PALMER STATION MONTHLY SCIENCE REPORT

May 2022

***RVIB Nathaniel B. Palmer* tied up at the new Palmer Pier for the first time.** *Image Credit: Matt Glover*

NEWS FROM THE LAB
Angela Klemmedson, Winter Laboratory Supervisor

May was a busy month at Palmer Station – filled with port calls, staff turnovers, and preparations for incoming science groups. Wintering ASC staff arrived on station, split into two *R/V Laurence M. Gould* port calls, to turnover with summer ASC staff. We welcomed Cristian Ferman of T-998-P (Hosticka) to perform annual inspection and maintenance of equipment in Terra Lab. Additionally, three ASC divers and three ASC antennae riggers arrived onsite to install anodes on the new pier and replace equipment on towers, respectively. Dr. Kim Bernard and Julia Fontana, two scientists from B-459-P (Bernard), arrived during the third May port call, which was the first time the *RVIB Nathaniel B. Palmer* has ever tied up at the Palmer Pier. This historical event was made possible by the newly constructed pier that extends further into the deeper waters of Hero Inlet than the previous pier.

The scientists from B-459-P (Bernard) are returning after starting a multi-year study in the winter of 2019. They arrived May 29 with two Xactic tanks of juvenile krill, which were transferred to the Palmer aquarium room and into four large tanks to begin a long-term feeding experiment. Three other scientists with this group are concurrently studying krill aboard *RVIB Nathaniel B. Palmer* (NBP22-05) and intend to deliver two additional Xactic tanks of juvenile krill mid-June.

The labs and station have returned to pre-pier construction conditions, thanks to the hard work of our dedicated ASC staff, notably Hannah James (summer Lab Manager) and Nerissa Fisher (Instrument Technician). During the pier construction, labs, offices, and the aquarium room were used as temporary work and living spaces to accommodate the additional personnel on station. This month, these spaces were returned to their designated functions, all instruments brought back online, and the labs set up for winter science groups. Angela Klemmedson, the incoming winter Lab Manager arrived May 22 for a quick turnover before Hannah James departed. The

summer and winter Research Associates worked together to maintain the Terra Lab instruments and bring the pier tide gauge back online.

Overall, weather conditions were exceptionally clear and calm this month. The May temperature record for Palmer Station was broken on the 21st (details in the "Monthly Weather Synopsis" section of this report). However, the favorable conditions have provided spectacular sunrises and sunsets, and allowed the riggers to service remote towers that are accessible by small boat.

B-459-P: CAREER: "The Omnivore's Dilemma": The effect of autumn diet on winter physiology and condition of juvenile Antarctic krill

Dr. Kim Bernard, Principal Investigator, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

Personnel on Station: Kim Bernard and Julia Fontana

Collecting krill on the southbound, *RVIB Nathaniel B. Palmer*: We transitted south to Palmer Station aboard the *RVIB Nathaniel B. Palmer*, departing Punta Arenas on May 20. Our search for krill began in Wilhelmina Bay during the night of May 27. After 10 hours and a thorough acoustic survey of Wilhelmina Bay (see cruise track in Figure 1), we found not a single krill aggregation. The following evening, however, our fortunes turned and during the EK80 calibration, the NBP drifted over a large aggregation of krill. Once the calibration was complete, we promptly turned the ship around and trawled over the path it had drifted along, catching ~10,000 juvenile krill (Figure 2)! We maintained the krill in two large Xactic tanks that were plumbed with natural seawater and transferred them to Palmer Station on May 29. Julia Fontana and Kim Bernard moved to shore (the rest of B-459 remained onboard to continue research down the Peninsula) and immediately began preparing to set up the long-term feeding experiments.

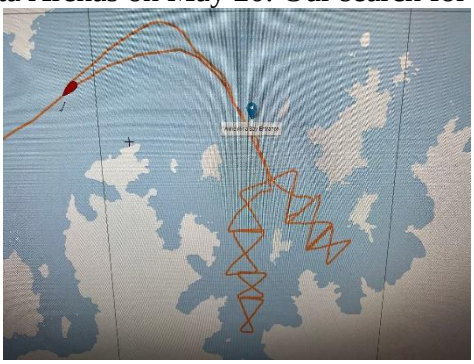


Figure 1. May 27th cruise track of our acoustic survey of Wilhelmina Bay. No krill found.

Figure 2. Kim Bernard picks juvenile krill from the catch. Photo credit: Giulia Wood.

Setting up the long-term feeding experiment: Our long-term feeding experiment consists of four feeding environment scenarios (FES) in the four large circular indoor tanks in the Palmer Aquarium Room. Each tank is set-up to receive unfiltered natural seawater from the seawater intake. The four FES's represent the following feeding environments: (1) no supplemental food, only the unfiltered natural seawater (NAT), (2) supplemental food, copepod powder (COP), (3) supplemental food, diatom powder (DIA), and (4) supplemental food, mixture of copepod and diatom powders (COP+DIA). Each tank has approximately 1,300 juvenile krill.

