PALMER STATION
MONTHLY SCIENCE REPORT

July 2016

Members of the Manahan Group sampling sea ice from the *ARSV Laurence M. Gould*. *Image Credit: Linda Armbrecht*

NEWS FROM THE LAB
Ben Cournoyer, Winter Laboratory Supervisor

July was and eventful month here at Palmer Station. All labs were occupied, reminiscent of the summer months. The icefish embryos being raised by the Detrich group matured at an impressive rate considering the low temperatures. In addition we had the pleasure of hosting the NSF Advanced Training Program in Antarctica for Early career scientists: Biological Adaptations to environmental change (NSF Antarctic Biology Course) organized by the collaborative efforts of Donal Manahan and Deneb Kerentz. This course brings early career scientists to Antarctica to get firsthand experience conducting research at remote field stations. The labs were a flurry of activity as the students prepared and conducted their projects.

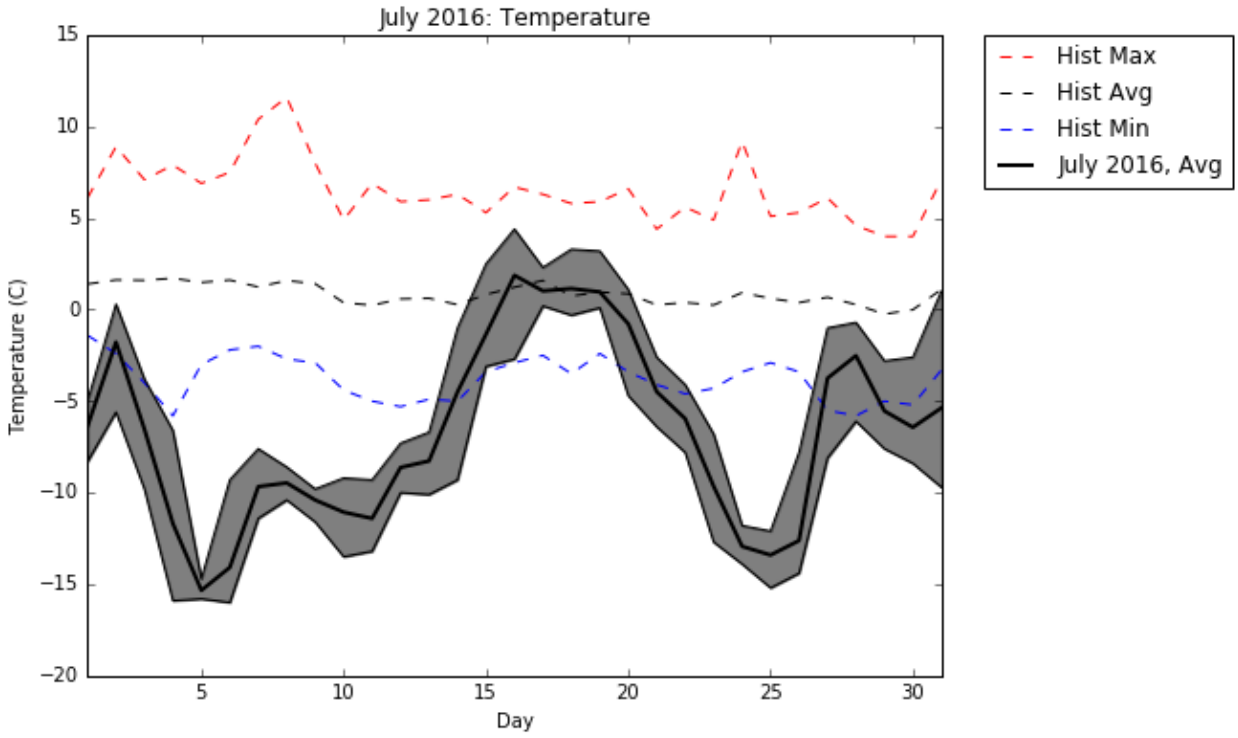
As the month came to a close we said good bye to the student group as well as Nathalie Le François of the Detrich group and a number of ASC staff who have been with us since April. The remaining twenty-one winter-overs won't see the Laurence M. Gould until station turnover in October.

