Increasing Arctic Ocean awareness

The main objective of the ACOBAR project is to develop a system for the environmental monitoring of the interior of the Arctic Ocean. Here, we speak to Coordinator Stein Sandven

Can you explain a little about the background of your project, its aim and where the concept came from?

The direct background for ACOBAR comes from previous Arctic projects, especially the DAMOCLES project. Our goal is to develop Arctic Ocean underwater observing systems using acoustic methods, gliders and drifting ice buoys. The Arctic Ocean plays an important role in the climate systems, but the knowledge about the processes in the Arctic Ocean is limited due to lack of systematic observations.

How did you first become involved with the programme and what has your input been thus far?

NERSC (Nansen Environmental and Remote Sensing Centre, Norway) initiated ACOBAR, one of several Arctic projects at our centre. NERSC is working with satellite remote sensing, modelling and data assimilation, analysis of climate data, and development of new observing systems for the Arctic Ocean.

What are the expectations and objectives of the project?

The project aims to improve our knowledge about the Arctic climate. The Arctic region plays an important role in the global climate system, but there are many ice-ocean-atmospheric processes that are poorly understood. It is therefore important to collect more data f to study processes that are essential in the climate system.

How it has progressed thus far?

During IPY (International Polar Year) from 2007 to 2009, research efforts in the Arctic were significantly enhanced. Several field experiments were conducted, a lot of new data was collected, and new results of Arctic atmosphere, sea ice and ocean research are published frequently. After IPY, research activities in the Arctic will continue, mainly with short term funding.

SCIENTISTS PARTICIPATING IN THE ACOUSTIC TOMOGRAPHY EXPERIMENT, FRAM STRAIT, SEPTEMBER 2009.

What is the wider impact of your research?

Climate in the Arctic has changed significantly in the last decades, which has strong impact on economic activities, environment and human life. Research on climate in the Arctic has therefore large socioeconomic benefits. New knowledge about the Arctic environment is needed for sustainable development in the region.

Are there any 'partners' involved in your research? If so, can you explain their expertise, what they contribute and what they will gain from their involvement?

Arctic research is very internationally-orientated with extensive collaboration between scientist in many countries. For example, ACOBAR has partners from the USA, Germany, France and UK. They contribute with various instruments, observing platforms, and expertise in using the systems in Arctic conditions.

Furthermore, has your organisation collaborated with international partners – has the collaborative approach worked?

Yes, as described above, NERSC is working with partners in many countries who have leading expertise in Arctic research.

Can you tell us if you faced any major challenges so far?

One of the major challenges in Arctic research is to carry out successful field experiments. There is always a risk for failure when working under harsh Arctic conditions. Common problems are that instruments don't function properly, data collection is interrupted, experiments have to be cancelled or postponed, due to difficult weather and ice conditions.

What is the expected output of the project?

- New scientific results about the role of the ocean inArctic climate
- Promising results from testing new observing technology
- Validation data for improvement of ice-ocean models
- Capacity building: learning about new technologies for Arctic research

New technology reveals the Arctic's secrets

Stein Sandven of the Nansen Environmental and Remote Sensing Center in Norway tells International Innovation about an exciting new project that will aid research in the remote and inaccessible areas of the Arctic Ocean

Images © Krzysztof Rosinsk

To construct ocean observing systems for the polar regions is a particular challenge, not least because of the harsh environment including sea ice. The Arctic Ocean lacks adequate observing systems, and technologies such as Argo floats are not suitable for use in ice-covered seas. This lack of data causes severe uncertainties in detection of temperature and salinity changes, understanding of ocean-ice interactions and in modelling of processes and climate. During the International Polar Year from 2007-2009, several new instruments and platforms for ocean observations were deployed and ACOBAR (ACoustic Technology for OBserving the Interior of the ARctic Ocean) plans to develop some of these technologies further.

