

PALMER STATION MONTHLY SCIENCE REPORT

JUNE 2015



Twinkling stars illuminate the night sky above Terra Lab on a clear winter night.

(Image Credit: Julian Race)

NEWS FROM THE LAB

Emily Longano, Winter Laboratory Supervisor

As June came to an end so did the winter science season at Palmer Station. Prior to their departure, the O'Brien team (B-036-P/L) hosted an alternative science lecture in the form of an aquarium open house. Highlights of the evening included a side by side dissection of a red-blooded coriicep and a white-blooded icefish to illustrate the rare, translucent properties of the icefish. For many residents of station, this was a unique opportunity to see the fish up close and witness the scientists in action. The event was a wonderful experience for all participants.

This month station was excited to welcome members of the Antarctic Infrastructure Modernization for Science (AIMS) project to Palmer for an extremely brief site visit. The team toured station and met with the heads of each department to better understand how things operate on station. For many members of the project crew, it was their first visit to Palmer Station.

On June 26th, the final boat of the winter season departed Palmer Station and steamed north to Punta Arenas. We bid farewell to our departing friends with a barbeque in celebration of the winter solstice. For the remainder of the winter season, there will be 18 ASC staff members on station.

JUNE 2015 WEATHER

Lance Roth, Research Associate

The month of June was cold and dry. Temperatures remained below freezing for most of the month. High wind events brought huge icebergs into the inlet which prevented the LMG's navigation to the pier at times.

Due to cold temperatures, there was no rain, but we did observe a total of 14 cm of snow. The maximum temperature was 3.5 °C (38.3 °F) on June 26th, and the minimum temperature was -12.5 °C (9.5 °F) on June 10th. The average wind speed was 10 knots, and the highest gust recorded was 60 knots on the June 9th.

Some sea ice was observed in the area. On June 10th several large icebergs made their way into Hero Inlet and Arthur Harbor preventing the LMG from tying up to the pier. The sea ice and icebergs were blown out on June 23rd allowing the LMG to finally come into port. The tide gauge on the pier measured an average sea surface temperature of -1.6 °C (29.1 °F). The minimum sea temperature recorded was -1.8 °C (28.8 °F) on June 14th, 15th, and 19th, and the maximum sea surface temperature recorded was -0.9 °C (30.4 °F) on June 26th.

A-373-P: TROPOSPHERE-IONOSPHERE COUPLING VIA ATMOSPHERIC GRAVITY WAVES

Dr. Vadym Paznukhov, Principal Investigator, Boston College

Personnel on station: Vadym Paznukhov

Vadym Paznukhov departed station mid-June.

Installation of the two instruments at Palmer has been completed, and the location for the three antennas needed for the three-channel system installation has been determined. This installation is planned for October-November 2015.

GPS receiver

The GPS antenna has been installed on the roof (specifically on the railing) of the Terra Lab building. It is connected to the GPS receiver using 30m low loss LMR400 cable, which enters the building through the available penetration point and runs along the pre-existing cable tray to the Septentrio GPS receiver. The Septentrio GPS receiver is set up in a rack mount inside the Terra Lab. The system is functioning normally and data quality is under review.



Figure 1. GPS antenna installation on the roof of the Terra Lab building.

