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14. ABSTRACT
The objective of this DURIP award was to build three Ice-Tethered Profiler with Velocity (ITP-V) systems for deployment in support of future Navy scientific investigations of the Arctic Ocean. This work was accomplished. To the standard ITP instrument that measures sea water temperature and salinity versus depth, the ITP-V adds a multi-axis acoustic-travel-time current meter and associated attitude/motion measuring unit to make direct, 3-D observations of ocean flow. The three new systems are scheduled to be deployed to support the ONR Stratified Ocean Dynamics of the Arctic DRI.

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Acquisition of Ice-Tethered Profilers with Velocity (ITP-V) Instruments for Future Arctic Studies

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http://www.whoi.edu/itp

LONG-TERM GOALS

The PI group seeks to observe the upper Arctic Ocean using autonomous instrumentation and build understanding of the physical processes controlling the evolving thermohaline stratification, the ocean currents and air-ice-sea interactions on time scales of minutes to seasonal and longer.

OBJECTIVES

Build three Ice-Tethered Profiler with Velocity (ITP-V) systems for deployment in support of future Navy scientific investigations of the Arctic Ocean.

APPROACH

The instrument design and construction is based on prior developmental work and field testing of prototypes, and the subsequent successful use of 5 operational ITP-V systems during the Marginal Ice Zone DRI program. The ITP-V is assembled from subsystems constructed in house as well as components from commercial vendors. Key personnel at WHOI involved in the construction and validation testing of ITP-V systems beyond the PIs include J. O'Brien, F. Thwaites, J. Kemp and C. Marquette.

The ITP-V is a variant of the ITP system that has contributed to sustained observations of the Arctic Ocean below sea ice since 2004. The ITP concept is, in short, Argo of the Arctic - a play on the international program maintaining an array of profiling floats throughout the temperate oceans. Briefly, the ITP system consists of three main components: a buoyant surface instrument package that typically sits atop an ice floe, a weighted, wire-rope tether suspended from the surface package, and an instrumented underwater unit that travels up and down the wire tether (Figure 1; Krishfield et al., 2008; Toole et al., 2011). The current design of the ITP surface

expression is a conical-shaped buoy that houses a controller, inductive modem electronics, a GPS receiver, and an Iridium satellite phone with associated antennae and batteries within a watertight aluminum housing capped by an ultra-high-molecular-weight polyethylene dome. The electronics case sits within a foam body designed to provide buoyancy for the plastic-jacketed wire rope tether and end weight should the ice fracture or melt, and to provide modest protection in the event of ice ridging. The profiler unit (much like an Argo float in shape and size) mounts on the tether and cycles vertically along it. Via an inductive modem, raw sensor and associated engineering data files are relayed from the underwater vehicle to the surface buoy at the completion of each one-way profile, which then transmits them by satellite to a logger computer at WHOI. The ITP-V instruments add a multi-axis acoustic-travel-time current meter and associated attitude/motion measuring unit to the standard ITP sensor suite to make direct, 3-D observations of ocean flow (Figure 2, 3; Thwaites and Krishfield, 2013; Cole et al., 2014; 2015).

TASKS COMPLETED

The 3 ITP-V systems were fully built/assembled by early August, 2016 and spin tests were performed. These tests involve logging data from the inertial measurement unit in the underwater vehicle at various known physical orientations to determine the relative alignment of the current meter and inertial measurement unit and quantify sensor biases of the flux gate compass and accelerometers. The ITP-V systems are now ready for deployment in support of future Navy research programs in the Arctic.

RESULTS

Nothing to report. The ITP-V systems are now ready for deployment in support of future Navy research programs in the Arctic. Specifically, the plan is to use these systems in support of the Stratified Ocean Dynamics of the Arctic (SODA) DRI program.

IMPACT FOR SCIENCE

Observations and insights deriving from ITP-V instruments are advancing understanding of ice-ocean interactions and their representation in numerical models. In turn, improved predictions and assessments of the future state of the Arctic Ocean will result.

RELATIONSHIPS TO OTHER PROGRAMS

The three ITP-V systems constructed under this funding are scheduled to be used during the ONR Stratified Ocean Dynamics of the Arctic (SODA) DRI program.

ITP-V systems were previously used in the Marginal Ice Zone DRI study:
http://www.apl.washington.edu/project/project.php?id=miz
and in a follow-on research study entitled "Upper-Ocean Variability in the Arctic's Amundsen and Nansen Basins," Grant N00014-15-1-2547.

EQUIPMENT LIST: 3 ITP-V Systems – Completed and ready for use.

FIGURES/PICTURES

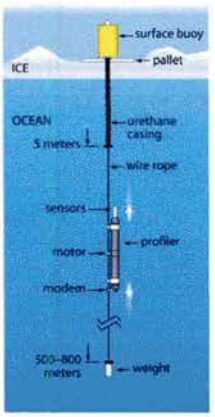

Figure 1. Schematic drawing of the Ice-Tethered Profiler instrument system.

Figure 2. Engineering drawing of the Ice-Tethered profiler with Velocity.

Figure 3. Right. Photograph of an MIZ ITP-V being deployed (top) and in a test jig used to validate sensor orientations (bottom).

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