

Interactive comment on “Effect of volcanic aerosol on stratospheric NO₂ and N₂O₅ from 2002–2014 as measured by Odin-OSIRIS and Envisat-MIPAS” by Cristen Adams et al.

Anonymous Referee #2

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1 General Comments

The paper addresses the reduction of NO₂ and N₂O₅ by heterogeneous reactions in the lower stratosphere after mediumsize volcanic eruptions based on satellite data. Anticorrelations between aerosol optical depth and NO₂ can be seen. A big problem with the paper is that it totally relies on monthly zonal means which is not appropriate for the rather local and short lived volcanic plumes. Because of this, MIPAS SO₂ data are provided as 5-day means (Höpfner et al., 2015). Several important volcanic events listed there are missing or placed at the wrong latitude (Figure 3). There is also no need to use inconsistent climatological ozone for the photochemistry, from both instruments,

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OSIRIS and MIPAS, are selfconsistent data available. The paper presents interesting data but before publication it needs major revision.

2 Specific comments

Abstract: Do the authors mean a 4 km thick layer above the tropopause, in tropics and midlatitudes, and against what conditions is the change?

Please define NO_x in line 9 of page 2.

Please improve wording in line 13 of page 3, it contains contradictions.

From the data version number, it looks like that Höpfner et al (2015) is used (line 9ff, page 4), here also the SO₂ data prior to 2005 are OK. In these data, especially if the 5-day means are used, all important volcanic events should be identified with significance (see also lines 15 and 25, page 8). This is not the case for the older dataset presented in Höpfner et al (2013) which had the focus on the middle and upper stratosphere.

For the crude assumptions on the Mie scattering efficiency the wavelength should be repeated (line 2, page 5). The statements on particle size (line 5, page 5) are confusing, more details please, give at least a range for the effective particle size. If you model particle size from aerosol formation from injected SO₂, you get an increase in effective particle size for both volcanoes. What is the basis for the crude error assumptions (factor 3)?

Isn't there also an averaging kernel for OSIRIS (line 19ff, page 5)?

In Fig. 1 an additional panel with the zonal wind at 20 km (?) might be useful (line 21, page 6).

Why are different partial columns given in section 3.3 (line 23, page 7) and earlier in the text (including abstract)?

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In Table 2 at least the eruption of Rabaul in Oct. 2006 is missing.

There appear to be contradictions between Fig. 3 and 4. Improve Fig. 3 concerning SO₂ with the Höpfner (2015) 5-day dataset. Place the symbols for the volcanoes at the correct latitude. It might be better to use volume mixing ratios at 19 km (or 3 km above the tropopause) instead of the partial columns to reduce data gaps. The results are also sensitive to the treatment of negatives in the individual data.

I don't understand the statement on tropospheric water vapor (line 22, page 8). The current understanding is that for explosive eruptions SO₂ is directly injected into the stratosphere, in the plume only water from the volcano might matter, but the satellite sees only what comes out of the plume.

Section 4.2: In Figs. 1, 6 and 7 appear often extinction ratios < 1. Please explain or correct, from definition this should not happen. Please adjust color bars to reasonable range,

Don't use formulations like 'somewhat linear' (line 4, page 10; line 3, page 12).

3 Technical corrections

Line 20ff, page 1: Better 'anticorrelation' instead of 'relationship'.

Line 6, page 5: typo and bad wording.

Figure 3, caption line 4: Do you mean a 4 km thick layer 3 km above the tropopause? Please improve text.

Truncate Figs. 6 and 7 at 12 km, the data below are not reliable. Say 'aerosol extinction ratio' also in captions. The black contours are superfluous. The colorbars should have the same steps as the colors in the figures (less is more!).

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Fig.8: Caption: Say 'correlation coefficient' instead of 'R'. The colorbar should have the same steps as the colors in the figure.

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