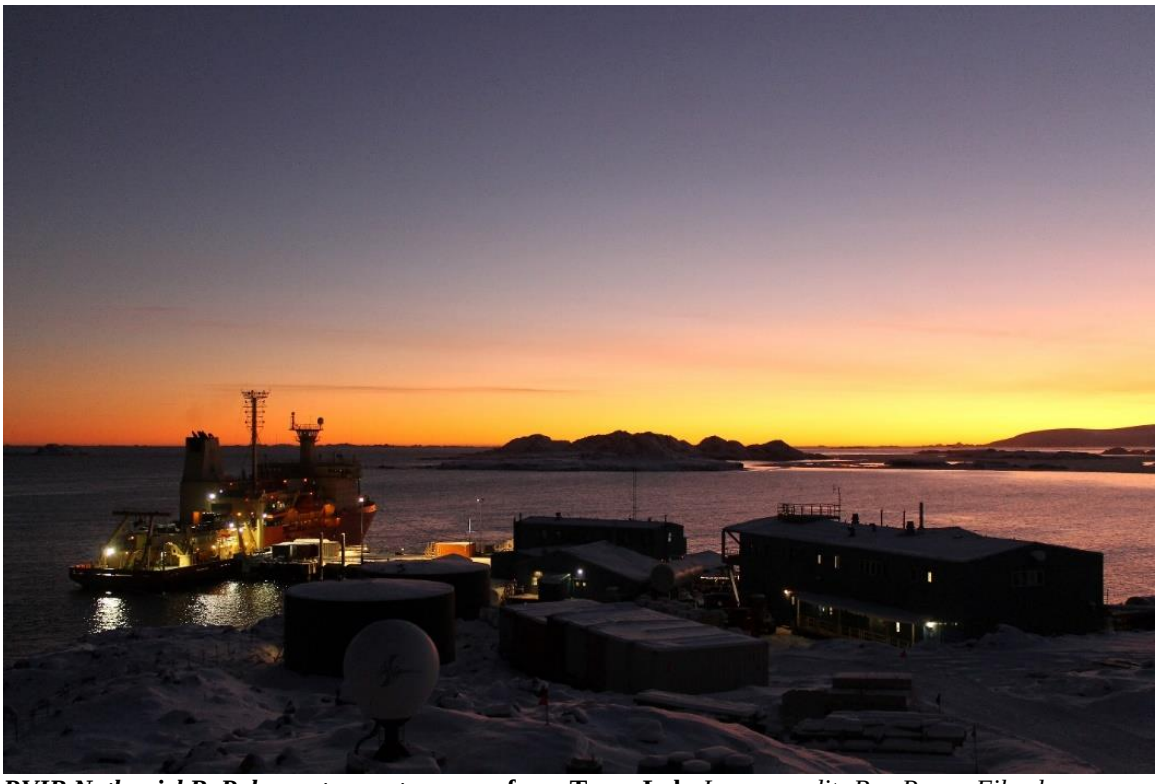
Time-point zero (TP0): We started our initial TP0 experiments and measurements on May 30, running the full week. This included (*i*) 3 x respiration rate experiments (n=48 krill), (*ii*) 1 x instantaneous growth rate experiment (n=100 krill), and (*iii*) collections of krill for lipids (n=10

krill), protein (n=10 krill) and carbon-hydrogen-nitrogen (CHN) (n=10 krill). In addition, we have been measuring tank parameters daily and collecting samples for later measurement of particulate organic carbon (POC) in the tanks and in the seawater intake.

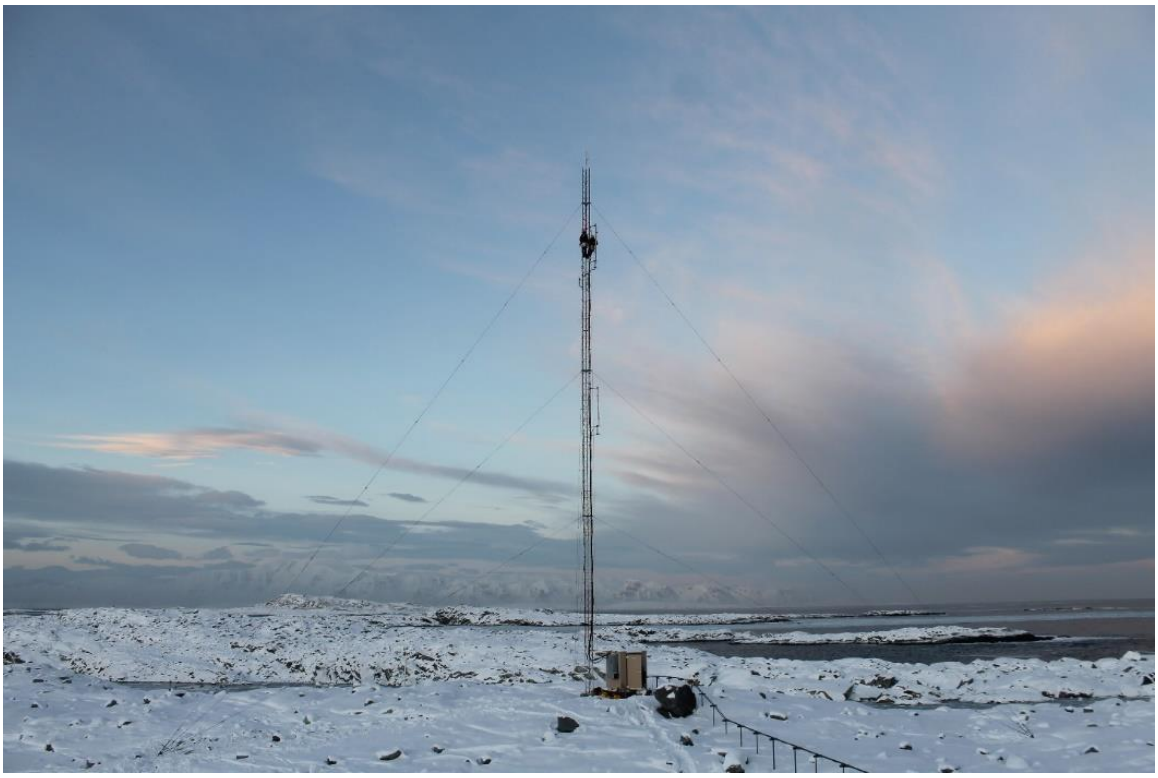
Outreach: Since departing our home-base in Oregon, Kim has made 14 short videos about the team's journey south, including time in quarantine in Chile. These videos are posted on Instagram (@psycho_kriller) and Twitter (@psycho_kriller) and have received 4,311 views as of 3 June 2022.

