

# PALMER STATION MONTHLY SCIENCE REPORT

MAY 2021



C-013-P field team member Darren Roberts lines up the frame of sight for one of the newly deployed time lapse cameras on Torgersen Island. He and Megan Roberts (also of C-013-P) received three of these cameras on LMG21-04SB, and were able to set them up during the portcall. Megan and ASC Research Associate Marissa Goerke can be seen standing in approximate Adélie penguin colony locations to ensure the camera is pointed in an optimal position to view as many penguins during the Palmer Pier build. *Image Credit: Hannah James*

## NEWS FROM THE LAB

Hannah James, Winter Laboratory Supervisor

The month of May brought a new crew and a much needed break in the weather to Palmer Station for the summer to winter turnover. After a nearly three week quarantine in San Francisco, two weeks at the dock in Punta Arenas, and 11 days at sea to ensure that the R/V LAURENCE M. GOULD could arrive at Palmer Station and remain in a “Green Status” according to the COVID-19 Response Leveling Procedure, line handlers were called to the pier and the ship was docked. This was the first time the ship had been at station since the last turnover in December, so there was a bustle of activity with cargo, special projects, on-site summer science wrap-up, and turnover of ASC staff.

Along with summer personnel, the northbound ship was loaded with R/V RIGIL, SOLAS Mia, and the Marine Landing Craft. All three of these boats will undergo maintenance in Punta Arenas in the next few months. We also shipped laboratory equipment to be calibrated in the states, air samples taken by the Research Associate throughout the summer, and of course samples collected by onsite summer grantees to be further analyzed at home institutions were packaged with care and sent north from the labs.

The R/V LAURENCE M. GOULD departed station the afternoon of May 24. I would like to extend my sincere thanks to Randy Jones (Summer Lab Supervisor) and Marissa Goerke

(Summer Research Associate) for facilitating and coordinating all the summer science activities on station. It is always a pleasure to turn over with each of them. Although she wasn't on site, our offsite supervisor Jamee Johnson (Peninsula S&TPS Manager) was always available and incredibly supportive during this port call. A final thank you goes out to the onsite grantees representing the LTER group: Darren and Megan Roberts (C-013-P (Cimino) and C-024-P (Friedlaender)), Rachael Young (C-019-P (Schofield)), and Daniel Lowenstein (C-045-P (Van Mooy)). The labs are now too quiet for my liking, but I have many plans in place to improve science spaces during these upcoming quiet months in BioLab.

### **C-013-P and C-024 PALMER LONG TERM ECOLOGICAL RESEARCH (LTER): PREDATOR COMPONENT**

C-013: Dr. Megan Cimino, Principal Investigator, University of California at Santa Cruz, Santa Cruz, CA

C-024: Dr. Ari Friedlander, Principal Investigator, University of California at Santa Cruz, Santa Cruz, CA

Personnel on station: Megan Roberts, Darren Roberts

In May we were able to complete boat based field work on 8 out of the 24 days that we were on station.

All field work concluded in May. The last of the giant petrel chicks fledged towards the middle of the month. South polar, and brown skua sightings ended in May. Although some of the local nesting birds have departed, we did see a continued increase in sightings of Antarctic petrels, cape petrels, and snow petrels.

All samples were shipped north.



**Image 1** -A giant petrel chick very near fledging at Elephant Rocks. *Image Credit: Megan Roberts*

Marine mammal monitoring continued with fur seal, elephant seal, crab-eater seal and Weddell seal numbers declining in the area. Humpback whale numbers were relatively low but transient animals moved through the area consistently throughout May. Minke whale observations were sporadic throughout the month. Humpback whale biopsy efforts continued successfully through May, with individuals remaining in the area until the very end of the season.



**Image 2-** A Humpback whale resting in Wylie Bay.

*Image credit: Darren Roberts*

We installed two time-lapse cameras on Torgersen Island and one camera at Humble Island to monitor Adélie penguin breeding phenology, occupancy patterns and any possible disturbance during the Palmer Station pier construction. The rest of the month was spent finalizing data, packing our gear, and preparing for the shipment of samples and cargo to the United States and to Punta Arenas.

