PALMER STATION MONTHLY SCIENCE REPORT

March 2025

A pod of 18 killer whales was spotted traveling through the southern boating area. Station residents were able to witness this from the crow's nest on top of GWR, while C-024-P (Friedlander) group was able to get a closer look and count of the individuals.

Image credit: Dr. Natasja van Gestel

NEWS FROM THE LAB

The month of March was spent wrapping up the productive summer season for deployed science groups at Palmer Station. The local weather made it obvious that the summer season has come and gone as temperatures, daylight, precipitation, wind, and brash ice made field work more and more challenging as the days flew by. Deployed groups spent the final field days of the season collecting data as weather and sea-state allowed. When the winds were too high to be out on the water or local islands, cargo paperwork and preparations to pack up lab spaces and samples to meet end-of-season deadlines were the main focus.

With the seasons changing, we also saw a huge shift in wildlife populations throughout the month. The Adélie penguins are no longer frequently seen, and fur seals have started to return to their winter resting spots. Whale sightings from Arthur Harbor became less and less frequent, and even the sheathbills aren't seen on the boardwalks as frequently.

I would like to thank the March Science Tuesday presenters: Instrument Technician Danny Tropper, C-020-P (Steinberg) lab member Benjamin Klempay, ASC Research Associate Ben Rosen-Filardo, and C-024-P (Friedlaender) lab lead Mason Cole. This summer season was filled with Science Tuesday presenters, and it was always a packed-house with audience members. It was such a treat to hear from so many people this year, with topics ranging from current projects here on station, to the workings of our boat engines, past masters and PhD work, dinosaurs previously inhabiting this continent, to the data taken during our daily polls written on the Palmer Station galley. Thank you to everyone who presented throughout the season!

As this is the final report for the Summer 2024-25 summer field season, I would like to echo the many thanks that are given from individual lab groups in the reports that follow. This season was full of hard work, collaboration, and excellent communication throughout all of the deployed lab groups as well as supporting ASC staff. Field seasons always have their challenges, but the amount of science and data collected in the past six months was an amazing thing to be a part of, and every single person who deployed to Palmer Station played a role in the success of the lab groups hosted in both Terra Lab and BioLab spaces. So thank you to all ASC staff, NSF visitors, and grantees near and far!

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: Dr. Natasja van Gestel and Tiego Ferreira de la Vega

Science

The open-top chambers that raise temperatures inside them are only deployed during the summer. In March cooler temperatures allowed more snow to accumulate, which is why March has been the month we have removed the chambers before winter truly sets in.

Warming responses in cold ecosystems with short growing seasons could be slow, which is why longer-term projects, such as ours, is able to capture the responses that are evident over longer time scales. We had already noticed in our first field season that warming led to greater carbon uptake (more photosynthesis) in plots closest to the glacier (youngest site). However, though we noticed the changes physiologically, it was not until this year that this translated into visible greening inside the warmed plots compared to the control plots (Figure 1), further supporting our a priori hypothesis that warming speeds up successional processes at the youngest site.

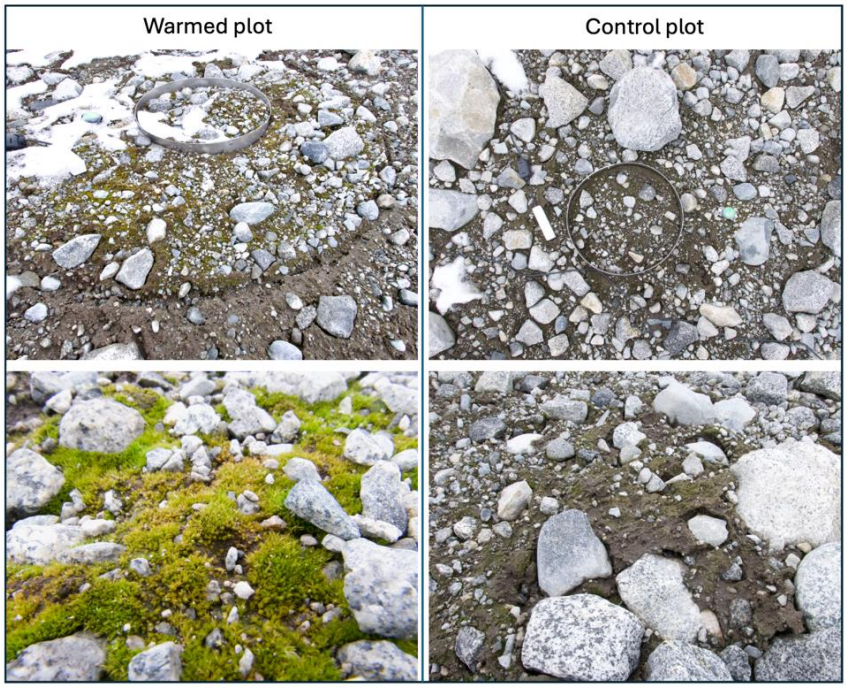

Figure 1- Mosses, possibly Polytrichum, have a head start in the warmed plots compared to control plots. It is possible that our young site is a former peatbank that was covered by the glacier, as also evidenced by the darker soil (more organic matter). *Image credit: Natasja van Gestel*

In contrast, photosynthetic uptake of mosses at Litchfield Island has been reduced with warming even in during the first field season (2022-2023 austral summer). Though visual differences between warmed and control plots were hard to detect this year, since 2022 the *Chorisodontium* moss has shown more browning across the site in general, whereas *Polytrichum* moss has remained vibrant green.

Our growth chamber experiment in the BioLab incubators was a success. The aim of this experiment was to find out how warming affects growth rates of specific microbial taxa and how warming affects the microbial players in the carbon cycle. The warming experiment in the growth chamber lasted four weeks. Once a week I measured photosynthetic rates and respiration rates of cores that were set aside for flux measurements. All samples were flash-frozen in liquid nitrogen and kept at -80^{o}C.

Outreach/Broader Impacts

On March 7 the Bahía Agradable returned to Palmer Station for the second time this season. The visit went smoothly. I was glad to help with the tour around station in my capacity as station science lead and as a Spanish speaker. It was great see familiar faces from the first visit, and to welcome new visitors from the Argentine Navy. In fact, crew from this vessel recently made the news as they recently responded to a distress call from a Chilean supply vessel: https://maritime-executive.com/article/argentine-navy-rescues-chilean-supply-vessel-off-antarctica

Acknowledgements

I would like to thank ASC on station. My task as Station Science Lead was made easy because of the professionalism and support of ASC, from station manager, administrator, and boathouse, to lab supervisor and instrument tech to FEMC, powerplant, logistics, waste/recycling, painter, construction/waste heat loop, and chefs. Everyone has a role that aids in the advancement of science. I also really appreciate the grantees and the great science done by them, and their excellent science presentation in which all groups shared their research.

In all, the austral 2024-2025 summer season was a big success, with a great group of people on station that I am fortunate to call my Palmer family. Thank you for providing me with the opportunity to help lead the science on station.

C-013-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (PAL-LTER): ECOLOGICAL RESPONSE TO "PRESS-PULSE" DISTURBANCES ALONG A RAPIDLY CHANGING WEST ANTARCTIC PENINSULA

Dr. Megan Cimino, Principal Investigator, University of California at Santa Cruz.
Personnel on Station: Helena Dodge, Allison Northey, and Wriley Hodge.

