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Multimode Phase Velocity Measurements using a Model Space Search Approach

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Surface wave tomography suffers from limited depth resolution because most information has been derived from fundamental mode phase velocities. By including higher mode phase velocity measurements the depth resolution can be significantly improved. We have adapted the fully non-linear waveform inversion technique of Yoshizawa and Kennett (GJI, 149, 118, 2002) to make multimode dispersion measurements for path specific 1-D profiles, and thus measure both fundamental and higher mode phase velocities with similar coverage. We have extended the method into a fully automatic procedure using a model space search approach which provides us with phase velocity measurements and uncertainties and have analysed over ninety thousand seismograms. The fundamental and higher mode phase velocities of thirteen percent of these seismograms had already been measured by van Heijst and Woodhouse (GJI, 137, 601, 1999), who used a mode branch stripping technique. Our measurements agree extremely well with those from this independent technique. For the multimode analysis we have constructed global Rayleigh wave phase velocity maps (up to the fourth overtone) with unprecedented resolution and for the first time with corresponding uncertainties.