Shipment of avian and marine mammal samples is very paperwork intensive and logistically complicated. We would like to specifically thank all of the people involved in the process. We would especially like to thank Randy Jones, Hannah James, Ben Bonnett, Jon English, Landon Fink, Brian Catrell, Dave Morehouse, and Jamee Johnson. Additionally we would like to express our gratitude for the support provided by the entirety of ASC, other science groups, the captain and crew of the R/V LAURENCE M. GOULD, and USAP.

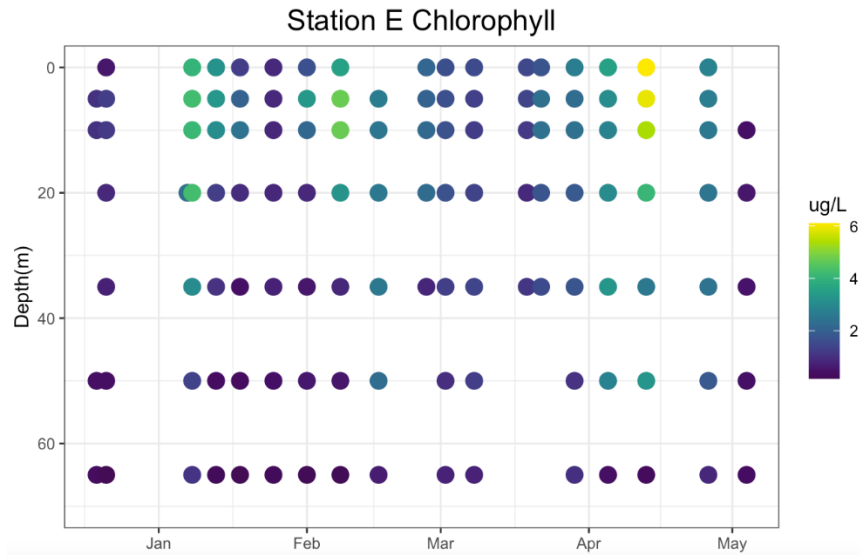
**C-019-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM, PHYTOPLANKTON COMPONENT**

Dr. Oscar Schofield, Principal Investigator, Rutgers University, Institute for Earth, Ocean, and Atmospheric Sciences, Department of Marine and Coastal Sciences

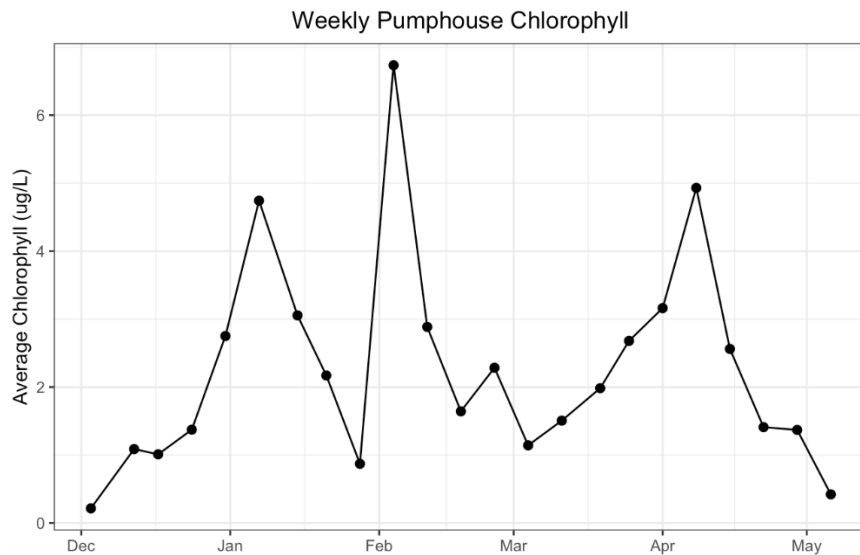
Personnel on station: Rachael Young

As the field season wrapped up in May, C-019 and C-045 achieved their final sampling event at Station E on May 5<sup>th</sup>, the latest LTER water column sampling date recorded since 1991! Once sampling and processing were finished, the lab was packed up and all science equipment was returned.

