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Coherence of tracked arrivals in SPICEX

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In the fall of 2004, 250Hz broadband signals were received at 500km and 1000km ranges on a near full water-column vertical array in the North Pacific ocean. Individual ray arrivals of very high SNR could easily be identified and tracked using a turning-point filter (time-delay beamforming accounting for channel structure), thus providing accurate vertical coherence estimates.

The observations can be compared to standard Monte Carlo estimates of coherence made using accurate parabolic-equation acoustic propagation in an ensemble of ocean states consistent with the standard Garrett-Munk ocean internal-wave spectrum. Acoustic coherence can also be expressed as a depth-dependent structure function. This is naturally estimated by the full-wave travel-time sensitivity kernel (TSK) which provides a linearized transformation from the internal wave spectrum to the structure function.

Environmental measurements were conducted almost concurrently with the acoustic trials, constraining the acceptable ocean variability. Allowances must be made for scattering by sound-speed variability along isopycnals (spiciness) in the upper mixed layer. The most important conclusion to date is that the vertical coherence is depth-dependent but this statement must be qualified by the ability of the beamformer to separate arrivals.