Unfavorable weather made conducting boating fieldwork challenging, but we were still able to get out on 25 of the 31 days in March for at least some portion of the day. Gentoo penguin chick fledging masses were obtained at Biscoe Point and in the Joubin Islands, completing the season.

Figure 2- Gentoo penguin chicks/fledglings make their way to the ice and the beach at Biscoe Point. *Image credit: Helena Dodge.*

Brown skua work concluded this month with nest monitoring of breeding pairs from Humble and Dream Islands, as well as Biscoe Point. Our South polar skua sightings on Shortcut Island continued throughout March.

We banded Giant petrel chicks on all local islands throughout the month of March, and we continued our chick growth study on Humble Island.

Figure 3- Giant Petrel chick at banding. *Image credit- Wriley Hodge.*

Marine mammal monitoring continued with observations of large numbers of fur seals, declining elephant seal numbers, sporadic leopard seal, crab-eater seal, and Weddell seal sightings. Whale observations in the Palmer area decreased during March but humpback whales were still regularly seen.

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

We are continually grateful for ASC support. Special thanks to Hannah James for coordinating ASC and grantee field volunteers who assisted with Gentoo fledgling measurements. Thank you to the ASC and grantee volunteers who assisted with this work, and ASC staff who installed landing pins at Point 8 and Loudwater Cove to allow for good anchorage sites for conducting fieldwork. As always, a big thanks to the Boat House for launching us so frequently this month.

C-019-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (PAL-LTER): ECOLOGICAL RESPONSE TO "PRESS-PULSE" DISTURBANCES ALONG A RAPIDLY CHANGING WEST ANTARCTIC PENINSULA

Dr. Oscar Schofield, Principal Investigator, Rutgers University, Institute for Earth, Ocean, and Atmospheric Sciences, Department of Marine and Coastal Sciences
Personnel on Station: Abby Tomita and Mya Sharpe

March was a busy month for the C-019-P (Schofield) lab as they collected core LTER measurements at Station E, cleaned the lab spaces, and prepared all northbound samples and cargo. In total, Abby and Mya, alongside the C-045-P (Van Mooy) lab, were able to go to Station E for five out of eight opportunities this month. Though high winds and swell prevented the group from going out in the second half of the month, they were still able to collect data and discrete water samples at the beginning and end of the month.

Mya collected glacial meltwater from the Arthur Harbor side of the backyard three times over the month, despite the glacial stream of interest being either completely dry or frozen further upstream. Seasonal changes like variation in temperature can make these samples difficult to collect. The glacial meltwater samples, collected since January, will be sent to Rutgers University where Mya will characterize the chemical composition of the water, analyzing for trace metals, copper speciation, dissolved oxygen, and transcriptomics.

Figure 4- Left to right: Abby Tomita, Danny Tropper, Mya Sharpe, and Stephen Root after successfully recovering the RU26 AUV Glider from Station E. *Image credit: Matt Gosselin*.

On March 22, Abby and Mya retrieved RU26, the AUV Glider that the Schofield group deployed on January 7. Over the 74.2-day deployment, RU26 travelled 1438.9 km total, averaging a speed of roughly 21 km per day. RU26 was assigned missions by the team back at Rutgers, travelling the 600 line of the LTER research cruise track (Figure 2a) and making its way inshore to the Palmer Deep canyon. The 600 line is extremely well studied from previous annual cruises due to its proximity to Palmer Station. Sending the Glider to this track ensures that some data along that line was still collected this year since there was no LTER cruise this summer season. Retrieval of RU26 would not have been possible without the help of ASC, and the group extends a huge thank you to Stephen Root, Danny Tropper, and Matt Gosselin.

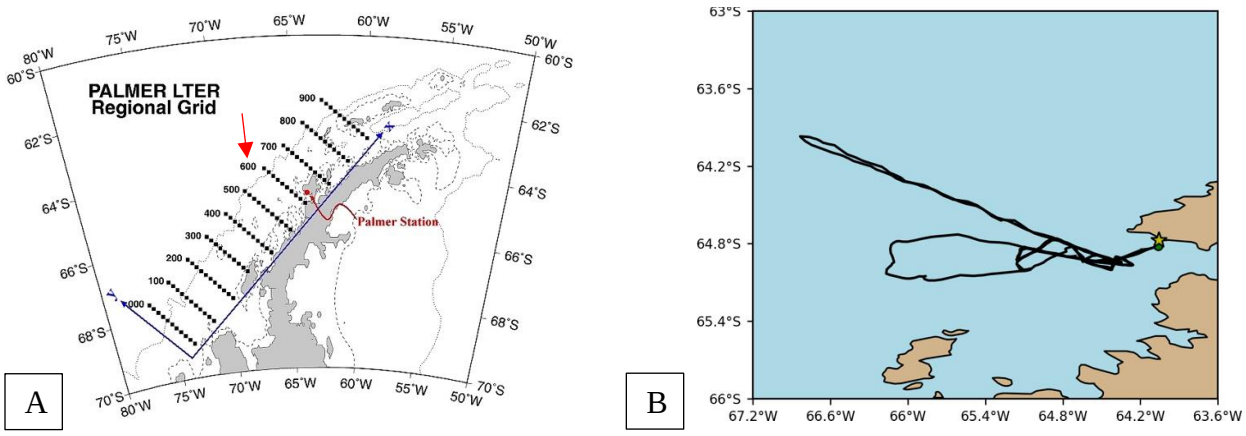

Figure 5- A) Palmer LTER Sampling Grids, with the 600 line highlighted (https://pallter.marine.rutgers.edu/research/sampling-grids/). B) RU26 Deployment Track over 74.2 days. The Yellow Star indicates Palmer Station. https://marine.rutgers.edu/cool/data/gliders/deployments/deployment.php?deployment=ru26d-20250107T1348&iserver=maps).

The 2024-2025 summer season was full of new challenges, accomplishments, and adventures for the members of the Schofield lab, as all of them were new to the on-station component of the LTER. Abby, Mya, and Charlotte gained new skills and a sense of confidence that will continue throughout their careers. This season would not have been possible without the other groups in the LTER along with everyone on station who facilitated this science.

C-020-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (PAL-LTER): ECOLOGICAL RESPONSE TO "PRESS-PULSE" DISTURBANCES ALONG A RAPIDLY CHANGING WEST ANTARCTIC PENINSULA

Dr. Deborah Steinberg, Principal Investigator, Virginia Institute of Marine Science, William & Mary's Batten School, Section for Coastal & Ocean Processes

Personnel currently on station: Maya Thomas and Benjamin Klempay

The C-020-P (Steinberg) lab has come to their last month completing science at Palmer Station for the 2024-2025 season. With the combined efforts of Isabelle and Meredith in the first half of the season, and Maya and Benjamin in the latter half, this has been a successful season for the zooplankton laboratory. For her dissertation, Maya completed six dissolved organic matter (DOM) excretion experiments on four different zooplankton taxa (including the aggregate and solitary forms of *Salpa thompsoni*, the dominant animal in the water column this year). The majority of water collected will later be analyzed at her home institution, the Virginia Institute of Marine Science, but the chlorophyll *a* analysis has already been completed at Palmer Station for each experiment.

Figure 6- Maya Thomas, zooplankton lab lead, conducting her zooplankton dissolved organic matter experiments in the labs at Palmer Station. *Image credit: Benjamin Klempay*.

