Identification of response and timing issues at permanent European broadband stations from automated data analysis

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To tackle the ever increasing amount of available broadband seismic data from European network providers for routine analysis, manual data processing and retrieval of certain observables (e.g. dispersive traveltimes, polarisation parameters) needs to be replaced by automated processing tools. We developed an automated routine to measure inter-station phase velocity curves of fundamental mode Rayleigh and Love waves by pairwise cross-correlating seismograms from all available permanent stations in Central and Northern Europe. Making use of path-specific reference models based on CRUST2.0, only three parameters that control the acceptable bandwidth of a given observation are required for our automated routine to identify and pick acceptable dispersion curves. As the measurements are based on the phase difference of the waveforms at two stations, the measurements are 2π ambiguous and we select the solution that is in general closest to our reference curve. While applying this routine to the entire dataset, we observe at some stations systematic deviations from the expected measurement which may not be related to wave propagation effects. These include timing and response information issues, of the latter most prominently polarity switches. As we compare wavefields that propagate in both directions between two stations, both these effects lead to distinct deviative patterns in the measurements. A polarity problem at one station, for example, leads to dispersion measurements that are offset from the reference curve with a π offset instead of the expected 2π. Timing issues on the other hand lead to symmetric deviations (for the two propagation directions) that are in general smaller than π. Statistical analysis of our measurements against the expected dispersion curves from our reference models allows us to construct a map of anomalous stations in Europe. Furthermore, we have also indications that some instruments may not only have phase but also amplitude issues.