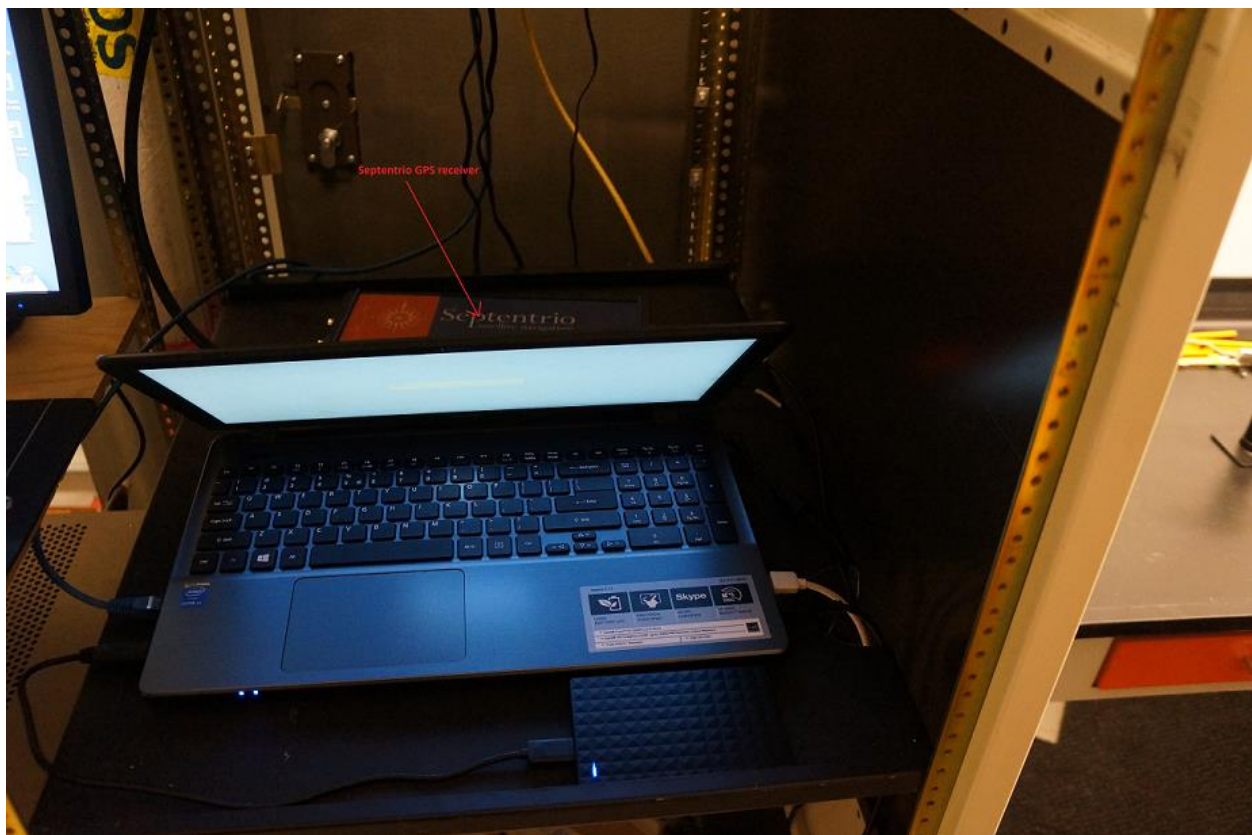


Figure 2. Septentrio GPS receiver is set up behind the control laptop computer inside the rack mount in Terra Lab.

Together with Palmer Lab Manager, Ms. Emily Longano, and Maintenance Specialist, Mr. George Warren, we explored the possibility of a more optimal location for the GPS receiver system on the GWR building. We determined an ideal way to connect the GPS system from the “ham shack” to the antenna, which would be installed on the roof of the building using pre-existing penetration point.

HF system

A receive HF loop antenna has been installed in a Palmer station “backyard” directly behind Terra Lab as shown in Figure 3.



Figure 3. HF receive antenna installed behind Terra Lab building.

The loop antenna is connected to the HF receive system via RG-8U coaxial cable (approx. 30 m long), which is laid on the rocks. The HF receive system, consisting of the USRP digital receiver and Octoclock-G timing card, is installed in the same rack mount one level above the control computer and Septentrio GPS receiver. Details of the HF system setup are shown in Figure 4.

