# PALMER STATION MONTHLY SCIENCE REPORT

## March 2023


**Mount Williams towers over Palmer Station, as seen from the departing R/V LAURENCE M. GOULD on the LMG23-02NB cruise.** *Image Credit: Dr. Natasja van Gestel.*

### NEWS FROM THE LAB

Hannah James, Summer Laboratory Supervisor

March certainly came in like a lion and went out like a lamb, both with weather and the tempo around the labs. It was a bustling station (when the weather allowed it), but as soon as the R/V LAURENCE M. GOULD sailed north with six groups, the labs seemed eerily quiet. The C-024 (Friedlaender), B-285 (Bowman), C-020 (Steinberg), C-045 (Van Mooy), C-019 (Schofield), and B-086 (van Gestel) groups all packed up their lab spaces and boxes of samples from their season and sailed north on Thursday, March 16. It was an incredibly productive season for each of these groups, as you have read in previous reports and will continue to read in this one.

But just because so many groups left doesn't mean there isn't room for more! In addition to the continued field work of the C-013 (Cimino) and B-027 (McClintock) groups, the B-046 (Teets) group moved onto station after a very successful cruise down and up the Antarctic Peninsula. Their time on station was short but productive, as you can read below. As the month came to an end, so did most of the ASC staff's season. The R/V LAURNCE M. GOULD's return for the LMG23-03 port call brought a majority of the winterover crew, including the lab staff. I would like to welcome back Angela Klemmedson to the Winter Laboratory Supervisor position, Ben Rosen-Filardo to the Research Associate position, and welcome Kim Sonderland to her first season as the Instrument Technician. This winter season will see more lab science than has been on site for the past few winter seasons, so stay tuned for next month's report!

As I close out my summer season, I would like to say thank you, as always, to our supportive station managers - Andrea Dixon and Bob Farrell - and our science support direct supervisor - Jamee Johnson. It was an incredibly productive season for so many of our grantees, and their leadership and management of station played a huge role in this.

**B-046-P: MECHANISMS OF ADAPTATION TO TERRESTRIAL ANTARCTICA THROUGH COMPARATIVE PHYSIOLOGY AND GENOMICS OF ANTARCTIC AND SUB-ANTARCTIC INSECTS**

*Dr. Nicholas Teets, Principle Investigator, Department of Entomology, University of Kentucky*
Personnel on station: Cleverson Lima, Jack Devlin

Terrestrial Antarctica has a lower diversity of species compared to other continents due to limited resources and the harsh, unpredictable environmental conditions that are experienced year-round. One dramatic example is that Antarctica harbors only one endemic insect species, the midge *Belgica antarctica* (Diptera: Chironomidae). The Antarctic midge evolved special adaptations to cope with the challenges associated with life in Antarctica, and characterizing the mechanisms that allow these organisms to thrive in the continent since its separation from South America (over 30my ago) is the focus of our research.

**Figure 1-** *Belgica antarctica* adult male walking on the alga *Prasiola crispa*. *Image Credit: Jack Devlin.*

The project objectives for this season were 1) collect *B. antarctica* at various islands in the vicinity of Palmer Station, 2) retrieve temperature data loggers that were deployed in the previous season, and 3) assess stress limits and potential long-term consequences of different stressors (including exposure to freezing, dehydration, and microplastics) in *B. antarctica*.

Cleverson Lima and Jack Devlin arrived at Palmer Station on March 13, 2023. Yuta Kawarasaki and J.D. Gantz assisted with initial collections at Cormorant and Humble Islands. Further collections took place at Christine, Hermit, and Torgersen Islands, and Bonaparte Point, and these insects were used for experiments on station and will be sent to the University of Kentucky to continue our research.

Data loggers deployed in *B. antarctica*'s habitat on several islands were retrieved. Preliminary data showed ground temperatures vary considerably from site to site, reaching as high as 33°C in

the summer at Dream Island, and as low -12°C in the winter at Cape Tuxen (18°C and -8°C in islands around Palmer).

