that your correction only works if wind direction does not

change? Generally, I have a hard time to follow the reasoning in section 3.2. Please extend and clarify or remove.

- Caption Fig. 11: “corrected for the perspective”. What do you mean?

2. Given that the main benefit of the paper is technical documentation, it should clearly mark the range of applicability. There should be a discussion on “finer” effects and their consequences, e.g. radiative transfer issues, inhomogeneous plumes, bent plumes, several plumes partially masking each other, large SO_2 optical thicknesses.

3. The paper several times quotes the “compensation effect” (e.g. L252). A key motivation of the work is to show that the “compensation effect” does not work. It might be useful for the general (non-expert) reader to add some explanation and discussion on this effect. Doesn’t Fig. 4 show that the compensation effect works perfectly for the telecentric “approach”?

Other comments:

Abstract, L16: “Here we propose a new method . . .” Isn’t the new method based on the assumption of constant mean SO_2 fluxes? I would argue that this assumption is utterly important to mention, in particular since the goal is to study SO_2 flux variability (L25).

L44: SO2 -> SO_2

L47: “Future developments promise further improvements”. Remove, devoid of any content.

L50: optical density -> absorption optical density

L52,55: light extinction due to scattering by aerosols and molecules

L57, 58: While not central to the paper, it might be worthwhile mentioning typical assumptions: small ODs, absorption cross section that are independent of ambient pressure and temperature?

L95: Put a reference to Fig. 1 already here.

L173: "(consisting of only one large pixel)" I do not understand this comment. Please explain.

L174: Explain what orthographic, telecentric and perspective projections are.

L232: CD: acronym not defined.

Fig. 3: "plume diameter" -> plume distance (and diameter)

Fig. 8: Why is the FOV angle called "alpha"? The text calls it "gamma", while "alpha" is the inclination angle.

Fig. 9: Caption: SO_2 fluxes, Figure y-axis: SO_2 emission rates. Are they the same?

Fig. 10: "Mean flux" -> Is it the same quantity as the SO_2 emission rates in Fig. 9? What is the averaging period?

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-274, 2016.