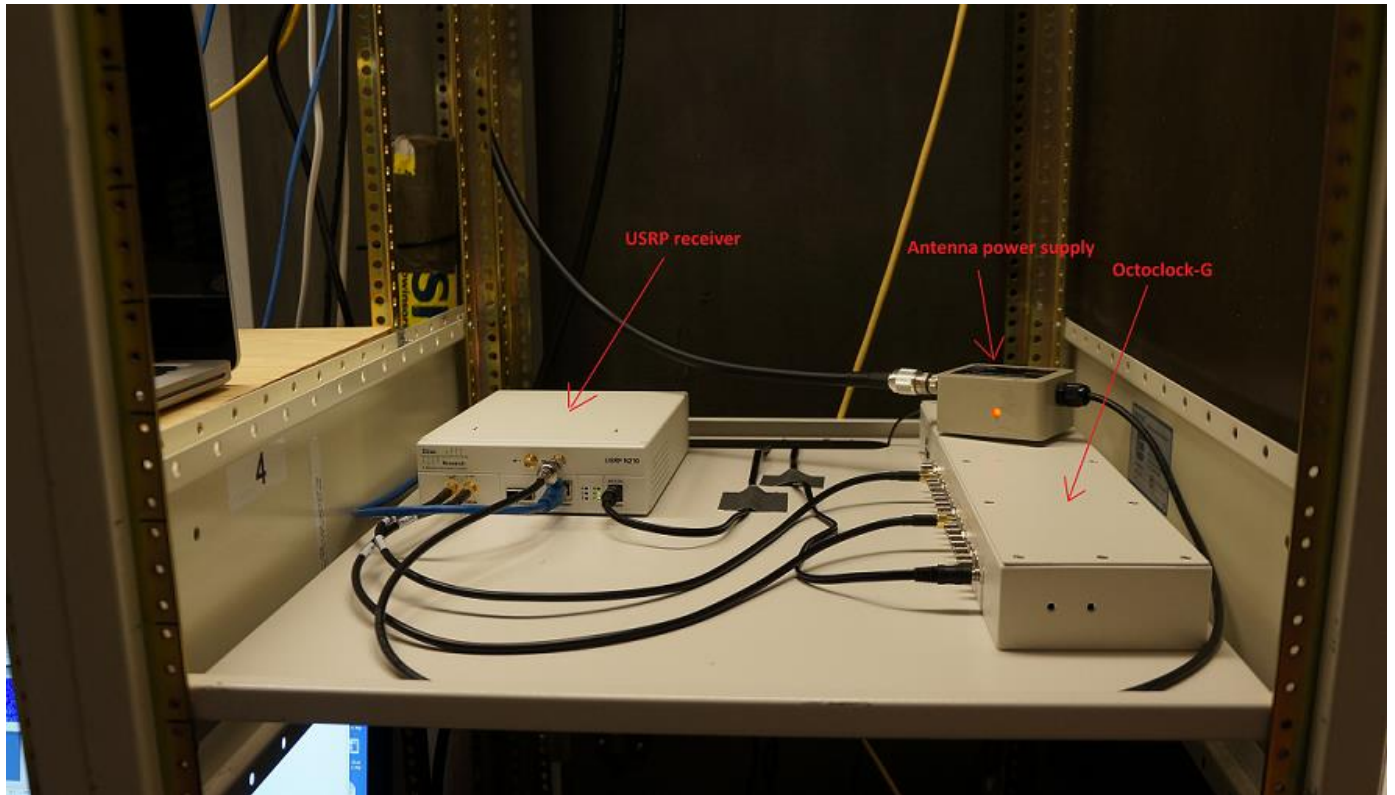


Figure 4. HF system components.

The complete bi-static sounding system (which includes a transmitter at Vernadsky station) started routine operation in early June. We are learning to dynamically select optimal operating frequencies to adjust for the rapidly varying Antarctic ionosphere. Data quality appears reasonably good with a typical signal to noise ratio of at least 20 dB even with the lowest transmit power of about 1-3 Watt. These results are very encouraging. We are also experimenting with receiving the ionospherically reflected signal at Vernadsky station to have observations at two spatially separated points.

Three-channel system

Locations were surveyed for the three receive antennas to be installed in October. The locations of the antennas were marked with the wooden poles; however, these were soon knocked down by strong wind gusts. In order to preserve the locations of the antennas until the antenna installation, Palmer Research Associate, Mr. Lance Roth, mapped the exact locations of the antennas using a GPS navigator. The marked antenna locations are shown in Figure 5.



Figure 5. Locations for the upcoming three receive antennas to be installed in October (blue flags).

