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Comment on angeo-2020-91

Anonymous Referee #1

Referee comment on "Detection of Kelvin-Helmholtz billows over the National Capital Region of India using SODAR" by Nishant Kumar et al., Ann. Geophys. Discuss., <https://doi.org/10.5194/angeo-2020-91-RC1>, 2021

The article is devoted to experimental studies of Kelvin-Helmholtz billows (KHB) in a stably stratified atmospheric boundary layer (SBL) by acoustic sounding. The measurements were carried out in the Delhy region (India) for 9 months using a research one-component (vertical) non-Doppler sodar developed at the National Physics Laboratory (NPL). The relevance of experimental studies of KHB in the ABL is not in doubt at present due to their relationship with the generation of turbulence under dynamic stability conditions. However, there are many remarks to the article.

General remarks:

1) In the Introduction, the research problem is very unclear. The synopsis is written inconsistently. Some parts of the review (for example, lines 49-53) are not related to the topic of the article. The publications cited in the review are randomly selected: many publications are not relevant to the subject of the article (for example, Beyrich, 1993; Choudhury, and Mitra, 2004; van Haren and Gostiaux, 2010). Some of the cited publications do not contain the statements cited by the authors of the article. Some publications are cited incorrectly (see, for example, lines 220 and 289).

In general, based on the review, it is impossible to get a clear idea of the problem, its current state and the specific task posed by the authors.

2) The figures do not illustrate well the work done. KHB are visible more or less clearly only in Fig. 2 and Fig. 4c. But even on these echograms it is practically impossible to

determine the wave parameters, and such estimates are also absent in the text. In addition, the figures are poorly represented (too small inscriptions and numbers along the axes).

3) The article does not analyze the conditions for the occurrence of KHB. Comparisons of sodar echograms with the time series of meteorological parameters according to the data of the weather station at 20 m a.g.l., shown in the two figures, do not give any idea of the relationship between the KHB and the average SBL parameters and are practically not commented on.

4) The article does not contain statistics of frequency and parameters of KHB. The data shown in Table 2 are too few for analysis and conclusions, although they are given in the text.

5) There are no comparisons of the results obtained with other experimental studies, or with models, although there are many such publications.

6) The Conclusion consists of general phrases, and no specific conclusions from the study are provided.

7) The text of the article contains many stylistic, lexical and grammatical errors, which sometimes lead to a complete loss of the meaning of some phrases. Only a small subset of these errors are shown as examples in the next section.

Some specific remarks:

Line 12: The abbreviation "KH" is explained on line 55.

Line 12-13: "KH billows are a primary cause of mixing in stably stratified conditions" - is an unwarranted strong statement. Mixing can be caused by individual bursts, buoyancy waves and non-periodic vortices. Which one is "primary" is unknown. Turbulence in LLJ without KHB is shown in [Kallistratova et al. 2013: Profiles of vertical wind speed variances within nocturnal low-level jets observed with a sodar]. In work [Zaitseva et al. 2017: The Effect of Internal Gravity Waves on Fluctuations in Meteorological Parameters of the Atmospheric Boundary Layer] it was shown that the effect of buoyancy waves on turbulent mixing can significantly exceed the effect of KHB.

Line 16: "K-H billows" is the third version of abbreviation for "Kelvin-Helmholtz billows" in 7 lines.

Line 16: "various minutes" - wrong word choice

Line 17: "lower portion of the troposphere» - wrong word choice

Line 18: «Most recognised billows are round the resolution limit of SODAR» - grammatical errors lead to ambiguous meaning of the phrase

Line 18-19: "several of the cases" – grammatical error

Line 20: "October months", "related with"

Lines 25-42 are not related to KHB, many references are incorrect (eg Asimakopoulos et al., 1976 - not about ABL width, but about Ct^2).

Lines 40-45: Descriptions of two independent processes are mixed, descriptions are inaccurate and do not correspond to the given references.

Line 45: "the turbulence here is thought to be associated with Clear Air Turbulence" – is a tautology here. The term CAT is used in the aviation safety literature to refer to turbulence in the troposphere.

Line 48: "The static stability also modifies the forms of turbulent eddies" - this is an incorrect statement, possibly due to incorrect formulation.

Line 51-53: "The continuous exhaust of smoke from industries and vehicles spreads throughout the atmosphere; however, the direction of movement of smoke is horizontal rather than vertical." - Neither before nor after this phrase is the physics of smoke propagation mentioned, it is not clear why this phrase is here.

