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Small-aperture array translational and rotational seismograms from distant earthquakes - an example of Jan Mayen Mw 6.8 of August 30, 2012 earthquake

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We compare two independent methods of determining phase velocity of body and surface waves. The first method is based on matching the waveforms of relevant acceleration and rotation rate components derived from a small-aperture seismic array (ADR method). The second method utilizes time delays of corresponding wave phases across the small-aperture array, whereas the sufficient accuracy is reached thanks to focusing on times at which the ground velocity passes through zero value (ZPD method). Both methods are illustrated on the Jan Mayen Island earthquake of Mw 6.8 of August 30, 2012, 13:43:23 UTC as recorded in a small array installed in the vicinity of the underground gas storage Pribram-Haje, the Czech Republic. The array consists of 7 broadband stations with flat frequency response between 0.03 to 30 Hz (sensors Guralp CMG-40T). The area of the network is approximately 14 km2. The array is located about 2740 km from the epicenter of the Jan Mayen Island earthquake. Seismic rotation rate components have been calculated by the ADR method, where the applicability of the method was checked by comparing the real array records with those calculated using the first-order Taylor's expansion around central station. The acceleration seismograms have been obtained by performing the time derivative of the corresponding components in the frequency domain. The prevailing frequency of the rotational rate components is 0.08 Hz, while that of the translational components about 0.06 Hz. Very good waveform match is observed both for the transverse acceleration and vertical-axis rotational rate components as well as for the vertical acceleration and translational-axis rotational rate components. For the S-wave group, the velocity derived matching the relevant acceleration and rotational rate components is 5.87 km/s while the velocity estimated from the time delays across the array (ZPD) is 5.74 km/s; in both cases the values correspond to an apparent phase velocity along the surface. For the main surface wave group, amplitude ratios lead to phase velocity of 3.46 km/s which agrees well with the value 3.47 km/s determined using the ZPD method. When using a suitable multiple filtering, both methods allows to determine dispersion of surface-wave phase velocity.