B-036-P/L: COLLABORATIVE RESEARCH: THE PHYSIOLOGICAL AND BIOCHEMICAL UNDERPINNINGS OF THERMAL TOLERANCE IN ANTARCTIC NOTOTHENIROID FISHES

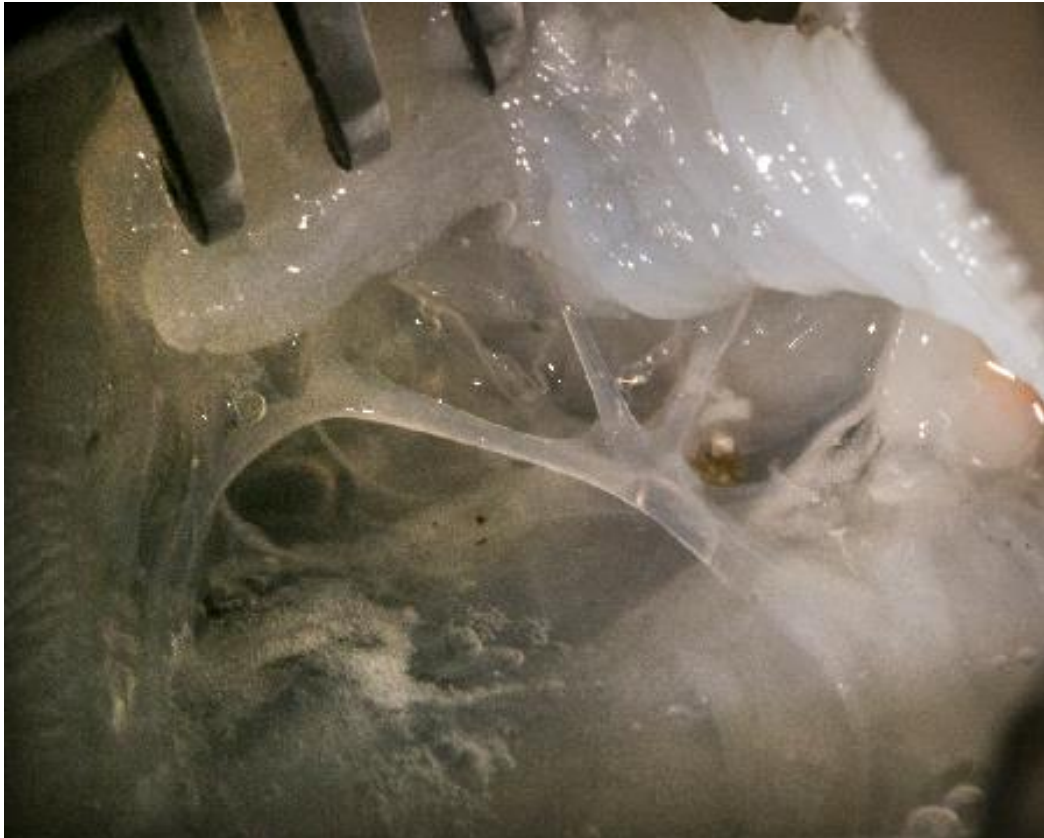
Dr. Kristin O'Brien, Principal Investigator, University of Alaska Fairbanks, Institute for Arctic Biology

Personnel on Station: Amanda Biederman, Elizabeth Crockett, Stuart Egginton, Elizabeth Evans, Anthony Farrell, Theresa Grove, Iskander Ismailov, Kristin O'Brien, and Jordan Scharping.

Members of B-036-P/L departed station at the end of this month after a successful field season.

We continued to expand our experiments in the month of June, with data collection and analyses, in order to elucidate the physiological and biochemical underpinnings of thermal tolerance in Antarctic notothenioid fishes. Our research is examining the effects of warming over an acute timescale (hours), as well as using temperature acclimations. We are quantifying behavior, systems-level function (e.g., cardiovascular, neuronal), and characteristics and function of cell and subcellular processes (e.g., mitochondrial, biological membranes, gene regulation) with an eye toward the responses of physiological and biochemical processes to elevations in temperature.

Dr. Stuart Egginton (University of Leeds) completed the work in which the *in situ* heart preparation is used to quantify maximum cardiac power output in both ambient and warm-acclimated notothenioids exposed to a range of temperatures. Our results indicate that the red-blooded *Notothenia coriiceps* is able to sustain cardiac work with both acute and chronic warming, with a greater stability than either of the two icefish species under investigation, the white-hearted (-Mb) *Chaenocephalus aceratus*, and the red-hearted (+Mb) *Chionodraco rastrispinusus*. While *C. aceratus* hearts failed with only a short duration exposure to warm temperatures, cardiac output was maintained after warm-acclimation in hearts of *C. rastrispinusus*. Accompanying the higher sensitivity of icefish hearts to afterload, we have demonstrated a similar ability of branchial and hypobranchial vessels (photos below) to generate force (i.e., vascular tone) in *C. aceratus* and *N. coriiceps*, as befits their genetic relatedness, while vascular reactivity in *C. aceratus* is generated by a reduced set of agonists with significantly lower efficacy.