In addition to DOM experiments, Maya also co-lead deploying the C-045-P (Mooy) lab's sediment trap. Throughout the season, the sediment trap was successfully deployed and recovered three times. We used particle inceptor traps (PIT) to capture particles as they sank throughout the water column. Maya focuses on the zooplankton-mediated sinking material that mostly occurs in the form of fecal pellets. To do this, she places a jar with polyacrylamide gel into the PIT trap so that sinking particles can settle into the

Figure 7- Salp fecal pellets in their incubation container after a completed DOM experiment. *Image credit: Maya Thomas.*

gel. This makes it easier to identify individual particles since the gel allows the pellets to better retain their original shape and kept separate from other particles.

As the season is coming to a close, it is important to mention how all of the successful work this year could not have been possible without the help of all of the personnel at Palmer Station. Everyone has contributed to this research in one way or another, and we cannot thank everyone enough for the assistance we have received.

C-024-P: Palmer, Antarctica Long Term Ecological Research (PAL-LTER): Ecological Response to "Press-Pulse" Disturbances Along a Rapidly Changing West Antarctic Peninsula

Dr. Ari Friedlaender, Principal Investigator, University of California, Santa Cruz, Santa Cruz, California
Personnel on station: Mason Cole and Ricky Robbins

Survey Efforts and Data Collection Summary

March marks the second half of the 2025 season for the C-024-P (Friedlaender) group, led by PI Dr. Ari Friedlaender. Mason Cole (Ph.D. student) and Ricky Robbins (field technician) continued to collect and analyze data at Palmer Station this month. The group's main research hypotheses are focused on understanding the behavior, ecology, life history and demography of baleen whales in the waters around Palmer Station, and the potential for ecosystem competition and partitioning between baleen whales and other krill predators. The research objectives are addressed through a multi-platform approach, which combines both observational and direct sampling methods. These include visual boat-based surveys, photo-identification, tissue biopsy sampling, drone-derived measurements, passive acoustic recording devices, and animal-borne motion-sensing tags. These data are also integrated with seasonal and oceanographic parameters (e.g. krill abundance measured from echosounders). The field team based at Palmer Station conducts research in the station's local and extended boating areas.

The station team conducted near-daily visual surveys (as weather allowed) aboard the SOLAS RHIB Avior, primarily in the local boating area around Palmer Station. For each survey, we collected photo-ID, behavioral observations, and seabird co-occurrence. In March, the Friedlaender group reached the maximum permitted number of biopsy takes, at which point biopsy sampling ceased for the season. As of April 6th, we have observed 257 individual humpback whales (Fig. 8A) and collected 102 biopsy samples. We do not have animal-borne tags to deploy this field season. We attempted to recover another mooring at Station H, but this mooring never surfaced despite good acoustic communication (similar to that at the Wauwermans), again, likely due to damage to the attached buoys.

In addition to humpback whales, we have sighted 30 Antarctic minke whales (though distinguishing individuals is more difficult than in humpback whales), roughly18 killer whales, and 7 fin whales (!) in the local boating area (Fig. 8A). Minke whales were generally sighted closer to small islands or Anvers Island than were humpback whales, and were only seen alone or in groups of two. A large group of about 15 killer whales was seen in March, an uncommon occurrence locally, proceeding northwest through the local area. An exceedingly rare sighting for this nearshore area occurred (again!) on April 4th, when we encountered a group of five more fin whales toward the western limit of the local boating area (Fig. 8A). We documented the group thoroughly before they left the boating area.

Humpback whale spatial habitat use varied over time, visualized as shifting "hotspots" on a map (Fig. 8B). It is likely that these hotspots reflect krill patch distribution, efficient travel corridors, or a combination thereof. Surface-feeding humpbacks (e.g. lunge feeding, bubble-netting) were observed particularly frequently in the open western region of the local boating area above an arm of the Palmer Deep Canyon head (Figs. 8C, D).

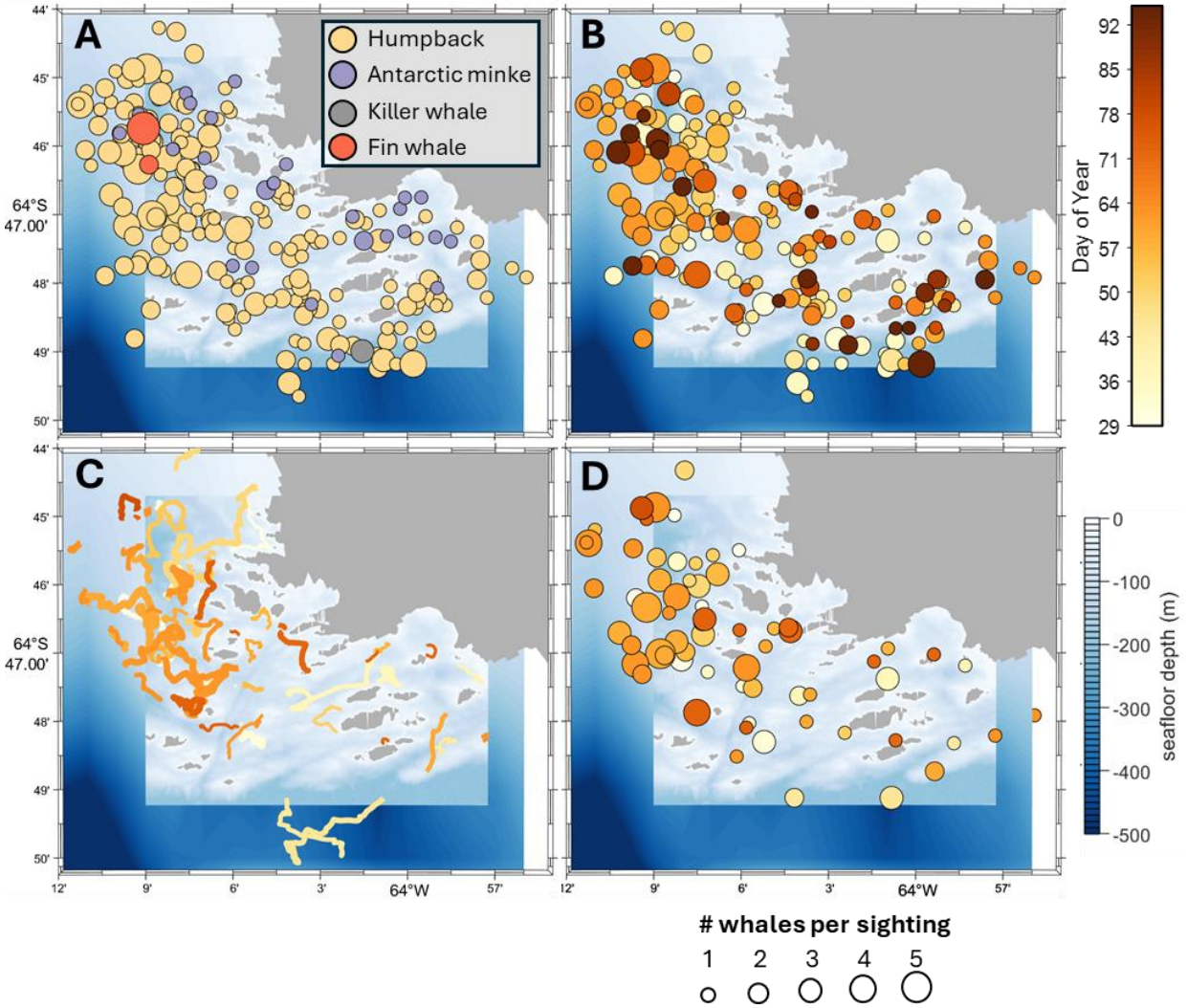

Figure 8- A) Map of 2025 season cetacean sightings in the local boating area by species and group size. B) Map of all 2025 season humpback whale sightings in the local boating area, colored by day of year. C) GPS tracks of the SOLAS RHIB Avior while following surface-feeding humpbacks. D) Surface feeding humpback encounter locations. Local bathymetry around Palmer Station is from the PRIMO project (2005), and the coarser-resolution bathymetry of the surrounding area is from publicly available 1-minute ETOPO data.