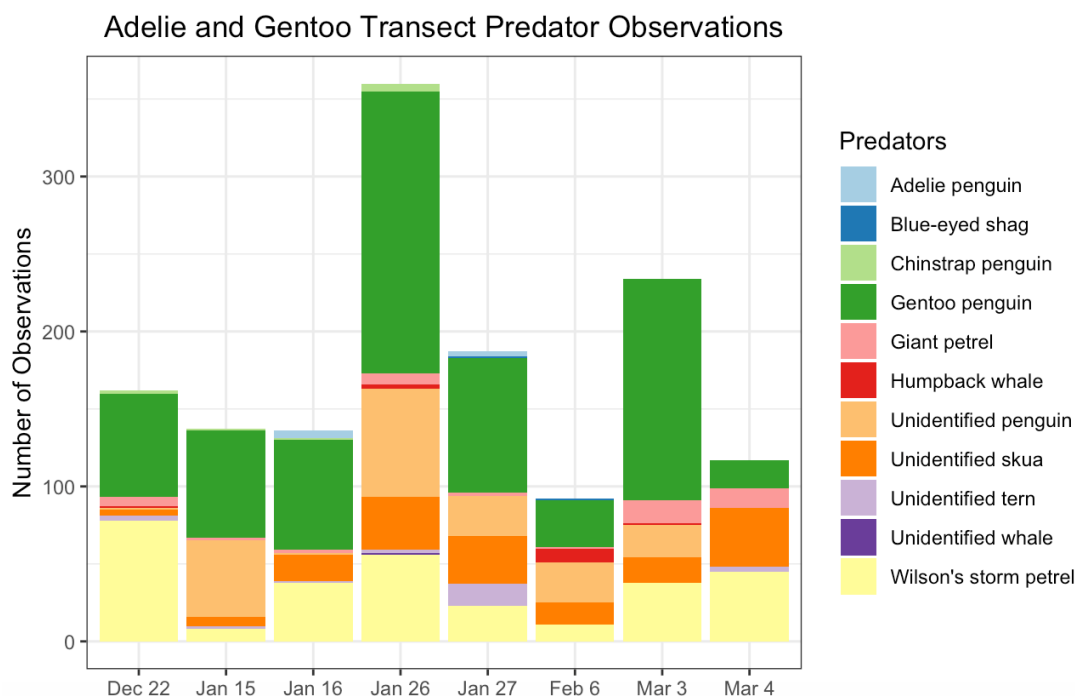
Data collected throughout the field season from December 19<sup>th</sup> through May 4<sup>th</sup> showed three distinct chlorophyll blooms (Fig. 1 and Fig 2.) along with predator observations comprised largely of gentoo penguins, unidentified penguins, and Wilson’s storm petrels. (Fig 3.).



**Figure 1** Chlorophyll concentration (ug/L) at Station E. There were 3 peaks throughout the season on January 8<sup>th</sup> (4.28 ug/L), February 8<sup>th</sup> (4.72 ug/L), and April 13<sup>th</sup> (6.1 ug/L).



**Figure 2.** Average chlorophyll concentration (ug/L) from weekly pumphouse samples. There were 3 peaks throughout the season on January 7<sup>th</sup> (4.74 ug/L), February 4<sup>th</sup> (6.73 ug/L), and April 8<sup>th</sup> (4.93 ug/L).



**Figure 3** Predator observations from the Adélie and Gentoo transects. Adélie transect dates include December 22nd, January 16th, January 26th, and March 4th. Gentoo transect dates include January 15th, January 27th, February 6th, and March 3rd.

