PALMER STATION MONTHLY SCIENCE REPORT

MAY 2015

Equipped with the Google Trekker camera backpack, members of B-518-P and Palmer Station boating support staff depart for Biscoe Point. The researchers are studying human impacts on Palmer Station and the surrounding area.
(Image Credit: Ryan Andres)

NEWS FROM THE LAB

Emily Longano, Winter Laboratory Supervisor

The winter science season is strongly marching forward here at Palmer Station. The *ARSV Laurence M. Gould (LMG)* returned to Chile at the beginning of the month to drop off several science groups and pick up new researchers.

One of the new projects, A-373-P (Paznukhov), made a brief trip to the Ukrainian base, Vernadsky Station, to install an HF transmitter to compliment the HF receiver that is installed at Palmer. Our chef, Mike Hiller, and I compiled a package with American snacks, fresh fruits, and Palmer Station souvenirs to thank the base for hosting our scientist.

On May 9, Palmer Station participated in Global Big Day, a global birding event run by Cornell University. Volunteers from around station collected bird observations throughout the day. The

observations were logged by science support staff and entered into the global observation database. Overall, the event drew participants from over 100 countries and collectively recorded observations on over half of the world's known bird species. This event is a continuation of the strong relationship the station has with avian research.

APRIL 2015 WEATHER
Lance Roth, Research Associate

We started out the month of May with no snow on the ground and a lot of rain. Temperatures remained above zero for almost half of the month, and we received over 1.5 inches of rain. This moisture later turned into a sheet of ice as temperatures dropped. This ice sheet remains under several layers of snow and has made both station and backyard travel extremely difficult.

We saw a total of 42.4 mm of precipitation with 23 cm of snow. The maximum temperature was 5.0 °C (41 °F) on May 11th, and the minimum temperature was –12.6 °C (9.3 °F) on May 29th. The average wind speed was 7 knots while the highest five second gust was 46 knots recorded on the 17th of this month.

No sea ice was observed in the area, however on May 29th several large icebergs made their way into Hero Inlet and Arthur Harbor. The tide gauge on the pier measured on average sea surface temperature of -1.0 °C (30.2 °F). The minimum sea temperature recorded was -1.5 °C (29.3 °F) on May 7th and the maximum sea surface temperature was -0.5 °C (31.1 °F) which was observed on May 1st and 2nd.

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

Personnel on station: Timothy Clingenpeel and Neal Dupree

Members of A-109-P departed station at the beginning of this month after successfully completing their objectives.

A-373-P: TROPOSPHERE-IONOSPHERE COUPLING VIA ATMOSPHERIC GRAVITY WAVES
Dr. Vadym Paznukhov, Principal Investigator, Boston College

Personnel on station: Vadym Paznukhov

Installation of two major instruments was planned for the May-June 2015 deployment: a GPS receiver and bistatic single-channel HF system.

GPS receiver installation:

The GPS system consists of a Septentrio PolaRx4 Pro receiver and an AT1675-120W-TNCF-000-RG-39-NM-R Choke-Ring antenna. In accordance with the season plan, the equipment was installed in the Terra Lab with the antenna set-up on the roof of the building. Unfortunately, it was not possible to have an optimal setup for the antenna on the roof due to interference with UV sensor already located on top of the roof. This is illustrated with Figure 1 showing that the antenna was positioned in the location #3 – the lowest of the three desired points.

Figure 1. Westward view from the roof of the Terra Lab building. Proposed positions #1 and #2 were not approved, and the antenna was installed at position #3.

In this position, it is expected that the TEC measurements, which are extracted from the phase information of the recorded GPS signal, will have interference due to the multiple reflections of the wave from the surrounding objects on the roof of the building. GPS data collection began on May 25th. A careful assessment of the quality of the data will require at least one month of data collection, so it will be done after the PI returns to the USA.

At this moment, it is possible to produce ionospheric parameters from the amplitude measurements of the GPS signal, the S4 scintillation index data. Figure 2 shows an example of the first measurements made with the Palmer GPS system.