The local abundance of both humpback and Antarctic minke whales exhibited pulsed trends between late January and early April (Fig. 9). Humpback abundance seemingly peaked in late February and early March, though significant numbers are present later in the season than is typical (Fig. 9). Surface feeding behavior was most prevalent during February and early March, with no surface feeding observed since mid-March, consistent with enhanced diel vertical migration of krill patches (deeper daytime patches).

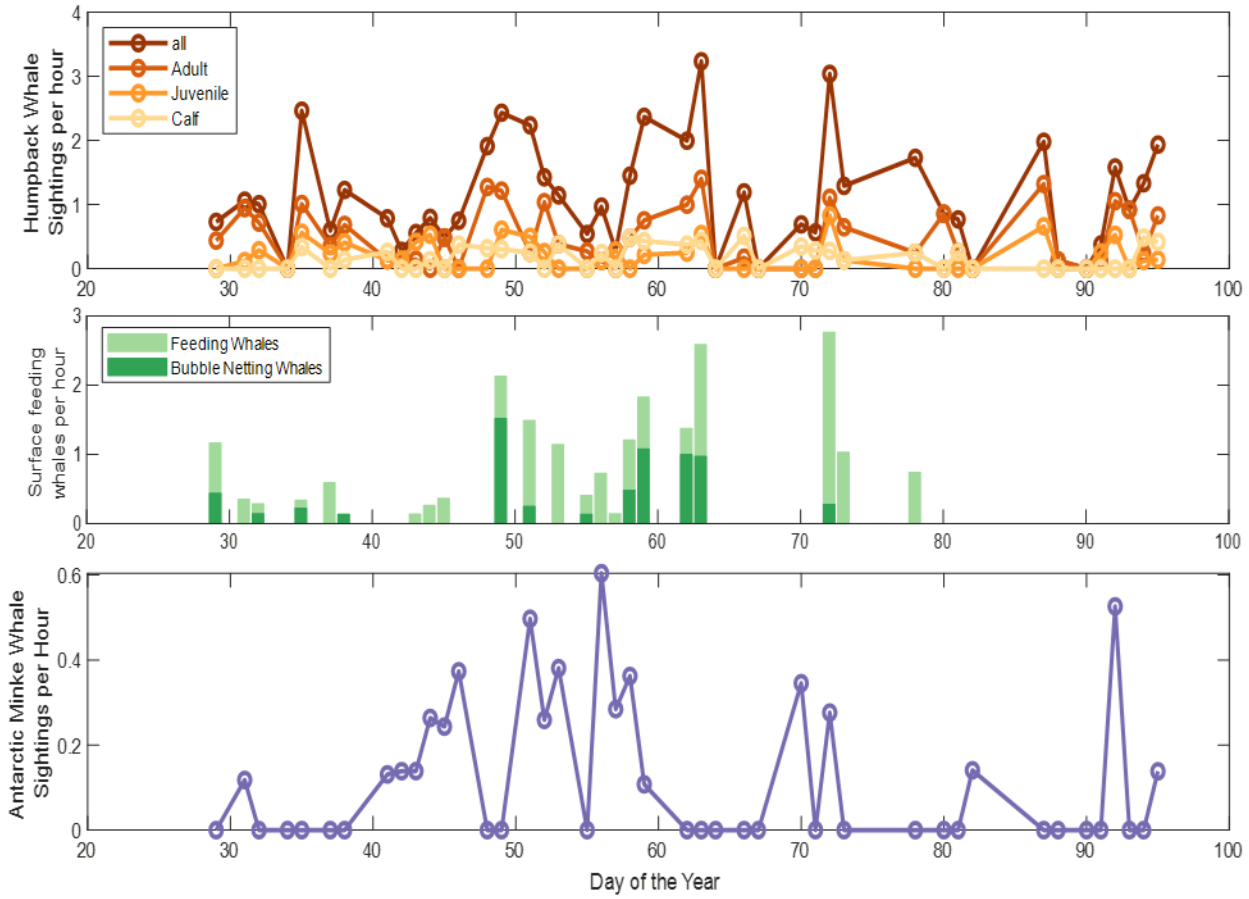

Figure 9- 2025 sighting phenology for (A, B) Humpback and (C) Minke whales.

Photo-Identification

Photo-identification is done using the markings, scarring, and coloration on the fluke of the animal (Fig. 12). There is relatively little site fidelity and low residence times for humpbacks in the Palmer Station survey area, though this is potentially an artifact of the limited size of the survey area. Though the individual resight rate was higher than typical in February, very few individuals were resighted from late February through early April (Fig. 11). This matches our understanding from previous seasons and tag data that most Humpback whales do not reside within the Palmer Station survey area for extended periods of time.

Figure 10- A humpback whale fluke photo-ID shot showing clear identifying marks. *Image credit: Ricky Robbins.*

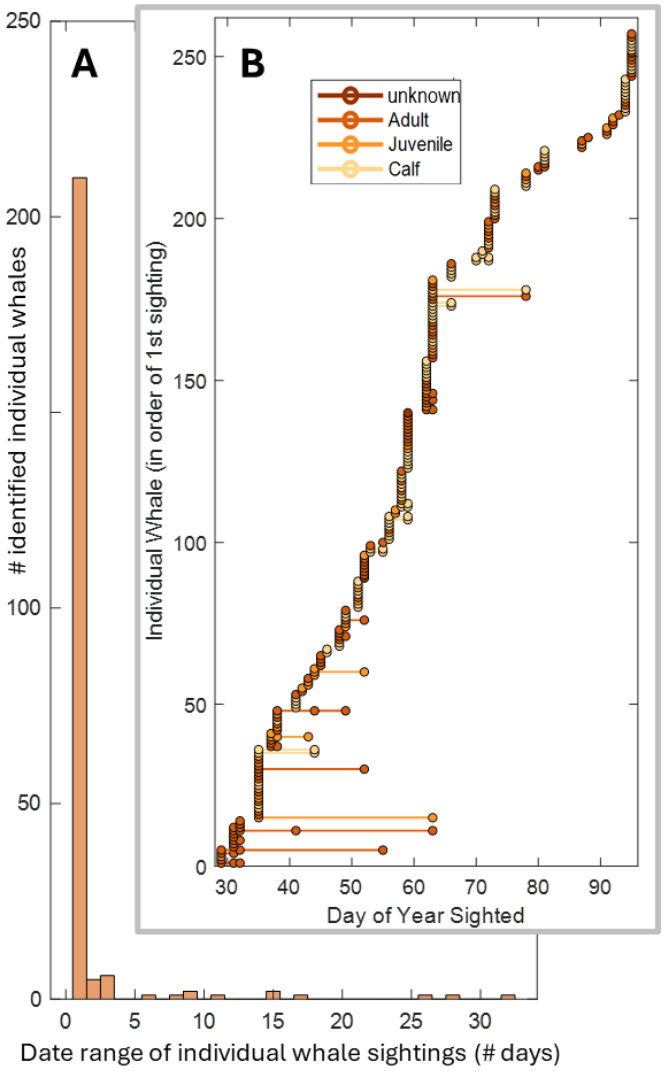

Figure 11- Date range (A) and phenology (B) of individual whale sightings and resights in the local boating area for the 2025 season. Date range in (A) is the range of dates between first and last sightings of the individual; 1 = only seen on one day.