Looking ahead: Over the next month, we will conduct TP1 (starting June 20), which will include the experiments and collections described above. In addition, we will conduct functional response feeding experiments to determine feeding rates in response to food concentrations. We will also begin processing samples for protein, ammonia and chlorophyll-*a*, and will begin analyzing respiration rates from TP0. We will continue to make short videos describing our research and experience. In addition, we will be contributing to the build-up towards the inaugural World Krill Day (August 11).

RESEARCH ASSOCIATE MONTHLY REPORT
May 2022
Ben Rosen-Filardo



***RVIB Nathaniel B. Palmer* at sunset, as seen from Terra Lab.** *Image credit: Ben Rosen-Filardo*



Antenna Riggers replacing the VHF tower webcam. *Image credit: Ben Rosen-Filardo*

A-111-P: THE NEXT GENERATION OF GEOSPACE RESEARCH FACILITIES AT PALMER STATION

Andrew Gerrard, Principal Investigator, New Jersey Institute of Technology

Extremely Low Frequency/Very Low Frequency (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. Lightning source currents are estimated or directly measured by experimental observations of individual natural and rocket−triggered lightning flashes in North America. Together, the North American and Antarctic data sets are used to experimentally identify and analyze the components of lightning and the effects of lightning, such as lightning-induced electron precipitation (LEP), that are observed in the Antarctic, more than 10,000 km away.

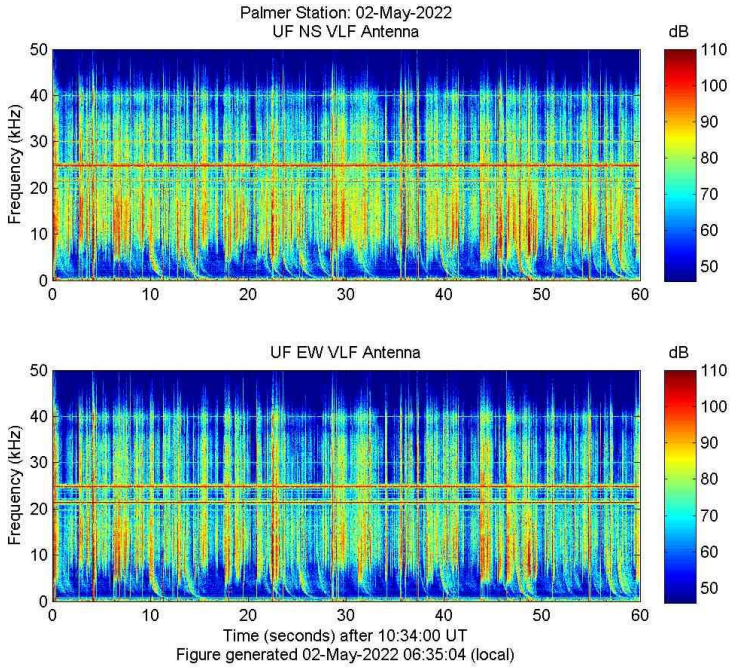


Figure 3. Real-Time broadband VLF Spectrogram from Palmer Station, Antarctica.

Both the Extremely Low Frequency and Very Low Frequency systems operated well this month. The spectrograms were reviewed daily and bi-weekly antennas inspections were done as weather allowed.

Current VLF/ELF data from Palmer Station can be observed at: http://halo.ece.ufl.edu/realtime_palmer_bb.php.

A-111-P: SAMBA MAGNETOMETER

Andrew Gerrard, Principal Investigator, New Jersey Institute of Technology

The three-axis fluxgate magnetometer at Palmer is one in a chain of eleven longitudinal, ground-based magnetometers extending down though South America and into Antarctica. The primary scientific goals are the study of Ultra Low Frequency (ULF) waves and the remote sensing of mass density in the inner magnetosphere during geomagnetically active periods. Palmer's magnetometer is also a conjugate to the Canadian Poste de la Baleine Station, allowing the study of conjugate differences in geomagnetic substorms and general auroral activity.

SAMBA stands for South American Meridional B-field Array. The sites are approximately along the 0° geomagnetic longitude and ranging from -5° to -48° geomagnetic latitude. In combination with other magnetometer chains, including the AGO (Automated Geophysical Observatory) systems elsewhere in Antarctica, the stations create an almost complete, cusp-to-cusp-long meridional chain at approximately 0° magnetic meridian.

The magnetometer was originally installed at Palmer in 2005, and a replacement installed in April of 2008. In 2017 the project was taken over by Andrew Gerrard. On February 27th, 2017 the USAP IT blocked all northbound VPN traffic under a larger umbrella of blocking all northbound encrypted-tunnel traffic. Since that time there has been much discussion, but the magnetometer is still considered a security vulnerability. The Research Associate has been

working with the home institution at the University of California, Los Angeles to resolve this issue. As of September 30th, 2020 at 7:45am local time, the magnetometer was removed from the network. The instrumentation and computer are still operational. Data will continue to be collected and stored locally. The RA is working with the IT department to send out the data to UCLA when requested. More information can be found at: http://magnetometers.bc.edu/index.php/palmer.