Currently, in the laboratory we are measuring low and high thermal limits in *B. antarctica*. Initial results indicate that *B. antarctica* can withstand the highest and lowest temperatures recorded in their habitats with little trouble; for example, over 90% survival was observed after 24h at 18°C. In addition, *B. antarctica* seems to cope with longer-term exposure to ecologically relevant temperatures, as survival was high after 7 days at either -5°C or 15°C. In addition, experiments aiming to quantify the risk of anthropogenic pollutants (such as microplastics) to Antarctic polyextremophiles are being conducted during our stay at Palmer Station.

We want to acknowledge the assistance and support of all ASC staff/Palmer Personnel throughout our stay during this year's field season. Special thanks to the Peninsula Field Supervisor, Diane Hutt, the Marine Lab Tech, Amy Chiuchiolo, the Palmer Lab Manager, Hannah James, and to the Palmer Instrument Tech, Lance Roth, for their continual assistance with lab and field matters, and their readiness in providing all the necessary equipment that our research needed.

**Figure 2-** The field team at Cape Tuxen. *Back row, left to right:* JD Gantz, Jack Devlin, Vitor Pavinato, Diane Hutt, *Front row:* Cleverson Lima, Yuta Kawarasaki. *Image Credit: Adina Scott.*

**B-027-P: ASSEMBLAGE-WIDE EFFECTS OF OCEAN ACIDIFICATION AND OCEAN WARMING ON ECOLOGICALLY IMPORTANT MACROALGAL-ASSOCIATED CRUSTACEANS IN ANTARCTICA**

*James McClintock and Charles Amsler, Principal Investigators, University of Alabama at Birmingham*
Personnel on station: Charles Amsler, Margaret Amsler, Jami de Jesus, Hannah Oswalt

Personnel movements this month: Addie Knight departed with LMG 23-02 on 16 March.

March was dominated by daily monitoring of seawater chemistry and of amphipod molting and mortality (as was February after our main experiment started and as April will be until it is finished). The seawater chemistry measurements are standard within the ocean acidification science community to ensure that results are repeatable across studies. If we did not make these measurements, or were not able to ground truth them with seawater standards that we shipped down, we would not be able to publish our results in any reputable journal.

Our experimental setup was described in our February sitrep. Although the mixing tanks where pH is controlled are constantly monitored via pH electrodes, and each day we check the pH in all 24 experimental buckets with a separate probe, more precise measurements are required. We do these on one-quarter (six) of the experimental buckets each day. We also use these more precise measurements to adjust the setpoints for the microprocessors controlling the experiment because the pH reported by the probes can (and does) drift a bit over time.

For the chemistry, we carefully siphon water from the six daily buckets into glass stoppered bottles to minimize contact with the ambient atmosphere. Then again very carefully to avoid bubbling or mixing, water is pipetted out for precise pH determination in a thermally-jacketed spectrophotometer.


**Figure 3**- *Left:* Water being siphoned out of an experimental bucket for seawater chemical analysis. In the bucket to the left of the image, the pH is being measured using a pH probe (done with each bucket each day) and the bucket temperature is also being measured. *Right:* Spectrophotometric measurement of pH.

Again being careful to minimize mixing with ambient air but with a bit more leeway, water from the sample is then siphoned into a temperature-controlled chamber in a titrator to determine its alkalinity. Knowing the temperature and salinity of the water in the bucket sample, the spectrophotometrically-determined pH, and the alkalinity, other seawater carbonate chemistry parameters can be calculated.

**Figure 4**- *Left:* The titrator used to determine seawater alkalinity. *Right:* removing amphipod molts and dead amphipods, if any, from an experimental bucket.

The other daily activity is removing and enumerating molts of each of the three amphipod species in the buckets as well as any dead amphipods, if any. After the experiment ends, a variety of additional parameters will be determined from the remaining amphipods at our home lab in Alabama.

