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Improving seismic crustal models in the Corinth Gulf, Greece and estimating source depth using PL-waves

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A recent shallow earthquake in the Corinth Gulf, Greece (M_w 5.3, January 18, 2010; Sokos et al., Tectonophysics 2012) generated unusual long-period waves (periods $>$ 5 seconds), well recorded at several near-regional stations between the P- and S-wave arrival. The 5-second period, being significantly longer than the source duration, indicates a structural effect. The wave is similar to PL-wave or Pnl-wave, but with shorter periods and observed in much closer distances (ranging from 30 to 200 km).

For theoretical description of the observed wave, structural model is required. No existing regional crustal model generates that wave, so we need to find another model, better in terms of the PL-wave existence and strength. We find such models by full waveform inversion using the subset of stations with strong PL-wave. The Discrete Wavenumber method (Bouchon, 1981; Coutant 1989) is used for forward problem and the Neighborhood Algorithm (Sambridge, 1999) for stochastic search (more details in poster by V. Plicka and J. Zahradník).

We obtain a suite of models well fitting synthetic seismograms and use some of these models to evaluate dependence of the studied waves on receiver distance and azimuth as well as dependence on source depth. We compare real and synthetic dispersion curves (derived from synthetic seismograms) as an independent validation of found model and discuss limitations of using dispersion curves for these cases. We also relocated the event in the new model.

Then we calculate the wavefield by two other methods: modal summation and ray theory to better understand the nature of the PL-wave.

Finally, we discuss agreement of found models with published crustal models in the region. The full waveform inversion for structural parameters seems to be powerful tool for improving seismic source modeling in cases we do not have accurate structure model of studied area. We also show that the PL-wave strength has a potential to precise the earthquake depth.

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