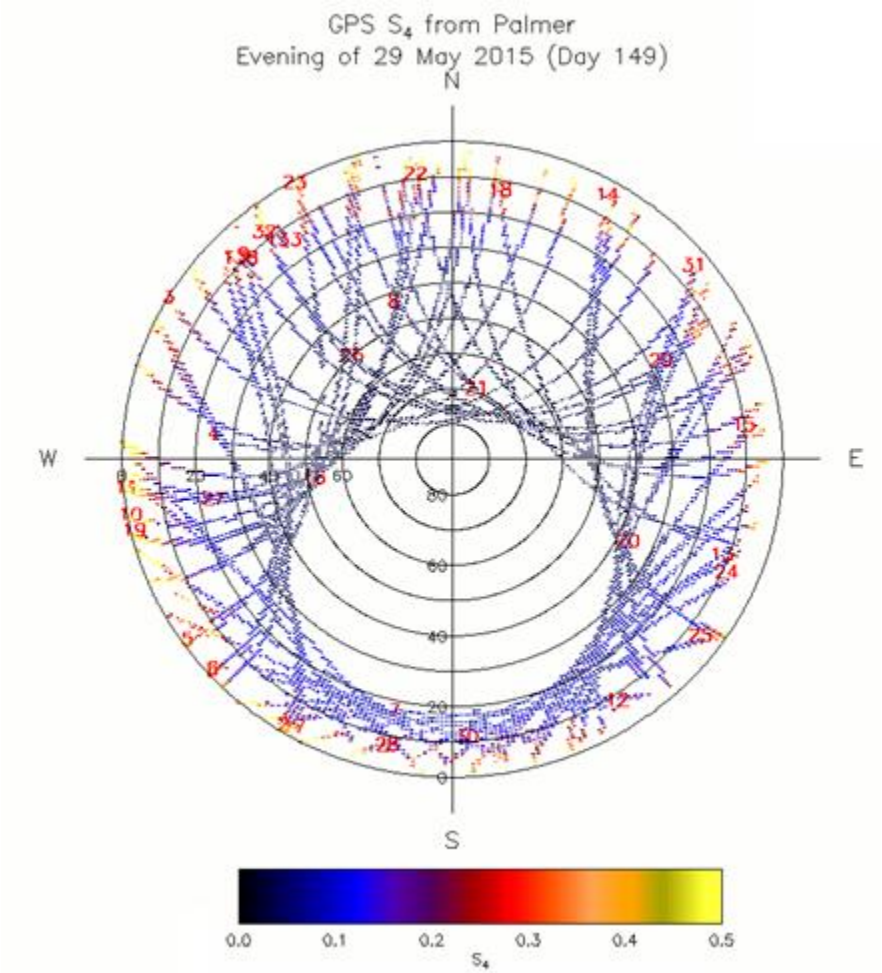

Figure 2. S4 scintillation measurements collected on May 29, 2015. The amplitude of the S4 index is shown along the satellite tracks thus illustrating the section of the sky which is covered with measurements. The low values of S4 index (< 0.2) indicate the absence of irregularities.

We will be analyzing the quality of the collected data in detail assessing the necessity of relocating the GPS to a less obscured location.

HF system installation:

The HF system includes a transmitter (based on ICOM-718) deployed at Vernadsky Station and receiver (based on USRP software defined radio) installed at Palmer Station. From May 26th to May 29th, the PI traveled to Vernadsky to test the transmitter and to put it into operation. The HF system installation is similar to the projected scenario. Both systems have been installed and deployed, and the first soundings between Vernadsky and Palmer have been made. A somewhat unexpected result is the high level of the direct signal (ground wave) which is comparable to the ionospherically reflected signal. Thus currently we are in search of the optimal configurations for the transmitting and receiving antennas and also the optimal operating power for the transmitter. The transmitter can be controlled using a personal computer that allows advance scheduling and operating modes.

Figure 3. Transmitter assembly at Vernadsky Station. The system includes ICOM-718 transceiver, antenna tuner, power supply box, modulator, and PC computer.