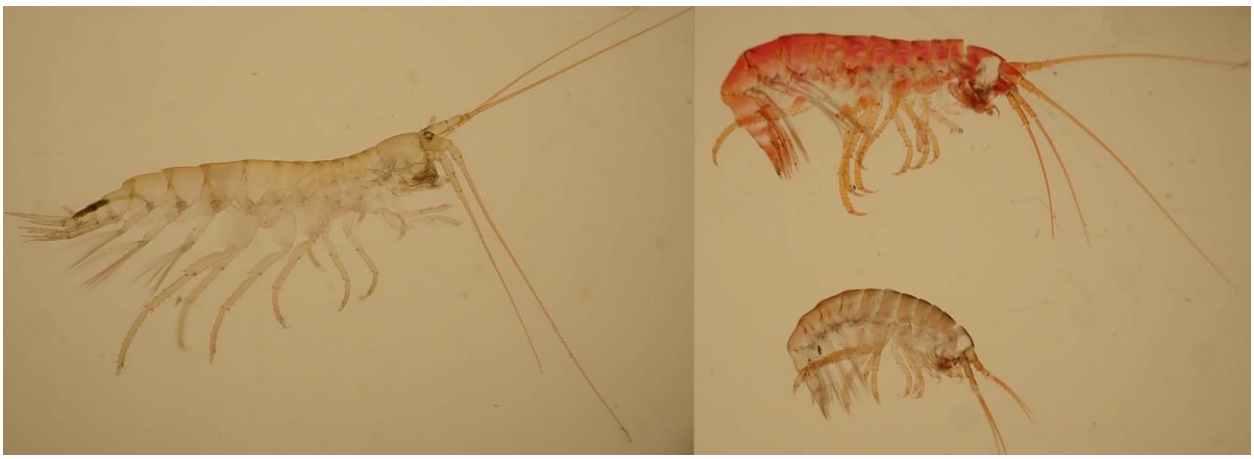

**Figure 5**- Molts from our three focal amphipod species: *Djerboa furcipes (left), Prostebbingia gracilis (upper right),* and *Gondogeneia antarctica (lower right).*

In March we were also able to make dives at our B-236 transect sites, two in the local boating area and one, with a day of RHIB support, in the Wauwermans Islands. Being able to revisit these sites, particularly the Wauwermans site, to see how they had and had not changed is very useful to our ongoing analysis of data from that project.

We are grateful for the generous and professional assistance from numerous ASC staff in facilitating our activities. In particular, Hannah James and Lance Roth facilitated our laboratory operations and coordinated our overall station support while Barb Krasinski, Matt Gosselin, and Matt Cabell facilitated our boat diving activities.

**B-086-P: ANTARCTICA AS A MODEL SYSTEM FOR RESPONSES OF TERRESTRIAL CARBON BALANCE TO WARMING**

*Dr. Natasja van Gestel, Principal Investigator, Department of Biological Sciences, Texas Tech University.*

Personnel on station (for the first two weeks of the month): Dr. Natasja van Gestel and Sara Bohi Goulart.

In the first week of March we finished up physiology measurements of mosses from the lab warming experiment. Data from the lab warming experiment will provide complementary information to the field warming experiment. In the field we are dealing with various species of moss within an ecosystem (see Figure 6), and hence, carbon fluxes in the field are influenced by multiple species of moss. Changes to the carbon balance in response to field warming cannot be attributed to individual species of moss, unless we have more specific physiology information of those species and how they respond to warming.

**Figure 6–** Extensive moss peatbanks on Litchfield Island. Moss communities are dominated by the mosses *Polytrichum* and *Chorisodontium*. ACA permit no. 2023-007 (ASPA 113).

Our remaining time at Palmer Station was spent on doing final sample collections and data entry. We also downloaded all the environmental data and did logger maintenance (loggers will remain in place over the winter).

Regarding outreach, we had one final Zoom session, but this time *in Dutch* with a school in the Netherlands. PI van Gestel grew up trilingual in the Netherlands (English, Spanish and Dutch).

The school had been following the B-086-P blog from the start (https://www.nvangestel.com/antarctica).

The B-086-P team departed Palmer Station on March 16 on the ARSV Laurence M. Gould. Hence, the week before was dedicated to Proformas, sample preparation and packing.

