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Analysis of resolution problems in ray-based traveltime tomography under regular station deployments like USArray

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Traveltime sensitivity kernels depend on how traveltimes are estimated; with the family of banana-doughnut kernels as well-known good approximations when frequencies are low, and rays when frequencies are very high.
We extend previous analyses on small-scale problems to the case of large and dense arrays like Earth Scope/USArray.
By combination of the multichannel deconvolution method (Jacobsen et al. 1999) and the distortion spectrum method (Jacobsen et al. 2008) we are able to pin down that very pattern in deep earth where efficient approximations (such as geometric rays) perform worst compared to modelling with more accurate sensitivity kernels. We call this special irregular slowness pattern “the Devil’s checkerboard”.
In this way, we show that the ray approximation will tend to fail dramatically for fine scale structure still resolved by accurate sensitivity kernels, and we extend the analysis also to possible shortcomings of other kernel approximations like “fat rays” and summary rays.

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