Wave-Ice Interaction and the Marginal Ice Zone

Prof. Peter Wadhams
Department of Applied Mathematics and Theoretical Physics
University of Cambridge
Wilberforce Road, Cambridge CB3 0WA, UK
phone: +44 1223 760372 fax: +44 1223 765900 email: p.wadhams@damtp.cam.ac.uk

Award Number: N00014-12-1-0130
http://www.apl.washington.edu/project/project.php?id=miz

LONG-TERM GOALS

The long-term goal is to gain a complete understanding of the physical processes involved in the interaction between ocean waves and a sea ice cover, in terms, of scattering, attenuation, and mechanical effect of the waves on the ice.

OBJECTIVES

The main thrust of our work in this project is to design and build a large number of wave-measuring buoys, subsequently using them to acquire an unprecedented volume of in-ice directional wave data. These data will be used by the modelling community to parameterise and understand the influence of incoming ocean waves on sea ice, and the effect of the ice on the waves (attenuation, spreading).

APPROACH

Our observations divide into (1) Attended process experiments, carried out using internally-recording high-data rate buoys; and (2) Survey experiments from autonomous deployed buoys, primarily during the summer ice breakup of 2014.

WORK COMPLETED

Activity during the second year continued to focus on the design and build of wave buoys for the 2014 field experiment, in collaboration with the British Antarctic Survey, Cambridge. Dr Doble travelled to Cambridge on nine occasions over this period for various meetings, working towards the deployment of three prototype buoys in the summer of 2013. These were deployed from the icebreakers *Louis St Laurent* (one buoy deployed on ice as part of a multi-buoy array) and the *Araon* (two buoys, deployed into open water). The buoys have performed well and have tested a variety of situations – of the two Korean-deployed buoys, one has since frozen into an extensive floe, while the other has encountered significant waves, open water and ice rafting. Work is now focusing on incorporating the lessons learned and completing the build of 20 “version 2” buoys to be deployed in March from our ice camp. We are aiming to ship these at the beginning of 2014.

Figure 1: Prototype wavebuoy in the workshops at BAS. The finished buoy has a large flotation collar below the solar panel deck.

Ice-Ocean also completed the design and construction of 10 "Process Buoys" for attended wave experiments. These were extensively upgraded from our original concept, using a high-quality attitude and heading reference system (AHRS) together with an accurate twin-antennae GPS compass. The instruments logged the AHRS parameters at 50Hz, together with GPS-derived fixes, heading (accurate to better than 1^{o}) and velocities at 10Hz. The 30MB hourly files are logged to SD card internal memory.

First deployment of these Process Buoys took place during a short field experiment in summer 2013 aboard the research hovercraft *Sabvabaa*, out of Longyearbyen, Svalbard. The unexpectedly large retreat of sea ice in the European sector this year put most of the sea ice out of comfortable range for the hovercraft, however, and we were only able to access the closest ice, directly north of Svalbard's NW tip, at around 81^{o}N. The process buoys were deployed in arrays of four and six buoys, drifting in very open pack under the influence of dominantly north (off-ice) winds. The wave climate was very calm and the experiments will therefore primarily serve an instrument test and validation role.

Figure 2: Preparing a Process Buoy aboard the hovercraft

The buoys performed extremely well, and we are looking forward to using them whenever a deployment opportunity is available for targeted process studies in 2014. We are currently pursuing opportunities aboard three vessels in the Fram Strait region for next year.

Figure 3: Deployment of a process buoy and tracker pole in open drift ice north of Svalbard from a hovercraft.

RESULTS

Results from the hovercraft experiment are currently being worked up.

IMPACT/APPLICATIONS

Much experience was gained in the use of a hovercraft for small-scale ice experiments. Though very promising in many ways, the vehicle requires further development before it can become a routine, reliable platform for experimentation or equipment deployment.

RELATED PROJECTS

"Proving and improving wave models in the Arctic Ocean and its MIZ", Sea State DRI, Award Number N0014-13-1-0290