B-005-P: COASTAL OCEAN DYNAMICS APPLICATIONS RADAR (CODAR)
Josh Kohut, Principal Investigator, Rutgers University Department of Marine

Coastal Ocean Dynamics Applications RADAR (CODAR) was developed between 1973 and 1983 by NOAA's Wave Propagation Laboratory. It is a high frequency radar that operates at 12 MHz so can receive signals from over the horizon. There are CODAR antennas at Palmer (just below Terra Lab near Hero Inlet) and also at the Joubins and the Wauwerman Islands. Each system measures the radial component of ocean wave velocity by transmitting a fundamental frequency at 12 MHz and receiving a reflected signal at twice the fundamental frequency (half the wavelength). By combining the measured velocity components from the three stations, the total wave velocity can be determined. The Doppler shifts of the reflected signals can be used to measure surface currents. Wave velocity can be affected by currents at depths of 1 meter and shallower and thus a measureable with CODAR.

Two of the three sites' transmitter and receivers were shipped north on LMG21-11. The system is still continuously collecting data from the remaining site. The PI has deemed the data useful information from the single site.

The data will be available in the future at: https://marine.rutgers.edu/~codaradm/.

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION.
Kent Anderson, Principal Investigator, Incorporated Research Institutions for Seismology (IRIS)

Palmer's seismic station, code named PMSA, is part of the Global Seismic Network (GSN), a collection of 150+ sites worldwide, operating under the aegis of the Incorporated Research Institutions for Seismology (IRIS), and managed by the United States Geological Survey's Albuquerque Seismological Laboratory (ASL). The site was installed in March 1993. As of August 2006, PMSA is also used as an ancillary seismic system for the CTBT/IMS installation; CTBT-specific protocols for the seismic system are covered in the CTBT (T-998) section this document.

A standard seismic station consists of three seismometers oriented to detect ground motion along three mutually perpendicular lines. Most of the time the directions chosen are north-south, east-west, and up-down. The seismometers in the Palmer Station installation are "forced balanced" instruments, which means that they work by keeping an inertial mass stationary with respect to the instrument (and the earth). When a seismic wave arrives, the ground moves, carrying along the housing of the seismometer. The inertial mass tends to remain stationary and not move with the instrument, but it is electronically "forced" to travel along with the instrument (and the earth). The amount of "force" necessary to make it move with the rest of the instrument is proportional to the ground acceleration and is recorded as the raw data from the seismometer.

By examining time of arrival, azimuth, magnitude, frequency and wave type of the incoming waves, seismologists can determine the location, depth of focus, magnitude, type of faulting that occurred, ground acceleration in gravitational force and the structure of the medium (the earth) through which the waves traveled to reach the station. The Research Associate operates and maintains on-site equipment for the project.

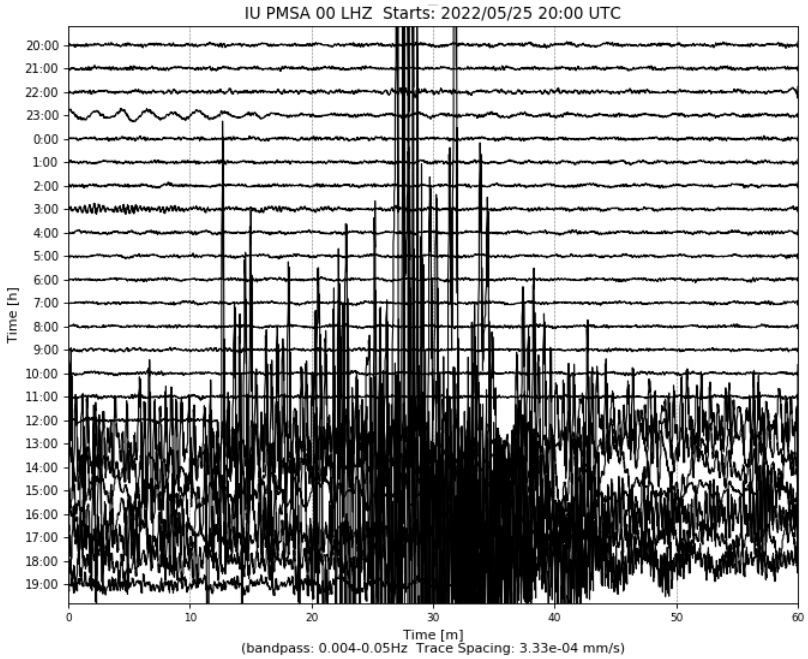


Figure 4. Earthquakes occurring on May 26, 2022 in Southern Peru and in the South Pacific Ocean.

The system operated consistently throughout the month. The time stamp and seismic activity found on the Heliplot was checked daily. The seismometer is not affected by the pile drilling for the pier project as shown above. Current data from Palmer station can be found on the USGS site: https://earthquake.usgs.gov/monitoring/operations/stations/IU/PMSA/#heliplot.

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 inter-annual 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 Scripps Institution of Oceanography flask sampling project analyzes air samples to assess variations in the atmospheric oxygen content caused by exchanges of O_2 between the atmosphere and the Southern Ocean. The oceans tend to be a source of oxygen to the air in the spring and summer, and a sink for oxygen in the fall and winter. The spring emissions are mostly due to photosynthesis in the water, while the winter uptake is due to mixing processes, which bring oxygen depleted waters from depth up to the surface. These exchanges lead to variations in the

oxygen content of the air above the water, and these changes are rapidly mixed around the latitude band by zonal winds. Measurements of the seasonal variations in oxygen content at Palmer and other sites may be valuable for documenting changes in the biological productivity of the southern oceans over time.

