Acoustic tomography in the Fram Strait

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Background studies


The goal is to improve the estimation of heat, mass and freshwater fluxes through the Fram Strait by combining acoustic tomography, oceanographic data from gliders, floats and moorings with ice-ocean models through assimilation.
Acoustic experiments in the Fram Strait 2005 – 2012
EU projects DAMOCLES and ACOBAR

To develop components of an observing system for the Arctic Ocean based on underwater acoustic methods including tomography, data transmission and communication to/from underwater platforms, and navigation of gliders.

Source deployment

Deployment of STAR mooring

Glider recovery, 2008

Listening in the lab
Sound propagation Fram Strait (HM 2011)
Nested high-resolution (3.5 km) Fram Strait model
From 16 August 2008 to 1 August 2009 the acoustic source transmitted a sweep from 190 Hz to 290 Hz every third hour. SD=388m
Acoustic data processing and model validation

1. Acoustical raw-data (.rov)
2. Time keeping (.txt)
3. Mooring motion (.txt, nav)
4. TP Positions (.mat)

(Separate flow chart)

Ocean fields:
- TOPAZ-3 (.nc)
- CTD (.dat)

LEGEND:
- Stored data
- Process
- Data
- Document
- Junction
Acoustic measurements compared to the Fram Strait model and CTD data 21-25 September 2008
Observed and modeled travel time during 1 year

Modeled travel time < observed travel time => FS model is too warm
Conclusion: Acoustic travel time has (1) been inverted to temperature (E. Skarsoulis, et al. 2010), best fit 150-500 m temperatures (2) used for validation of TOPAZ and the Fram Strait model (Sagen et al. 2010)
Fram Strait acoustic system 2010 – 2012
FOR ACOUSTIC TOMOGRAPHY, NAVIGATION OF GLIDERS, PASSIVE ACOUSTICS

Three TOMO sources:
• sweep 200-300 Hz in 60s
• 80 s RAFOS sweep: @ 260 Hz

Two RAFOS sources:
80 s RAFOS sweep: @ 260 Hz

Low frequency Receivers
• 36 m long arrays in A,B,C
• 700 m array in D.

Passive system in C
Acoustic receptions from A on D – on day 403
First acoustic data downloaded – 2011
Receptions at deep receiver array at D from A and B
Glider experiments

A challenge to operate glider in the West Spitsbergen Current:

- strong boundary current
- events up to 80 cm/s
- most of energy used there

6 glider missions in Fram Strait from 2008 - 2011 in open water only

2010 testing RAFOS receptions

First glider mission under ice in 2011
Temperature measured by glider SG127 in summer 2011 along the whole track

Under ice
GLIDER IS EQUIPPED WITH ACOUSTIC RECEIVER AND PROGRAMMED TO RECEIVE THE ACOUSTIC SIGNALS FROM THE SOURCES

Yann Le Page
Future scenario of an Arctic acoustic observing system

cabled moorings with source and receiver

two cabled ATAM moorings with shore terminus

autonomous source with receiver

drifting ice tethered acoustic platforms (source/receiver)

acoustic thermometry path

cable