

Institute of Mathematics of the Academy of Science of the Czech Republic

Žitná 25, 115 67 Praha 1, Czech Republic

SN Applied Sciences

Manuscript title: Closure scheme for stably stratified turbulence without critical Richardson number

Authors: Matteo Caggio^(*), Mario Schiavon, Francesco Tampieri, Tomáš Bodnár

(*) corresponding author, matteocaggio@gmail.com

Response to Reviewers and Editor

Dear reviewers and editor,

We would like to thank you for your comments. We have incorporated all suggestions and marked the changes of the manuscript with colour. We hope we have been able to answer all your requirements and that we have corrected all the misprints.

REVIEWER #1:

– Equations 1-3: should define all variables (velocity, pressure, etc).

Answer: We corrected. Footnote 1 of the old version of the paper has been incorporated in the beginning of Section 2 after the second-order scheme, Eqs. (1) - (3).

– Equations 1-3 and elsewhere: explain colours.

Answer: We removed the colours.

– Footnote 2: why are the diffusion terms neglected if they should not be neglected in stratified flows? This choice should be better justified.

Answer: We modified footnote 2 of the old version of the paper (now footnote 1) in order to better clarify our assumptions.

– Below equation 14: "production of turbulence" should be "production of turbulence kinetic energy"; "dissipation of turbulence" should (I think) be conversion to potential energy via buoyancy flow, shouldn't it? (There is no dissipation term in equation 14.)

Answer: We corrected in "production of turbulent kinetic energy". Equation (14) contains the dissipation term expressed accordingly to the Kolmogorov hypothesis as in (8)₁.

– In (33), the similarity functions are functions of (z/L) , while in figures 1-2 they are plotted as functions of Ri . What happened to z ? In (34) they are shown to be linear in z . Are figures 1-2 plotted at $z = L$? This should be more clear.

Answer: The similarity functions, originally introduced as functions of z/L , could be expressed in terms of the gradient Richardson number as in (34), where G_m , S_m and S_h are functions of the gradient Richardson number (see section 2.4), while $\kappa z/l$, introduced in (36) in terms of z/L , could be expressed as a function of the gradient Richardson number as described in the footnote 3.

– Section 3 should focus on results, and a new section 4 should present conclusions. As is, the manuscript ends abruptly with no concluding discussion or remarks.

Answer: We divided the section containing the results (section 3) from the section containing the discussion of our results and the conclusions (section 4).

– Figures 4-7 should be discussed more clearly and individually. Many details in these figures go unmentioned.

Answer: The description of Figs. 4-7 in Section 4 was extended, including now the more detailed discussion of the presented curves.

I would like to see more discussion of the similarities and differences of the present model with other models in the figures. Yes, it is good that there is no critical Ri , but other models have also removed that restriction. Please clearly describe how your model compares, advantages and disadvantages, etc. Also, to better evaluate this model, it would help to compare with field data or DNS results.

Answer: The description of similarities and difference with respect to other models in Section 3-4 was added, trying to point out the most distinct features of those models compared to the presented one.

There are several minor typos and spelling mistakes that should be fixed on revision.

Answer: We corrected.

REVIEWER #2:

I would only suggest that the authors clearly summarise their scheme.

Answer: The main steps in developing the presented model are now summarized in the last paragraph of the Introduction.

Some typos: Introduction, first line: two consecutive "the" Introduction, last paragraph, line 2: "that does not exhibits any..." suggestion: that does not have Section 3, line three: "for the all range $R_i > 0$, namely it does not present any threshold" suggestion: "for all $R_i > 0$, so there is no threshold.

Answer: We corrected.

EDITOR:

The corresponding author should be highlighted in the order of authors, e.g., by an asterisk. Please understand that the manuscript can only be accepted if a clear indication of the corresponding author is provided in the order of authors.

Answer: We highlighted the corresponding author.

Article Highlights: Please provide three short bullet points (maximum of 120 characters each) summarizing the key findings and implications of the paper. These should be presented in non-technical language and not repeat verbatim text found in the abstract. They should be placed beneath the abstract under the heading of "Article Highlights".

Answer: We added the article highlights.

Introduction: In the final paragraph, explain the structure of the manuscript, i.e., explain how the paper is organized, add the outline of the paper like "In the next section, we consider [...], section 3 shows [...] . In section 4, we present [...]" .

Answer: We added a paragraph in the end of the introduction.

– Authors claimed this is a Research Article (Article type). Thus, a discussion of the results is mandatory. Add a section Discussion. In the section Discussion, do include relevance of your work and explain why it is important, i.e., its relevance and added value. Please note the work presented in the manuscript must be set within the context of other work published previously. Therefore, compare the results presented in the manuscript with results presented in relevant papers published earlier by other authors. Please cite those papers properly and add proper reference.

– Separate Results and Conclusion. Ideally, results are presented in section results, discussed in section Discussion and the summary of the work presented in the manuscript is concluded afterwards.

– Add a section Conclusion: Restate your hypothesis or research question, restate your major findings, explain the relevance and the added value of your work. Highlight any limitations of your study, describe future directions for research and recommendations. No bullet points or enumeration, please.

Answer: We compared our results with results presented in previous relevant papers. We added the section 4 that concerns the discussion of our results and the conclusions. In particular, limitations of our analysis, potential directions of future research and the relevance and added value of our analysis are discussed in the conclusions.

The statement of conflict of interest is not in line with the journal submission guidelines. Please double-check the "Submission guidelines" available at the journal's website ([springer.com/snass](https://www.springer.com/snass)), specifically section "Competing Interests" and adapt the statement accordingly.

Answer: We corrected.

We found overlap with an article by the same author(s) from a conference proceeding which can be accessed at www2.it.cas.cz/fm/im/im/proceeding/2021/2. We recommend the author(s) clearly indicate within their Acknowledgements section that data has been presented previously and provide details of this.

Answer: We better clarified this in the end of the second-last paragraph of the introduction and we added reference [4].

Prague, Czech Republic, 31st May 2022

Sincerely yours,

Matteo Caggio