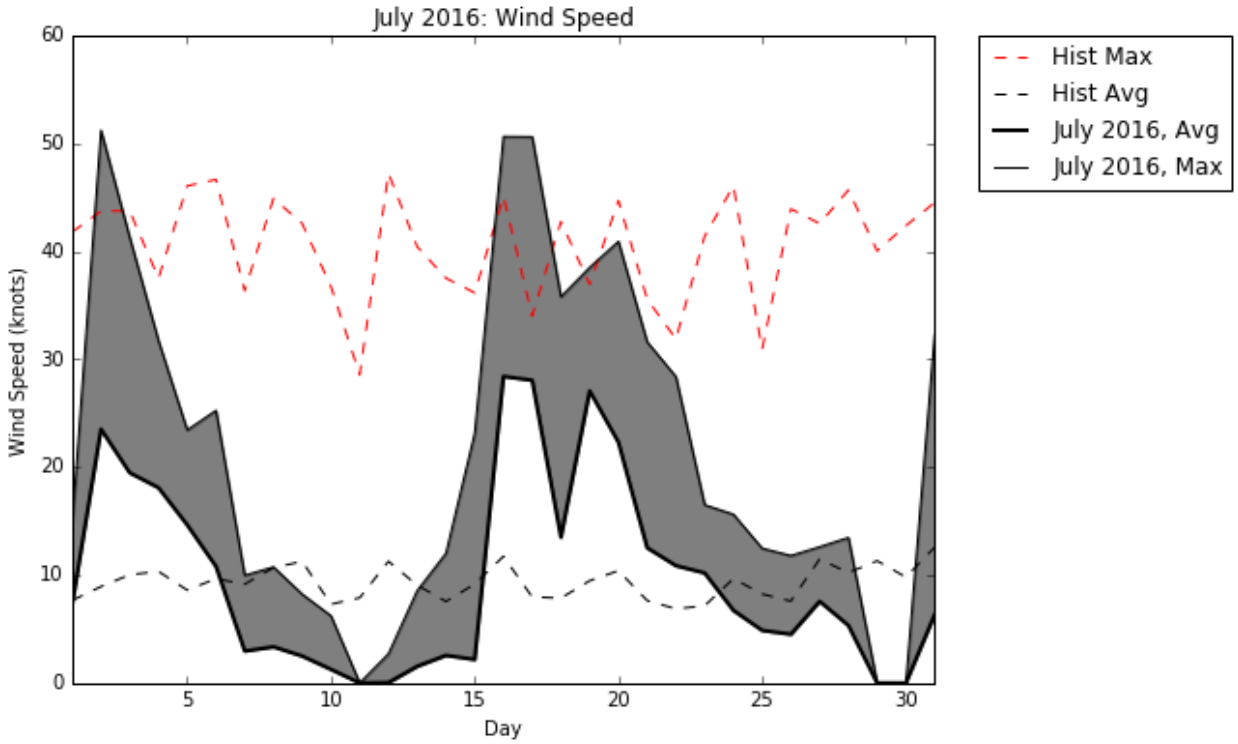
July 2016 WEATHER
Lance Roth, Research Associate

The following table gives the weather data for the month of July. The times are in UTC.

Temperature
Average: -6.7 °C / 19.9 °F
Maximum: 4.4 °C / 39.92 °F on 16 Jul 01:38
Minimum: -16 °C / 3.2 °F on 6 Jul 02:07
Air Pressure
Average: 993.2 mb
Maximum: 1018.9 mb on 15 Jul 23:05
Minimum: 949.4 mb on 3 Jul 14:29
Wind
Average: 9.6 knots / 11.1 mph
Peak (5 Sec Gust): 58 knots / 67 mph on 17 Jul 18:30 from N (9 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 24.1 mm / .95 in
Total Snowfall: 16 cm / 6.2 in
Greatest Depth at Snow Stake: 72 cm / 28.1 in
WMO Sea Ice Observation: Ship in easily penetrable ice. More than 20 bergs, with growlers and bergy bits.
Average Sea Surface Temperature: -1.7 °C / 28.9 °F

The following two plots show the month's average temperature and wind speed plotted against the historical average (where the historical average goes back to November 30, 2001). Temperatures were much cooler on average this month and created sea ice in both Arthur Harbor and Hero Inlet. We also experience high winds on two occasions with wind gusts of over 65 mph. The wind events broke up some of the ice in the harbor, but it quickly returned with the low temperatures.