The percentage changes in oxygen are very small. Relative to the 20.95% background, the summer-winter differences are only about 0.01%. Some special precautions are necessary so that the O_2 content of the samples isn't perturbed at this low level. Among these precautions are maintaining a constant pressure and temperature in the flasks during sampling. This dictates the installation of the sampling station indoors and the use of a pump module with a bypass valve for avoiding pressure buildup. The Research Associate collects samples fortnightly from Terra Lab.

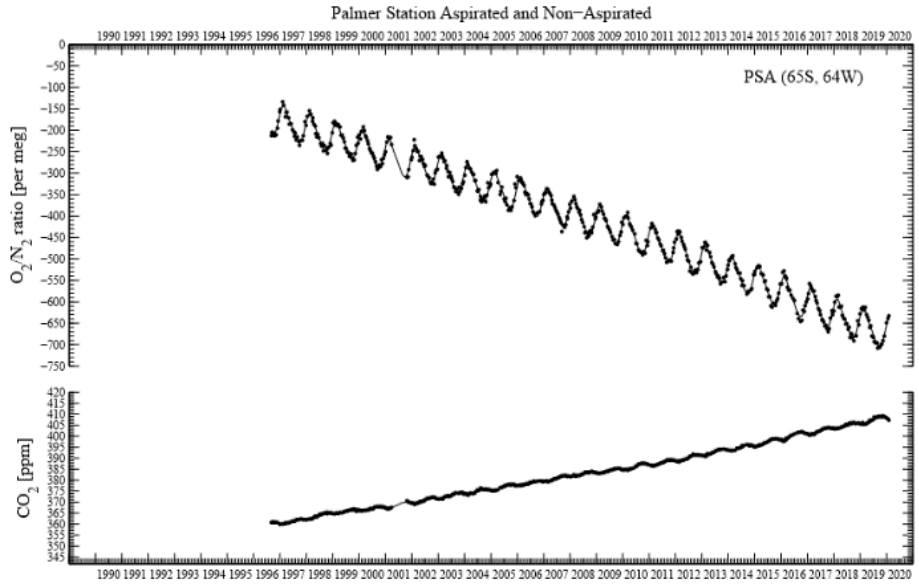


Figure 5. Historical plot of O_2/N_2 ratio per meg and CO_2 ppm updated on July 29, 2020.

Air samples were collected on May 2 and May 18. Wind conditions must equal or exceed 5 knots from a direction between 5° to 205° constantly for over an hour with no interference from human traffic on foot or in vessels. These air samples will be shipped to Scripps Institution of Oceanography in California for analysis. More information and data can be found at: https://scrippso2.ucsd.edu/osub2sub-data.html.

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 (N_2O) and halogen containing compounds.

The Research Associate collects weekly air samples for the CCGG group and fortnightly samples for the HATS group. Wind must be between 5 and 15 knots and consistently blow from one sector with no people, equipment, or boats upwind of the sampling location.

Carbon Cycle Greenhouse Gases (CCGG) samples were collected on May 2, May 9, May 17, May 24, and May 31 during favorable wind conditions. More information and data for the Carbon Cycle group can be found at: https://www.esrl.noaa.gov/gmd/ccgg/trends/.

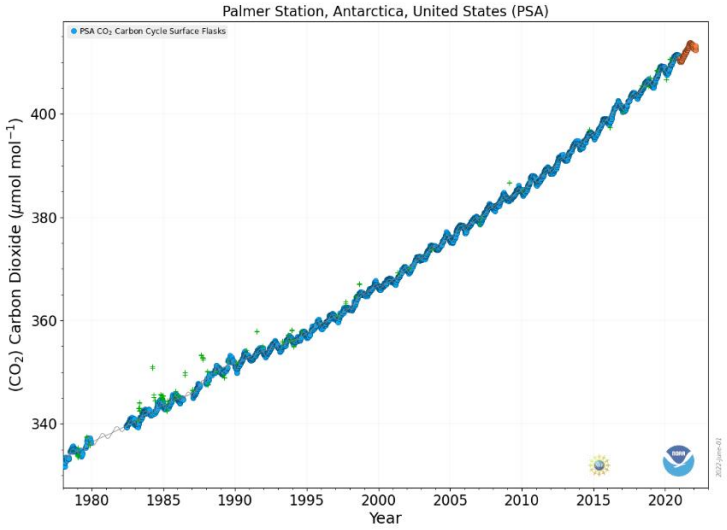


Figure 6. Carbon Dioxide (CO2) Levels at Palmer Station dating back to 1978. Orange dots are preliminary data.

The Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on May 9 and May 27 during favorable wind conditions. You can visit https://www.esrl.noaa.gov/gmd/hats/ for more information about the Halocarbons and other Atmospheric Trace Species group.

