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Observability of Multiply Reflected P Waves

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In order to constrain the shallow structure of the Earth in global tomography, Love and Rayleigh waves are often used. However these waves are mostly sensitive to the S wave velocity structure. P-wave energy is evanescent and leaking away at every surface reflection that generates an S wave which travels much deeper into the mantle. For that reason, to study the shallow P velocity structure of the Earth, we need to study P-waves at regional distances if a good seismic station coverage is available. Otherwise we can use multiple P reflections at teleseismic distance when regional data are not available (as in the oceans for instance). The major aim of this work was first of all to ensure that these multiply reflected P waves can adequately be observed in real data and also to investigate after how many reflections at the surface these waves can still be seen.We also investigate how strongly the amplitude of multiply reflected P diminishes because of energy loss into S waves and attenuation.
For this study we are stacking real data in the Time-Slowness domain.We used data records from the dense network of US ARRAY, which allows us to make a very large number of observations. Our study shows that both PPP and PPPP waves show a clear maximum of energy in the Tau-P plot. Which means that they can be well observed for epicentral distances > 60 degrees and for events with Mw >6.0, despite the ray-theoretical prediction that at certain distances almost all of their compressional energy is converted to shear waves. The maximum of energy associated to these multiple P wave consistently shows a negative slowness perturbation (dp). Indicating the waves may deviate from the great circle.