This incredible season and dataset would not have been possible without the unwavering hard work of every individual at Palmer Station! Randy Jones, our lab manager, and Ken Block and Mike Burns, our marine technicians, deserve a special thanks for going above and beyond to ensure all our science needs were met and exceeded!

**C-045-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – MICROBIAL, BIOGEOCHEMICAL COMPONENT**

Dr. Benjamin Van Mooy, Principal Investigator, Woods Hole Oceanographic Institution

Personnel on Station: Daniel Lowenstein

The month of May saw transition and wrap up at Palmer. We were able to get out to Station E twice before the R/V LAURENCE M. GOULD arrived, possibly the latest water column sampling in the LTER’s 30-year history, and we completed one more 24-hour incubation.

Once the R/V LAURENCE M. GOULD arrived and the Marine Technicians became occupied with the seawater intake project, we wrapped up the research season, packed our labs, and prepared for the upcoming LTER cruise.

We would like to express a HUGE thank you to the team at Palmer. Despite historically bad weather throughout the season, we’re extremely happy with what we were able to accomplish— 21 CTD sampling events at Station E, 12 incubation experiments, over a dozen acoustic krill

population surveys supplemented by monthly net tows, all of which will help us elucidate how carbon flows through this dynamic area of the ocean.

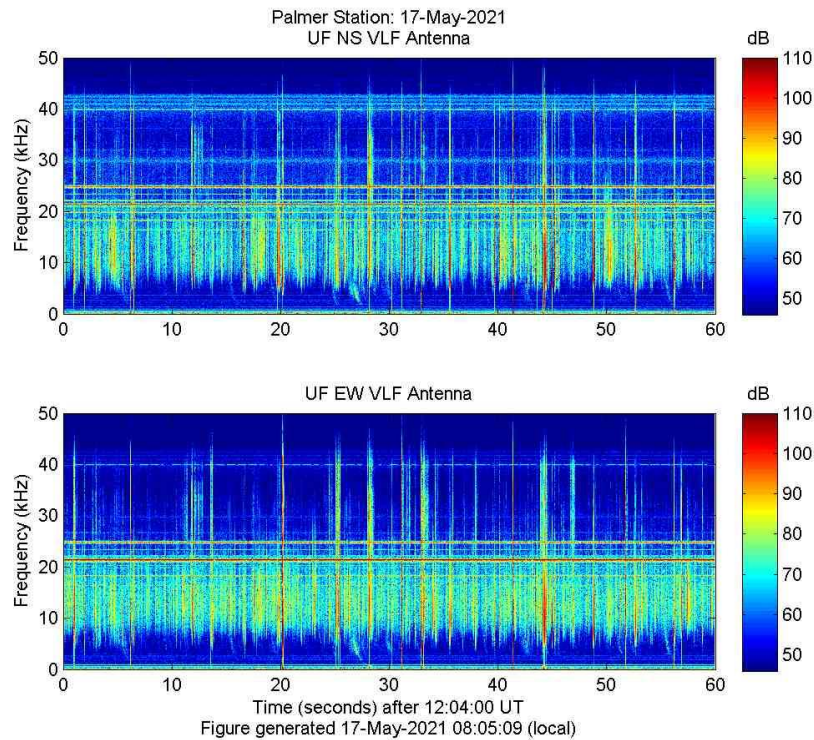
**PALMER STATION  
RESEARCH ASSOCIATE MONTHLY REPORT  
May 2021**

Marissa Goerke and W. Lance Roth

**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 4-** Real-Time broadband ELF/VLF Spectrogram from Palmer, 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\\_nb.php](http://halo.ece.ufl.edu/realtime_palmer_nb.php) and

[http://halo.ece.ufl.edu/realtime\\_palmer\\_bb.php](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 through 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 27<sup>th</sup> 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 30<sup>th</sup>, 2021 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.

The SeaSondes are in warm storage in Terra Lab. The system is no longer collecting data.