We would like to use this opportunity to thank the ASC staff for their help in our research, both direct and indirect help. In particular, we would like to thank Hannah James and Keri Nelson in assisting us at Litchfield Island. We would further like to thank Barb Krasinski, Matt Gosselin, and Matt Cabell for their help with the Zodiacs and boat training. Thanks to Joseph Singleton and Jon English for help with logistics, the "wasties" Amy Varga and Alex Mendelson for recycling and overall cheery nature, Fran Sheil and Aleia Greene for their fantastic food (which certainly was a morale booster!), Jesse Patton, Brian Niceley, and Doc Joe Shubert, for the occasional help in the field, Cody Lewis and Jeff "Moss" Mossen for IT support, Chris Borghesani for communications and providing us with radios, Marissa Goerke for providing data (and overall a source of knowledge research and instrumentation at Palmer Station), Ian Mannix for providing the bamboo flags to mark our site, Guy Thomerson for keeping the station warm and functional, and Lance Roth for lab assistance. Last, but not least, we would like to thank Station Manager Andrea Dixon for her expert leadership of the station, and efficient and productive meetings. It was not just the research support, however, but the building of friendships and to make us feel part of the Palmer community. You were all an inspiration. Thank you.

**C-013-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM, SEABIRD COMPONENT**

*Dr. Megan Cimino, Principal Investigator, University of California at Santa Cruz.*
Personnel on Station: Megan Cimino, Megan Roberts, Darren Roberts

During March, gentoo penguin chick fledging masses were obtained at Biscoe Point and in the Joubin Islands.

**Figure 7-** Gentoo penguin chicks at Biscoe Point.

Brown skua work concluded this month with nest monitoring and growth measurements of breeding pairs from Dream Island to Biscoe Point. Our south polar skua study on Shortcut Island also continued throughout March.

Giant petrel chick banding on all local islands was completed in March. Thanks to volunteers from station, our giant petrel chick growth study on Humble Island will continue through April. We deployed our last GPS loggers on giant petrels this month concluding all bird tagging for the season.

**Figure 8-** Giant petrel banding on Delaca Island.

Marine mammal monitoring continued with observations of fur seals, elephant seals, sporadic leopard seal and crab-eater seal sightings and a few Weddell seals. Whale observations in the Palmer area decreased dramatically during March with sporadic sightings of humpback whales.

Sediment trap contents were collected from Adélie colonies on Torgersen, gentoo colonies on Biscoe and chinstrap colonies on Dream Island. These Palmer area sediment trap samples as well as Avian Island samples will be processed for otoliths. Limpet trap contents were also collected and processed from kelp gull colonies on four local islands.

We would like to thank the entire crew at Palmer this year for making it a very successful and enjoyable season.

**PALMER STATION**
**RESEARCH ASSOCIATE MONTHLY REPORT**
**March 2023**
Marissa Goerke

**Terra Lab with a dusting of snow at sunset, March 27, 2023.** *Image Credit: Marissa Goerke*

## 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.

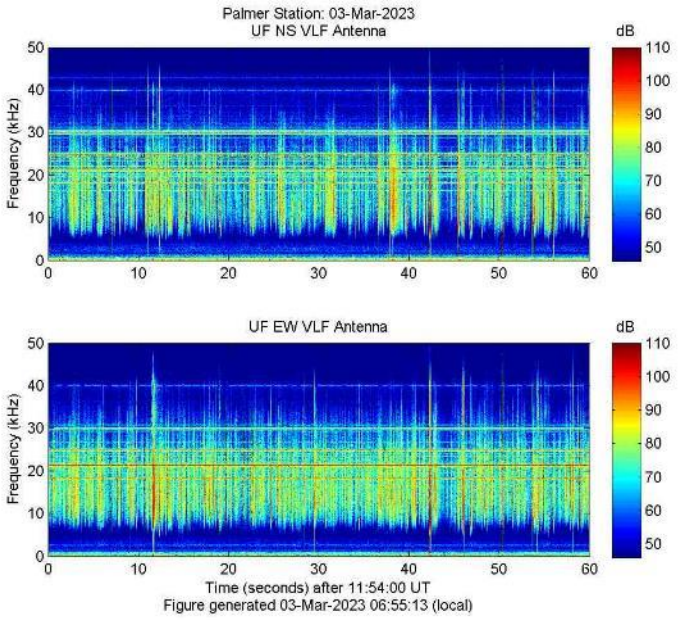


**Figure 9**- Real-Time broadband VLF Spectrogram from Palmer Station, Antarctica.

Both the Extremely Low Frequency and Very Low Frequency systems operated well this month. The spectrograms were reviewed daily and bi-weekly antenna 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 March 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 project is preparing to ship the new system that will be compatible with the network down this year. More information can be found at: http://magnetometers.bc.edu/index.php/palmer.

