

Interactive comment on “Power Spectra of Random Heterogeneities of the Solid Earth” by Haruo Sato

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I am grateful to Prof. Cormier for his informative comments, which are helpful for revising the manuscript.

(1-3) About the validity of $d \ln V_p/V_s = 1$, $d \ln \rho/d \ln V_s = 0.8$, and their depth dependence. . .

Reply: I agree with the reviewer’s comments. I introduced the reduction of the number of independent randomness in order to simplify the mathematics of elastic wave scattering process (Sato, 1984). Those assumptions are appropriate for shallow depths as the reviewer says; however, many papers use these assumptions in their analyses even in the mantle. I will write comments on this problem in the revised manuscript.

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(4) Resolution limit of the tomography . . .

Reply: I agree that PSDFs estimated from tomography have a problem because of their resolutions. PSDFs estimated from tomography are plotted in Figure 3 a, but they are not plotted in Figure 8, where the annotation “Velocity tomography” in the middle of the figure is mistyped. I will correct it in the revision. As enumerated in Tables, tomography results show $0 < \kappa < 0.5$, which seems to be reliable.

(5) scattering and intrinsic attenuation. . .

Reply: I first intended to review the measurement of intrinsic attenuation in parallel with the estimate of scattering coefficient. But I give up this task since various different assumptions are used in different measurements. Therefore, I do not discuss about intrinsic attenuation in this review paper.

(6) Kolmogorov spectrum. . . . Although viscosity is large, there still may be some validity to consider the shapes and domains of this spectrum for thermally driven convection, similar to its original application to atmospheres. . .but it is quite possible that larger scales (500 km and greater) are. . .

Reply: I also imagine a possibility for the existence of random structure derived from convection motion in the mantle. However, I can not find any literatures which physically derive the power-law spectrum according to the Kolmogorov cascade like process for high viscosity fluids. Therefore, I do not mention about the physical origin and I would like to leave it for future studies.

(7) Smoothness and complexity of heterogeneity spectrum. . .

Reply: I agree that the heterogeneity spectra over a broad scale is multi-modal in character, with each mode driven by a fundamentally different mechanism as the reviewer says. I will refer to Stixrude and Lithgow-Bertelloni (2007) on the velocity variation due to chemical and phase stability at different depths, which is a possible candidate especially for the heterogeneity in the vertical direction.

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(8) Depth dependence of small scale heterogeneity...

Reply: I will comment these works based on the MLTW analysis supposing isotropic scattering in the revised version.

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