

Interactive comment on “A decadal satellite record of gravity wave activity in the lower stratosphere to study polar stratospheric cloud formation” by Lars Hoffmann et al.

Anonymous Referee #2

Received and published: 25 October 2016

The paper describes an accurate analysis of the gravity wave activity in the lower stratosphere retrieved from AIRS for the northern and southern hemispheres. A new methodology (detrended and noise-corrected 15 micrometer brightness temperature variances, which are calculated from AIRS channels that are most sensitive to temperature fluctuations at about 17 – 32 km altitude) was developed to introduce the new data set which is presented in this paper. The results of this part of the paper are convincing and the authors put a lot of effort to weight their results in terms of error analysis, observational filter etc. Thus, the formulated goal to provide "the new AIRS data set to identify local hotspots and sources of gravity wave activity, to characterize its seasonal cycle at northern and southern mid and high latitudes, and to analyze

C1

correlations with stratospheric background winds" is well done.

The PSC part is much weaker. Especially, the discussion related to Fig. 11 is only partially convincing.

First of all, in contrast to Section 4, here ERA Interim data are used to specify the atmospheric background. This certainly leads to smooth temperature fields not containing any mesoscale gravity wave activity. I suppose, this was done by purpose. But why? As shown in this paper ECMWF operational analyses and forecasts are reliable to detect gravity wave activity.

Second, the assignment of PSC observations from MIPAS to the AIRS gravity wave activity is somehow strange for me. For example, take Fig. 11 for 25 Jan 2007: Ice PSCs are observed over Scandinavia, enhanced gravity wave activity over Greenland. The respective text reads: "On 25 January 2007, MIPAS detected ice PSCs over Scandinavia as well as Germany and Poland at synoptic-scale temperatures up to 6 – 9 K above Tice. These detections are located downstream of Greenland, where strong gravity wave activity was present at the east and north coast according to the AIRS observations. Weak gravity wave activity is also visible over the Scandinavian Mountains."

The ice PSCs over Germany and Poland are not marked in the plot. But this is minor. Do the authors suggest that the mountain waves over Greenland formed the ice PSCs some 1000 km downstream over Scandinavia? I think so as a quite similar text passage is given for the 7 Jan 2011 case. I would suggest to either run simple backward trajectories to see if Tice was reached on some stage or to use different diagnostics to detect mesoscale gravity wave activity from the ECMWF operational data above the actual observation location. Recently, Khaykin, S. M., A. Hauchecorne, N. Mzé, and P. Keckhut, 2015: Seasonal variation of gravity wave activity at midlatitudes from 7 years of COSMIC GPS and Rayleigh lidar temperature observations, *Geophys. Res. Lett.*, 42, 1251–1258, doi:10.1002/2014GL062891 used a threshold value of the horizontal

C2

divergence to relate their observed gravity wave-induced temperature perturbations to the atmospheric state simulated by the ECMWF. Another possibility would be to use CALIPSO data if available for the time periods to verify the extent, depth, and heights of the detected ice PSCs.

As I wrote before, Section 5 needs careful revision.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-757, 2016.