**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.

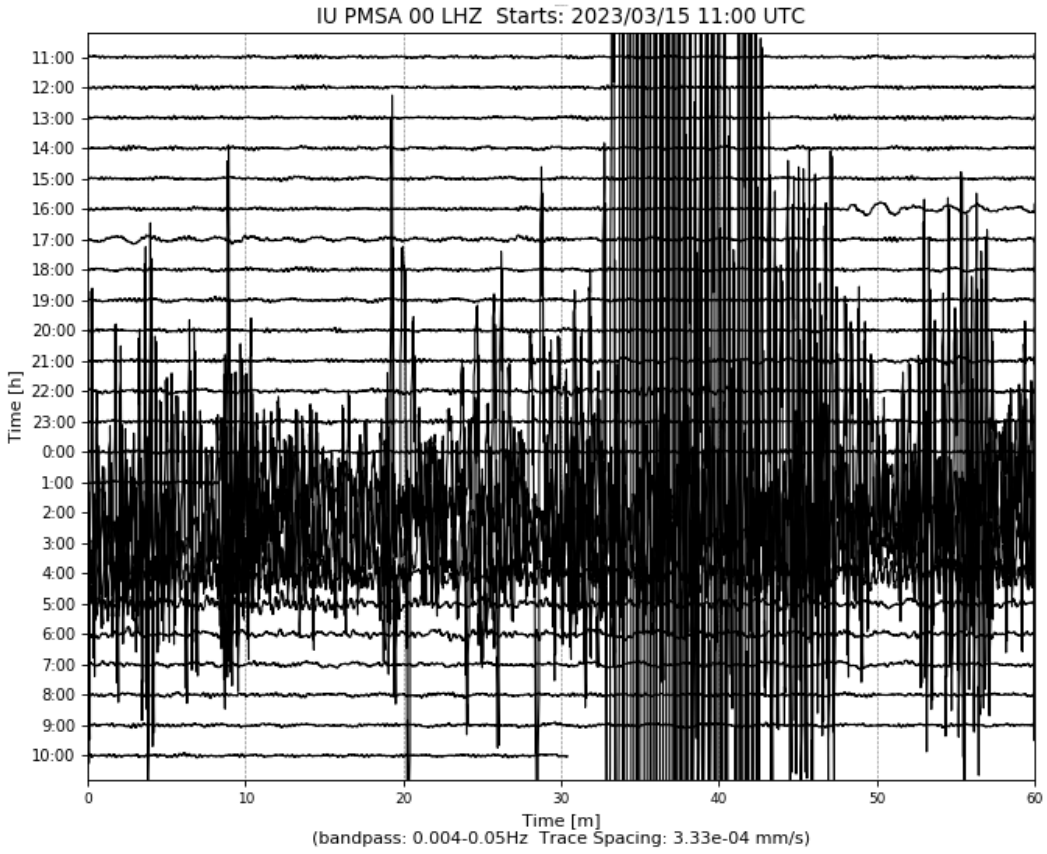


**Figure 10-** A magnitude 7.0 earthquake on March 15, 2023 in the Kermadec Islands region as recorded from the Palmer seismic sensor.

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 $O_2$ (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.

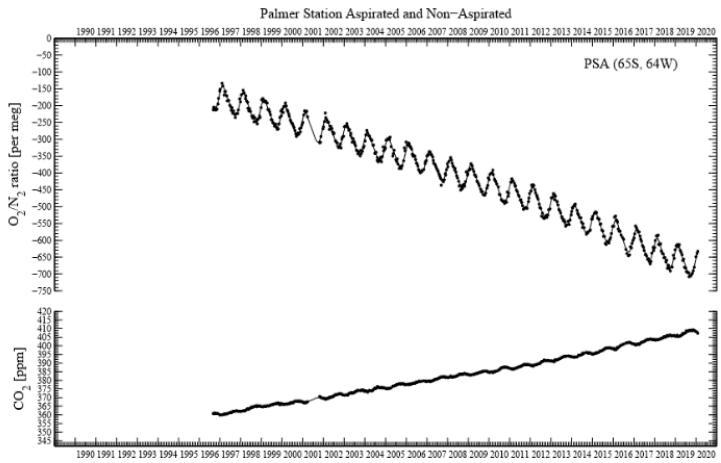


**Figure 11-** Historical plot of $\mathbf{O_2/N_2}$ ratio per meg and $\mathbf{CO_2}$ ppm updated on July 29, 2020.

Air samples were collected on March 2 and March 15. 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 March 6, March 13, March 20, and March 27 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/.

