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Wave propagation across a passive margin using coupled local modes

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The coupled-mode method of Maupin (1988) is used to deal with wave propagation in two-dimensional media with rapid lateral variations of elastic properties inside a waveguide, overlying a homogeneous half-space. This method allows a better description of the wavefield than that obtained using the classical ray theory for surface waves, but still at a reduced computational cost in comparison with fully numerical methods. It is based on the expansion of the wavefield on the basis of the trapped, local modes (Woodhouse 1974) of the structure, ponderated by excitation coefficients which are position-dependent. These classical modes, whose energy is confined in the waveguide, are supplemented by the so-called improper (or radiation) modes. The spectrum of these latter is continuous, and they are associated with the energy leak towards infinity below. The lateral evolution of the coupling between the whole set of local and improper modes of a simplified passive margin model, is determined. Specific attention is paid to frequencies where the wavenumber of a mode is close to its cut-off, that is, where a trapped mode is about to enter or leave the continuum. Broadband synthetic seismograms, calculated in an elastic model of the More passive margin (Norway), are presented.