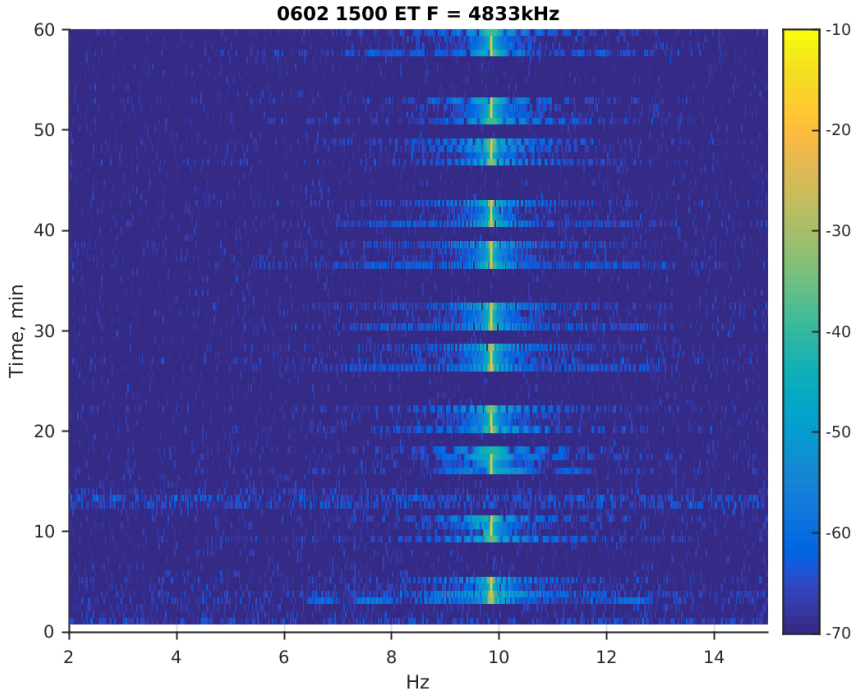

Figure 4. An example of Vernadsky-Palmer sounding on June 2, 2015 made at three interlaced frequencies. One of the three sounding frequencies is shown in this plot. Each frequency takes 2 min of operation.

We are experimenting with different modes in search of the optimal operation scenario. There is also certain interference from the CODAR system which is deployed at Palmer Station and operates at 12.7 MHz. Detailed analyses of both GPS and HF data quality will be performed after the PI returns to the USA, and a determination will be made as to whether the current configuration meets the requirements of the scientific goals.

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

At the conclusion of LMG15-04, Dr. Tony Farrell left Palmer to return to his home institution (University of British Columbia), while Mr. Jordan Scharping (Virginia Tech Carilion) and Ms. Elizabeth Evans (Ohio University) joined the team for the LMG15-05.

We continue to expand our experiments, 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 over longer time scales (days). 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) is collecting data on heart rate (f_H) during thermal ramping. To date, our results indicate that the red-blooded *Notothenia coriiceps* is able to raise f_H with warming in the absence of cardiac arrhythmia, to a higher temperature threshold than either of the two icefish species under investigation, the white-hearted (-Mb), *Chaenocephalus aceratus*, and the red-hearted (+Mb) *Pseudochaenichyths georgianus*. One of our objectives is to identify the extent to which cardiac arrhythmia may define a useful index of thermal tolerance (critical thermal maximum or CT_{MAX}). Our initial findings suggest that this is the case in icefishes. We have also started to accumulate data on vascular reactivity in *C. aceratus* and *N. coriiceps* in order to investigate whether the higher sensitivity of icefish hearts to afterload (the pressure against which the heart has to work) is reflected in the degree of vascular tone that may be produced. In addition to this work, Stuart Egginton is completing the work that Tony Farrell started during LMG15-04, in which the *in-situ* heart preparation is being used to quantify maximum cardiac power output in ambient and warm-acclimated notothenioids exposed to a range of temperatures.

