We thank the Referee for the comments, see our response below.

General:

In both case studies we added the GPS location colored by number concentration and vertical profiles of temperature and water vapor concentration. Also we added the wind data from the SMEAR II mast (there were no wind measurements available from the airplane during case studies). Also the analysis was expanded to take into account the new figures, especially how it can be difficult to separate horizontal variability from vertical variability in number concentrations given our flight tracks in the case studies.

We expanded on one of the hypothesis by adding the following paragraph:

“Another possibility is that the RL and the FT contain different precursor vapors that did not initiate nucleation or particle growth on their own, however when the vapors are mixed in the interface between the two layers NPF occurs. For example on May 2, 2017 Beck et al. (in preparation) measured the composition of naturally charged ions using a mass spectrometer on board an aircraft concurrently with our measurements. It was found that during the first flight (~02:30-04:00 UTC) the chemical composition was different in the RL compared to the FT. For example highly oxygenated molecules (HOMs) as well as iodine containing compounds were present in the RL while methanosulfonic acid (MSA) and sulfuric acid were detected in the FT.”

Regarding transport we added the following paragraph.

“One possible explanation for the elevated nucleation mode particle layers could be long-range transport coupled with changes in the particle number size distribution such as particle shrinkage. However, it is not clear why such process would favor the RL-FT interface. If the particle emissions were released into the ML they would likely be distributed more or less uniformly throughout the RL and not be concentrated at the top of the RL. If the transported particles subsided from the FT, we would expect to see particle layers at various altitudes in the FT on different days, and the layers would not be localized at the top of the RL. We studied the origin of the airmasses in the particle layers and found that they were mostly coming from the so-called “clean sector” in the northwest of Hyytiälä (Figure 8). During other than winter months this sector is associated with non-polluted air and NPF from natural precursors (Tunved et al., 2006).”

Timing:

There was a mistake in the caption of Figure 3 in the original version. The time range in the new version is correct.

The timing of the particle flux was correct all along.

Location:

We added horizontal flight track plots to the case studies.

Data:

1) The PSM had problems working

2) Kangasluoima et al. (2016) showed that the detection efficiency and cutoff diameter of the PSM had only slight change at 60 kPa compared to 100 kPa, suggesting that the PSM would be suitable for our airborne studies.

However we have had problems with the PSM showing erroneously large concentrations towards the end of ascends usually at altitudes above 2 km. In these cases the background number concentration measured by the PSM, when a filter is placed before the inlet, starts to increase from the normal values at some altitude and keeps increasing until the descend starts.

In the first case study the N(1.5-3) increased in the layer and decreased above the layer, but still remains elevated in the FT during rest of the ascend compared to descend. Since the N(1.5-3) is elevated in the layer but decreases right above it despite the gain in altitude (similar change is seen in SMPS/UCPC) would suggest that the increase in N(1.5-3) is not only due to the elevated background problem that the PSM sometimes shows during ascends.

3) The instruments were powered by separate batteries. The main reason for the limited flight time (~2.5 h) was the battery life. Also on this day we were coordinating our flight with another airplane. The other plane was carrying an instrument (mass spectrometer) that required some periods of stable pressure in order to produce reliable data and that is why there were periods of horizontal flight.

4) The plot contained 30 size distributions the mean time resolution was about 2.2 min (we changed this to the manuscript). The first scan in the figure was at 11:58 and the last scan at 13:03. To match the profile we changed the last scan to 13:17.

5) We think the vertical profile of number concentrations in different size ranges is enough to support the analysis.

References

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