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MLTWA and Attenuation mapping of Mount St. Helens (Washington, USA)

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Removing complex path effects is vital to model seismic sources and image volcanic structure. Mount St Helens (MSH), a stratovolcano of the Cascadia volcanic arc and one of the most active in the United States, shows frequency dependent signatures of shallow heterogeneity in seismic signals that bias the final observations, especially if using seismic coda waves. Here we present a novel framework for seismic imaging with coda waves, which can be used to better constrain hazard map and seismic source model.

Multiple Lapse Time Window Analysis (MLTWA) is the most widely used method to discriminate between scattering and intrinsic attenuation in volcanoes.
The technique is applied to MSH to model its average attenuation properties. The dataset comprises waveforms recorded between 2000 and 2003, before the last eruption of the volcano (2004). As a result, we obtain a prevalence of scattering attenuation at lower frequencies (3 - 6 Hz) and absorption at higher frequencies (12 - 18 Hz), suggesting a new interpretation of this behaviour in a volcanic area.

These results have been applied to better constrain the 2D imaging of the MSH using the new technique of 3D frequency-dependent sensitivity kernels in the Q coda waves attenuation imaging.
The main aim is to compare the results of the kernel-based inversion to test the improvement in terms of data fit, resolution and stability with respect to ray-dependent attenuation maps of the area. The sensitivity kernels have been employed to obtain a multiple scattering imaging using frequency dependent kernels based on the Paasschens approximation of the Energy Transport Equation solution in three dimensions. The use of the kernels function can bring to an extension of the resolution of the investigable area and to the removal of low frequencies effects produced by shallow heterogeneity. The combination between the attenuation imaging with geomorphological information (e.g. debris avalanche) allows discriminating surface effect from the plumbing system one.