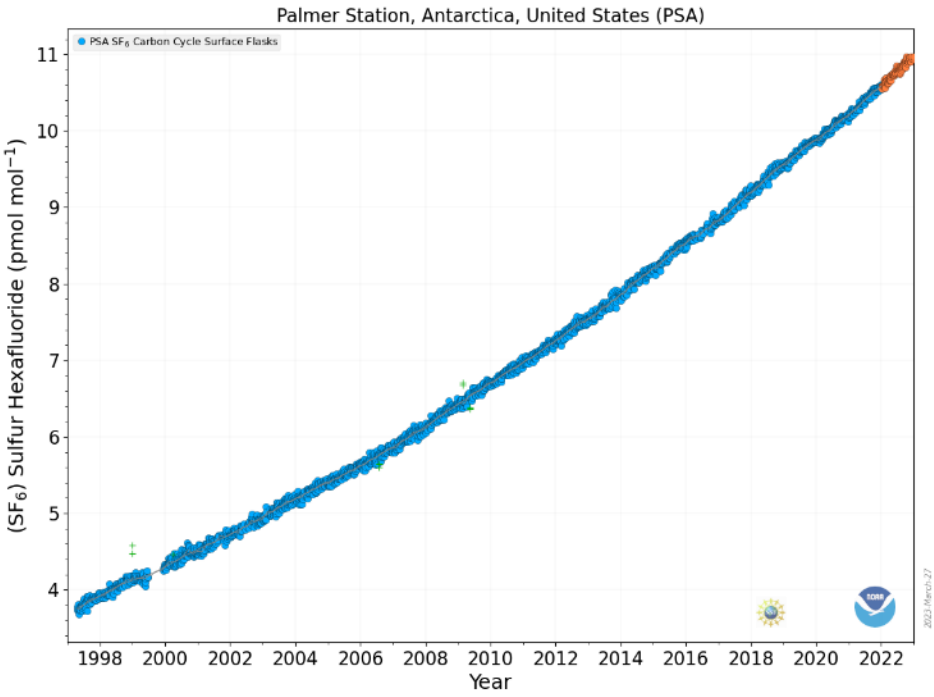


**Figure 12-** Sulfur Hexafluoride ($SF_6$) levels at Palmer Station dating back to 1997. Orange dots are preliminary data.

Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on March 8 and March 25 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.