Branchial arteries in *C. aceratus*



Hypobranchial arteries in *C. rastrispinosus*

Using both differential and density-gradient centrifugation, graduate student, Ms. Amanda Biederman from Ohio University, finished isolation of synaptosomal and mitochondrial membranes from the brains of both white- and red-blooded notothenioids. These membranes are being returned to Ohio University for analyses of membrane fluidity and Arrhenius break temperatures (ABT). Amanda will investigate differences in membrane physical and chemical properties among white- and red-blooded species, and she will examine potential correlations between membrane properties and the results of experiments (described below) that involve the neurophysiological responses to acute warming.

Experiments were completed by Dr. Kristin O'Brien to determine whether mitochondrial function limits thermal tolerance. Mitochondrial respiration assays were conducted in heart mitochondria from red- and white-blooded species. Dr. Lisa Crockett finished isolations of mitochondrial membranes from heart ventricles in several species of white- and red-blooded notothenioids at both ambient and CT_{MAX} temperatures to determine if changes with acute warming in the physical and/or chemical properties of mitochondrial membranes may correspond to limits in cardiac performance. Mitochondria and mitochondrial membranes are being shipped to our home institutions for identifying oxidized proteins, measuring enzyme activity, quantifying unsaturation indices of the phospholipid cardiolipin, and for determining levels of oxidative damage to membrane phospholipids (e.g., phospholipid hydroperoxides).

Dr. Iskander Ismailov and Mr. Jordan Scharping completed experiments in which they recorded spontaneous behavior accompanying whole-animal warming in both white-blooded *C. aceratus* and red-blooded *N. coriiceps* (n=6). They also completed electrophysiological recordings of spontaneous Purkinje cell activity in the cerebellum of *N. coriiceps* (n=4) and *C. aceratus* (n=6) during an experimental ramping of temperature in the region of the cerebellum. The primary objective of these experiments is to explore the contributions of neuronal sensitivity to elevated temperatures in order to gain a greater understanding of the physiological processes that limit thermal tolerance in Antarctic notothenioids. Data from these recordings will be analyzed in the coming months.

Dr. Theresa Grove finished collecting nuclei isolated from hearts of both white-blooded (*C. aceratus*, -Mb; *P. georgianus*, +Mb), and red-blooded (*N. coriiceps*) held at both ambient temperature and CT_{MAX}. Nuclei will be shipped to University of Alaska Fairbanks in order to investigate whether DNA binding by hypoxia inducible factor (HIF) is altered with temperature. Electrophoretic mobility shift assays will be conducted in the fall by Dr. Theresa Grove, who will be spending part of her sabbatical at the University of Alaska Fairbanks.

Ms. Elizabeth Evans continued to help with blood and tissue collection, and in addition, she completed collection of tissues, including brain samples, from white- and red-blooded species in order to pursue her senior Honors thesis at Ohio University in academic year 2015-2016.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT

June 2015

W. Lance Roth

B-005-P: IMPACTS OF LOCAL OCEANOGRAPHIC PROCESSES ON ADELIE PENGUIN FORAGING OVER PALMER DEEP: COASTAL OCEAN DYNAMICS APPLICATIONS RADAR (CODAR)

Josh Kohut, Principal Investigator, Rutgers University

The CODAR system consists of three transmitters/receivers located on Anvers Island, Wauwerman Island and on Howard Island in the Joubins. The data from all three transmitters is compiled on computers in Terra Lab and plots of the surface currents over the Palmer Deep are generated.

The CODAR system has been operating normally.

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION.

Kent Anderson, Principal Investigator, Incorporated Research Institutions for Seismology (IRIS)

Station PMSA is one of more than 150+ sites in the GSN, monitoring seismic waves produced by events worldwide. Real-time telemetry data is sent to the U.S. Geological Survey (USGS). The Research Associate operates and maintains on-site equipment for the project.