Graduate student, Amanda Biederman, has been working on a procedure to simultaneously isolate synaptosomal and mitochondrial membranes from the brains of both white- and red-blooded notothenioids. She has now completed making the modifications to improve the yield, enrichment, and repeatability in order to prepare biological membranes from the Antarctic species. Using differential and density-gradient centrifugation, and analyses of membrane marker enzymes, Amanda has been able to prepare enriched fractions of synaptosomal and mitochondrial membranes from both *C. aceratus* (-Hb) and *N. coriiceps* (+Hb). These membranes are being stored frozen and will be returned to Ohio University for analyses of membrane fluidity and Arrhenius break temperatures (ABT). She plans to determine whether there are differences in membrane physical properties among white- and red-blooded species, and look for potential correlations between her results and results of the experiments involving the neurophysiological responses to warming.

Experiments continue by Dr. Kristin O'Brien and Dr. Lisa Crockett to determine whether mitochondrial function and/or properties of mitochondrial membranes limit cardiac performance and thermal tolerance. Mitochondria are being isolated from cardiac and skeletal muscle in notothenioids (differing in expression of hemoglobin and myoglobin) held at either ambient temperature or exposed to their critical thermal maximum (CT_{MAX}). Mitochondrial respiration rates are being measured, and aliquots of mitochondria will be shipped to our home institutions for identifying oxidized proteins, measuring enzyme activity, quantifying unsaturation indices of the phospholipid cardiolipin, and determining levels of oxidative damage to membrane phospholipids (e.g. phospholipid hydroperoxides).

Dr. Iskander Ismailov and Mr. Jordan Scharping have performed experiments quantifying whole animal behavior with environmental warming in both white-blooded *C. aceratus* and red-blooded *N. coriiceps* (n=3 for each species). They have also begun electrophysiological recordings of Purkinje cells in the cerebellum of *N. coriiceps*. The experimental plans for the remaining time will include regional warming of the cerebellum in order to determine the temperature at which cerebellar function begins to decline. These experiments will contribute to our understanding of the physiological processes that limit thermal tolerance in Antarctic notothenioids.

Dr. Theresa Grove is continuing to collect 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}. After isolation, nuclei are being frozen and 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 has been helping out with blood and tissue collection, and in addition, she is harvesting 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.

B-518-P: TEMPORAL VARIABILITY IN NATURAL AND ANTHROPOGENIC DISTURBANCE OF PALMER STATION, ANTARCTICA
Dr. Andrew Klein, Principal Investigator, Texas A&M University; Dr. Paul Montagna, Co-PI, Texas A&M-Corpus Christi, Dr. Terry Wade, Dr. Jose Sericano and Mr. Stephen Sweet, Co-PIs Texas A&M University

Personnel on station: Andrew Klein, Terence Palmer, and Stephen Sweet

Members of B-518-P departed station at the beginning of this month after successfully completing their objectives.

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

Personnel on Station: Bouvard Hosticka

The member of T-998-P departed station at the beginning of this month after successfully completing his objectives.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT
May 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 in the Seismic Vault in order to continue power out to a new Weather Tower that was installed earlier this season. The work inside the vault should be done by June 3rd.

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.

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 interannual variations in atmospheric O_2 (detected through changes in O_2/N_2 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 CO_2 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 LMG15-05.

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.

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 well throughout the month. A new GPS antenna was installed on the railing near the SUV, but it does not affect the cosine of the irradiance.

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. The Trimble GPS was used to find the best location for the A-373-P (Paznukhov) project.

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 has 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 has 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.

Vadym successfully installed his Septentrio PolaRxs GPS receiver (with GPS antenna) and HF receiver here at Palmer Station. He was also successful at Vernadsky Station where he installed

an HF transmitter. The system is up and running, but further processing is necessary before any feedback will be available.

B-466-P: FLUORESCENCE INDUCTION AND RELAXATION (FIRe) FAST REPETITION RATE FLUOROMETRY (FRRF)
Deneb Karentz, Joe Grzymski, 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 weekly data downloads were performed when possible. B-036-P/L (O'Brien) is performing light and noise sensitive studies in the aquarium near the FRRF instrument which shifts the schedule of these maintenance events.

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.

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 collected. 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 cargo strap on the data logger has been replaced by bolts and clips. The new PALMOS meteorological system has been unpacked and will put together inside Terra Lab before it is installed out on the new tower. Once all of the cables and connectors are soldered together, the system should be operational.