An automated station for polar ice-ocean interaction monitoring - AMIGOS-III

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The Automated Meteorology - Ice - Geophysics – Ocean observing System (AMIGOS-III) is an autonomous multi-sensor station designed to support investigations of ice-ocean-atmosphere interactions in polar environments. It consists of a microprocessor running a simplified Linux operating system, with weather, GPS, accumulation, and surface melt, and includes a set of ocean and ice measurement sensors (CTD, doppler current flow, and DTS thermal profiler). Two stations were installed on the Thwaites Eastern Ice Shelf in January 2020 and are transmitting data as of this writing.

Table 1: AMIGOS-III Main Design Components

- **Structure, Power, and CPU**
  - CPU: Triton-3 single-board computer, internal ethernet, serial, and USB ports; Linux OS, watchdog function;
  - Iridium modem and antenna;
  - Aluminum truss tower, 3 m sections, total 9 m installed (1.5 m sub-surface, 7.5 m exposed);
- 6 x 100 amp-hr batteries, 4 x 65 W solar panels

- **Weather / Climate**
  - Vaisala WX7530 weather station;
  - Campbell Scientific sonic snow-height sensor

- **Ice Motion Sensor**
  - Dual-Frequency GPS – Topcon GRS-1 receiver, PGA-1 ant.

- **Snow-Firm Energy Balance Sensors**
  - Albedometer (opposing Apogee SP-212 hemisphere meters);
  - 4 to 16 thermistors, sub-surface and along tower.

- **Sub-Ice Ocean Sensors**
  - DTS laser-stimulated fiber optic thermal profiling system;
  - Seabird MicroCAT SBE-37/IMP CT sensors, w/ press.;
  - Nortek Aquadopp doppler current meters;

Sample Data Sets from the station (Jan 15- Feb 26)

![Image of AMIGOS-III Tower installed at Thwaites Glacier Ice Shell]

![Interior of electronics enclosure box (top) and electronics box connector panel (bottom) for a field-installed AMIGOS-III station on the Eastern Thwaites Ice Shelf (75.049° S, 105.583° W, “Cavity Camp”). Top panel has the major electronic components labeled: A, Linux processor board from Polar66 Engineering (R. Ross) with power switching and 32 Gb data storage; B, TopCon B110 GPS receiver and development board; C, SeaBird Inductive Modem Module (IMM) for decoding inductive data transmission from the ocean sensors; D, WinSystems Windows-OS computer for interfacing with the distributed temperature sensing controller (DTS); E, power conditioner (DC-DC inverter) to provide 12.0 volts to camera; F, internet switching hub; G, router; H, NAL AL3A-R Iridium modem. The surrounding white electronics enclosure box is 40 x 30 X 25 cm. Lower panel is an image of the exterior bottom wall of the enclosure, showing the port arrangements for the AMIGOS-III. Port functions clockwise from upper left: power cable input, ethernet access for laptop, Campbell Scientific CR-1000X ethernet connection, four-wire input for upward- and downward-looking lightmeters, five-wire input for Vaisala weather data and sensor power; two-wire input from Seabird inductive coupler circuit (ICC) to IMM; three-wire power input to the CR-1000X; ethernet port for DTS communications and data; ethernet port for camera communications and power; unlabeled grounding lug.

![Interior of the battery box enclosure (top) and battery box connector panel (bottom) for the station in Figure 3. Six 100-amp hour batteries fit in the box with 2.5 inches clearance along the connector panel wall (not shown). Top and bottom panel labels: A, solar panel input (left side, top two ports), spare power output (lower left side port), main power and DTS power output (right side, two ports); B, solar power controller for battery recharging and system fuses; C, sensor and data input ports (ethernet port for CR-100x, top left, snow height sensor input, middle left power output to DTS, lower left; top right, borehole thermistor cable input; lower right, tower air-snow thermistor cable input); D, CR-1000X data logger for thermistors and snow height measurements. Battery box enclosure is 80 x 65 x 45 cm.

![Ocean String support Camera image, Feb 12 2020]

![Distributed Temperature Sensor (DTS) Profiles](image)

![CTD Profiles of Ocean Temperature and Salinity](image)

![Time-series of CTD data](image)

![Temperature / Salinity Plot (2 stations)](image)