July 2016: Temperature
Temperature (C)
Day
Hist Max
Hist Avg
Hist Min
July 2016, Avg


July 2016: Wind Speed
Wind Speed (knots)
Day
Hist Max
Hist Avg
July 2016, Avg
July 2016, Max

B-037 ANTARCTIC NOTOTHENIOID FISHES: SENTINEL TAXA FOR SOUTHERN OCEAN WARMING

H. William Detrich, Principal Investigator
Marine Science Center, Dept. of Marine and Environmental Sciences, Northeastern University

Personnel on Station:

1-2 July: Nathalie Le François, Laura Goetz, and Sierra Smith
3-30 July: Nathalie Le François, Laura Goetz, Kathleen Shusdock, and Sierra Smith
31 July: Laura Goetz, Kathleen Shusdock, and Sierra Smith

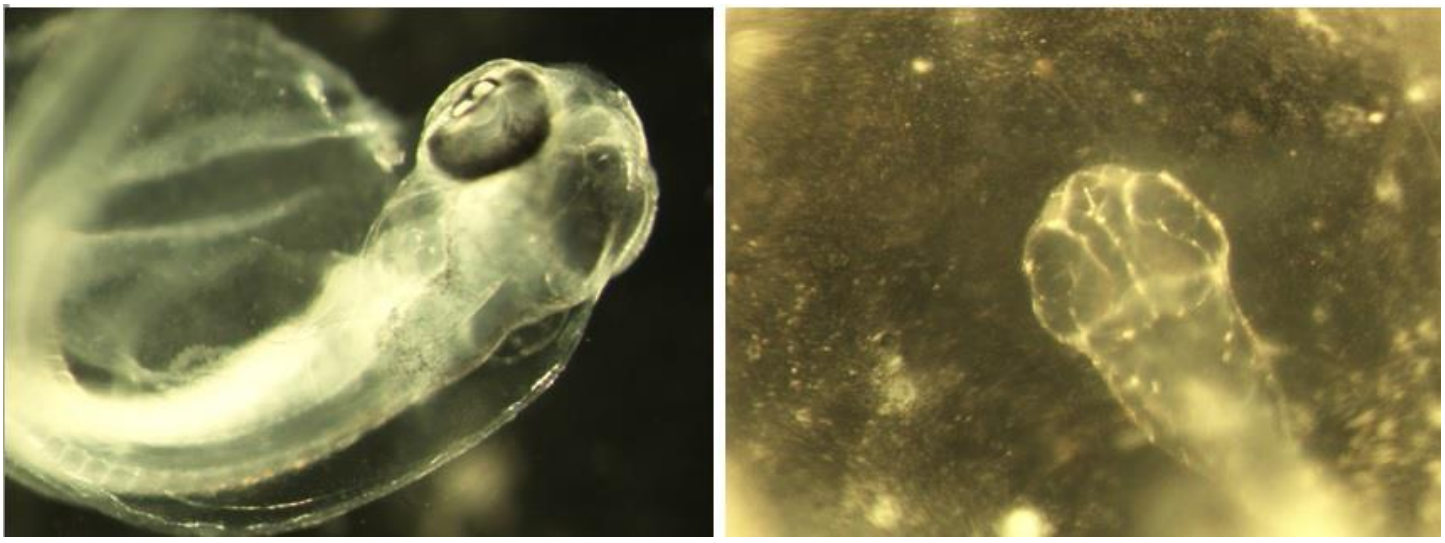
Synopsis – Antarctic notothenioid fishes have evolved a remarkable suite of characteristics, including the acquisition of macromolecular antifreezes by most species and the loss of red blood cells and hemoglobin by the "white-blooded" icefish family, as the Southern Ocean (SO) cooled to the freezing point of seawater (–1.9°C) over the past 25-40 million years. Today, these cold-adapted fishes are threatened by rapid warming of the SO, the temperature of which is likely to increase by 2-4°C over the next two centuries. The long-term goal of my research program is to assess the molecular and organismal consequences of this warming by analysis of the effects of elevated temperature regimes on gene expression in developing embryos of red- and white-blooded Antarctic notothenioids (the Bullhead notothen *Notothenia coriiceps* and the Blackfin icefish *Chaenocephalus aceratus*, respectively).

Fishing – None performed during this period. Team members worked with fish stocks and embryos already present in the Palmer Station aquarium.

