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Basin-scale time reversal communications

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During November 1994, broadband acoustic signals were transmitted from a 75-Hz source to a 20-element, 700-m vertical array at approximately 3250 km range in the eastern North Pacific Ocean as part of the Acoustic Engineering Test (AET) of the Acoustic Thermometry of Ocean Climate (ATOC) program [Worcester et al., *J. Acoust. Soc. Am.* 105, 3185-3201 (1999)]. The AET tomography signal can be treated as a binary-phase shift-keying (BPSK) communication signal with an information rate of 37.5 bits/s. With the multipath arrivals spanning 5-8 seconds, this data represents an extreme case of intersymbol interference (ISI). The AET array data are processed using time reversal combined with frequent channel updates to accommodate channel variations over the 20-min long reception, followed by a single channel decision-feedback equalizer (DFE). The almost error-free performance using all 20 array elements demonstrates the feasibility of time reversal communications. Further, comparable performance of single receive element communications integrating over multiple transmissions indicates that the ocean provided temporal diversity as well as the spatial diversity provided by the array.