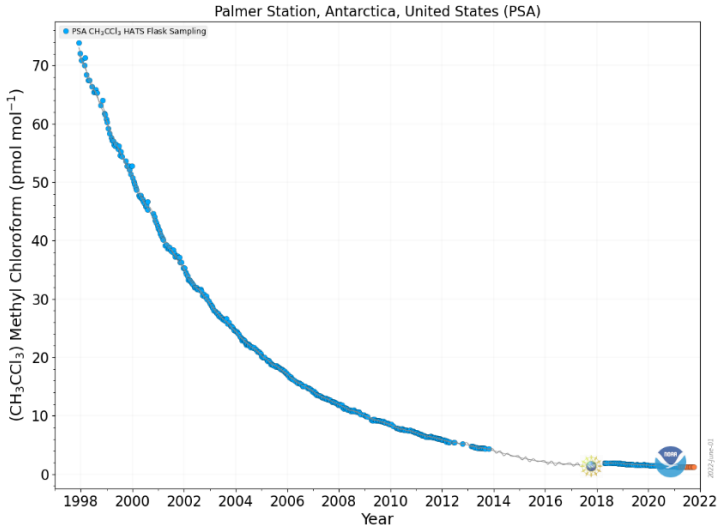


Figure 7. Methyl Chloroform (CH3CCL3) Levels at Palmer Station dating back to 1997, one of the Halocarbon and Trace Gases measured at Palmer Station. Orange dots are preliminary data.

All samples collected on station are sent back to the Earth System Research Laboratories in Boulder, Colorado for analysis.

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

Scott Stierle, 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 Ground-based Ultraviolet (GUV-511) filter radiometer, an Eppley Precision Spectral Pyranometer (PSP), and an Eppley Total Ultra Violet Radiometer (TUVR) also continuously measure hemispheric solar flux within various spectral ranges. The Research Associate operates and maintains on-site equipment for the project.

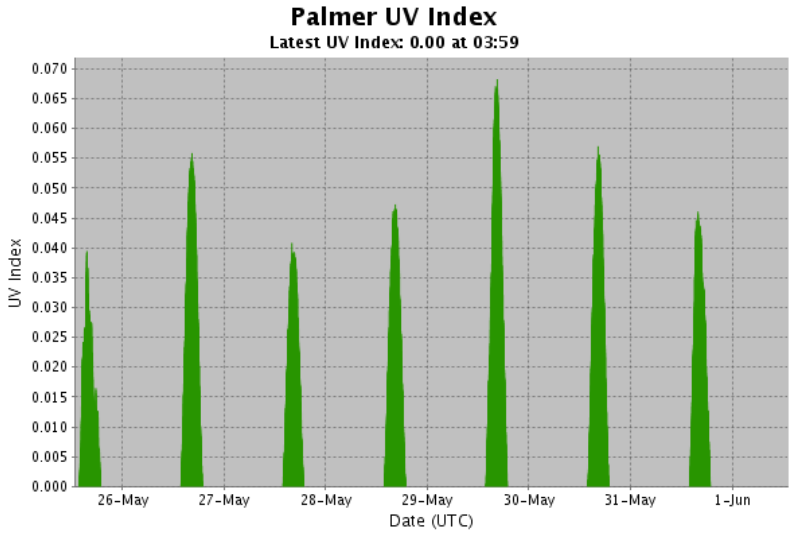


Figure 8. UV index generated from the GUV-511 radiometer in real time.

The log was filled out and collectors were cleaned on a daily basis. Once a week level checks were performed to confirm that the instrumentation was within +/- 0.2 degrees. The weekly log was sent out each Monday and a bi-weekly SUV-100 UV Absolute Scan was performed on May 6 and May 21 without issues.

For more information visit: https://esrl.noaa.gov/gmd/grad/antuv/.

R-938-P: TERASCAN SATELLITE IMAGING SYSTEM

Justin Maughmer, Principal Investigator, System Administrator, United States Antarctic Program

TeraScan is an integrated system of hardware and software designed for automated reception of data from meteorological/environmental satellites and for processing the data into images and data overlays. The system collects, processes, and archives DMSP and NOAA satellite telemetry, capturing approximately 25-30 passes per day. The data files for these images and overlays are of a special format called TeraScan Data Format (TDF). 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.

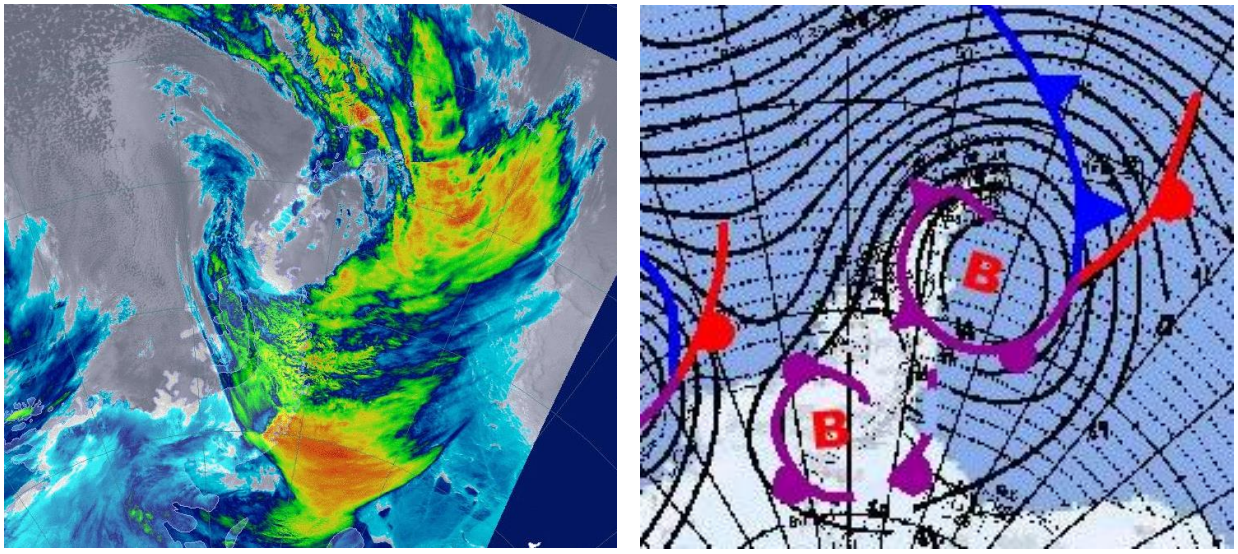


Figure 9. NOAA-19 May-16 satellite pass (left) explained by the Chilean Navy Meteorological Map (right).