Palmer Station Science – July was a busy month for B-037 as the team continued our scientific program on the effects of warming on the development of embryos of the Bullhead notothen *Notothenia coriiceps*. Le François, Goetz, Shusdock, and Smith maintained and sampled 11 clutches of *N. coriiceps* embryos that were produced in late May and early June by *in vitro* fertilization. The embryos have subsequently been incubated at –1°C (controls) and at +4°C (experimentals). Critical tasks have included: 1) preserving embryos at key developmental stages for future analyses of gene expression and bone development; 2) microscopic documentation of the development of control and experimental embryo cohorts; 3) evaluation of methods for the cryopreservation of sperm from several species – success in these endeavors would facilitate future reproductive studies by eliminating the need to catch synchronously fertile males and females; 4) disinfection of embryos to enhance their long-term viability; and 5) tracking embryo mortality to guide our efforts to develop new husbandry methods in the future.

Personnel Deployments – Team member Shusdock arrived at Palmer Station on 3 July aboard the *LMG*. Le François departed Palmer Station northbound to Punta Arenas, Chile, on 31 July. Goetz, Shusdock, and Smith remain on station to continue our over-winter embryological studies at Palmer Station.

We thank the station and ship personnel for their dedication and professionalism in support of B-037. Your tremendous assistance has helped B-037 to achieve its goals during the month of July.



A comparison of bullhead Notothen (*Notothenia coriiceps)* embryos raised at ambient (right) and five degrees above ambient temperature (left) sixty days after fertilization. Note the increased development in the left pane. *Image Credit: Laura Goetz*

B-301 NSF Advanced Training Program in Antarctica for Early Career Scientists: Biological Adaptations to Environmental Change

Donal T. Manahan[1] and Deneb Karentz[2], co- Principal Investigators

[1]Department of Biological Sciences, University of Southern California, Los Angeles, CA
[2]Department of Biology and Department of Environmental Science, University of San Francisco, San Francisco, CA

Personnel on station**:** Deneb Karentz, Kevin Archibald, Linda Armbrecht, Madeleine Brasier, Jackson Chu, Dillon Chung, Erin Collins, Rasmus Ern, Christina Frieder, Cherry Gao, Kai Lohbeck, Kerry Nickols, Connie Phong, Matthew Sasaki, Gordon Showalter, Ben Speers-Roesch, Angela Zoumplis

The NSF Polar Programs, Antarctic Sciences Section has been supporting an advanced training program in Antarctica since 1994. The previous nine versions of the "Antarctic Biology Course" have been held during January at McMurdo Station. The major expectations from this training program are to 1) introduce new researchers to the unique features of biological processes in an extreme cold environment, 2) place that understanding of Antarctic biology in the context of environmental change in polar regions, 3) train course participants in modern field and research methods used to study the mechanisms that are unique to biology in Antarctica, 4) foster an appreciation for the importance of the physical and biological components of the Antarctic

ecosystem on global processes, and 5) prepare early career scientists for success in developing their own independent research programs in polar regions. 228 participants have been involved in the past nine sessions of the Antarctic Biology Course, representing 128 different institutions in 24 countries (and 29 nationalities).

The Manahan Group along with some of the members of the *ARSV Laurence M. Gould*.
Image Credit: Deneb Karentz

The 10th NSF Advanced Training Program in Antarctica for Early Career Scientists: Biological Adaptations to Environmental Change was held in July 2016, and for the first time on the Antarctica Peninsula. Cruise LMG16-06 on the *ARSV Laurence M. Gould* began on June 26. Departure from Punta Arenas was originally scheduled for June 25, but we were delayed for over one day. We were further delayed arriving at Palmer Station, first because of an attempt to intercept and retrieve a glider from another project. This activity was unsuccessful due to sea conditions. The remaining portion of the cruise to Palmer Station was impeded by ice and weather. We arrived on July 3 (original arrival was anticipated on June 30) and departed on July 31 (a day early to accommodate potential delays on the transit north due to ice).

The participants of the 2016 Antarctic Biology Course are PhD students and post-docs from fifteen different universities and five countries. These early career scientists all have an interest in polar research, but have not previously had Antarctic field experience. Course activities were conducted on the ship and at Palmer Station during July. The course started on the southbound

transit when we held a series of lectures and discussions to introduce course participants to key features of the Antarctic environment and explore potential research questions in polar science. Lectures and discussions were continued at Palmer Station throughout the month.

