Under ice robotic exploration of the mcmurdo sound and ross ice shelf. B.E. Schmidt[1], J. D. Lawrence[1], M. R. Meister[1], D. J. G. Dichek[1], C. D. Ramey[1], B. C. Hurwitz[1], J. J. Lutz[1], J. P. Lawrence[1], A. Spears[1], J. B. Glass[1], A. S. Stockton[1], J. S. Bowman[2], N. Speller[1], M. Philleo[1].
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Introduction: The NASA-funded RISE UP program (Ross Ice Shelf & Europa Underwater Probe) is a three-season project to monitor basal ice conditions, ice-ocean interactions, and environmental conditions from the ice to the sea floor beneath the McMurdo sound sea ice, the McMurdo Ice Shelf, and the Ross Ice Shelf. The main feature of the program is the novel and scientifically capable Icefin hybrid AUV/ROV vehicle that will conduct surveys from the ice to the seafloor to provide an integrated picture of the conditions below the ice. Nominally, the project will conduct its work in the 17/18, 18/19, and 19/20 austral summers. In cooperation with the Antarctica New Zealand Ross Ice Shelf Programme, PI Christina Hulbe, RISE UP will also deploy Icefin through a borehole at two positions on the Ross Ice Shelf to access previously unmapped regions of the sub-shelf water column.

Icefin Vehicle: The Icefin vehicle was developed under Schmidt's startup and redesigned under the NASA PSTAR RISE UP. The vehicle includes instrumentation for mapping geophysical and ocean environments. Icefin is currently fitted with sensors for scientific analysis of the ice-ocean system including the science instruments detailed in Table 1. The guidance navigation and control of Icefin allow for efficient collection of scientific data through the fusion of an advance fiber optic gyro (FOG) inertial measurement unit (IMU), compass, DVL, altimeter and pressure sensor for low-level motion control and high-level localization. Icefin also includes vehicle health sensors such as leak detectors and power remaining useful life. The vehicle is rated to 1.5 km depth, weighs 280 lb in air, is 9" wide and 12' long. The vehicle is deployed horizontally or vertically through a drill hole and supervised by a 3 mm diameter Kevlar-reinforced fiber optic tether rated to 600 lb with a strength-enforced termination at the vehicle and a length of 3.5 km for communication, data retrieval, and vehicle recovery. The vehicle's thruster design provides control for full holonomic five degrees of freedom with no protruding surfaces. This allows the vehicle to easily control pitch, yaw, heave (up and down) and sway (side-to-side). The thruster configuration provides the stabilization that is necessary to hover in the water for data and image collection missions, and eventually for sampling.

Manufacturer/Sensor
Kongsberg Forward Camera OE14-377 (NTSC version)
DeepSea Power & Light HD Multi SeaCam Up/down camera-side view
Maccartney Luxus Laser Pointer
LinkQuest NavQuest DVL - 600 micro with ADCP
Neil Brown CT Sensor
TriTech SeaKing *650 kHz DST SideScan Sonar*
Kongsberg GeoSwath Mapping Sonar**
Seabird Scientific Combination pH/O.R.P. (Redox) Sensor
JFE Advancetech RINKO FT Dissolved Oxygen Sensor
Turner Designs Cyclops 6-K Turbidity Sensor
Turner Designs Cyclops 6-K CDOM/FDOM Sensor

I will highlight the first results of RISE UP's first field season from October 2017 to early January 2018. This season includes data collection at three sea ice locations, two that allow us to swim Icefin underneath the ice shelf, and one at the Erebus Glacier Tongue. Onboard Icefin, we collect data from two sonars, two cameras, a DVL/ADCP, and sensors for conductivity & temperature, depth, pH/ORP, DO, CDOM/FDOM and turbidity. I will describe Icefin (below), and provide preliminary observations of the basal ice conditions, oceanographic properties below the sea ice and ice shelves, and seafloor conditions we observed. Future work includes development of cell counting and microscopes for the vehicle, and optimization of sea floor characterization.