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Comment on wes-2022-40

Stefan Emeis (Referee)

Referee comment on "Evaluation of low-level jets in the southern Baltic Sea: a comparison between ship-based lidar observational data and numerical models" by Hugo Rubio et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2022-40-RC1, 2022

The manuscript tries to evaluate low-level jet (LLJ) characteristics over the southern part of the Baltic from ship-based measurements. In principle, this is a good idea. Such information is needed for wind energy purposes and for model evaluation.

Unfortunately, the manuscript and the used datasets have some unfavourite properties which lead to an unsatifying result. Thus, I am sorry to suggest a rejection of this manuscript in its present form. Especially the revision issues 2 and 3 listed below are difficult to heal as they do not originate from the direct influence of the authors. A chance could be to find an attractive scientific question which could be addressed and answered with the available data. But this would mean to write a quite different paper.

There are three major revision issues:

Issue 1:

Astonishingly, the seminal works of Smedman and co-workers on LLJs over the Baltic Sea in the 1990s have completely been ignored.

Two mechanisms are given in the manuscript for the formation of LLJs over the Baltic: (1) advection of nocturnal jets formed over land, and (2) baroclinicity. But one decisive mechanism is missing: the flow transition taking place when air moves from the land to the sea. Especially when warm air moves from rough land to a colder and much smoother sea, a sudden acceleration due to the sudden reduction of surface friction sets in. Smedman and co-workers based their data interpretation on this mechanism.

I suggest that in any new version of this manuscript the section on LLJ formation mechanism is re-written starting with the papers and ideas of Smedman et al. Also a look at a very recent overview paper (most probably it came out after the authors finalized their manuscript) by Schulz-Stellenfleth et al. (2022, DOI: 10.1127/metz/2022/1109) might be useful.

Issue 2:

Evaluation of the lidar data in this manuscript is very much biased by two facts: (1) by the limited height of 300 m of the lidar measurements, and (2) by the ferry time schedule which allows for measurements at certain sections of the ship track at very few hours of the day only. The ship is always at the same place at the same hour of the day. Due to these two facts, neither a proper diurnal variation of the LLJ characteristics nor a proper frequency, core height, and core speed analysis of the LLJs can be made. Due to the second deficiency, the advantage of a moving lidar (compared to those in fixed positions) nearly completely disappears.

Issue 3:

The numerical models used in the manuscript have their own intrinsic deficiencies (in this context, the work of Sandu et al. (doi:10.1002/jame.20013) should be read and cited).

At the end of the day this leads to a comparision between limited measurement data and limited model data which does not really makes sense.

Given the three above mentioned issues, it is not clear to the reviewer what is the actual purpose of this publication? This publication merely gives a record of lidar measurements onboard a ferry. The above mentioned limitations are partly addressed in the manuscript, but no conclusions are drawn from these facts.

A few minor comments:

l 38 „as" instead of „us"

l 44/45 extension: lateral or vertical? (If lateral, it seems very small; if vertical, it seems very large)

l58-61 the paper Wagner et al. (2019) should be mentioned here again as it is already listed in the list of references

l 138-149 “newest”: at least a year must be given or even better a citation in order to properly identify the version of ERA5 data (the hint to the ECMWF webpage does not help either as webpages may be updated in future)

l 182-205 the LLJ detection algorithm can only work, if the height of the LLJ core is much lower than 300 m. What happens, if the core height is closer to the uppermost measurement level? This issue has to be discussed. Fig. 8c proves this problem.