

## Review of Von Hobe et al., ACPD, 12, 30661–30754, 2012

### Reviewer: Rob MacKenzie

This paper presents an overview of the scientific activities undertaken within the RECONCILE project, and attempts a synthesis of these results. The synthesis is not entirely successful, and this will have to be addressed if the paper is to act as more than a “final report” of the project.

It is useful and interesting to read about the RECONCILE project in depth, but a paper in ACP must provide a demonstrable contribution to scientific understanding beyond bringing together previously reported results; even a review must synthesise the previous work into a new perspective, and I did not always find that in this long paper.

The lack of synthesis is most obvious when looking at the Abstract and Conclusions. Although it is good to have a forward look at the end of the Conclusions, there seems to be almost nothing else in this section. I would expect the Abstract and Conclusions to accurately reflect the main scientific findings presented in the paper. Scientific findings which do not merit a mention in the Abstract and Conclusions should be deleted from the main text. Overall, I expect that the paper can be made suitable for inclusion in ACP, subject to addressing my main concern, above, and the substantive points below. I expect that the paper will become much shorter in the process of addressing these concerns.

I want to make plain two conflicts of interest in my comments below. (1) One of the authors, Francis Pope, has recently joined the department I work in. (2) I am co-author of some of the papers to which I refer below. I don't think that either of these minor conflicts invalidates my review.

### Substantive points:

P30668: here, or elsewhere, I expected to read a discussion of the importance of N<sub>2</sub>O (Ravishankara, 2009).

Section 3.2.1. This section should, I think, lay-out clearly the added value of the Geophysica payload compared to that of previous missions, and, similarly, explain how the sampling strategy/flight pattern planning differed from previously. The Geophysica characteristics are discussed in Stefanutti et al. (1999a); the APE-POLECAT payload and sampling strategy are discussed in Stefanutti et al. (1999a, b); and the most recent payload description of the Geophysica is discussed in Cairo et al., (2010), if I'm not wrong. I declare a conflict of interest, being co-author in all of these, but I can't see any reason for not drawing a reader's attention to this prior work, which explains why the payload is what it is and why the aircraft flies as it does.

Section 4.2.2. This section makes important claims about deficiencies in our understanding of the sources and transport of refractory particles in the stratosphere, deficiencies that are highlighted in the Conclusions. However, the reporting of results as fractions and repeated use of the word “many” (p30691 lines 4 and 10) makes it difficult to follow the logic in section 4.2.2. Presumably the space debris are the reason for the change in vertical gradient inside and outside the vortex, whilst there is a second finding – that refractory particles are composed on crustal material at times – which is

equally true of aerosol inside and outside the vortex. Overall, if this is a key section, it should be re-written to present results and implications as clearly as possible.

Section 4.3.3. I did not see any mention of these significant results in the Abstract or Conclusions.

Section 4.3.4 should either summarise briefly the significance of the new measurements (and this summary itself should be referred to in the Abstract and Conclusions) or the section should be deleted. At the moment, the section simply points to other papers.

Sections 4.4.1 and 4.4.2 are very sketchy. If this work is important enough to be included in the synthesis, then it should be described properly. Otherwise, the section should be deleted.

Section 5.2: the scientific significance of this rather long discussion was not clear to me. The message seemed to be “in some respects the model does well, in others it doesn’t”, which is underwhelming to say the least.

Conclusions. Overall, there seems to be a hint of hyperbole in the Conclusions. P30705, lines 5-6. Is the imperative here consistent with the analysis of modest-to-negligible UV increases discussed at the end of section 6? P30705, lines 9-11: this is a rather bald statement. It should be made clear whether the discussion here concerns a direct effect of climate change on the stratosphere, or an indirect effect.

#### **Minor points:**

Author list: the current affiliation of my colleague, Francis Pope, is incorrect.

Abstract: I don’t think it is appropriate to include the clause “and the ozone layer is predicted ...” in the Abstract, because (i) it is not a result of the present study, (ii) it is a statement that should be supported by references, and (iii) it is contentious – perhaps, under global warming, the ozone layer will never return to 1980 conditions.

Abstract and throughout: could I make a plea, perhaps forlorn, not to split infinitives? So, “To predict realistically...” (line 11) and so on. I know it’s pedantic!

Abstract (line 13): do the authors really want to claim that they have been comprehensive in their study of “remaining questions”? There is not a single question I or others could dream up that you have not considered?

Abstract (line 20). This list is so long and complicated I think you’d better just put a full stop after “as follows”.

Abstract (p30665, line 4): is it possible to squeeze in another couple of words to be more specific about which parameterizations in which models are improved (ie treatment in microphysically explicit models, or in global chemistry-transport models, or in chemistry-climate models)?