Work is being done inside the Seismic Vault in order to extend power out to a new Weather Tower that was installed earlier this season. The work inside the vault will continue again once all the conduit is in place and the cable is ready to be pulled.

A-109-P: ANTARCTIC EXTREMELY LOW FREQUENCY/VERY LOW FREQUENCY (ELF/VLF) OBSERVATIONS OF LIGHTNING AND LIGHTNING-INDUCED ELECTRON PRECIPITATION (LEP).

Robert Moore, Principal Investigator, University of Florida

ELF/VLF radio wave observations at Palmer Station are used to provide a deeper understanding of lightning and its effects on the Earth's inner radiation belt. The Research Associate operates and maintains on-site equipment for the project.

The VLF functioned normally this month. The antenna was inspected twice this month. The ELF is fully functional and operating without any problems. Both external hard drives were swapped out with fresh ones.

O-202-P: ANTARCTIC METEOROLOGICAL RESEARCH CENTER (AMRC) SATELLITE DATA INGESTOR.

Mathew Lazzara, Principal Investigator, University of Wisconsin

The AMRC computer processes satellite telemetry received by the Palmer Station TeraScan system, extracting Automated Weather Station information and low-resolution infrared imagery and sending the results to AMRC headquarters in Madison, WI. The Research Associate operates and maintains on-site equipment for the project.

The data ingestor computer system has been operating normally all month.

O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL TO DECADAL VARIATIONS IN TERRESTRIAL AND MARINE ECOSYSTEMS.

Ralph Keeling, Principal Investigator, Scripps Institution of Oceanography

The goal of this project is to resolve seasonal and inter-annual variations in atmospheric O₂ (detected through changes in O₂/N₂ ratio), which can help to determine rates of marine biological productivity and ocean mixing as well as terrestrial and oceanic distribution of the global anthropogenic CO₂ sink. The program involves air sampling at a network of sites in both the Northern and Southern Hemispheres. The Research Associate collects samples fortnightly from Terra Lab.

The air samples were taken every two weeks. New flasks arrived on the LMG15-05B and sampled flasks were shipped north on the same vessel.

O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD WORLDWIDE FLASK SAMPLING NETWORK

Don Neff and Steve Montzka, Principal Investigators, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

The NOAA ESRL Carbon Cycle Greenhouse Gases (CCGG) group makes ongoing discrete measurements to document the spatial and temporal distributions of carbon-cycle gases and provide essential constraints to our understanding of the global carbon cycle. The Halocarbons and other Atmospheric Trace Species (HATS) group quantifies the distributions and magnitudes of the sources and sinks for atmospheric nitrous oxide (N₂O) and halogen containing compounds. The Research Associate collects weekly air samples for the CCGG group and fortnightly samples for the HATS group.

Samples were collected for the carbon cycle and the halocarbon and trace species projects. Sampled flasks were shipped north on LMG15-05B.

O-264-P: ULTRAVIOLET (UV) SPECTRAL IRRADIANCE MONITORING NETWORK

James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

A Biospherical Instruments (BSI) SUV-100 UV spectroradiometer produces full sky irradiance spectra ranging from the atmospheric UV cutoff near 290nm up to 605nm, four times per hour. A BSI GUV-511 filter radiometer, an Eppley PSP Pyranometer, and an Eppley TUVR radiometer also continuously measure hemispheric solar flux within various spectral ranges. The Research Associate operates and maintains on-site equipment for the project.

The system operated normally throughout the month.

O-283-P: ANTARCTIC AUTOMATIC WEATHER STATIONS (AWS).

Mathew Lazzara, Principal Investigator, University of Wisconsin

AWS transmissions from Bonaparte Point are monitored using the TeraScan system and the University of Wisconsin's Data Ingestor system. Data collected from this station is freely available from the University of Wisconsin's Antarctic Meteorological Research Center (AMRC) website. The Research Associate monitors data transmissions for the project and performs quarterly maintenance on the station at Bonaparte Point.

The system operated normally throughout the month. Daily quality checks of the downloaded data were performed as scheduled.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION.

Joe Pettit, Principal Investigator, UNAVCO

Continuous 15-second epoch interval GPS data files are collected at station PALM, compressed, and transmitted to the NASA-JPL in Pasadena, CA. The Research Associate operates and maintains on-site equipment for the project.

