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Acoustic sensing of ocean temperature in the Fram Strait

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Acoustic thermometry builds on accurate measurements of the time it takes for an acoustic signal to travel from the source to a receiver. In most ocean environments, several arrivals are resolved. Acoustic forward modeling, e.g. ray tracing, is used to determine the paths the acoustic energy propagates along through the ocean. If each arrival can be associated with a given ray path, the averaged sound speed along the particular path can be calculated through established inversion schemes. This gives mean temperature with a vertical resolution. Acoustic thermometry provides average temperature along a section of 300 km in 205 seconds and can be repeated as often as wanted. The integral measurements of temperature provided by thermometry are complementary to satellite data, and high accuracy in-situ measurements from moorings and gliders

Under the EU ACOBAR project, a triangle of acoustic sources and receivers was implemented in the deeper part of the Fram Strait to facilitate for acoustic thermometry. The acoustic experiment was implemented August 2010 and completed in August 2012. Acoustic travel time measurements were carried out every 3 hours along 3 tracks over 2 years. The acoustic environment in the Fram Strait is complex and it was difficult to resolve, identify and track arrivals. However, through advanced data processing, stable acoustic arrival time structure was obtained. The arrival time structure compared well to acoustic predictions. This forms the basis for doing acoustic inversions to obtain depth-range averaged sounds speed, which again is converted to temperature. The acoustic travel times and the depth-range averaged temperatures have been shown to be useful data for validation of ice-ocean models and for ocean monitoring.

In 2014 the acoustic and oceanographic measurements will be continued and extended northward as part of the recently funded by the Research Council of Norway “Arctic Ocean under melting ice” (UNDER-ICE).