# Attenuation structure of the crust of Japan revealed from the MLTWA of short period-S waves recorded by Hi-net stations

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Detailed information on the attenuation structure provides insight into the nature of complexities in the earth structure and composition. We compute scattering loss, intrinsic absorption and the seismic albedo, which is the ratio of scattering loss to the total S-wave attenuation, by using the Multiple Lapse Time Window Analysis (MLTWA) (Hoshiba, 1991; Fehler et al. 1992, Sato and Fehler, 1998) in Japan. Also coda attenuation is computed for the same data set and results are compared with those from other attenuation parameters. This work may be considered a reappraisal or extension of the pioneer work done by Hoshiba (1993).

For this study, we have collected Hi-net data from more than 135,000 events with magnitudes higher than 1.5 and maximum 3.5 within the period June 2002-December 2007. Hi-net stations uniformly cover the Japanese Islands with a spacing of 20-30 km, allowing us to plot high resolution maps. From each station we obtained data for the three components and the records provide signals sampled at a 100Hz rate. For every station, we collected events within a radius of 100km and a maximum depth of 40km. At least 20 events are collected at every station to perform each calculation. If a smaller amount of data is available calculations are not performed. Then our results will show lateral variations of the average properties of the crust around each station. We consider the square sum of the three component amplitudes of the incoming S-waves and the following coda as a measure of the energy arriving to the station. Then, a single energy envelope, representing the total energy arriving to each station will be considered for each event. From this envelope, attenuation parameters will be evaluated by using the MLTWA.

The results of every measure for each attenuation parameter are assigned to the coordinates of each station. This is an important decision since we wish to show the dependency of the results with the location of the station used to perform each measurement. The result in each station should represent an average of the attenuation parameters around the station. Taking into account that the maximum hypocentral distance under consideration is 100 km and the maximum depth is 40 km, this is quite a large volume of about 100 km depth (in the single scattering approximation).

In the intrinsic absorption maps we can see the following: i) high levels of absorption in Hokkaido, ii) higher absorption in the west side than in the east side of Tohoku area, iii) high absorption in the volcanic arc in Tohoku for the lower frequencies, iv) high absorption in Central Japan, v) high absorption in the Kinki spot in Kii peninsula and iv) higher absorption in Kyushu than in Chugoku and Shikoku regions. In Figure 2, maps show similar characteristics to those corresponding to intrinsic absorption as well as for the frequency dependence. In the scattering loss maps we notice the following: i) scattering loss is high in the volcanic arc in Hokkaido and Tohoku areas for the 1-2Hz band, ii) high values in some regions of Central Japan, iii) high values in Chugoku region for 4-8Hz, 8-16Hz and 16-32Hz as well as for the Kinki spot, iv) low values in Shikoku for all the frequency bands and higher values in Kyushu. It is possible to correlate these results with results found by means of velocity tomography. A good example of this correlation corresponds to the Chugoku region and to the Kinki spot. In both regions we can see strong frequency dependence for the scattering loss. In these regions, velocity tomography studies have been performed. These studies show the existence of very important velocity anomalies that have been interpreted as upwelling of fluids from the mantle (Nakajima and Hasegawa, 2007). Another good example of this is the behavior of the northern region of Hokkaido, where a large velocity anomaly has been detected (Nakamura et al. 2008).