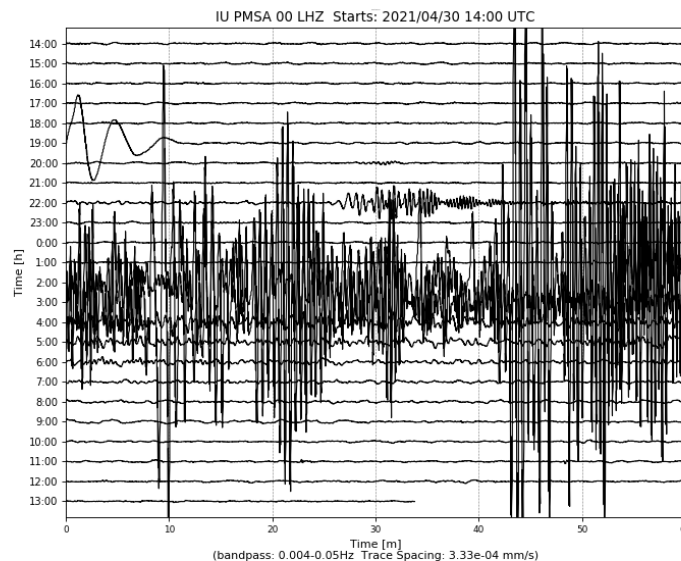
The data will be available in the future at: <https://marine.rutgers.edu/~codaradm/>.

**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 5-** 6.8 Magnitude earthquakes near the east coast of Honshu, Japan on May 1, 2021



The system operated consistently throughout the month. The time stamp and seismic activity found on the Heliplot was checked daily. Current data from Palmer station can be found on the USGS site: <https://earthquake.usgs.gov/monitoring/operations/stations/IU/PMSA/#heliplot>.

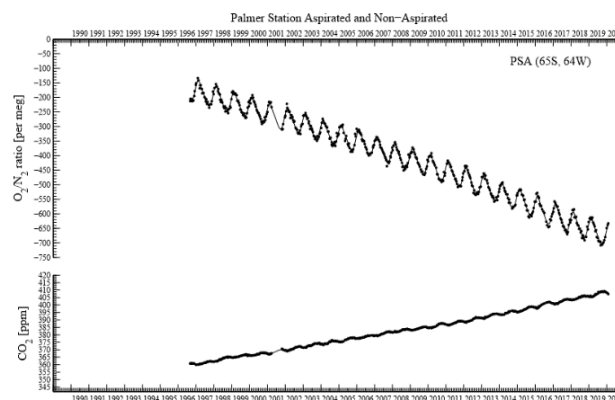
## **O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL DECADAL VARIATIONS IN TERRESTRIAL AND MARINE ECOSYSTEMS.**

Ralph Keeling, Principal Investigator, Scripps Institution of Oceanography

The goal of this project is to resolve seasonal and inter-annual variations in atmospheric O<sub>2</sub> (detected through changes in O<sub>2</sub>/N<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> 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 process, 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<sub>2</sub> 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. Due to a lack of inventory, the RA has been instructed by the Principal Investigator to only sample once a month for this season until the supply chain is more reliable.



**Figure 6-** Historical plot of O<sub>2</sub>/N<sub>2</sub> ratio per meg and CO<sub>2</sub> ppm updated on July 29, 2020

