Atmos. Meas. Tech. Discuss., 4, C1011–C1013, 2011
www.atmos-meas-tech-discuss.net/4/C1011/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Early in-flight detection of SO₂ via Differential Optical Absorption Spectroscopy: a feasible aviation safety measure to prevent potential encounters with volcanic plumes" *by* L. Vogel et al.

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Received and published: 6 July 2011

I've read with interest the paper entitled "Early in-flight detection of SO2 via Differential Optical Absorption Spectroscopy: a feasible aviation safety measure to prevent potential encounters with volcanic plumes." The paper is clearly written and well structured and is certainly an important and innovative contribution to the boiling hot problem of volcanic plume hazard for the aviation safety. It examines the ability to detect SO2 by a cluster of onboard, forward pointing mini-DOASes and to use their information to avoid

the plume by changing the flight altitude. SO2 is used here as a proxy for volcanic ash, usually the most dangerous compound of the plume. Based on plane approaches of the SO2 rich plume of Popocatèpetl volcano (Mexico), as well as sophisticated radiative transfer simulations, the authors convincingly demonstrate that this technique works very well and at great distance for good viewing visibility. Furthermore, the wavelength dependent attenuation coefficients of SCDs reported in this study will be of interest for the DOAS users among the volcanology community. For these two reasons this paper is a valuable contribution that deserves to be published in AMT. I would like however suggesting a few additions and corrections that could improve the paper before its publication.

General Comments

My main concern is about the applicability of the method in the case of an ash rich plume. The ash plume of Popocatepetl was ash free, while the plumes that are the most dangerous to airplanes are ash rich. I understand that a field campaign with ash and SO2 plume encounters is difficult and costly to set up, but I think that some radiative transfer simulations taking into account ash in the plume should be added to the paper. This might be done for example by adding a collocated scattering and absorbing aerosol in the model run type B, supposed to represent a large scale volcanic plume. This point is important to because Kern et al. (2009) have documented the attenuation effect of ash on SCDs measured using UV cameras measurements. The presence of ash could partly mask the SO2 absorption and diminish its detectability by UV sensors.

The second point that could be improved in the paper is the comparison with the existing multispectral IR imaging system introduced by Prata and Bernardo, 2009. Does it have a longer detection range? Are there cases when UV detection works where IR could fail? Are the two methods complementary (remote detection vs. close range 2D imaging?)

In page 2831 I think the authors could mention the paper by Bernard and Rose (1990) about the crazing effect of H2SO4 on the airplanes windows, which is more detailed that the ICAO report cited in the manuscript.

Technical corrections

Page 2833 ln 10: replace identify by identified

Page 2841. Although I'm not a native English speaker, the last sentence of paragraph 3.3 sounds odd to me and should be reworded

Page 2846: replace e.q. by e.g.

Page 2855 The use of the x symbol for "times" might create some confusion with ln(X) and its Taylor approximation. Also the term "weak absorber" needs to be defined explicitly. Caption of figure 6: replace an vertical by a vertical

Reference

Bernard, A. and Rose, W. I. 1990. The injection of sulfuric acid aerosols in the stratosphere by El Chichón volcano and its related hazards to the international air traffic. Journal of Natural Hazards 3:59-67.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 2827, 2011.