Reply to reviewer#2

We thank the reviewer for the helpful comments and suggestions on the manuscript. Please find below the point-by-point response and the changes in the manuscript. Replies are presented using times roman fonts and new or reworded text passages from the revised version are highlighted in *italic*.

Minor Comments:

Line 59: I guess not only in the Arctic this is important. . .

Like also reviewer #3 recommended, we are now highlighting Antarctica as well.

Paragraph starting line 83: Your statement '. . .are so far only very limited. . .' when discussing the current (prior to this MIPAS paper) state of PSC type observations. I would argue strongly that the previously-derived CALIOP satellite PSC Climatologies render this statement incorrect. See papers by Pitts et al. (ACP, 2007, 2009 etc). I recommend you be up-front about the previous CALIOP satellite climatologies and note its achievements and strengths, but then state clearly where your new MIPAS dataset fills in gaps left by CALIOP, and the MIPAS dataset strengths. This could be done in a new paragraph following line 110.

We followed the reviewer suggestion and rephrased this section including related Pitts et al. references as well and more context on MIPAS:

CALIOP analyses of multiple winters of PSC particle type distributions in a climatological sense are presented by Pitts et al. (2009, 2011, and 2013). These studies stressed the scientific potential comprehensive multiannual PSC climatologies would have. PSC analyses of MIPAS were so far restricted on individual winters (Spang et al. 2005a, 2005b) or specific case studies (Höpfner et al., 2006b, Eckermann et al., 2009). A better latitudinal coverage up to the pole than CALIOP as well as homogenous day and night time coverage by MIPAS provide substantial additional information on climatological PSC distributions. Furthermore, MIPAS data are available for the time period from July 2002 to May 2006, before CALIOP became operational.

Line 342: Provide a reference that SH winter 2010 was a warm winter. (de Laat & van Weele, Scientific Reports, 2011 , doi:10.1038/srep00038).

We followed the reviewer suggestion.

Figure 5: MIPAS NAT in 2009 (middle top figure) shows NAT between mid May and mid June below about 17km altitude. This is not seen in the CALIOP NAT area (middle bottom figure). This is separate from the tropopause-level NAT &ice issues which you discuss in the text. Can you explain why MIPAS sees NAT here but CALIOP doesn't?

We explained now more detailed the potential processes behind this artificial high cloud detection by both CALIOP and MIPAS in the following paragraph:
"… for each PSC type in Figure 5. Note that the CALIOP and MIPAS detection algorithms are also sensitive to cirrus clouds in the tropopause region. In May, CALIOP and especially MIPAS show clouds classified as NAT at 12 km, which might be an artefact of the algorithms. It should be mentioned that CALIOP is detecting by far more ice than NAT clouds in this altitude region, and that the total coverage for NAT plus ice of both instruments is in good agreement. This is indicating that cirrus clouds at the tropopause are the most likely explanation for these detections. For so far unknown reasons these early winter cloud events at the tropopause are in most cases miss-classified as NAT for MIPAS. In addition, the MIPAS measurements show cloud detections at higher altitudes than CALIOP (up to 16 km) for this early winter period. The large FOV of MIPAS likely causes these unexpected and potentially overestimated cloud tops at and above the polar tropopause. Optical thick cirrus clouds in the lowest part of the FOV create overestimation in cloud top height of up to 1.5 to 2 km for IR limb sounders (Spang et al., 2012, Spang et al. 2015). The vertical grid box size of 2 km for MIPAS compared to 180 m for CALIOP causes also a slight overestimation in the cloud top occurrence statistics for MIPAS."

Line 529-530: You should refer to de Laat & van Weele (Scientific Reports, 2011), doi:10.1038/srep00038 who show anomalously warm temperatures in MLS data and discuss the role of minor SSWs in 2010. Remove and replace line 530 and the personal communication with reference to this paper instead.

We followed the suggestion of the reviewer.

Technical Corrections:

All technical corrections have been considered in revised version of the manuscript.