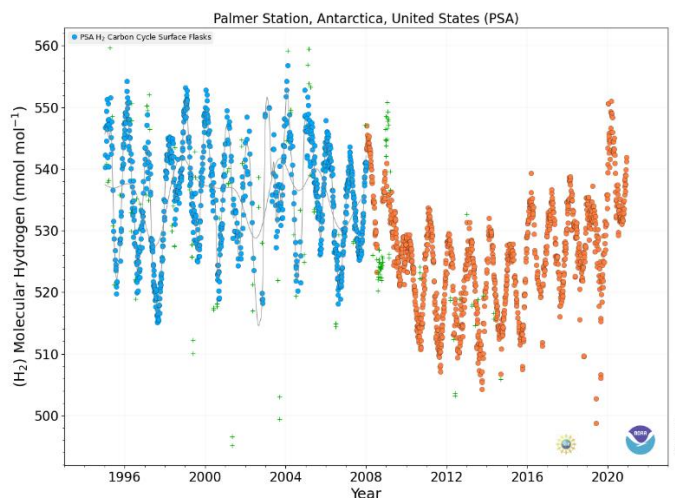
Air samples were collected on May 18 at 07:38 local time. Wind conditions must equal or exceed 5 knots from a direction between 5° to 205° constantly for over an hour with no interference from human traffic on foot or in vessels. Due to a lack of resources the grantee has asked for a single sample on or near the 15<sup>th</sup> of each beginning this month and continuing until cargo can be shipped more often than twice a year. These air samples will be shipped to Scripps Institution of Oceanography in California for analysis. More information and data can be found at: <https://scripps2.ucsd.edu/osub2sub-data.html>. This data was shared with the onsite LTER grantees because it has interesting collaboration potential.

### **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

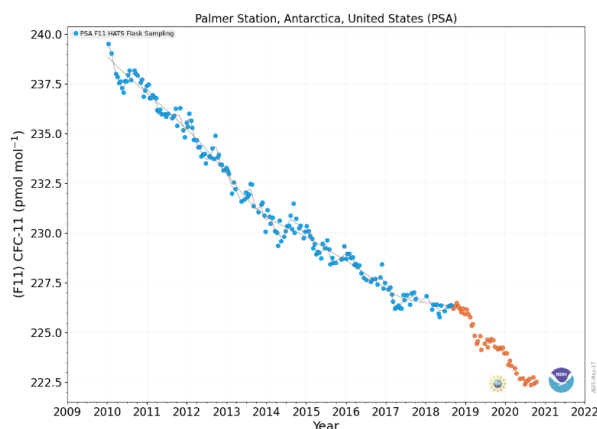
The NOAA ESRL Carbon Cycle Greenhouse Gases (CCGG) group makes ongoing discrete measurements to document the spatial and temporal distributions of carbon-cycle gases and provide essential constraints to our understanding of the global carbon cycle. The Halocarbons and other Atmospheric Trace Species (HATS) group quantifies the distributions and magnitudes of the sources and sinks for atmospheric nitrous oxide (N<sub>2</sub>O) 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 3 at 08:33 local time, May 10 at 07:47 local time, May 17 at 10:52 local time, and May 26 at 08:09 local time 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 7-** Molecular Hydrogen (H<sub>2</sub>) Levels at Palmer Station dating back to 1995. Orange dots are preliminary data.

The Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on May 9 at 11:00, and May 26 at 08:56 local time 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.

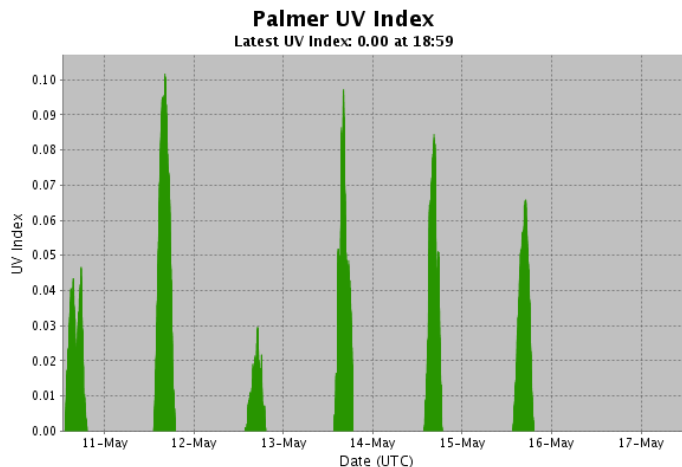


**Figure 8-** CFC-11 (CCL3F) Levels at Palmer Station dating back to 2010, one of the Halocarbon and Trace Gases measured at Palmer Station. Orange dots are preliminary data.

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 9-** UV index generated from the GUV-511 radiometer in real time in late March.

