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NUMERICAL EXPERIMENTS IN BROADBAND RECEIVER FUNCTION ANALYSIS

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ABSTRACT

The use of broadband receiver function analysis to estimate the fine-scale *S*-velocity structure of the lithosphere is becoming increasingly popular. A series of numerical experiments shows several important aspects of this technique, with emphasis on estimation of dipping interfaces. The recent modification introduced to the receiver function analysis technique that preserves absolute amplitudes (Ammon, 1991) is more robust than the previous technique of modeling receiver functions that were normalized to unit amplitude. Using the latter method, shallow (e.g., depths less than ~ 2 km) high-velocity contrast interfaces may alter the apparent amplitudes of *Ps* phases and produce inaccuracies in the Earth model developed. The use of absolute amplitudes minimizes this potential for error. When research targets include deep dipping structure, tight stacking bounds (e.g., $\leq 10^\circ$ in backazimuth (BAZ) and epicentral distance (Δ)) should be applied to avoid attenuating *Ps* phases and to aid in the identification of reverberations or scattered energy. Reverberations sample a relatively large lateral range about the recording site (e.g., a radius of 1 to 1.5 times the depth of the reflecting interface) and in the presence of dipping interfaces exhibit drastic variations in amplitude and arrival time as a function of BAZ and Δ. Thus, they cannot readily be used to provide constraints on the Earth structure. Formal inversion techniques, which attempt to match all arrivals in the waveform, must be used with caution when modeling receiver functions from complex regions. Only those phases whose amplitude and arrival-time variations as a function of BAZ and Δ are consistent with those of *Ps* conversions should be modeled. Forward modeling may resolve, depending upon the data quality and noise level, *S*-velocity contrasts greater than ~ 0.2 to 0.4 km/sec. Layers of thickness 2 to 5 km may be accurately imaged, and transition zones may be examined by considering various frequency bands of the data. In order to better understand the resolving power of the data, the averaging functions associated with the receiver functions may be calculated from the observed data and, if desired, used in the forward modeling process.

INTRODUCTION

Teleseismic *P* waveforms recorded at a three-component seismic station contain a wealth of information on the earthquake source, the Earth structure in the vicinity of both the source and the receiver, and mantle propagation effects. Receiver function analysis models the *P*-to-*S* converted phases (*Ps*) and reverberations associated with boundaries beneath the recording site. For events more than 30° distant, *P* waves are steeply incident and dominate the vertical component of ground motion, whereas *Ps* are contained almost exclusively on the horizontal components of ground motion. The amplitude, arrival time, and

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