ASPECT International Workshop on Antarctic Sea Ice Thickness 5-7 July 2005, Hobart, Australia

Conveners Steve Ackley (AUI Chairman) and Tony Worby

Overview by Chris Banks
Thickness of sea ice is fundamental to the Earth's climate system and yet our knowledge of this variable is limited. In July 2006, 60 delegates travelled to Hobart, Tasmania to meet and discuss all aspects of this issue at the International Workshop on Antarctic Sea Ice Thickness. The meeting had oral and poster presentations on a variety of topics including a number of presentations on the collection of data using Autosub.

During the "Upward Looking Sonar and Autosub" session there were three presentations on Autosub. Mark Brandon (Open University) presented an introduction to Autosub and its use in the northern Weddell Sea in 2001. Results were shown not only concerning sea ice thickness but also using the same technology to measure krill swarms beneath the ice. Next, Chris Banks (Open University) presented work on using the upward-looking acoustic Doppler current profiler (ADCP) to measure sea ice draft in the eastern Amundsen Sea during March 2003. Finally, Jeremy Wilkinson (Scottish Association for Marine Science) showed some stunning three-dimensional images of the under-ice surface, collected using the upward-looking multibeam sonar.

The meeting generated much interest in Autosub and demonstrated the unique contribution that Autosub can make. For further details see http://www.aspect.aq/workshop2006.html.

Chris Banks, Mark Brandon and Jeremy Wilkinson's travel costs were funded by the CASEE programme.

Abstracts:

ADVANCES IN AUV TECHNOLOGY FOR ANTARCTIC UNDER-ICE OPERATIONS
PART I: NATURE OF SONAR DATA
Peter Wadhams (1) and Jeremy Wilkinson (2)
ABSTRACT
We describe the datasets on ice draft that have been collected under sea ice by AUVs, comprising experiments with single-beam and sidescan sonars and the more recent multibeam sonar data collected by Autosub off NE Greenland. To date, the highest quality data (multibeam) comes from the Arctic. In the light of what is known about the nature of Antarctic sea ice and Antarctic pressure ridge structure from drilling, photography and other data sources, we discuss how multibeam sonar can best be used to map the nature of Antarctic sea ice and what might be expected to be observed. We recommend strategies for AUV ice profiling operations in different parts of the Antarctic.
(1) Dept. of Applied Mathematics and Theoretical Physics, University of Cambridge, England.
(2) Scottish Association for Marine Science, Oban, Scotland.

ADVANCES IN AUV TECHNOLOGY FOR ANTARCTIC UNDER-ICE OPERATIONS
PART II: MULTIDISCIPLINARY AND MULTISENSOR OPERATIONS WITH AN AUV

Jeremy Wilkinson (1) and Peter Wadhams (2)

ABSTRACT

The polar oceans are an ideal home for AUV technology as the sea ice cover prevents the use of most autonomous oceanographic platforms. At present under-ice investigations have been limited to military submarine operations in the Arctic and ROVs, divers and ULS in the Antarctic. AUVs offer scientists the flexibility to determine the location as well as timing from which scientifically controlled and directed missions can occur as well as being able to sail close to the ice bottom or work in areas of shallow bathymetry. More importantly the AUV can be viewed as a multidisciplinary, multisensor tool which enhances partnership between scientists from different disciplines. We present results of ice thickness monitoring that has been performed with the Autosub AUV in the Arctic, its relevance to the Antarctic, and how the ice thickness results when combined with information from other sensors onboard Autosub are of significance to a number of scientific disciplines.

(1) Scottish Association for Marine Science, Scotland.
(2) Dept. of Applied Mathematics and Theoretical Physics, University of Cambridge, England.

MEASUREMENT OF SEA ICE DRAFT USING AN UPWARD LOOKING ADCP ON AUTOSUB AUV

Christopher J. Banks (1), Mark A. Brandon (1) and Paul H. Garthwaite (2)

ABSTRACT

During March 2003 Autosub, the autonomous underwater vehicle (AUV) operated by the UK National Oceanography Centre in Southampton, performed a number of missions below sea ice close to Thurston Island. This talk will provide details of using on-board instrumentation to provide values for the sea ice draft in the region. The onboard instrumentation involved is an upward looking acoustic Doppler current profiler (ADCP), consisting of four beams each with a value for range to surface. The other instrument is a conductivity-temperature-depth sensor (CTD) and provided values of vehicle depth. Following a novel methodology to correct for, amongst other factors, vehicle orientation and sound speed, these values of range can be used to measure ice draft. The talk will outline these processing steps and present probability density functions for each of the missions. The impact of a geostatistical examination of the data will be provided to account for the variable density of sample points across the study regions.

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UNDER SEA ICE MEASUREMENTS IN THE NORTHWESTERN WEDDELL SEA USING THE AUTONOMOUS UNDERWATER VEHICLE AUTOSUB II

Mark A. Brandon (1), Christopher J. Banks (1) and Andrew S. Brierley (2)

ABSTRACT

The AUV Autosub 2 was first used under sea ice in February 2001 at the northern edge of the Weddell Sea (~63ºS, 50ºW) in a combined physical and biological study. The AUV was equipped with a single beam upward looking scientific echo sounder operating at two frequencies that provided data on both sea ice draft and the

quantitative distribution of zooplankton. The AUV was also equipped with several other sensors including high-resolution CTDs, upward and downward looking ADCPs, a chlorophyll sensor, a dissolved oxygen sensor and a photosynthetically active radiation (PAR) sensor. For this experiment the AUV was sent on two types of completely autonomous missions, one being under sea ice and up to 80 km length at depths of 150 to 250 m and the other ~10 km and under specifically targeted individual icebergs. In total we collected over 130 km of under sea-ice data from which, after making various corrections, we derive an ice draft for each mission and then a synoptic ice draft distribution. As well as comparing the distribution with upward looking sonar data collected just to the south, the sensors have given a unique view of the ice edge under different conditions.

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