The system operated normally throughout the month.

T-312-P: TERASCAN SATELLITE IMAGING SYSTEM

The TeraScan system collects, processes, and archives DMSP and NOAA satellite telemetry, capturing approximately 25-30 passes per day. The Research Associate operates and maintains on-site equipment for the project. The TeraScan weather and ice imagery is used for both research and station operations.

The system operated normally throughout the month.

A-357-P: EXTENDING THE SOUTH AMERICAN MERIDIONAL B-FIELD ARRAY (SAMBA) TO AURORAL LATITUDES IN ANTARCTICA

Eftyhia Zesta, Principal Investigator, University of California Los Angeles

The three-axis fluxgate magnetometer is one in a chain of longitudinal, ground-based magnetometers extending down though South America and into Antarctica. The primary scientific goals are the study of ULF (Ultra Low Frequency) waves and the remote sensing of mass density in the inner magnetosphere during geomagnetically active periods. The Research Associate maintains the on-site system.

The magnetometer functioned normally this month.

A-373-P: TROPOSPHERE-IONOSPHERE COUPLING VIA ATMOSPHERIC GRAVITY WAVES

Vadym Paznukhov, Principal Investigator, Boston College

The goal of this project is to enhance the comprehensive research understanding of troposphere-ionosphere coupling via Atmospheric Gravity Waves (AGWs) in the Antarctic region. Both experimental and modeling efforts will be used on the Antarctic Peninsula to investigate the efficiency and main characteristics of such coupling and will address several questions remaining in the current understanding of this coupling process.

The system functioned normally, but there is concern with noise at 4MHz and 2.22 MHz which has yet to be identified.

B-466-P: FLUORESCENCE INDUCTION AND RELAXATION (FIRe) FAST REPETITION RATE FLUOROMETRY (FRRF)

Deneb Karentz, Joe Grzymiski, Co-Principal Investigators, University of San Francisco

The focus of this project is to identify and evaluate changes that occur in genomic expression and physiology of phytoplankton during the transition from winter to spring, i.e., cellular responses to increasing light and temperature. A Fast Repetition Rate Fluorometer (FRRF) with a FIRe (Fluorescence Induction and Relaxation) sensor is installed in the Palmer Aquarium. The Research Associate downloads data and cleans the instrument on a weekly basis.

Daily instrument checks, weekly cleaning, and data downloads were performed when possible. B-036-P/L (O'Brien) was performing light and noise sensitive studies in the aquarium near the FRRF instrument which shifted the schedule of these maintenance events. Now that B-036-P/L has departed station, maintenance will resume at the same time every week.

T-998-P: INTERNATIONAL MONITORING STATION (IMS) FOR THE COMPREHENSIVE NUCLEAR TEST BAN TREATY ORG. (CTBTO)

Managed by General Dynamics

The IMS Radionuclide Aerosol Sampler and Analyzer (RASA) is part of the CTBTO verification regime. The automated RASA continually filters ambient air and tests for particulates with radioisotope signatures indicative of a nuclear weapons test. The Research Associate operates and maintains the instrument.

The system operated normally throughout the month. An individual sample was shipped north in the Silver Trunk as requested.

OCEANOGRAPHY

Daily observations of sea ice extent and growth stage are also recorded, along with continuous tidal height, ocean temperature, and conductivity at Palmer's pier.

Daily observations of the ice around station were made. The new tide gauge has been resetting for some unknown reason. The computer software has been updated and the instrument software will be updated in the near future to hopefully eliminate this issue.

METEOROLOGY

The Research Associate acts as chief weather observer, and compiles and distributes meteorological data. Weather data collected using the automated electronic system is archived locally and forwarded twice each month to the University of Wisconsin for archiving and further distribution. Synoptic reports are automatically generated every three hours by the Palmer Meteorological Observing System (PalMOS) and emailed to the National Weather Service for entry into the Global Telecommunications System.

PALMOS has operated normally. The new PALMOS meteorological system has been temporarily installed inside Terra Lab. It is currently operational and data is being record on the AWA software. Current work with Mesotech on the AWA output in ongoing in addition to work with FMC on the installation of the system.