ACOUSTICS2008/2926
A decade of acoustic thermometry in the North Pacific Ocean: Using long- range acoustic travel times to test gyre-scale temperature variability derived from other observations and ocean models

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Large-scale, range- and depth-averaged temperatures in the North Pacific Ocean were measured by long-range acoustic transmissions over the decade 1996-2006. Acoustic sources off central California and north of Kauai transmitted to receivers throughout the North Pacific. Even though acoustic travel times are spatially integrating, suppressing mesoscale variability and providing a precise measure of large-scale temperature, the travel times sometimes vary significantly on time scales of only a few weeks. The interannual variability is large, with no consistent warming or cooling trends. Comparison of the measured travel times with travel times derived from (i) the World Ocean Atlas 2005 (WOA05), (ii) an upper ocean temperature estimate derived from satellite altimetry and in situ profiles, (iii) an analysis provided by the Estimating the Circulation and Climate of the Ocean (ECCO) project, and (iv) simulation results from a high-resolution configuration of the Parallel Ocean Program (POP) show similarities, but also reveal substantial differences. The differences suggest that the data can provide significant additional constraints for numerical ocean simulations. The acoustic data show that WOA05 is a much better estimate of the time-mean hydrography than either the ECCO or POP estimates and provide significantly better time resolution for large-scale ocean variability than can be derived from satellite altimetry and in situ profiles.

Number of words in abstract: 208
Keywords:
Technical area: Acoustical Oceanography (AO) - ECUA
Session: AO00 - Acoustical Oceanography, REGULAR (not structured)
PACS #1: 43.30.Qd Global scale acoustics; ocean basin thermometry, transbasin acoustics
PACS #2:
PACS #3:
Presentation: Oral presentation preferred
Special facility: No special equipment
Best student paper competition: no
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