



Shear wave velocity structure from high resolution 2D Rayleigh wave group velocity tomography for India and surrounding regions

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We use 6794 regional waveforms from 2520 earthquakes ($M > 4.0$) recorded at 242 stations, located on the Indian subcontinent and Tibet, to compute fundamental mode Rayleigh wave group velocity dispersion curves between 10 s and 120 s. The Rayleigh waveforms for all these traces had a signal-to-noise ratio above two for the periods of our interest. The dataset provides a dense sampling of the Bay of Bengal and the Arabian Sea, the Indian subcontinent, the Himalayan foreland basin, the Himalaya, and the Tibetan Plateau, between latitudes 0° to 40° and longitudes 60° to 100° . These 1-D path average group velocity curves were linearly combined through a ray theory based tomography formulation to obtain 2-D maps of lateral variation of group velocities at discrete periods. For the tomography the region is parametrized as 1° triangular elements with slowness defined at the apex of each triangle (node points). The coverage and resolution of the tomography maps are explored by computing ray density map, raypath orientation map and a standard checker board resolution test. The best resolved features in the tomography maps are at periods between 15 s and 45 s and is of the order of $4^\circ \times 4^\circ$. From the ray density and raypath orientation maps we observe that the best resolved grids are the ones where there is maximum ray density and uniform raypath orientation. To optimise the choice of the apriori slowness vis-a-vis the sharpness of the observed anomalies in the tomography inversion, we performed apriori slowness test. We used a number of fixed apriori slowness values and computed the tomography images for every period. A plot of the apriori slowness versus sum of squares(residuals) provides the choice for the optimum value for every period. We observe that for most periods this is marked by a minimum in the tradeoff curve. However, for others we chose the value closest to the origin. Our results reveal that low period tomography maps provide tighter constraints on lateral velocity variations in the crust and image with high resolution ($3^\circ \times 3^\circ$) the cratons and thick sedimentary cover. The regions with low velocities depict the basin areas with high sediment cover whereas the high velocity regions are indicative of the cratons and shield areas. Finally, we model the group velocity curve at each node point using a quasi-linear least squares inversion scheme of Ammon and Hermann (2004) to obtain 1-D shear wave velocity structure beneath the node point. We will use cubic spline interpolation through these 1-D models to obtain 3-D shear wave velocity structure across the region of interest.