Lines 53-56: "When the shear in laminar flow between the masses (e.g., between the cold air below and the warm air above) rises to the point where the flow again becomes unstable, the onset of turbulence increases as Kelvin-Helmholtz (KH) instability on the interface." - it is not clear which physical process is described here, and where this description comes from

Line 57: there is "First", but no "second" in text

Line 61: "by using SODAR and RADAR (Singh et al., 1999; Van and Gostiaux, 2010)" - first author should be cited as "van Haren". There is neither SODAR nor RADAR studies in this article, as this work is about waves in the ocean

Line 52-63: "LIDAR (Lyulyukin et al., 2019)" - this work is devoted to SODAR studies

Line 68: "SODAR (SONic Detection And Ranging)" - abbreviations SODAR already used above

Lines 109-110: "Sound backscattering is found at small-scale turbulent temperature inhomogeneity's (Gilman et al., 1946)" - the link is incorrect because Gilman et al were unaware of scattering by small-scale turbulence

Lines 111-113: the references here are not well chosen, reference should be made to the original works of Tatarsky, Monin and Kallistratova

Line 106: "The example of KHB is presented in Fig. 2" - there is only one example in Fig 1

Line 119: "about the resolution" - wrong word error

Line 128: "temporal analysis", "height of the time series" - lexical or logical errors

Lines 133-135: "the assumption of a prominent role of convection in the formation of waves" - the conclusion looks logically unfounded. The small number of KHB episodes in comparison with the episodes of rising inversions rather indicates the opposite, which is confirmed by the data for March. In general, it is not entirely correct to draw conclusions about the relationship between the two parameters on such a small statistical sample.

Line 137: Incorrect reference. An article (Browning, 1971) is devoted to the study of waves in the upper troposphere, at altitudes of 6-11 km, and does not say anything about the "rising inversion layer" in the ABL

Lines 140-141: "an example ... are shown" – grammatical error

Lines 146-147: The references here are not correct, in the cited works propagation and evolution of the waves are considered. The phrase also contains grammatical errors, probably several prepositions are missing.

Lines 148-150: Link to Figure 4 is provided without any analysis. It is not clear what should be paid attention to in the figure, and what conclusion should be drawn.

Lines 159-160: "And advection velocity that is close to the wind speed averaged over their bottom" - the meaning of this phrase is not clear.

Lines 152-160 and the literature on convection cited in them are not related to the topic of the article and fall out of context.

Lines 161-163: «Petenko et al. (2016) observed and suggested that the eddies responsible for plume-like structures are on the order of the Kolmogorov scale for smooth walls and roughness height for rough walls» - such statements are absent in the work of Petenko

Lines 165-170: also several statements that do not completely coincide with those presented in the work of Petenko (2020)

Lines 176-177 fall out of context. Paragraph construction looks inconsistent and confusing

Line 178: Fig. 4 has already been discussed above, prior to Table 3, it confuses more

Line 181 (Table 4): What Table 3 shows is not clear. There are no heights there, no units are specified. What periods are indicated and how they were determined is not clear.

The numerical values themselves and the methods of their determination also raise questions: what is the meaning of the value 625 ± 620 ? Is there a 99.2% error? It is not clear what days are in question if only one date is given.

Lines 192-193: "The periodicity of the braids is average $(150 \pm 10\%)$ s in the layer depending on the meteorological conditions in Delhi region" - it is not clear how this parameter was calculated, this estimate does not occur in the text above. In the example shown in Fig. 4b, the period of the waves seems to vary from 150 to 300 s. On line 107, the authors give an estimate of 90-110 s. Dependence on meteorological conditions is also not specified.

Line 220: should be written as "DeSilva, I. P. D."

Line 289: should be "van Haren, H."

Figure 1: The capture is too laconic, it is not indicated what is shown on specific panels. Black background makes it difficult to read. No date, too small and frequent numbers on the axes, and especially on the color bar. The time zone, the moments of sunrise and sunset are not specified.

Figure 2: Two images of the same fragment, with a time scale difference of less than 30%

Figure 3: Chosen examples extremely poorly illustrate "clear KHB structures", as indicated in the text

General conclusion.

Despite the fact that the language and presentation of the data can be corrected, the content of the article remains unsatisfactory. The article does not present new and original ideas, the data are scarce and poorly presented. There is no acceptable quantitative (or at least qualitative) data analysis. Rather, the article is based on a presentation of the raw data and its general description. Despite the importance of the subject matter, there is no way to improve the content of the article and it should be rejected.