Biopsy Tissue Sampling

The biopsy samples **(**Fig. 12**)** are collected via crossbows with a specialized bolt. Photo-ID of flukes and dorsal fins are used to ensure that individuals are not double-sampled. These samples typically contain both skin and blubber and are used for a suite of analyses regarding the health, demography, and reproductive rates of baleen whales and respond to the ecological and environmental changes taking place along the Antarctic Peninsula. Skin samples are used for genetic identification and sexing of animals, and to determine the breeding stock of whales sighted around Palmer Station. Stress levels are determined using cortisol levels, while pregnancy is determined using progesterone and estrogen levels. Demographic parameters like pregnancy rates will be contextualized relative to interannual variability of regional environmental conditions including sea ice and krill availability to better understand how changes affect the ecology and population dynamics of Humpback whales. Blubber is also used to assess the presence of pollutants, specifically persistent organo-pollutants and the presence of endocrine disruptors that may indicate exposure to microplastic pollution.

Figure 12- Biopsy dart with biopsy visible at the time of sample collection on a Humpback whale. ACA-2025-019, NMFS Permit No. 27911. *Image credit: Ricky Robbins.*

C-045-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (PAL-LTER): ECOLOGICAL RESPONSE TO "PRESS-PULSE" DISTURBANCES ALONG A RAPIDLY CHANGING WEST ANTARCTIC PENINSULA

Dr. Benjamin Van Mooy, Senior Scientist, Marine Chemistry and Geochemistry, Woods Hole Oceanographic Institution
Personnel on station: Christina Rorres

The first half of March for the C-045-P (Van Mooy) group was very busy as we continued twice-weekly water sampling at Station E with the C-019-P (Schofield) lab. During each Station E day, the Van Mooy lab collects samples for lipids, carbohydrates, particulate organic carbon (POC), nutrients, $\delta^{18}O$ isotopes, and flow cytometry. These samples are collected with a CTD (Conductivity, Temperature, Depth) rosette and six niskin bottles collecting water from 5, 10, 20, 35, 50 and 65 meters, while Go-Flo bottles are used to collect water from the surface. For each depth, we filter one liter per sample type for lipids, carbs and POC. Filtering is completed as soon as possible after returning to station so the samples can be frozen in a -80C freezer. In addition to Station E samples, we are also collecting twice-weekly station pumphouse samples for our same standard parameters. The poor weather in the latter half of the month kept us from our usual RHIB *Hadar* sampling, but we were able get one last water collection day on March 28th, RHIB *Hadar's* last day. Most of these final two weeks of March were spent inventorying C-045-P (Van Mooy) supplies, packing northbound cargo and tidying the lab.

Figure 13: From left to right, Abby Tomita, Christina Rorres, and Benjamin Klempay excited for final Station E day of the season. *Image Credit: Mya Sharpe*

In addition to water sampling, we continued the particle interceptor trap (PIT) project with the C-020P (Steinberg) lab. Unfortunately, due to a lack of good weather windows, we were only able to successfully deploy and recover one sediment trap this month. This trap was deployed at 197 m for about 74 hours. In total we collected samples from three sediment traps throughout season.

A big thank you to our Palmer Station Lab Manager (Hannah James) and Instrument Technician (Danny Tropper) for all of your help this season. Thanks as well to the boathouse personnel (Barb Krasinski, David Goldman, and Matt Gosselin) for keeping science on R/V *Hadar* running efficiently.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
March 2025
Ben Rosen-Filardo and William Skorski

Penguins hanging out on Dead Seal Island on a beautiful sunny day, March 23 2025.
Image credit: Ben Rosen-Filardo

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

Dr. Hyomin Kim, Principal Investigator, New Jersey Institute of Technology; Newark, NJ

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.

The ELF/VLF radio wave observations at Palmer Station contributes to the wider network of experiments studying high-latitude geospace variables. Together with South Pole and McMurdo, these staffed U.S. Antarctic geophysical stations measures the interactions between Earth's upper atmosphere, the magnetosphere, and solar wind. In 2026, this imperative network will be managed by the NJIT-Polar Engineering Development Center (PEDC).

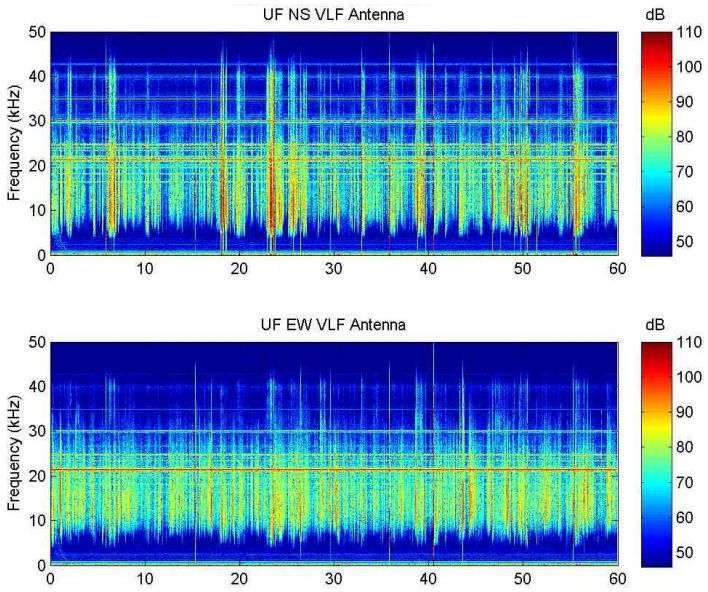

Figure 14. Real-Time broadband VLF and ELF Spectrogram from Palmer Station, Antarctica.

The new ELF/VLF PC has been set up and is now collecting data. Work is underway to resume sending real-time data over the USAP network. Bi-weekly antenna inspections were done as weather allowed to ensure continuous data collection.

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

A-111-P: SAMBA MAGNETOMETER

Dr. Hyomin Kim, Principal Investigator, New Jersey Institute of Technology; Newark, NJ

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. In 2024 the project was taken over by Dr. Hyomin Kim.

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. A new Raspberry Pi system was installed in 2023. The system has been down since December 8th, 2024 due to ongoing issues with the data acquisition software. More information can be found at: http://magnetometers.bc.edu/index.php/palmer.

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION.
Dr. David Wilson, Supervisor Research Geophysicist, USGS Earthquake Hazards Program, Albuquerque, NM

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-P) 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.

