ESC2016-**PREVIEW**, 2016
35th General Assembly of the European Seismological Commission

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European Seismological Commission
4-10 September 2016
Trieste

True backazimuths of surface waves from teleseismic earthquakes across AlpArray Austria measured by two independent methods

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As the first method, we utilize array beamforming technique to investigate deterministic surface waves from teleseismic earthquakes. Because the signal is well recognized and the fundamental mode for both Love and Rayleigh waves is separated before the beamforming, instead of searching for energy of all possible signals, we identify the frequency dependence of surface wave phase velocity and the true backazimuths of propagation. Using the dense seismic broadband network distributed in the Eastern Alpine region with interstation distances around 40 km, we consider each station as a centre of an array of neighboring 5 to 6 or 13 to 15 stations (sub-arrays). This allows us to calculate the local phase velocity dispersion curves for individual sub-arrays. By the beamforming, phase velocities are naturally corrected for the true propagation backazimuth, which is slightly frequency dependent for each event.

The second method uses the polarization of Love and Rayleigh waves. We focus on teleseismic surface waves measured on horizontal components. We filter the records both in the frequency and time domain to find out for which period range and which time window the polarization is stable across the array. This measurement is independent for each station and provides alternative view on the true backazimuths of wave propagation with respect to the array beamforming. This method has two outcomes: we can show how accurate the determination of sensor orientation can be. We measured the true orientation of the sensor by fiber optic compass, so that we can benchmark the teleseismic surface wave polarization. Further, the dispersion curves obtained by the array beamforming can be corrected for the backazimuths determined by the polarization analysis.

We invert the resulting dispersion curves for S and P wave velocity distribution with depth. We obtain a set of 1D models for particular regions of a diameter of 100 – 200 km around each station and to the depth of 200 km beneath the array.