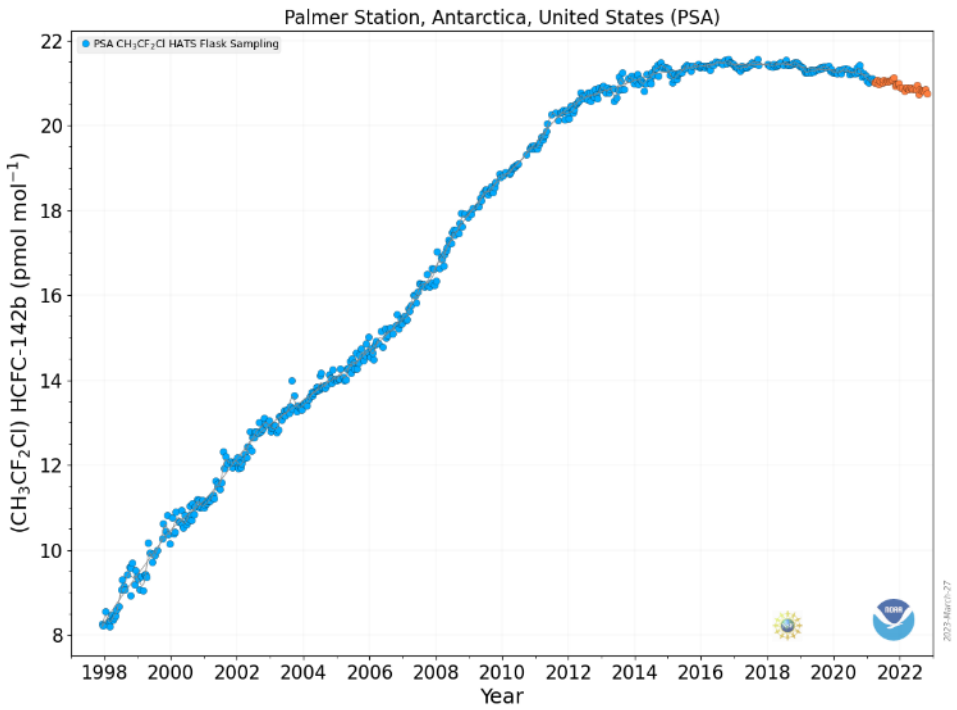


**Figure 13-** HCFC-142b ($CH3CF_2Cl$) levels at Palmer Station dating back to 2009, one of the Halocarbon and Trace Gases measured at Palmer Station.

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.

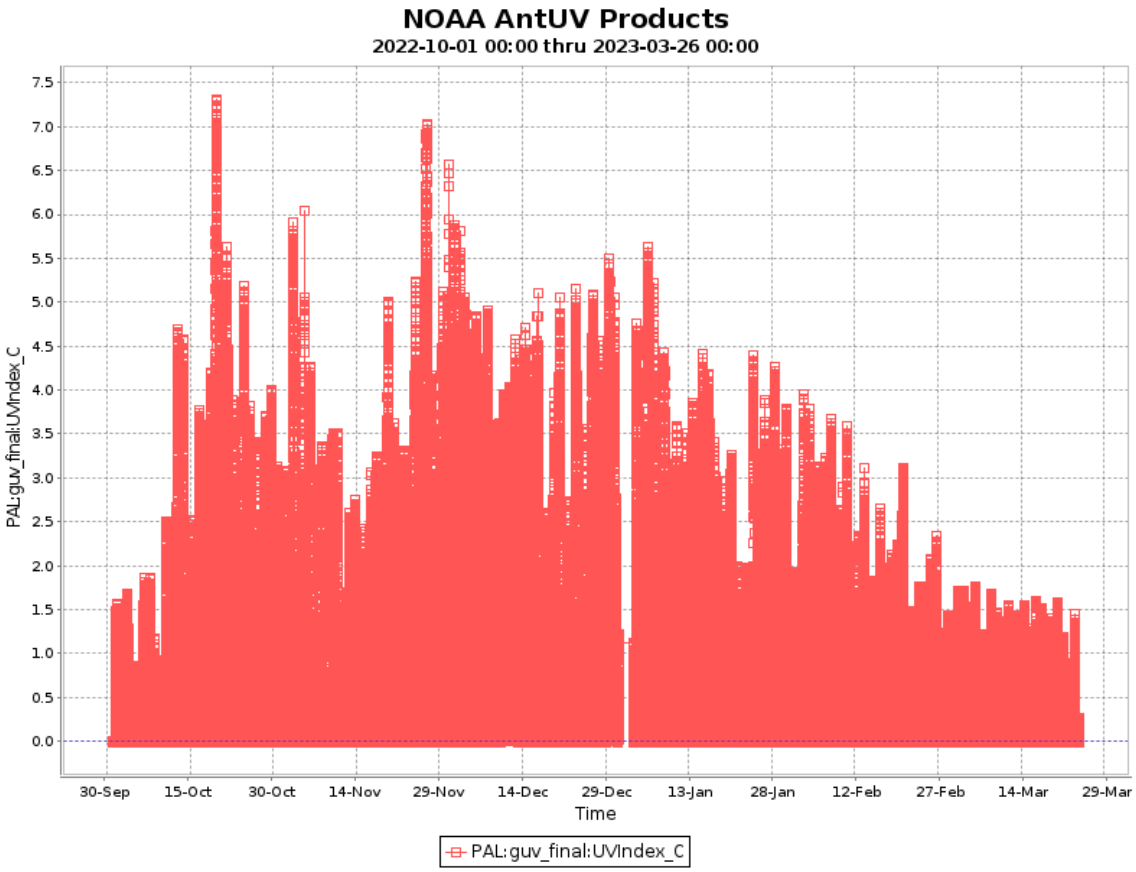


**Figure 14-** UV index generated from the GUV-511 for the 2022-2023 summer season.

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 bi-weekly SUV-100 UV Absolute Scans were performed on March 13 and March 27 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.