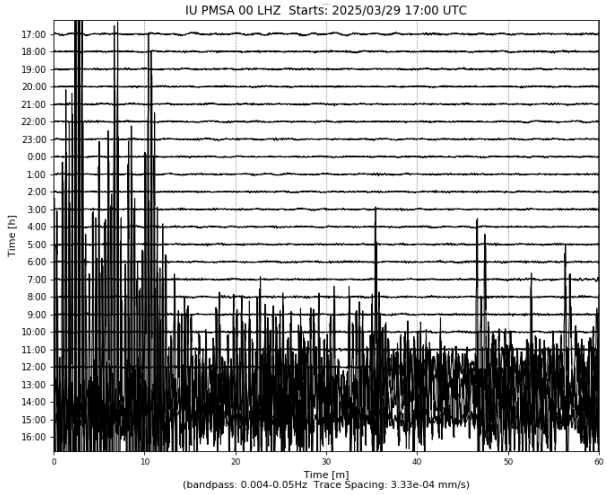

Figure 15. A March 30th magnitude 6.1 earthquake off the coast of Tonga, 82.4 km (51.1 mi) from the nearest city of Pangai in the Pacific Ocean (20.371S, 173.831W) as recorded from the Palmer seismic station.

The system performed normally during 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.

Drs. Vanda Grubisic and Ralph Keeling, Principal Investigators, National Oceanic and Atmospheric Administration /Global Monitoring Laboratory; Boulder, CO and Scripps Institution of Oceanography; La Jolla, CA

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.

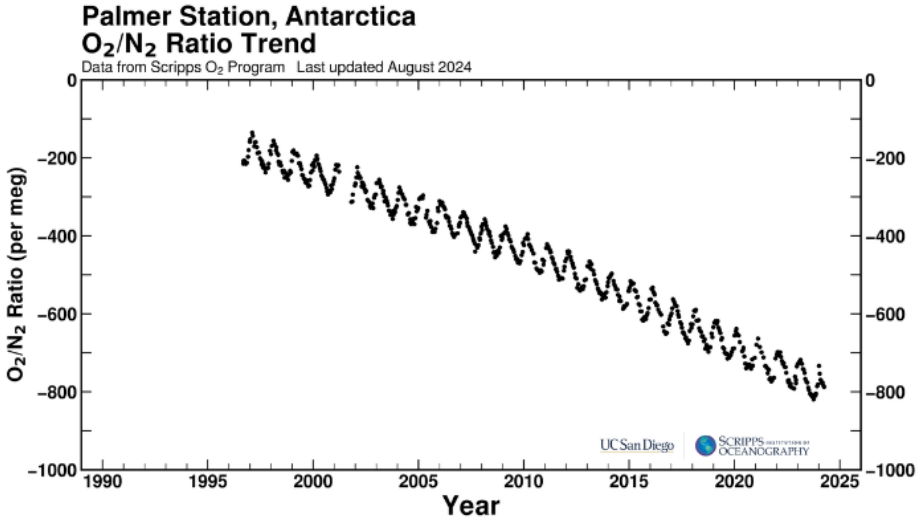

Figure 16. Historical plot of $\mathbf{O_2/N_2}$ ratio per meg and $\mathbf{CO_2}$ ppm, updated August 2024.

Air samples were collected on March 13th and March 25th. 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 are shipped to the Scripps Institution of Oceanography in California for analysis. More information and data can be found at: https://scrippso2.ucsd.edu/graphics-gallery/o2n2-graphics/psa.html.

O-264-P: COLLECTION OF ATMOSPHERIC AIR FOR THE NOAA/GMD WORLDWIDE FLASK SAMPLING NETWORK

Dr. Vanda Grubisic, Principal Investigator, National Oceanic and Atmospheric Administration /Global Monitoring Laboratory; 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 6th, 13th, 21st, and 26th during favorable wind conditions. More information and data for the Carbon Cycle group can be found at: https://gml.noaa.gov/ccgg/.

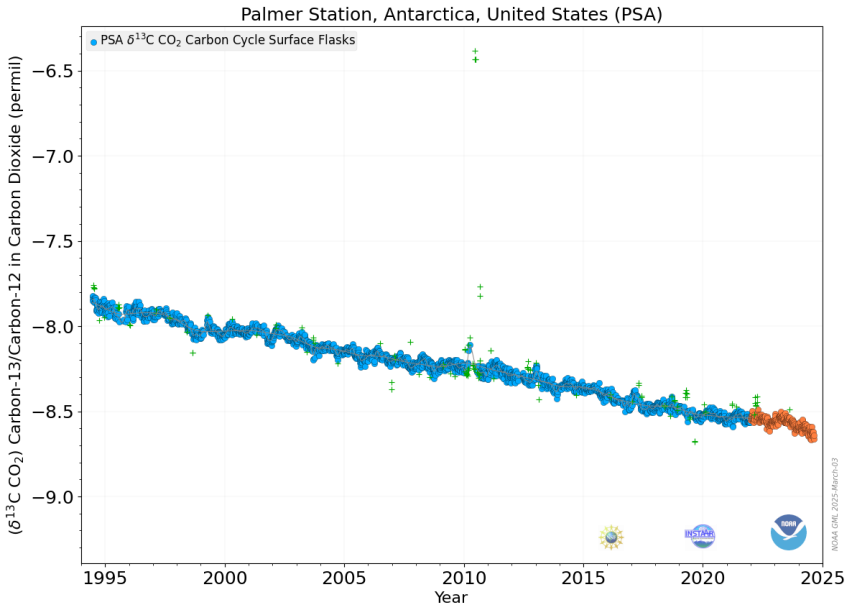

Figure 17. Carbon-13/Carbon-12 in Carbon Dioxide (δ13C-CO2) levels at Palmer Station dating back to 1994. Orange dots are preliminary data and green pluses are poorly mixed air masses, which should not indicate background conditions.

HATS samples were collected on March 3rd, 17th, and 26th during favorable wind conditions. More information and data for the Halocarbons and other Atmospheric Trace Species group can be found at: https://gml.noaa.gov/hats/

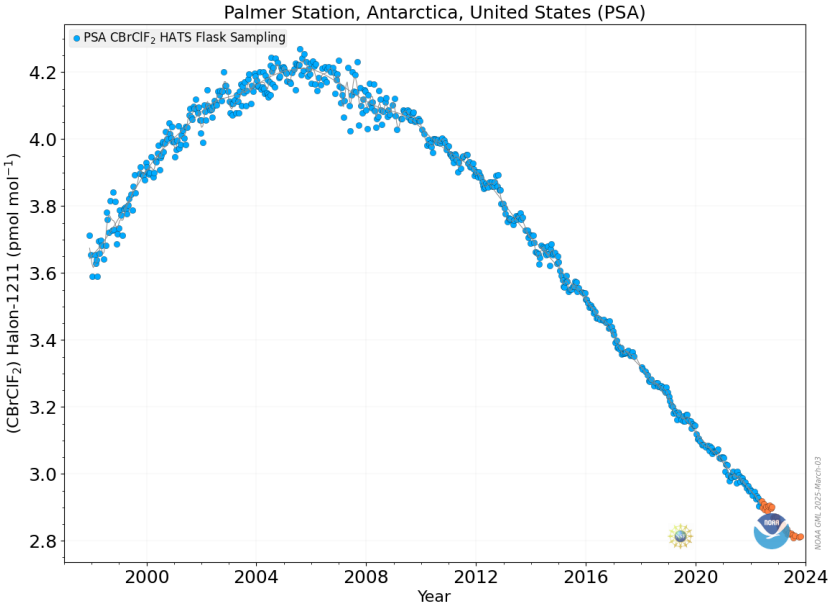

Figure 18. Halon-1211 ($CBrClF_2$) levels dating back to 1997, one of the Halocarbon and Trace Gases measured at Palmer Station. Orange dots are preliminary data.

