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Travel-time sensitivity kernels in long-range propagation

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The effect of increasing range on the sensitivity of finite-frequency travel-time observables to sound-speed perturbations is studied using the notion of wave-theoretic sensitivity kernels based on the first Born approximation of the Green's function and the notion of peak arrivals. Travel-time sensitivity kernels are examined in a range-independent background ocean environment. While at medium ranges the kernels exhibit zero-sensitivity cores on the eigenrays, these cores shrink and disappear at long ranges due to refraction and the kernels converge in the vertical towards the corresponding eigenrays; this behavior is not observed in free space. On the other hand the kernels expand in the horizontal cross-range direction and attain their maximum extent at the midpoint between source and receiver, similar to the behavior of the Fresnel volume in free space. Thus, stratification affects the shape of the sensitivity kernel in the vertical preventing expansion with increasing range but not in the horizontal such that the sensitivity kernel takes the form of a folded rug expanding the eigenray in the horizontal cross-range direction. [Work supported by ONR.]