PROJECT OBJECTIVES

ACOBAR's main objective is to develop an acoustic system for monitoring of the interior of the Arctic Ocean. The project will collect 3D observations of properties and transport of water masses in the Fram Strait, using an acoustic tomography array, consisting of source and receivers, in combination with Acoustic Ice-Tethered Profilers (AITPs), oceanographic moorings and profiling gliders. Navigation of gliders under the ice by use of acoustic signals from the tomography sources will be developed and tested. Data transmission by acoustic modems from underwater platforms to the surface for downloading to ships will be demonstrated. The AITPs are deployed on ice flows with underwater sound source, hydrophones, modems and satellite communication, allowing near real-time data transmission via satellite. ACOBAR will also help establish a new Arctic Ocean Observing System.

METHODOLOGY

The basic principle of acoustic tomography is that sound signals travels faster in warm water than in cold water, and faster with the current than against the current. Acoustic tomography uses precise measurements of acoustic travel times between pairs of acoustic sources and receivers. Through inversion techniques, internal ocean temperature can be retrieved with an accuracy of 0.01°C over a 200 km distance. In the same way, precise measurements of average current velocities can be determined from the difference between reciprocal travel times produced by simultaneous transmission of acoustic pulses in opposite directions along an acoustic path.

The benefits are: It permits rapid and repeated measurements over large ocean areas for climate and process studies: It measures average properties between moorings – spatial integration suppresses small variability that can contaminate point measurements: Provides depth resolution due to acoustic multipath and provides and powerful constraint for circulation models due to the integral nature of tomographic data.

In 2010 a multi purpose system for acoustic tomography, navigation of gliders and positioning of floats will be implemented in the Fram Strait, headed by Dr. Hanne Sagen at NERSC. The system consists of three acoustic transceiver moorings in a triangle configuration, with a receiver mooring in the middle. The system will obtain 3 D acoustic tomography data, and provide acoustic signals for underwater navigation of gliders and positioning data for underwater floats. Acoustic travel time data from the tomographic system demonstrates it strength when it is employed in conjunction with numerical ocean circulation models and data assimilation. This is a primary focus in ACOBAR. The tomographic data will be quality checked validated against standard oceanographical measurements from ships and moored profilers. The results ACOBAR attains from this scheme will be used to improve the ocean-observing capability in the polar oceans and will thus contribute to build Arctic Regional Ocean Observing System (Arctic ROOS), a component of the Global Ocean Observing System (GOOS).

In addition to NERSC, the ACOBAR experiments are supported by Alfred Wegner Institute for Polar and Marine Research, Scripps Institution of Oceanography, Woods Hole Oceanographic Institution, Université Pierre et Marie Curie, Aquatec Telemetry Limited, OPTIMARE, ENSIETA, ACSA, Applied Physics Laboratory, University of Washington, University of Bergen, and the Norwegian Coast Guard vessel KV Svalbard. The project will strengthen European expertise in underwater acoustic navigation, communication, data transmission and tomography. The project will also promote use of underwater acoustic technology for monitoring the ocean, transferring data and navigate gliders and other underwater platforms. The technology will be used to build a long-term ocean monitoring system for the polar oceans.

