

Interactive comment on “Continental Scale Antarctic deposition of sulphur and black carbon from anthropogenic and volcanic sources” by H.-F. Graf et al.

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First of all we would like to thank referees, Z. Fleming and one anonymous, for their constructive comments. We think their remarks helped improving the manuscript.

Both in a way requested an extension of the description of the inventory. We have therefore included few sentences making the approach more obvious for those not wishing to read the original paper. However, since it is so easy to obtain the Shirsat and Graf 2009 article in ACP and would have inappropriately extended the current manuscript, we hesitated to go into more detail.

We have taken Zoe Fleming's comments into account and modified the manuscript
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accordingly. We included the Bahia Paraiso accident, the Eisele et al 2008 article and eliminated “crude information” – although we really did not have much in-depth information on some of the important parameters. Hopefully in the future some of the national services are less reluctant publishing their fuel use information. There are unfortunately not many additional publications regarding Erebus of relevance to our study. We added those known to us, including one in press.

There were several other suggestions by the second, anonymous referee which we shall answer in the following:

DMS: We have currently a small project that aims at including DMS emissions to the inventory and will provide new model simulations to adequately assess the contribution of these marine sources to total sulphur deposition and atmospheric concentration. We have more specifically discussed these contributions in the updated manuscript and have especially made sure that the reader is not confused by this issue by mentioning where appropriate that we deal with anthropogenic emissions of S and BC plus S from Erebus volcano.

Long range transport: We included a short passage discussing the contribution of non-Antarctic sources and make especially use of a very recent publication by Stohl and Sodermann, who stress that it is unlikely that short lived substances have a strong impact on Antarctic pollution, hence underline the importance of local sources.

Seasonality: We are dealing in this manuscript with anthropogenic sources which have a very strong seasonality (shown in the initial Shirsat and Graf 2009 article and compiled in the current manuscript by Table 1). We wanted to avoid overloading the paper with enormous amounts of figures and therefore concentrated on atmospheric concentrations in December, the month with maximum emission and, hence, effect on atmospheric concentration. We followed the suggestion of the referee and included figures showing sulphate and BC concentration in the lowest model level. These show that the concentrations are only small, suggesting negligible effect on radiation and it

is therefore sensible to concentrate on deposition of these substances, which may act also as a placeholder for other, more toxic substances.

Model meteorology: We have included a short discussion regarding parameters we have tested to check model performance concerning meteorology: temperature and wind. Hopefully this is satisfactory. Comparing, as requested, simulated and observed precipitation remains a major problem since we are not confident (due to the fact that much of the snow deposited on ground is from blowing and measurements are prone to huge deficits due to high wind speeds) in the available measurements. Where there is most of the wet deposition, i.e. over the Southern Ocean, there are no observations at all.

We have further considered all the minor comments of the anonymous referee, specifically corrected downwind for upwind (26579, 5), omitted the remark about penguins – we obviously misinterpreted the quoted literature, indicate the effect of model resolution on the representation of topography, explain how weather conditions affect SO₂ build-up and what the effects of the katabatic winds is on the off-shore transport of surface emissions. We finally extended our conclusions as requested.

We would like to stress at the end, and do so in the new conclusions, that the simulations so far do not indicate significant immediate danger to the Antarctic environment as far as sulphur and BC are concerned. There are, however, some “hot spots” of surface deposition where it may be valuable to further search for other species, like heavy metals, polycyclic aromatic hydrocarbons and other toxic substances which are emitted especially together with BC, i.e. from ships. Our model simulation may help defining suitable sites from this analysis.

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