

Interactive comment on “Do gravity waves significantly impact PSC occurrence in the Antarctic?” by A. J. McDonald et al.

Anonymous Referee #3

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General Comments

McDonald et al. use measurement data of the POAM III and CHAMP-GPS experiments as well as UK Met Office analyzes to study the impact of gravity waves on Antarctic PSC formation. They present a statistical analysis which is a step forward compared with previous assessments which focus on case studies. The subject is of interest for readers of ACP.

Unfortunately, there are a couple of issues which need to be solved before the paper is suited for final publication (see specific comments).

Since referees #1 and #2 already provided detailed and thorough reviews, this will be a short review.

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Specific Comments

1) POAM measurements are limited to a small latitude band, slowly drifting from 65°S to 90°S during Antarctic winter and spring. The Antarctic Peninsula, being a hot-spot for mountain wave generation and subsequent PSC formation (e.g. Hoepfner et al., 2006; Eckermann et al., GRL, 2009), is located at 65°S to 75°S. POAM observations cover the Antarctic Peninsula in early winter, but do not cover it in late winter/early spring. The authors conclude that gravity waves are important for PSC formation in early winter, but less important later. However, this may be just due to the sampling of the POAM instrument. The authors point out that sampling issues may be a problem for the statistical analysis, but just adding this warning seems insufficient. Most likely another satellite dataset with better spatial coverage needs to be analyzed (e. g. Envisat MIPAS).

2) It seems the authors only consider type 1 PSCs (detected by enhanced aerosol extinction) but not type 2 PSCs (detected by optically thick ray paths, so-called z_min events) in their study. This will most likely have a negative impact on the statistical analysis presented in the paper.

3) Limb-sounders like CHAMP-GPS have limited horizontal resolution and parts of the gravity wave spectrum (i.e. short horizontal wavelengths) are not observed or wave amplitudes are damped. However, this part of the spectrum is probably also relevant for PSC formation, i.e. would be missing in the statistical analysis presented in the paper.

4) The authors should present a quantitative error analysis. Fig. 9 indicates that gravity wave contributions to Antarctic PSC formation are about 40% in June and 15% for later months. However, there are no error bars in Fig. 9 and I am afraid these may be rather large considering general comments 1-3?

5) The introduction of the paper is interesting, but a bit too long. Maybe summarize some of the major outcomes of other studies and references in a separate table or

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appendix?

6) There are some statements about POAM and CHAMP-GPS data quality and resolution, but I did not find corresponding information about UK Met Office analyzes.

7) Maybe indicate climatological values of H₂O and HNO₃ in the plot, i.e. about (3.1 +/- 0.8) ppm and (7.9 +/- 2.9) ppb for 18 km, polar winter conditions (Remedios, ACP, 2007) to give the reader some idea of typical values?

8) Fig. 6 is a bit confusing and should be discussed in more detail in the text. The caption text has errors (black stars and black curves?).

Technical Corrections

none (already listed by other referees)

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 3401, 2009.

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