IMAGES: DIPLOYMENT AND RECOVERY OF EQUIPMENT IN THE FRAM STRAIT

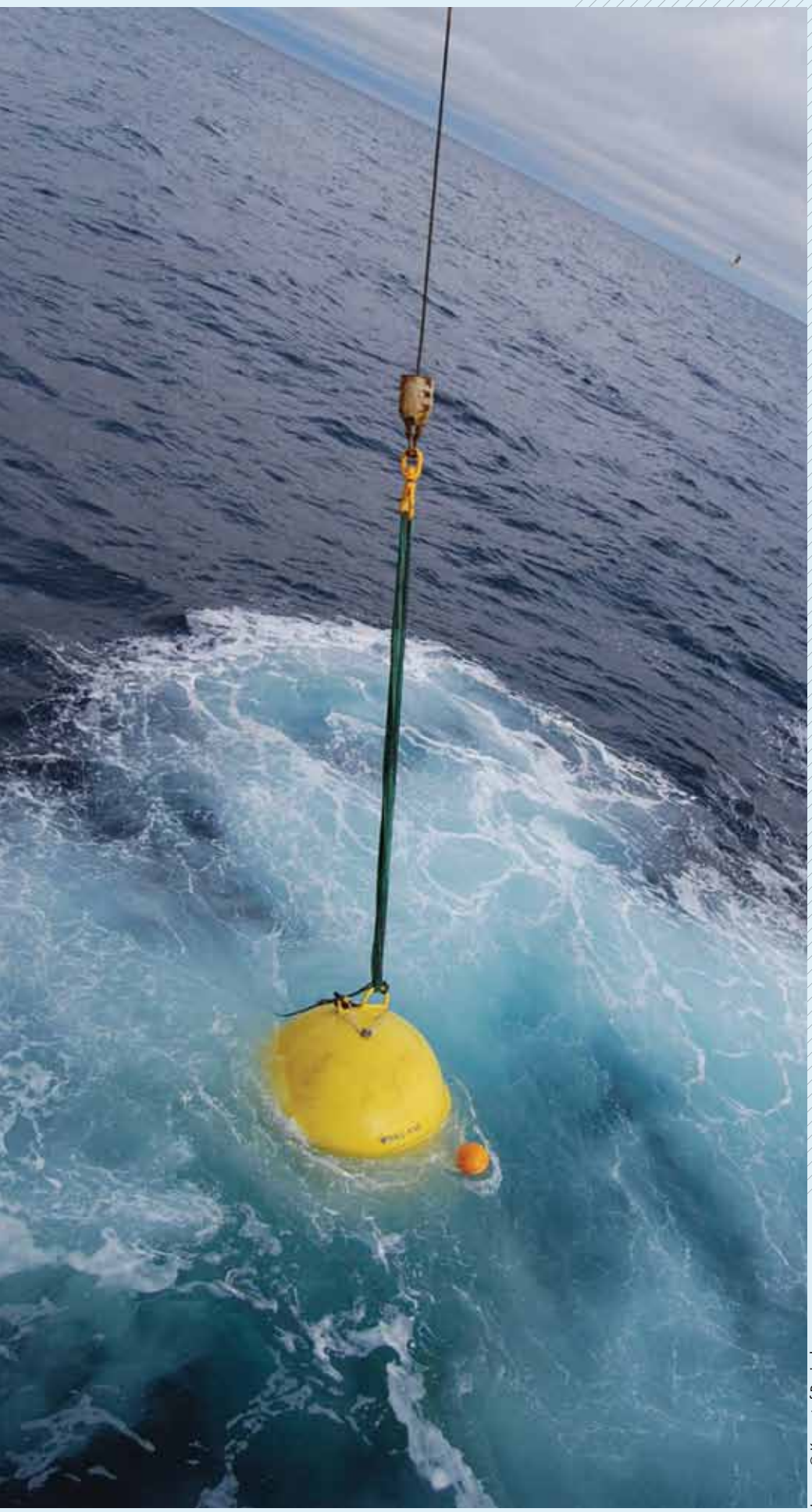

Image © Krzysztof Rosinsk

INTELLIGENCE

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Dr. Hanne Sagen
Project manager

CONTACT

Professor Stein Sandven
Research Director

Nansen Environmental
and Remote Sensing Center
Thormohlensgate 47
N-5006, Bergen, Norway

T: +47 55 20 58 00
E: stein.sandven@nersc.no

http://acobar.nersc.no

STEIN SANDVEN is research director at Nansen Environmental and Remote Sensing Center in Norway and professor II at the University Centre in Svalbard. He has been working in marine and polar remote sensing, oceanography and sea ice research for more than 30 years. He is coordinator of several national and international polar research projects with focus on satellite remote sensing and operational oceanography. At present he coordinates the EU ACOBAR project. In December 2007 he was elected chair of the Arctic Regional Ocean Observing System (Arctic ROOS). He has published about 50 papers in internationally-refereed journals and books.