Abstract, item (3): this is written as a new result, but appears to be confirmatory of earlier work, most recently reinvestigated by Katja Drdla to my knowledge. Also, in what sense can cold stratospheric aerosol be considered to be binary? When it forms late in winter after severe denitrification? This is discussed in the main text but I would prefer not to be left wondering these things as I read the abstract.

Abstract, item (4). Unlike the previous items, this reads like a summary of what has been done, not what has been discovered.

Abstract (p30665, line 16): “largest” not “highest”, surely?

P30666, line 5: this sentence tails off a bit: how much is enough?

P30666: “main scientific findings” to date, presumably, since the project is still running (and will in any case likely produce results after its official end)?

Figure 1: this is a useful figure for those coming into the field, but the caption should be more explicit, detailing what is shown in each insert.

P30672. Should “section 1.4” be section 2.4?

P30671 and/or section 3.1.2. As a co-author, I would argue that the work of Bogdan et al (2003a, b) on finely divided solutions is relevant here, providing a useful complement to the bulk studies. Of course, also because I’m a co-author, I cannot insist that this work is discussed here.

P30676. Line 10. Here, or in section 3.2.1, please give the Geophysica ceiling altitude with the RECONCILE payload.

P30676, line 18. Something funny with the English here. I’d say it should be “which used the premises of...”, or “under the auspices of...”

P30678/9. The final paragraph here might warrant a slight amendment: it is not immediately obvious how using clear-sky data only removes variability due to surface albedo changes.

P30684, line 11: should “LMDZrepro” be “LMDz-Reprobus”?

P30686, lines 5-7. I think this sentence could be more specific, to avoid sending the reader immediately back to the Kuttippurath and Nikulin reference.

Figure 15, caption. The caption must be fully self-contained, so that the reader can understand the content and implications of the figure. I can live with “See main text for details”, but not “See Wohltmann et al. (2012) for details”!

P30698, line 18: This sentence is difficult to follow. Perhaps “or 6.8% of the total” should be parenthesised using brackets or commas or dashes?

P30701, section 5.1: Amendments to models (or modelling), surely?

## References.

Bogdan, A., M. Kulmala, A. R. MacKenzie, A. Laaksonen, M. J. Molina, and A. Avramenko, The study of finely divided aqueous systems as a clue to understanding the formation mechanisms of polar stratospheric clouds: 1. HNO<sub>3</sub>/H<sub>2</sub>O and H<sub>2</sub>SO<sub>4</sub>/H<sub>2</sub>O systems, *J. Geophys. Res.*, 108 (D10), 4302, doi:10.1029/2002JD002605, 2003a.

Bogdan, A., M. Kulmala, A. R. MacKenzie, A. Laaksonen, M. J. Molina, and A. Avramenko, The study of finely divided aqueous systems as a clue to understanding the formation mechanisms of polar

stratospheric clouds: 2. HCl/H<sub>2</sub>O and HNO<sub>3</sub>/HCl/H<sub>2</sub>O systems, *J. Geophys. Res.*, 108 (D10), 4303, doi:10.1029/2002JD002606, 2003b.

Cairo, F., Pommereau, J. P., Law, K. S., Schlager, H., Garnier, A., Fierli, F., Ern, M., Streibel, M., Arabas, S., Borrmann, S., Berthelier, J. J., Blom, C., Christensen, T., D'Amato, F., Di Donfrancesco, G., Deshler, T., Diedhiou, A., Durry, G., Engelsen, O., Goutail, F., Harris, N. R. P., Kerstel, E. R. T., Khaykin, S., Konopka, P., Kylling, A., Larsen, N., Lebel, T., Liu, X., MacKenzie, A. R., Nielsen, J., Oulanowski, A., Parker, D. J., Pelon, J., Polcher, J., Pyle, J. A., Ravegnani, F., Rivière, E. D., Robinson, A. D., Röckmann, T., Schiller, C., Simões, F., Stefanutti, L., Stroh, F., Some, L., Siegmund, P., Sitnikov, N., Vernier, J. P., Volk, C. M., Voigt, C., von Hobe, M., Viciani, S., and Yushkov, V.: An introduction to the SCOUT-AMMA stratospheric aircraft, balloons and sondes campaign in West Africa, August 2006: rationale and roadmap, *Atmos. Chem. Phys.*, 10, 2237-2256, 2010

Stefanutti, L., L. Sokolov, A. R. MacKenzie, S. Balestri, and V. Khattatov, The M-55 Geophysica as a platform for the Airborne Polar Experiment, *J. Atmos. Oceanic Technol.*, 16, 1303-1312, 1999a.

Stefanutti, L., A.R. MacKenzie, S. Balestri, V. Khattatov, G. Fiocco, E. Kyrö, and Th. Peter, APE-POLECAT – Rationale, Road Map and Summary of Measurements, *J. Geophys. Res.*, 104, 23941-23959, 1999b.