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Formulation of Crustal Correction for the Direct Solution Method and its Application

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Direct Solution Method (DSM; Geller & Takeuchi 1995, GJI) is a method to compute synthetic seismograms by directly solving the weak form equation of motion in terms of appropriate trial functions, which does not require to compute intermediate quantities such as modes of free oscillation. Crustal correction is essentaial in inverting waveform data for mantle structure, and we should compute perturbations of synthetic seismograms for structure model perturbations including depths and shapes of discontinuities.

Woodhouse (1980, GJRAS) formulated such method in terms of mode basis. However his derivation is an extension of the method of Woodhouse (1976, GJRAS) which computes eigenfrequency perturbations by using Rayleigh's principle. It is not obvious whether his derivation is applicable to DSM which does not solve free oscillation problem nor use mode basis.

In this study we formulate the method to compute perturbations of synthetic seismograms by using similar derivation to the derivation of Woodhouse (1976, GJRAS) for eigenfrequencies perturbation. We show that results of Woodhouse (1980, GJRAS) are applicable to DSM regardless of types of basis functions.

Also, we invert broadband waveform data by applying the above crustal correction method. At moment we only have preliminary results, but the model obtained by incorporating the crustal correction shows clearer high velocity anomaly beneath continents and shallower depth extent of high velocity anomaly beneath old oceans. Fitting between data and synthetic seismograms for the inital spherically symmetric Earth model (anisotropic PREM) is greatly improved especially for around 100 sec surface waves by incorporating the crustal correction. If we re-examine data selection and further utilize those surface wave data, further improvement of resolution might be achieved especially for shallower part.