The imagery was checked daily. Both the METOP and NOAA satellite passes were captured normally.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION.
Joe Pettit, Principal Investigator, UNAVCO

The National Science Foundation (NSF) tasked and funded the USGS Antarctic Program to establish a GPS (Global Positioning System) Continuous Operation Reference Station (CORS) at Palmer to serve a variety of scientific investigations in Antarctica. A permanent GPS CORS known as PALM (1003) was established during April and early May of 1997. Four reference marks were set and, along with 10 existing survey marks, PALM was tied in by differential GPS methods.

The GPS data collected supports the International GPS Service (IGS). This system is used for global geophysical studies such as crustal motion monitoring and determination of the global frame. PALM also provides Palmer scientists with real-time differential GPS positioning capabilities. Continuous 15-second epoch interval GPS data files are collected at station PALM, compressed, and transmitted to the NASA-JPL in Pasadena, CA.

JPL/NASA is contracted to maintain the system, and they have sub-contracted to UNAVCO. While operation and maintenance of the GPS/CORS base station is the responsibility of the Research Associate, it is available for grantees who wish to use the roving systems and/or differential post-processing using data from the fixed reference station. Users are expected to have proper training prior to deployment to Palmer. The Research Associate may offer support to visiting grantees at their discretion.

The system operated consistently throughout the month. The lights on the Trimble, Javad, and Ashtech Receivers were all illuminated in the correct pattern and showed no signs of interruption. On May 10, the system was used to measure the height of the newly reinstalled tide gauge. More information can be found at the following website: https://www.unavco.org/projects/project-support/polar/base_stations_and_survey_systems/palmer/base.html.

Figure 10. Performing a GPS survey of the newly reinstalled tide sensor – May 10, 2022.

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

Managed by General Dynamics

The Comprehensive Nuclear Test Ban Treaty (CTBT) bans all nuclear explosions. Although not ratified, the U.S.A. is following through with the treaty, including the installation of monitoring stations around the world. The global verification regime for monitoring compliance is called the International Monitoring System (IMS). The radionuclide air particulate sampling station was installed at Palmer in October of 2005. Palmer's radionuclide sampler/analyzer (RASA) is a primary station in the IMS, known by its treaty code USP73 (and RN73). The pre-existing USGS seismic system is an auxiliary station, treaty code AS106.

Data collected by Palmer's RASA unit is relayed real-time via a virtual private network (VPN) across the Internet back to the CTBT Organization (CTBTO) in Vienna. As of August 2006, both the RASA and seismic systems have been certified by CTBTO. Palmer is now officially part of the IMS. 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 consistently this month. The RASA GUI was checked daily. The amount of filter material was checked as needed and no anomalies were heard coming from the blower. Daily filters were processed as needed and the monthly log was sent on time. The IMS room was prepared for the CTBT grantee's visit. The grantee arrived on May 22 and has been working to move the electronics and sampling area of the system to a new frame and update the cabling and blower. The frame provides for better performance and easier maintenance. Additional details about the treaty and monitoring stations can be found on the CTBTO web site, http://ctbto.org/.

PHYSICAL OCEANOGRAPHY

Palmer Station has a tide and conductivity gauge located on the west side of the pier at -64.774558° -64.055580° at a height of 11.31 meters (WGS-84). It was reinstalled at a deeper depth after the completion of the Palmer Pier. Installation and configuration of the tide gauge was completed on May 27.

The Research Associate acts as the station's physical oceanography observer by maintaining and observing the sea state. Observations of sea ice extent and growth stage is recorded along with continuous tidal height, ocean temperature, and ocean conductivity.

Observations of sea ice around station were made daily. Ice imagery, when available, was provided to the NBP on a daily basis. Tide level, sea water conductivity, and sea water temperature data is archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/tidegauge/.