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

Dr. Scott Stierle, Principal Investigator, National Oceanic and Atmospheric Administration /Global Monitoring Laboratory; 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.

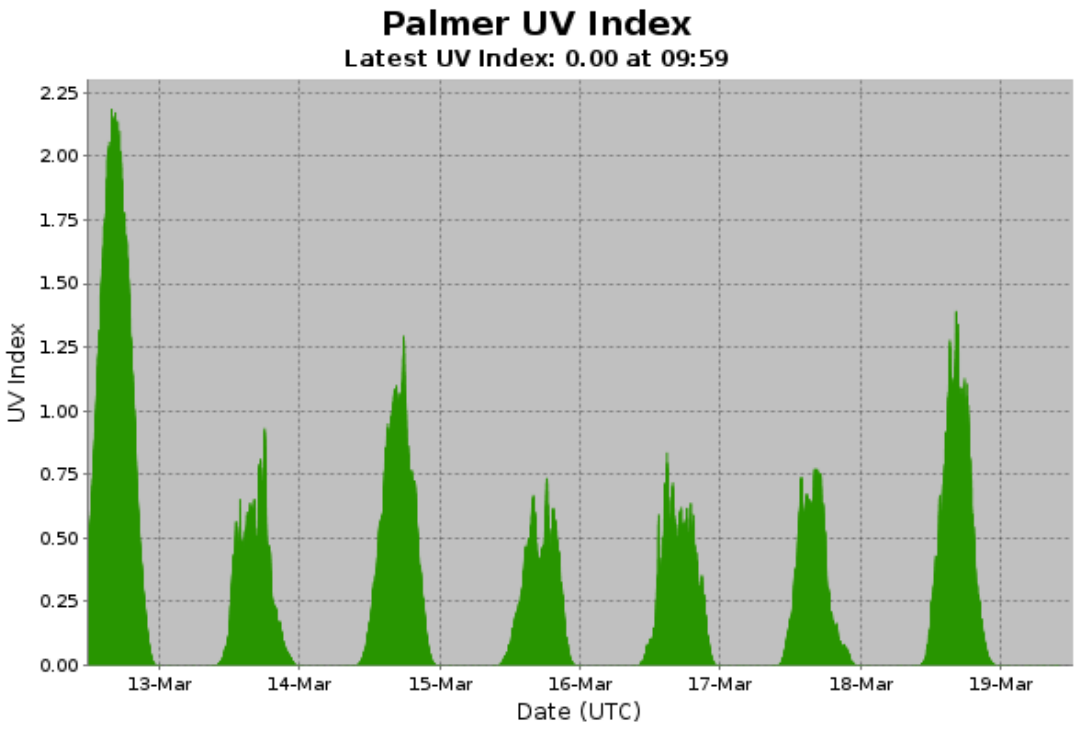

Figure 19. UV index generated from the GUV-511 radiometer in real time.

The log was filled out and collectors were cleaned on a daily basis. Level checks were performed once a week to confirm that the instrumentation was within +/- 0.2 degrees. The weekly log was sent out each Monday, and SUV-100 Absolute Scans were performed on March 12th and 31st without issues. The connector on the TUVR is broken, and the instrument has been intermittently reporting since November 5th, 2024. 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.

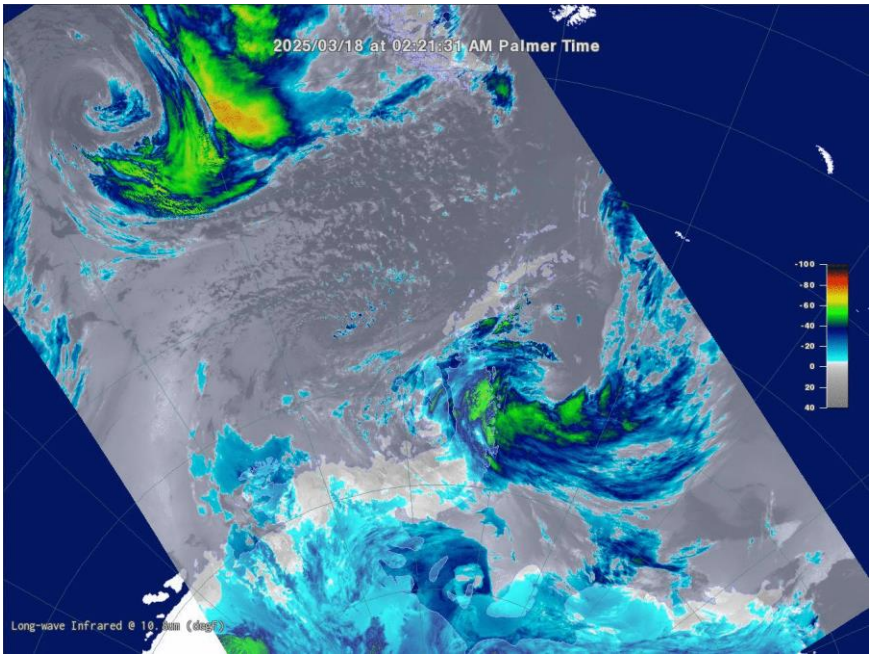

Figure 20. NOAA-18 March 18th satellite pass.

The imagery was checked daily. Both the MetOp and NOAA satellite passes were captured normally this month.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION.
Joe Pettit, Principal Investigator, EarthScope Consortium; Washington, DC and Socorro, NM

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 EarthScope. 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 source of the signal issues was found to be the antenna cable. On February 21, the bad Heliax cable was replaced with an LMR-400 cable on loan from the Satcom Engineer, and the system is now operational. A new cable will be arriving on PAL25-02 in April. For more

information, visit: https://www.unavco.org/polar-services/forward-fielded-instruments/palmer-station/

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 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 amount of filter material was checked as needed. Daily filters were processed and packed for 2025 Q1. The monthly log was sent on time. Additional details about the treaty and monitoring stations can be found on the CTBTO website, 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 depth of 11.46 meters (WGS-84). It was reinstalled at this deeper depth after the completion of the Palmer Pier in June 2022.

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. Sea ice imagery was provided to the R/V NATHANIEL B. PALMER to support their ongoing science cruise in the Ross Sea (NBP25-01).

