

Dear Editor:

According to your major and minor comments, we have done the following answers:

### **Major Comments**

**Q1.-Can the authors discuss the applicability of this ABL analysis to wider classes of wave equations. For example, dispersive and/or nonlinear wave equations? Besides geoacoustics, fields such as biomedical acoustics and electromagnetics, often use dispersive and nonlinear models.**

A1.- It would be adventurous to extrapolate directly the analysis in the present work to other methods without conducting actual experiments to support them. However, as requested, we can discuss on the subject. On one hand, the method itself does not make assumptions regarding the underlying PDE or numerical solver employed. On the other hand, it is fairly simple and general, involving calibration 1) on representative models, 2) using well-defined metrics, 3) involving just two parameters. Therefore we believe that the method has potential for broad application without significant modifications, which will be the subject of future research by the authors.

**Q2.- While the PSTD is widely used in wave propagation problems, other numerical methods are also available, such as spectral finite element methods and finite volume methods (amongst others). Are any of these results applicable to such methods. For example, is the efficiency of the SBL relative to the PML restricted to PSTD, or is it a more general result? While I don't expect the authors to implement ABLs in such solvers, a short discussion of the wider applicability would give the paper a wider scope.**

A2.- A similar argument can be made as in the previous question. The method is validated for a particular numerical method and PDE, and three different ABLs, but could be applied to other methods easily as long as we can identify analogous parameters for optimization. Using  $N_{ABL}$  is natural for Cartesian-grid-based methods, but that parameter could be replaced with other analogous parameters that control the thickness of the ABL with respect to the minimum wavelength in the model. As a consequence we have added the following paragraph in the manuscript at the end of section 3.1:

“Moreover, It is important to highlight that the methodology for calibration of ABLs presented in this work is based upon three main components. Firstly, using representative models, secondly, establishing suitable metrics for absorption and finally, reducing the calibration to two parameters. We are not adding any assumptions regarding the underlying PDEs used (linear acoustic waves, in our case). Similarly there are no assumptions tied to the numerical method (pseudospectral time-domain, in our case). Nevertheless two modifications are foreseen for broadening the applicability of the method. On one hand, in the case of using other physical models, we would need to modify Eq. (18) with an alternate energy proxy. On the other hand, in the case of using other numerical methods, we may need to replace  $N_{ABL}$  with an alternative parameter that is a measure of the thickness of the ABL with respect to the minimum wavelength. The actual results of the calibration,

of course, would be different for other PDEs and methods, but the calibration methodology is only expected to require the aforementioned, minor, modifications.”

Finally, mention that these comments were also pointed out by the first referee, therefore we also include the modifications previously done into this final version. Other comments related to this issue can be found in the conclusions.

### **Minor Comments**

**Q1.- Abstract, title of Sec. 2.4: Berenger’s paper uses the term “Perfectly Matched Layer”, not “Layers”. Recommend sticking to the singular.**

A1.- Checked

**Q2.- Line 100: What does “finite in space and time” mean? Does this mean “bounded”?**

A2.- Yes, we replace the word.

**Q3.- Line 245: Gao et al. is repeated.**

A3.- Checked

**Q4.- Line 251: Replace “less” with “the least”.**

A4.- Checked

**Q5.- Line 255: Eq. (18) is proportional to the (discrete)  $L^2$  norm.**

A5.- It is specified into the text.

**Q6.- Figures 3 and 5: The vertical axis is label “energy” which is not precise since the quantity given by Eq. (19) does not have the units of energy. Recommend using the notation defined in Eq. (19) on vertical axis.**

A6.- Changed.

**Q7.- Figure 7: What are the units on the x and z axes?**

A7.- They represent the nodal mesh position at each coordinate. We prefer to keep it this way because we believe that the reader will appreciate that this figure is expressed in terms of numerical parameters, in this case, the number of nodes at each direction.

**Q8.- Line 478: “Such” should not be capitalized. Also, “put to the test” could be replaced with “tested”.**

A8.- Changed.

**Q9.- Line 492: Need a space after “of”.**

A9.- Checked.

Finally mention that we have included into the marked pdf all the changes due to the other reviewer comment’s (including the aforementioned modifications in the major changes). We strongly believe that they improve the quality of the paper and are completely complementary to these changes.