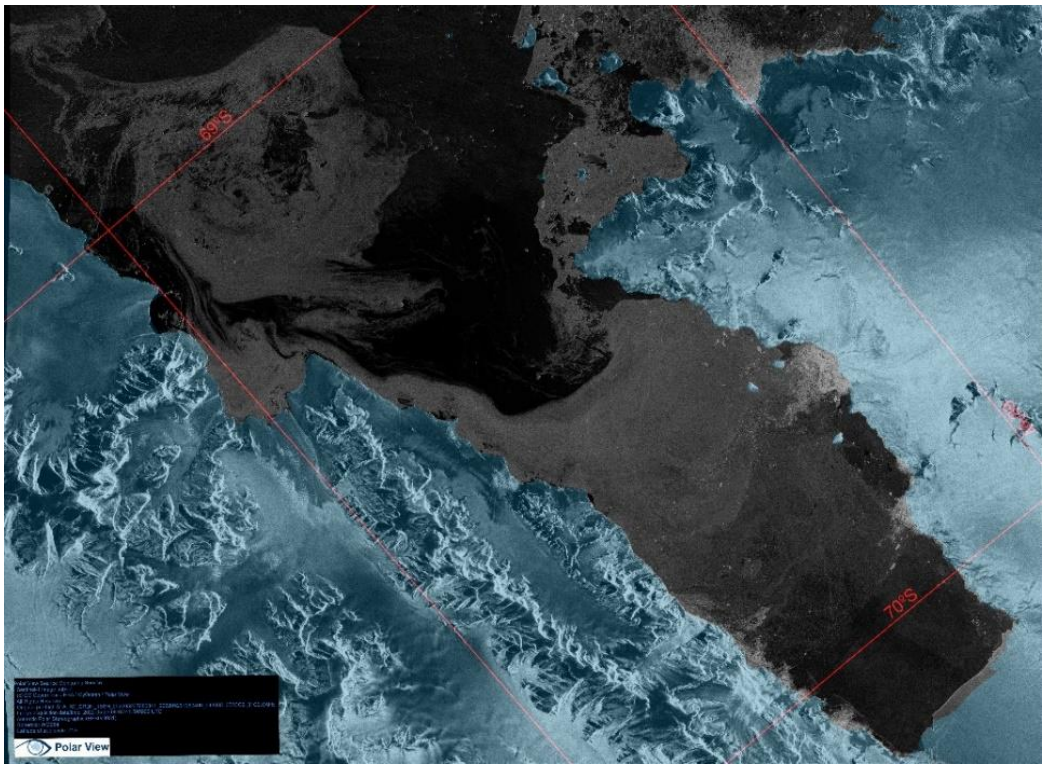


Figure 11. Polar View Sentiel-1 image from May 23.

METEOROLOGY

Mike Carmody, Principal Investigator, United States Antarctic Program

Palmer Station is Station 89061 in the World Meteorological Organization (WMO) Worldwide Network. Automated surface synoptic observations are made 8 times each day and emailed to the National Atmospheric and Oceanographic Administration (NOAA) for entry into the Global Telecommunication System (GTS).

The Palmer Automatic Weather Station (PAWS) is a collection of sensors, computers, and software that records the meteorological data and generates synoptic reports. PAWS began recording data in September of 2015. It was a replacement for the Palmer Meteorological Observing System (PalMOS) that was taken down in November 2017. The PAWS sensors and data acquisition hardware are located on a ridge in the backyard at -64.774130° -64.047440° at an elevation of 38.3 meters above sea level using the World Geodetic System-84. In addition to the synoptic and METAR reporting, PAWS also archives the current conditions at one-minute intervals and displays both raw data and graphs of the sensor data on our local intranet.

The Research Associate acts as Chief Weather Observer on station, measuring, compiling and distributing all meteorological data. Snow accumulation is physically observed by taking an average of five accumulation stakes found near the PAWS system. All weather data is archived locally and forwarded once per month to the University of Wisconsin on the first day of each month for archiving and further distribution.

The local weather station (PAWS) operated well throughout the month. All three remote AWS sites require maintenance so their functionality this season were sporadic at best. One minute weather data is archived on the AMRC website: http://amrc.ssec.wisc.edu/data/ftp/pub/palmer/

Monthly Weather Synopsis

A May temperature record was broken on May 21, when temperatures reached 48.2°F, exceeding the prior high of 47.3°F in 2014. There were several storms which deposited a total of 4 inches of rain and 18 inches of snow over the month. The peak wind speed for the month was 69 knots on May 16.

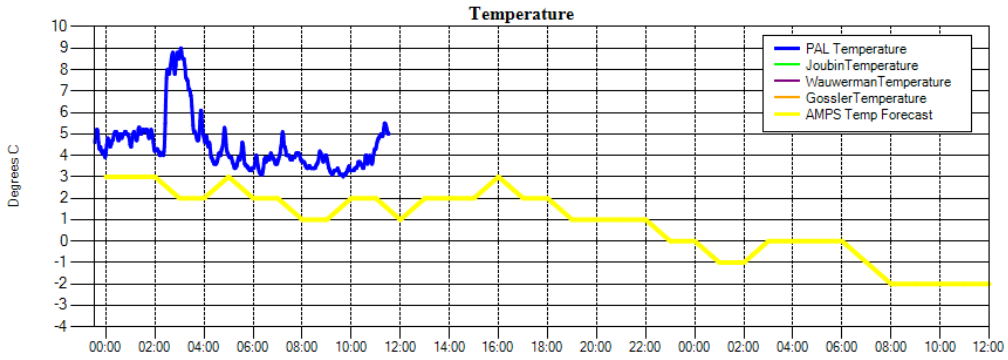


Figure 12. May temperature record broken on 5/21 at 06:03 UTC/03:03 local time.

Palmer Monthly Met summary for May, 2022

Temperature
Average: -.7 °C / 30.7 °F
Maximum: 9 °C / 48.2 °F on 21 May 06:03
Minimum: -7.2 °C / 19.04 °F on 26 May 12:49
Air Pressure
Average: 987.8 mb
Maximum: 1015.9 mb on 17 May 15:46
Minimum: 961.7 mb on 4 May 16:23
Wind
Average: 12.1 knots / 13.9 mph
Peak (5 Sec Gust): 69 knots / 79 mph on 16 May 05:30 from NE (37 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 90.2 mm / 3.55 in
Total Snowfall: 47 cm / 18.3 in
Greatest Depth at Snow Stake: 27 cm / 10.5 in
WMO Sea Ice Observation: 1-5 Bergs, bergy bits, growlers, grease, shuga, pancake ice, and brash ice