Dear Peter Haynes,

First we like to thank again the reviewers for their helpful comments on the manuscript. The revised version is definitely improved and we are happy to do the final correction and clarification for the final version accordingly to your suggestions and the minor comments by reviewer#2.
In addition, we like to thank the editor for handling the manuscript throughout the review process.

Please find below our point by point response.

Best regards

Reinhold Spang

Reply to the comments by reviewer#2:

1. New figure 12, top panel: The authors should use a finer axis scale for potential temperature; although the air is "moving isentropically", a scale in the interval of e.g. [338 : 345]K would be more appropriate. Actually, the air is slightly cooling, probably due to radiation cooling.

In Figure 12 we changed the potential temperature scale to 340 – 348 K in order to obtain still a good separation from the temperature trajectories and an identical temperature difference in the y-scale of 8K for both parameters. The slight change potential temperature is now better visible.

2. Page 32, lines 6-8: It is stated here that the vertical positions of the air masses are 400m above the tropopause. Since the standard deviation of the thermal tropopause as derived from ERA data is in order of 560m (as described in section 2.5), the interpretation of the trajectory calculations is then not as clear as stated here. Please comment on this issue.

The zonal mean statistics in Figure 9 showed already the deficit of the model compared to the CRISTA observations to create clouds well (>500 m) above the mid and high latitude tropopause. Consequently the model can only represent cases where the LMS clouds are close to the tropopause (here <~300-400 above the tropopause). The reviewer comment is correct. The distance of the location of the events is in the uncertainty range of the ERA interim based tropopause determination. Therefore, we looked into the temperature profiles of nearby radiosonde stations and found a high tropopause close to 12 km altitude, which is well reproduced by the ERA interim tropopause.

However, although the selected events are very close to the tropopause, the trajectories show how cirrus clouds may form in the LMS. Nevertheless we would like to underline the fact, that the results presented are consistent within the model, which is our major point here. For clarification we would like to show the evolution of the trajectories with respect to the vertical distance to the tropopause in Fig. 12 by adding the tropopause height from ERA interim along the trajectory (see next page).

We will change the section in the corresponding paragraph to:

The vertical positions of the considered air masses are around 400 m above the tropopause (shown by the tropopause height along the trajectory computed from ERA Interim data in Fig. 12). The temporal evolution of the trajectories shows a model consistent cross tropopause transport around 12 hours before the reference time (Fig. 12). At the reference time the air parcels correspond to the highest altitude occurrences of ice water content with respect to the tropopause in the CLaMS model runs.

Technical comment:
Please use “supersaturation” instead of “over-saturation”, since this is the usual term

We replaced the term *over-saturation* by *supersaturation* throughout the complete manuscript.

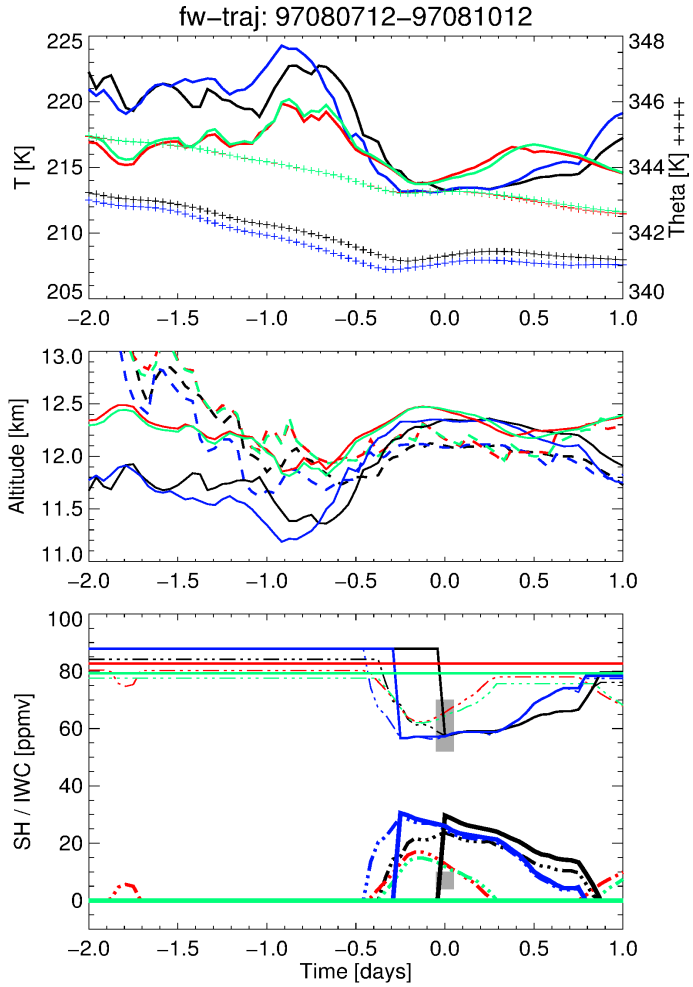

Figure 12: Forward trajectory calculations with respect to the reference time August 9 12:00 (–2 days to +1 day) with 1 hour temporal resolution. **Top:** the panel shows temperature and potential temperature (crosses) versus time for the four trajectories shown in Fig. 12; **middle**: altitude and superimposed tropopause height based on ERA Interim at the location of the trajectory; **bottom:** specific humidity (thin lines) and ice water content (thick lines below 40 ppmv) as simulated with the CLaMS cirrus module. In addition, SH and IWC for the conventional freeze-out at 100% saturation (dash-dotted lines) are superimposed. Grey shaded areas indicate IWC and SH range in the original 24h time step CLaMS model run at the reference time.