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Observational evidences of viscoelastic behaviour at low strain

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Theoretical formulations of inhomogeneous waves in low-loss media have been suggested by a number of researchers due to the important role played by anelasticity in changing the characteristics of seismic waves.

The Homogeneous Isotropic Linear Viscoelastic Model (HILV) introduced by Borcherdt (2009) is particularly promising because of its mathematical simplicity and the handiness to test the model in real seismograms.

We showed that the seismograms of the explosion of a 2^{nd} World War bomb found in Milan recorded by a seismic station at 2 km epicentral distance, exhibit a clear elliptical prograde P wave particle motion (Marcellini and Tento, 2011) as predicted by HILV. We observed a similar P wave prograde elliptical motion analysing a ML 4.8 earthquake occurred on July 17, 2011 in the Po Valley at a 48 km epicentral distance from a seismic station located at Palazzo Te, Mantova (Daminelli et al., 2013). In both cases the stations were situated on the deep quaternary sediments of the Po Valley. Based on measured Vp and Vs and the amplitude of the recorded motion, the strain at the station sites was estimated to be 10^{-6}, 10^{-7}.

In this paper we extend the analysis of the previously mentioned seismograms to check the feasibility of HILV application to other types of waves that are particularly relevant in fields such as the engineering seismology. We focus on the S waves (as it is well known HILV predicts the split of S in S type I and S type II) of the seismograms of the earthquake recorded in Mantova and on the Rayleigh waves of the explosion recorded in Milan.

The results show that observational evidences of HILV are not as clear as for P waves, probably because of noise or superposition of converted waves. However, once established the validity of HILV by P waves (that is very simple), the whole seismograms can be interpreted following HILV, confirming the relevancy of anelasticity also at low strain.

Borcherdt, R.D. (2009) “Viscoelastic Waves in Layered Media”, Cambridge University Press, 328 pp.

Marcellini, A. and A. Tento (2011) “Explosive Sources Prove the Validity of Homogeneous Isotropic Linear Viscoelastic Models”, BSSA, Vol. 101, No. 4, pp. 1576-1583.

Daminelli R., A. Tento, A. Marcellini (2013) "A Split of Direction of Propagation and Attenuation of P Waves in the Po Valley". Abstract S31C-2361, AGU Fall Meeting, San Francisco, CA, 9-13 December 2013.