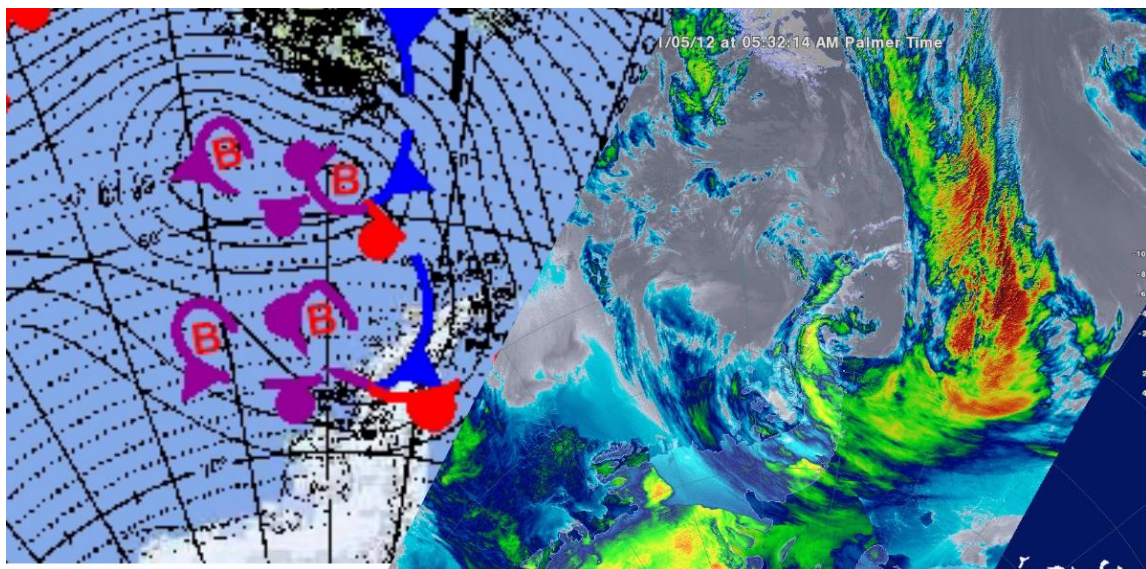
The system is having issues with the wavelength offset on the SUV-100 UV spectroradiometer. The Principal Investigator is aware of the issue and has provided a procedure to follow when this occurs. The log was filled out and collectors were cleaned on a daily basis. Once a week level checks were performed 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 7<sup>th</sup> and May 24<sup>th</sup> as scheduled 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 10-** NOAA-19 satellite pass on May 12 (right) compared with the Chilaen Navy Meteorological Map (left)

The imagery was checked daily. Data from the NOAA satellites look normal, while the data from the DMSP drops out. The TeraScan team is aware of the excessive noise, missing data, and anomalies of the DMSP passes and are trying to resolve the issue.

### **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 his/her 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. Data flow was monitored and was blocked by the USAP firewall due to a firewall expiration date. IT was notified and the issue was resolved without any loss of data. 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](https://www.unavco.org/projects/project-support/polar/base_stations_and_survey_systems/palmer/base.html).

**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 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. Additional details about the treaty and monitoring stations can be found on the CTBTO web site, <http://ctbto.org/>.