Fieldwork started on the trip south. From June 29-30 we sampled at five stations in the Drake Passage on the cruise track to Palmer Station – every half degree from 59 to 61º S. At each station on the southbound trip, the CTD/rosette was lowered to 1200 m and Niskin bottles were tripped at six depths on the upcast. Sample depths were determined from the vertical profile of temperature, salinity and fluorescence acquired during the downcast. Water samples from each depth were processed for quantification of nutrient concentrations (nitrate, phosphate and silicate), chlorophyll *a* concentrations, and phytoplankton cell densities. The water column was also sampled with an Isaacs-Kidd mid-water trawl (IKMT) and a 202 µm mesh zooplankton net, both towed from the stern of the ship. A phytoplankton net (64 µm) was deployed by hand at each station for surface sampling. Organisms in the IKMT and plankton net samples were identified and photographed to document biodiversity. Subsamples were frozen or otherwise preserved (e.g., formalin, ethanol) for future analyses.

Examination of the phytoplankton samples revealed the presence of 10-20 phytoplankton species at each station. These taxa were mostly diatoms, but silicoflagellates and dinoflagellates were also present. At the stations farthest south in the Drake Passage, the community was heavily dominated by one diatom species, *Trichtoxon reinboldii*. A variety of organisms were identified from the IKMT and the zooplankton net tows. These included krill larvae, amphipods, lantern fish, salps, copepods, pteropods and chaetegnaths. As expected, trawls made during daylight hours had many fewer specimens compared to trawls made during the dark nighttime periods.

On arrival at Palmer Station, Arthur Harbor and the surrounding coastal area was covered in pack ice. Several days were required to set up the labs and complete various trainings for field safety and station maintenance. With no small boating options, plankton samples were collected from the seawater inflow in the Palmer Station Aquarium. Organisms were identified and used for a variety of experiments. A time series was initiated to document species succession during this winter period.

On July 11 we departed for a three-day cruise on the *ARSV Laurence M. Gould*. At the outer edge of the Palmer Station two-mile small boating limit, a CTD cast was made in Biscoe Bay at the LTER station E. We transited from station E to the Palmer Deep and sampled for two consecutive days at the same location on a six-hour schedule. At each time point, sampling included a CTD cast to document vertical structure of the water column; whole water samples at six depths for chlorophyll and nutrient concentrations, and bacterial and phytoplankton cell densities; a mid-water trawl to evaluate pelagic diversity and abundance, and to capture live animals for further experimental work at Palmer Station; a zooplankton tow to collect smaller animals; and a phytoplankton tow to assess diversity. Water collections were also made to determine prokaryote/eukaryote community composition using various molecular methods (e.g., nucleic acid sequencing), to quantify gene expression, to set up experiments on effects of pressure on bacterial survival and physiology, and to create a bacterial fosmid library.

The IKMT and the zooplankton net samples on this cruise were predominantly comprised of krill, *Euphausia superba*. All life stage classes were present. Individual animals were measured for size and total biomass of each size class was measured. Flow meter data were used to estimate the in situ density of krill. Krill and other animals were kept in aquaria for return to Palmer Station and further experimentation.

After two days of diel sampling, two Blake trawls were made in the Gerlache Strait and a variety of fish and invertebrates were caught. These organisms were stored in aquaria for return to Palmer Station where physiological experiments were conducted. Sediment samples were also obtained with a Smith-MacIntyre grab sampler. The sediment was sampled for diversity of microorganisms based on microscopic examination and samples were preserved for future molecular analyses.

Before returning to Palmer Station on July 14, a CTD cast was made at Station E. On return to Station, experiments commenced to investigate physiological responses of krill to variations of temperature (e.g., cardiac physiology, respiration, etc.). Other invertebrates and fish were also tested for thermal responses (e.g., mass specific oxygen consumption). Enzyme assays (e.g., citrate synthase activity, sodium potassium ATPase activity), gut analyses and microbiome sampling were also carried out on a variety of species.

A second cruise on the LMG occurred from July 20-23. We again stopped at Station E for a CTD cast on the way out and the way back to Palmer Station. A Blake trawl was made in the Gerlache Strait to initiate a microbiome project that would survey various taxa from different locations. Unfortunately, we were only able to make the one successful trawl and will use the specimens from the one site for this investigation. Sea ice cores were taken in Flanders Bay and examined for vertical structure of species in the ice community, salinity, temperature, etc. Samples were collected for later analysis of gene expression (RNA sequencing), community analysis by molecular methods (16s and 18s sequencing) and nutrients.

While many results were obtained during the cruises and time on station, additional samples have been prepared for return to the US and further analyses. On July 30 we held a mini-symposium where many of the results from course activities were presented. The list of talk titles below provides a sample of the types of investigations carried out by the participants of the Antarctic Biology course.

