**Response to Reviewer 1**

Thank you very much for your time and effort dedicated to our manuscript! With the help of your advices, we have prepared a restructured, more balanced and more readable version of our manuscript. Our responses to your comments are marked in red below.

In the manuscript, the authors present tethersonde observations of temperature and wind speed during the TARA expedition in 2007.They analyze the occurrence of low-level jets, including statistics on their frequency and providing potential generation mechanisms. The paper is well written and structured. However, the scientific analysis of the tethersonde data needs to be put into a broader context of supporting observations. The results are compared to other studies, but the implications of the results remain unclear.

We have added analyses of supporting observations to put the tethersonde data into a broader context (see below).

Since wind shear below a LLJ core may be the main source of turbulence (Mahrt, 2002; Mäkiranta et al., 2011), it is unfortunate that wind direction is not available from the tethersonde measurements. Surface meteorology data for the whole period may provide important background information on the synoptic situation of each tethersonde launch. Surface pressure, temperature and wind direction also indicate the passage of frontal systems at the site. The temporal setting of the tethersonde profiles close to frontal passages may underline baroclinicity associated to transient cyclones as important LLJ forcing mechanism.

We thank the Reviewer for this suggestion. The ECMWF analyses suggested that five LLJs were related to fronts, but the surface observations showed signs of fronts in only four of them. These four LLJs were also associated with inertial oscillations (2 cases) and baroclinicity (2 cases). Hence, we have modified the manuscript so that we no more treat fronts as a causal forcing mechanism, but explain that a front is a favourable environment for LLJ occurrence, as (a) non-occluded fronts are baroclinic, (b) in case of a cold front, the cold air mass typically penetrates below the warm air mass, building a stably stratified layer in between, which favours the generation of inertial oscillations, and (c) wind in the cold air mass is very often gusty. Via analyses of time series of the surface observations and tethersonde data (when soundings were made frequently) we also found out that frontal signatures were related to 17 of those 22 cases that were previously classified as unexplained with respect to the generation mechanism of the LLJ (the high number is related to the fact that 14 of these unclear cases occurred during four days, affected by four frontal passages). We have modified Sections 3.4 and 3.5, as well as related text in the Abstract and Discussion and Conclusions.

While a potential generation mechanism is provided for about half of the detected LLJs, the other half remains unexplained. Did those unexplained have any common characteristics? How was their distribution over time, did they occur over a period of several days or rather in between periods of LLJs with obvious generation mechanism?

See above: now we only have five unexplained LLJs. Their common characteristic was that the jet was very weak: the strength varied between 2.1 to 3.1 m/s (the threshold for a LLJ was 2.0 m/s). This suggests that the forcing mechanism has been weak too, and therefore it is understandable that it remained unexplained.

Also in terms of the statistics, it would be helpful to have either a table or a timeline figure illustrating the launch time of the individual tethersonde profiles. Having no regularity for daily tethersonde launches, the statistics are biased. LLJs were detected on 18 of 39 days, but it would be wrong to extrapolate the resulting 46% to the whole period 25 April to 31 August. With 18 days of “LLJ detected” and thus 21 days of “no LLJ detected”, the result could be anything between 14 % and 84 % LLJ-days over the entire period. Comparing with other studies, the representativeness of the data collection has to be proven.

We have added a new Figure 2 to illustrate the temporal distribution of soundings. Further, some text was added in the manuscript:

Soundings were made as regularly as possible, depending on the weather conditions and technical possibilities, at least twice a week; the average pause between two sounding days was three days (Figure 2). There were, however, three weeks with only one sounding day per week (because of too heavy wind) and one week without any soundings (because of technical problems) (Page 3, lines 94 – 98).

We have also added an uncertainty estimate for the occurrence of LLJs (Page 5, lines 152 – 153), which is also mentioned when comparing the results against previous studies in Discussion and Conclusions (Page 13, lines 398 – 399).

In the majority of all soundings (54%), no LLJ was identified in the wind profile. Does this number change significantly when adjusting the criteria for Jet definition? Is there a general difference between the days with and without LLJ regarding baroclinicity, trajectories, or cloud cover (from surface radiation data)?

To count the occurrence of LLJs, the highest sounding per each day was chosen; 18 of these 39 cases, i.e. 46%, included a LLJ (Page 5, lines 151 – 152). If we lower the criterion of LLJ to 1.8 m/s$^{-1}$, 51% would be the occurrence of LLJs. The percentage grows quite slowly and in the criterion of LLJ 1.5 m/s$^{-1}$, the value is 62%. If we raise the criterion of LLJ to 3 m/s$^{-1}$, the occurrence of LLJs would be 23%. We have added part of this information in the manuscript.
To compare the level of baroclinicity between cases with and without a LLJ, we calculated for all sounding times the geostrophic wind difference between the surface and 1 km height. The results showed that baroclinicity was twice as common in cases of a LLJ as in cases without a LLJ (Page 8, lines 233 – 236).
Soundings with LLJ cases had twice more western Arctic air masses and almost twice less Russian Arctic air masses than soundings without LLJ (Page 12, lines 386 – 387).
No statistically significant differences were detected in cloud cover between the days with and without a LLJ.

Could the cases without LLJ even be more important for summertime Arctic atmospheric dynamics? What do both the observed occurrence and the absence of LLJs on the drifting ice station Tara imply for the coupling of the boundary layer and the free troposphere over the Arctic Ocean in spring and summer?

In general, the presence of a LLJ enhances the coupling of the boundary layer and the free troposphere (LLJs generated via inertial oscillations are a result of decoupling; in such cases they provide a negative feedback to the decoupling). This is due to the wind shear below the LLJ core, which generates turbulent mixing, which sometimes is an important (even the most important) source for turbulence in a very stable boundary layer. We address the importance and effects LLJs on the boundary layer in the Introduction (Page 2, lines 38 – 43). It is, however, not easy to provide more definite answers to the questions by the Reviewer. Comparisons of the flux-profile relationships in cases with and without a LLJ would allow us to better answer to the questions but, unfortunately, we don’t have high-quality turbulent flux data available from the Tara campaign. Looking at Figure 4 we see that cases with a LLJ are on average associated with higher near-surface temperatures and less strong temperature inversion than cases without a LLJ. We do not, however, have enough arguments to state that these are due to enhanced turbulent mixing due to the shear below and above the LLJ. We wish to have an opportunity to study this in the future on the basis of better data sets.

**Minor Comments:**

Page 2128, lines 18-21: Andreas et al. (2000) studied LLJ using tethersonde data rather than airsonde data, because their airsonde did have a too coarse resolution for wind. In general, balloon-borne radiosondes with 1 sec time resolution and an ascent rate of 5 m/s easily provide vertical profiles of temperature, humidity, wind speed and wind direction with 5 m vertical resolution. Lacking data on wind direction and being limited in launch conditions by wind speed, I don't agree that tethersondes have a "superior applicability in LLJ studies compared to traditional radiosonde soundings".

We agree with the Reviewer and have modified the text.

Page 2129, lines 14/15: How many days during the whole period had to be excluded because of high wind speed? Have the tethersonde measurements been limited by clouds?

Three days had to be excluded because of high wind speed. As the cloudiness in the Arctic is very high, it was not reasonable to avoid clouds. Still, usually the icing was in the cloud more intensive and the balloon did not reach as high as without clouds.

Figure 1: A few gridlines and the coordinates for the start and end point of the drift trajectory would help to pinpoint the measurement location.

We have modified the figure.