Solid Earth Discuss.,
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Interactive comment on "The relative contributions of scattering and viscoelasticity to the attenuation of S waves in Earth's mantle" *by* Susini deSilva and Vernon F. Cormier

Susini deSilva

susinidesilva@gmail.com

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Reviewer: The manuscript presents synthetic seismogram analyses of ScS multiple attenuation varying the importance of intrinsic attenuation and scattering in five different model scenarios. A simple comparison with the range of ScS Q values from a few prior studies and analysis of two earthquakes in this study is used to estimate the approximate balance between scattering and intrinsic attenuation in the upper and lower mantle. The modeling aspect of the study is well-conducted and the five scenarios provide a new and instructive perspective on the tradeoffs between scattering and intrinsic attenuation. The connection of the modeling results to inferences about

Earth's mantle via comparison with observational results is much weaker on account of the choice to ignore the wealth of relevant and easily accessible seismic data in modern community archives. Consequently, I am cautious about the value of the interpretations regarding the balance of scattering and intrinsic attenuation in the real rather than synthetic model mantle. The observational component of the manuscript should be substantially expanded to use global data from many sources and a large number of receivers as the available data resources have advanced greatly beyond those used in most of the references. Comparing a more statistically significant set of waveform analyses to the modeling results would be a powerful approach for evaluating the relative influences of scattering and intrinsic attenuation. Given the quality of the modeling component I would suggest focusing on that in this manuscript and refraining from insights into actual mantle properties rather than just model implications. Or, with much more observational analysis a compelling observational component could be added to this study.

Author Reply: In the interest of considering clear ScS and ScSScS phases uninterfered by depth phases and other arrivals (eg: S, SS, sS), as pointed out in section 2.2, authors prefer the use of deep events and observations in 10 – 30 degree distance range. While authors agree that an analysis of the full observational data set satisfying said conditions would be quite valuable to better constrain predictions regarding the real mantle, the main objective of the study is to set up a well-defined modelling method and illustrate how this perspective can be applied on observational data. Hence the current quantitative predictions of scattering vs. intrinsic attenuation contributions are restricted to the mantle regions sampled by the considered previous studies and presented earthquake data.

In the attached Fig. 1 we illustrate the currently available event clusters with preferable depths and appropriate moment magnitudes (> 6 Mw) from all catalogs of IRIS DMC 1970-01-01 – 2019-11-07, and in Fig. 2 the best distance range to observe uninterfered clear signals of ScS/ScSScS is highlighted (< 30 degrees), for the use of future observational studies applying the discussed method to resolve mantle attenuation characteristics in a global scale. We note that source radiation pattern must be kept in mind when searching for high SNR multiple ScS on transverse component seismograms.

Approximate total numbers of land-based stations (permanent and temporary experiments) available around each regional cluster of suitable events currently available in IRIS DMC are listed below. Tonga-Kermadec region – up to 50, Papua New Guinea region – up to 100, Banda/ Java sea region – up to 200, Philippine island region – up to 200, Japan/ eastern China region – up to 50, Peru/ Chile region – up to 100.

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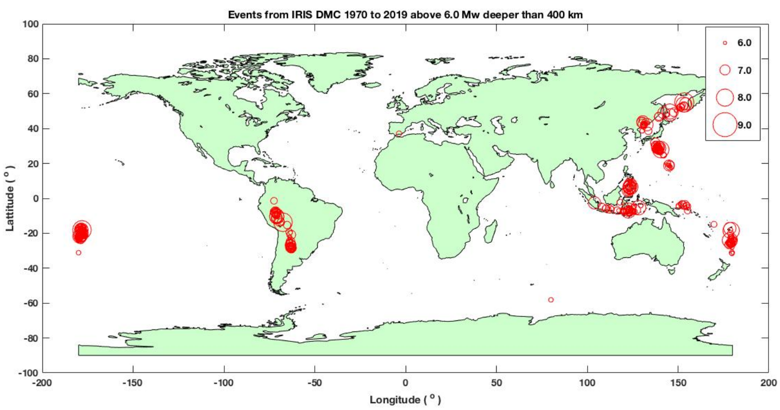

Fig. 1.

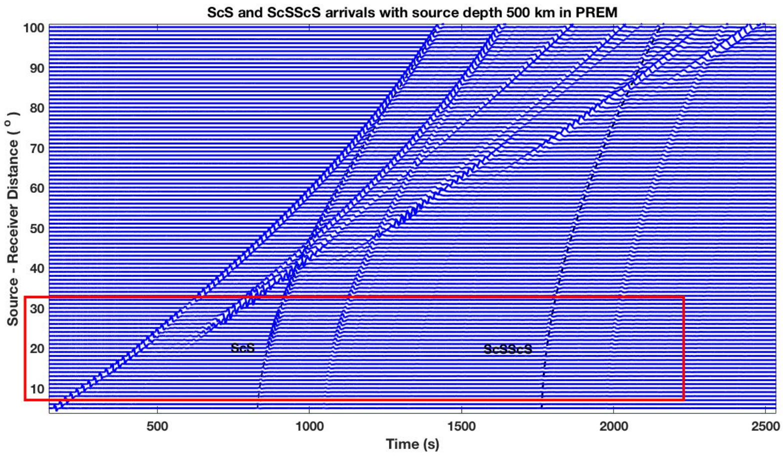
ScS and ScSScS arrivals with source depth 500 km in PREM
Source - Receiver Distance (°)
Time (s)
100
90
80
70
60
50
40
30
20
10
500
1000
1500
2000
2500
ScS
ScSScS

Fig. 2.