- Benthic biodiversity of Western Antarctic Peninsula - *Jackson Chu, Erin Collins, Madeleine Brasier*
- Selective feeding in Antarctic Amphipods - *Madeleine Brasier*
- Thermal sensitivity of Antarctic krill (*Euphausia superba*) performance: from molecules to grazing - *Dillon Chung, Rasmus Ern, Kerry Nickols, Madeleine Brasier, Jackson Chu, Matt Sasaki, Kevin Archibald, Ben Speers-Roesch*
- On the regenerative capacity of some Antarctic sponges - *Jackson Chu, Connie Phong, G. Max Showalter*
- Physical factors driving community diversity, abundance and gene regulation in winter sea ice- Flanders Bay, Antarctica - *Linda Ambrecht, Kevin Archibald, G. Max Showalter, Angela Zoumplis*

- Fluctuations in bacterio-, phyto-, and zooplankton abundance in Arthur Harbor, Antarctic Peninsula over one month in winter - *Matthew C. Sasaki, Kerry J. Nickols, Maddie Brasier, Linda Armbrecht, Kai T. Lohbeck, G. Max Showalter*
- Diel patterning over two days in plankton communities at Palmer Station, Antarctica, during winter 2016 - *Angela Zoumplis, Cherry Gao, Kai T. Lohbeck, Linda Armbrecht, Matthew C. Sasaki, G. Max Showalter*
- Bacterial growth and activity in the extreme marine Antarctic environment - *Connie Phong, G. Max Showalter*
- Fluid flows generated by krill - *Cherry Gao*
- A Dynamic Microbiome in Southern Ocean Krill - *Matthew C. Sasaki, Cherry Gao*

While our stay at Palmer Station has been very short (less than a month), the course participants accomplished quite a lot and have been very enthusiastic about their first Antarctic research experience. The 2016 Antarctic Biology Course has been a great success!

We sincerely thank Ken Keenan, the Palmer Station Winter Site Manager, and his staff; Al Hickey, the LMG Marine Projects Coordinator, and his staff; and Captain Stelly and the crew of the ARSV Laurence M. Gould for providing excellent support of our work.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
July 2016
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 seems to be working well, but one of the files is not updating. The grantee has been informed.

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.

The system operated normally throughout the month.

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/ELF system has operated well throughout the month.

A-119-P: DEVELOPMENT OF ANTARCTIC GRAVITY WAVE IMAGER.
Michael Taylor, Principal Investigator, Utah State University

The Gravity Wave Imager takes images of the night sky in the near infrared, observing the dynamics of the upper atmosphere. The camera takes one 20-s exposure image every 30s of a very faint emission originating from a layer located at ~55 miles of altitude.

The system has operated well throughout the month. There is an issue with the focus that can be addressed during clear night skies only.

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-231-P: QUANTIFYING ATMOSPHERIC IRON PROPERTIES OVER THE WESTERN ANTARCTIC PENINSULA
Yuan Gao, Principal Investigator, Rutgers University

The primary goal of this project is to quantify atmospheric iron properties in the marine atmospheric boundary layer of the Western Antarctic Peninsula (WAP). The specific objectives are to identify the sources of atmospheric iron; determine iron solubility, aerosol composition, and the iron-sulfur relationships; and to measure the temporal and spatial variability of atmospheric iron/dust fluxes.

The HV is working well and the filters have been changed weekly. The WD collected data while the LMG was not at the pier. TD bucket and instrumentation was damaged during a high wind event. Working on replacing parts before future sampling can take place.

O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL 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.

Air samples were taken twice this month.

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.

Due to unfavorable winds, samples were not taken regularly.

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 had issues with Windows 7. Updates seem to have taken care of the issues and all of the absolute scans were finally completed.

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.

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 well 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 TeraScan system worked well 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 was operational all 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 operated well throughout the month.

T-998-P: INTERNATIONAL MONITORING STATION (IMS) FOR THE COMPREHENSIVE NUCLEAR TEST BAN TREATY ORGANIZATION. (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 is having grounding issues with the blower causing dead time in the data. The issue can only be resolved by cycling the power on the blower motor controller.

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.

Observations of sea ice around station were made daily and the tidegauge worked well throughout the month. On July 11, 2016 the tide gauge was offset by 0.958606 meters to account for Palmer Station Local Mean Sea Level. The tide gauge has not moved, but an offset has now been applied to the data correcting the previous offset of zero.

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 once per 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.

The local weather station (PAWS) is working fine. The aspirating fan on the temperature/humidity sensor was rewired and replaced. Two of the three remote stations are still dormant do to the lack of sunlight.