Observations of arrival angles on the USArray

Anna Foster1*, Göran Ekstrom1, Vala Hjörleifsdottir2

1. Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY USA
2. Universidad Nacional Autónoma de México, Mexico City, Mexico

We have made estimates of the arrival angle of Love and Rayleigh waves at periods between 25-100 seconds at stations in the USArray Transportable Array. These estimates are made by fitting predictions of phase from an effective source location to the observed single-station phase measurements at all stations within some radius (100-200 km) of the station of interest. The back azimuth to the best-fit “effective source” corresponds to the best-fit arrival angle. The arrival angles are used to improve our two-station phase measurements, by correcting the geometry of the stations and source. However, on the scale of the TA, arrival angles can also be used to investigate the sources of refraction. As energy from an event propagates across the array, arrival angles tend to be largely unchanged along a given great-circle path. Variations up to 15° are observed perpendicular to the great-circle path direction. These banded patterns indicate that most refraction occurs as a result of large-scale structure outside of the study area. Within the array, the small changes in arrival angle observed in the propagation direction may be due to velocity contrasts within the array, or wave-front healing effects. We compare these observations to equivalent measurements made on synthetic seismograms calculated using SPECFEM3D_GLOBE. The synthetic data show the same banded patterns parallel to the propagation direction as the real data, but with major differences in the magnitude and occasionally even sign of the arrival angles. This comparison of real and synthetic observations can be used as a diagnostic tool to evaluate and improve global earth models.

*afoster@ldeo.columbia.edu