

Interactive comment on “Optical flow gas velocity analysis in plumes using UV cameras – Implications for SO₂-emission-rate retrievals investigated at Mt. Etna, Italy, and Guallatiri, Chile” by Jonas Gliß et al.

Anonymous Referee #3

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General comments:

This paper introduces a new post-correction method for the output of the Farneback optical flow algorithm. The Farneback algorithm tends to fail in low contrast regions, such as the central plume region, and apparently does not give any uncertainty estimate nor quality flags for its output that would allow a straight-forward filtering of unreliable motion vectors. The unphysical output is characterized by short randomly oriented vectors. The proposed post-correction method exploits this feature and replaces the unphysical output within a selected plume region by a local average obtained from a

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histogram analysis. Better velocity estimates for the plume central regions are thus obtained and the corresponding estimates of sulfur dioxide emission rates improved.

Evidence on the performance of the proposed post-correction algorithm is given for two different volcano cases: Mt. Etna in Italy and Guallatiri volcano in Chile. The algorithm has many tunable parameters but appears to perform well with the selected parameters for the two cases. The results are comparable to two reference methods: a cross-correlation method and using the uncorrected output from the Farneback method. The post-corrected emission rates are larger than the uncorrected ones, as expected when randomly oriented vectors are replaced by the local average. For the remotely located Guallatiri, estimates of the sulfur dioxide emission rate are given for the first time.

The manuscript is within the aims and scope of AMT and is suitable for publication with the corrections listed below. The scientific methods are commonly used in the field and presentation quality is generally good.

Specific comments:

P7, L8-11: Could you please add more details on the determination of the background intensities. Do you fit functions to the image background and then evaluate the fitted functions at the plume location to get the background intensity?

P10, Fig.3: Filtering out the vectors shorter than 1.5 pixels seems to effectively remove the unphysical vectors in the background. Considering the vectors in the remaining plume (red / blue shaded areas) how do you distinguish vectors due to real turbulent motion from the unphysical output of the Farneback algorithm?

P12, L17: Please write out the acronym ICA as it is introduced here for the first time.

P15, Fig. 7 and P19, Fig. 11: y-axis labels, legends and caption texts are in-

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consistent in describing what is plotted: absolute deviation $\Delta\Phi$, relative deviation $\Delta\Phi/\Phi_{\text{hybrid}}$ or ratio $\Phi/\Phi_{\text{hybrid}}$. The legend appears to be correct, i.e. ratios are plotted. Please make these consistent.

P19, L5: There is no evidence in the paper to make a generic statement about OF algorithms. Only the Farneback algorithm was applied to two cases. Please be more specific, for example: “We showed that the Farneback algorithm is able to resolve ...”

P25, Table 2: How sensitive is your method to the selection of parameters for the Farneback algorithm and the histogram analysis given here, and also for the selection of the ROI? Did you perform any sensitivity analysis? Is it just trial and error to arrive at the given values for the parameters? Why are both τ_{min} and $|f|_{\text{min}}$ needed in the histogram analysis, as Fig. 3 suggests that $|f|_{\text{min}}$ alone selects the plume region?

Suggestions for technical improvements:

P4, L15 and throughout the text: please do not abbreviate the word “Table” (see Manuscript preparation guidelines).

P6, Fig. 2: there is no label (b). Please remove the “in (b)” at the end of the caption or label the panels as (a) and (b).

P6, L5: replace “data is” with “data are”.

P8, L11 and throughout the text: please use “Figure” at the beginning of a new sentence, not “Fig.”.

P17, L12: replace “flow_histo” with “flow_hybrid”

P20, L3: replace “Etnas” with “Etna’s”

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