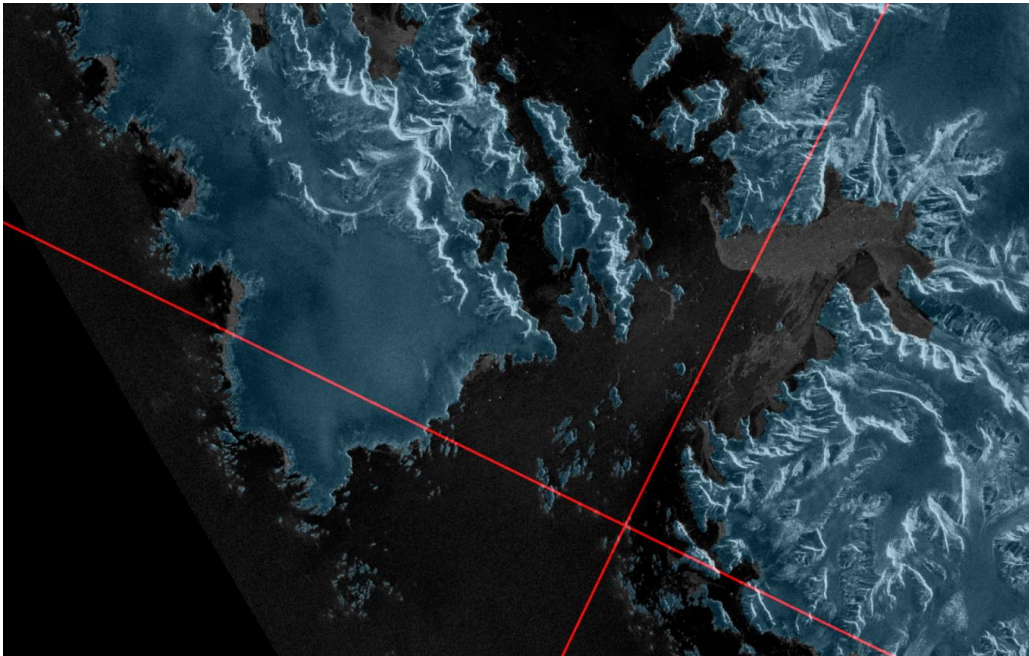
## PHYSICAL OCEANOGRAPHY

Palmer Station has a tide and conductivity gauge located on the pier at  $-64.774563^{\circ}$   $-64.054837^{\circ}$  at a height of (base datum) 12.13 meters. It was installed in 2018 as the previous location was not adequate for tide or temperature measurements.

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. The tide data was monitored continuously. Tide data is archived on the AMRC website:

<ftp://amrc.ssec.wisc.edu/pub/palmer/tidegauge/>.



**Figure 11-** Sentinel-1 Satellite image of the brash ice present around the Palmer Area on May 9, 2021

## 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  $-64.774130^{\circ}$   $-64.047440^{\circ}$  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. AWS2 has been found to only work in rainy conditions further troubleshooting is necessary. There is an issue with AWS3 at the Gosslers that will need to be addressed during a site visit. AWS1 has now dropped out due to low sunlight conditions. One minute weather data is archived on the AMRC website: <ftp://amrc.ssec.wisc.edu/pub/palmer/observations/>.

May started out cold with a minimum ambient air temperature of 11.94°F on the 2nd. Our maximum temperature of 46.04°F along with 5.63 inches of precipitation reduced our snowpack to 0 inches. Toward the end of the month we gained 9.8 inches of snow. The winds averaged 17.2 mph and peaked on May 12th with gusts of 72 mph. The average sea surface temperature was 31.1°F and our average ambient air temperature was 28.8°F.

### Palmer Monthly Met summary for May, 2021

<b>Temperature</b>
<b>Average:</b> -1.8 °C / 28.8 °F
<b>Maximum:</b> 7.8 °C / 46.04 °F on 18 May 23:11
<b>Minimum:</b> -11.7 °C / 10.94 °F on 2 May 09:37
<b>Air Pressure</b>
<b>Average:</b> 989.9 mb
<b>Maximum:</b> 1018 mb on 17 May 01:59
<b>Minimum:</b> 960.4 mb on 12 May 06:11
<b>Wind</b>
<b>Average:</b> 15 knots / 17.2 mph
<b>Peak (5 Sec Gust):</b> 62 knots / 72 mph on 12 May 03:43 from NE (35 deg)
<b>Prevailing Direction for Month:</b> NNE
<b>Surface</b>
<b>Total Rainfall:</b> 143 mm / 5.63 in
<b>Total Snowfall:</b> 25 cm / 9.8 in
<b>Greatest Depth at Snow Stake:</b> 19.2 cm / 7.5 in
<b>Average Sea Surface Temperature:</b> -0.5 °C / 31.1 °F