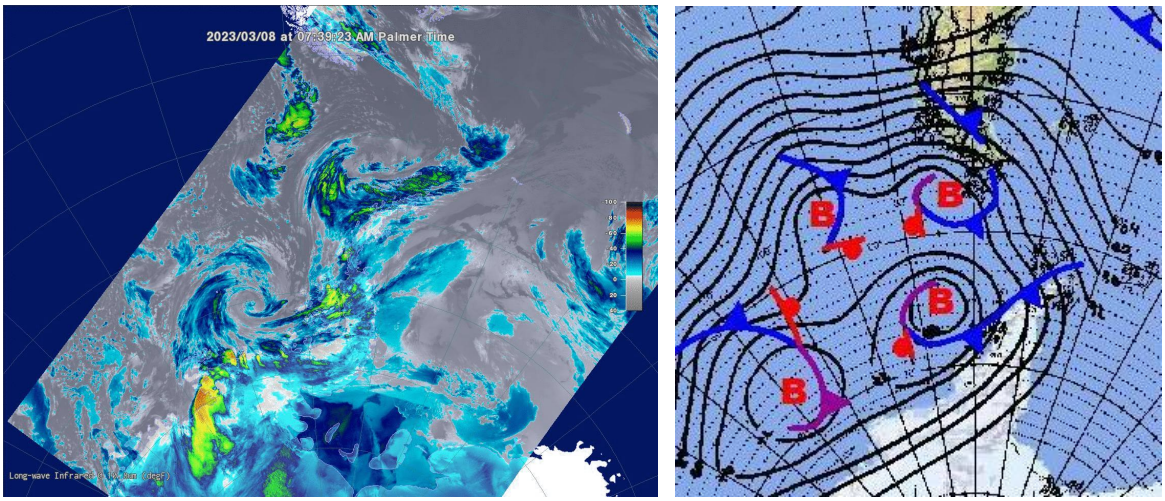


**Figure 15-** NOAA-19 March 8 satellite pass *(left)* explained by the Chilean meteorological chart *(right)*.

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 and Septentrio receivers were all illuminated in the correct pattern and showed no signs of interruption.

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.

**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 west side of the pier at -64.774558° -64.055580° at a height of 11.46 meters (WGS-84). It was reinstalled at this deeper depth after the completion of the Palmer Pier.

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.

Tide level, sea water conductivity, and sea water temperature data is archived on the AMRC website: http://amrc.ssec.wisc.edu/data/ftp/pub/palmer/.

## 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 remote island sites are now operational as of the end of the month.

One minute weather data is archived on the AMRC website:
http://amrc.ssec.wisc.edu/data/ftp/pub/palmer/.

### Palmer Monthly Met summary for March, 2023

| **Temperature** |
|---|
| **Average:** 1 °C / 33.9 °F |
| **Maximum:** 6.3 °C / 43.34 °F on 10 Mar 14:43 |
| **Minimum:** -4.2 °C / 24.44 °F on 29 Mar 05:58 |
| **Air Pressure** |
| **Average:** 975.7 mb |
| **Maximum:** 991.2 mb on 17 Mar 23:26 |
| **Minimum:** 952.3 mb on 22 Mar 09:35 |
| **Wind** |
| **Average:** 13.3 knots / 15.4 mph |
| **Peak (5 Sec Gust):** 55 knots / 63 mph on 12 Mar 05:12 from NE (41 deg) |
| **Prevailing Direction for Month:** NNE |
| **Surface** |
| **Total Rainfall:** 105.7 mm / 4.16 in |
| **Total Snowfall:** 29 cm / 11.3 in |
| **Greatest Depth at Snow Stake:** 10.2 cm / 4 in |
| **WMO Sea Ice Observation:** 1-5 bergs, bergy bits, growlers, and brash ice |
| **Average Sea Surface Temperature:** 1.28 °C / 34.3 °F |