

Geophysical Research Abstracts
Vol. 17, EGU2015-12034, 2015
EGU General Assembly 2015
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Temperature and salinity observations with high lateral resolution using acoustic data in the Gulf of Cadiz, NE Atlantic Ocean

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We present a methodology for inverting temperature and salinity from time and space-coincident acoustic reflectivity and XBT data. This method recovers low frequency content (< 10 Hz) of the impedance from XBTs and the high frequency content (> 10 Hz) from acoustic reflectivity. Afterwards, maps of temperature and salinity are calculated from impedance using the GSW equations of state and an empirical T-S relation. Acoustic data allows to recover the main physical parameters of the ocean along lateral sections of hundreds of km, covering all the full-depth water column and with vertical and lateral resolutions of 10 m and 100 m, respectively. This method was applied in the Gulf of Cadiz, NE Atlantic Ocean to recover the main physical oceanographic parameters in the ocean with accuracies of $\delta T_{sd} = 0.1$ C, $\delta S_{sd} = 0.09$ and $\delta \sigma_t = 0.02 \text{ kg/m}^3$ for temperature, salinity and potential density. Inverted temperature anomalies reveal baroclinic thermohaline fronts with intrusions. The observations support a mix of thermohaline features created by both double-diffusive and isopycnal stirring mechanisms.