Geophysical Research Abstracts
Vol. 12, EGU2010-10149-1, 2010
EGU General Assembly 2010

Recent Advances in Seismic Oceanography

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Recently seismic reflection methods have been successfully applied to oceanographic issues. Acoustic imaging of internal oceanic structure (“seismic oceanography”) is providing views of thermohaline finestructure with the potential to provide quantitative information on such processes as internal waves, eddy dynamics, and turbulent dissipation.
Here we present sound-speed data und subsequently temperature and salinity images inverted from combined seismic and hydrographic observations at unprecedented resolution. However, unlike the solid earth, where the boundaries between two rock masses may be sharp and a description by the impedance above and below the boundary suffice, the boundaries in the ocean are affected by diffusion processes, so that the reflection coefficient needs to be described by continuous profiles of the vertical impedance gradient or the underlying properties sound speed and density. These quantities can be related to temperature and salinity of the water. For this we use a T-S(z) relationship (temperature-salinity) derived from CTD observations and the equation of state for seawater to simultaneously calculate temperature and salinity for the whole profile in an iterative process. The inverted temperature and salinity maps thereby allow us to identify different water mass bodies at intermediate scales.
Furthermore, we use these accurate sound-speed models to derive reflector movement velocities of water mass bodies as an additional property from seismic reflection data. For migration of seismic data over the solid Earth we know the geometry and need to find the optimum sound speed model, here we reverse this procedure, given the sound speed model we can compute the optimum geometry for a dynamic fluid and hence its motion. The movement velocity gives a dynamic property to the instant seismic reflector image and may have great potential to study the temporal dynamics of the water structure.