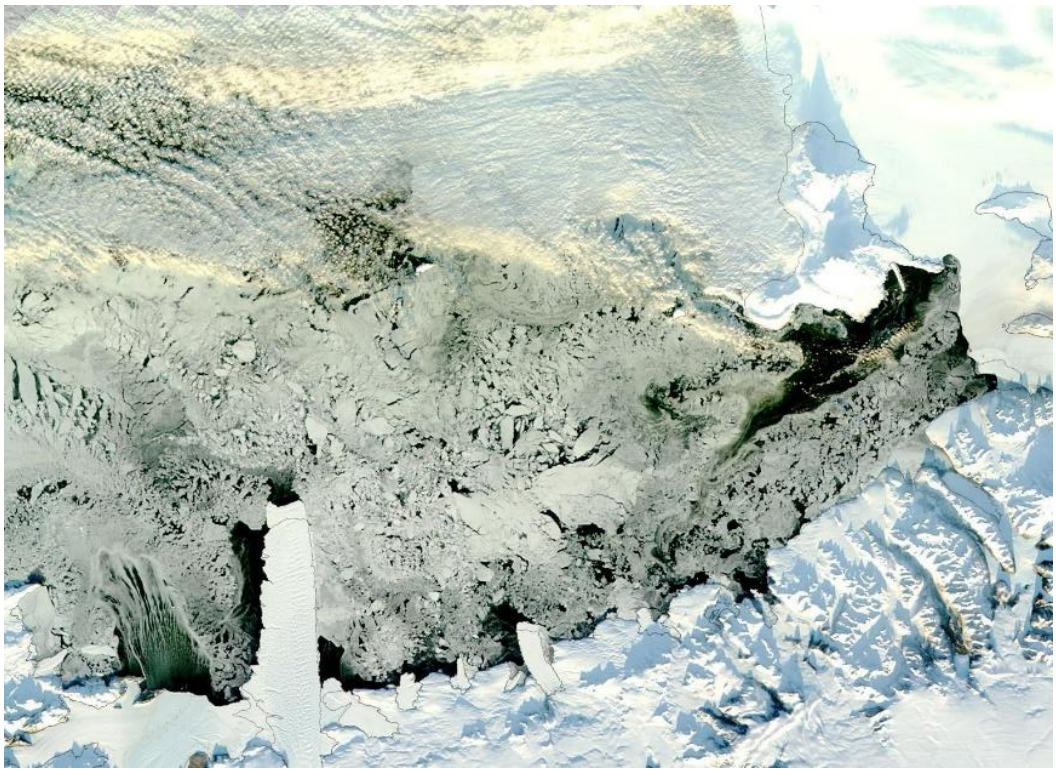

Figure 21. March 16th satellite imagery of the Drygalski Ice Tongue area, where NBP25-01 is operating until April. Source: NASA/MODIS Aqua

Tide level, sea water conductivity, and sea water temperature data is archived on the AMRDC website: https://amrdcdata.ssec.wisc.edu/dataset?q=Palmer+Station.

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 at five accumulation stakes found near the PAWS system. All weather data is archived locally and forwarded to the University of Wisconsin on the first day of each month for archiving and further distribution.

All AWS stations performed nominally for the month with the exception of AWS #2 which is still down due to radio communication issues. One-minute weather data is archived on the AMRDC website: https://amrdcdata.ssec.wisc.edu/dataset?q=Palmer+Station.

Palmer Monthly Met summary for March, 2025

Temperature
Average: 0.6 °C / 33.1 °F
Maximum: 8.3 °C / 46.94 °F on 13 Mar 14:20
Minimum: -3.1 °C / 26.42 °F on 25 Mar 09:16
Air Pressure
Average: 981 mb
Maximum: 1002.2 mb on 12 Mar 17:25
Minimum: 948.3 mb on 19 Mar 23:10
Wind
Average: 11.6 knots / 13.3 mph
Peak (5 Sec Gust): 52 knots / 60 mph on 19 Mar 05:28 from NE (37 deg)
Prevailing Direction for Month: SW
Surface
Total Melted Precipitation: 48.8 mm / 1.92 in
Total Snowfall: 20 cm / 7.8 in
Greatest Depth at Snow Stake: 8.2 cm / 3.2 in
WMO Sea Ice Observation: 11-20 bergs, bergy bits, growlers, brash ice
Average Sea Surface Temperature: 0.88 °C / 33.6 °F

On October 28th 2024, erroneous temperature data was reported due to a fan outage in our backyard temperature sensor enclosure. We were able to track down temperature data on station from a nearby temperature sensor as part of the RASA instrumentation. Using those values, we have omitted temperature data on October 28th 2024 from 15:17-15:28 UTC due to reported values being too high (> 6°C). An updated data file was sent to AMRDC for inclusion in the online archive.

Precipitation has returned to the mean, seeing 49.0 mm of rain for the month of March. As expected, with an increase in precipitation we have also experienced an increase in wind speeds. Temperature on station has remained fairly steady, hovering around 0°C (32°F).

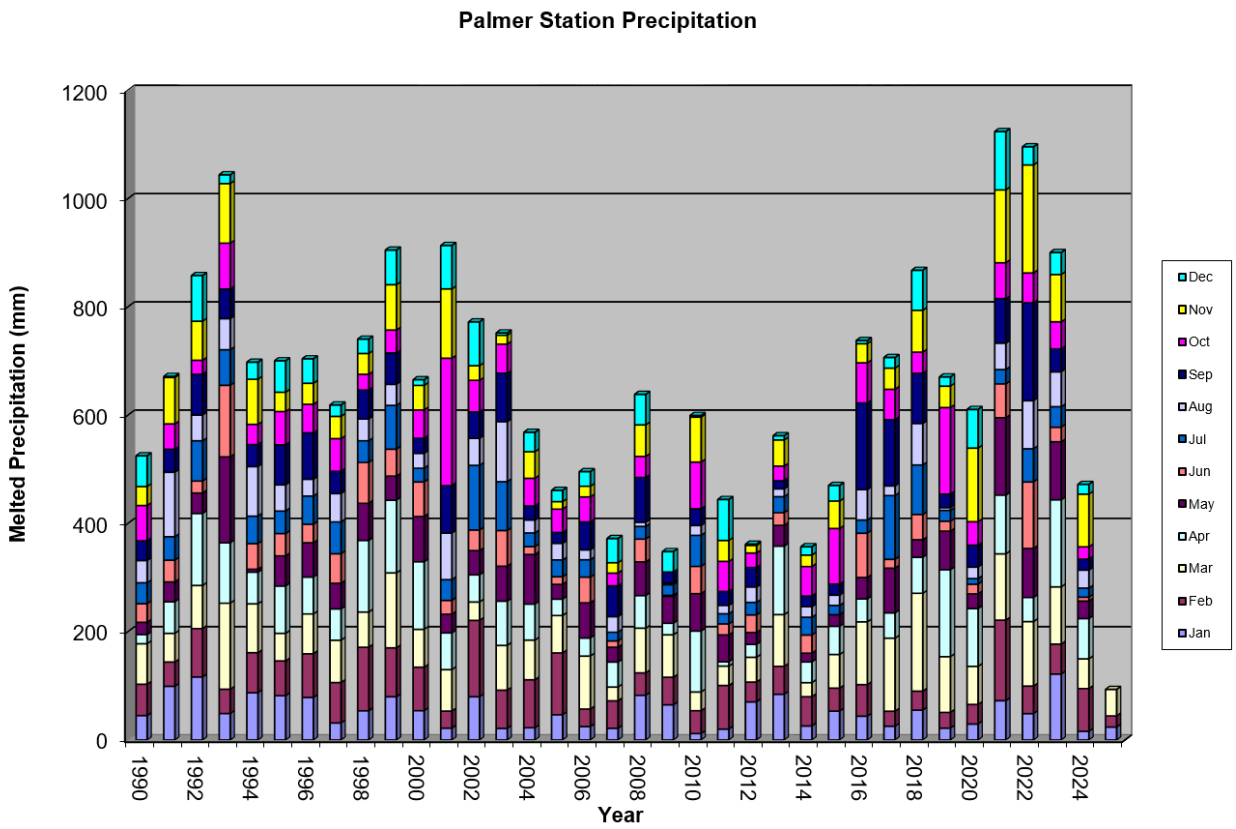

Figure 22. Palmer Station melted precipitation, 1990-present.

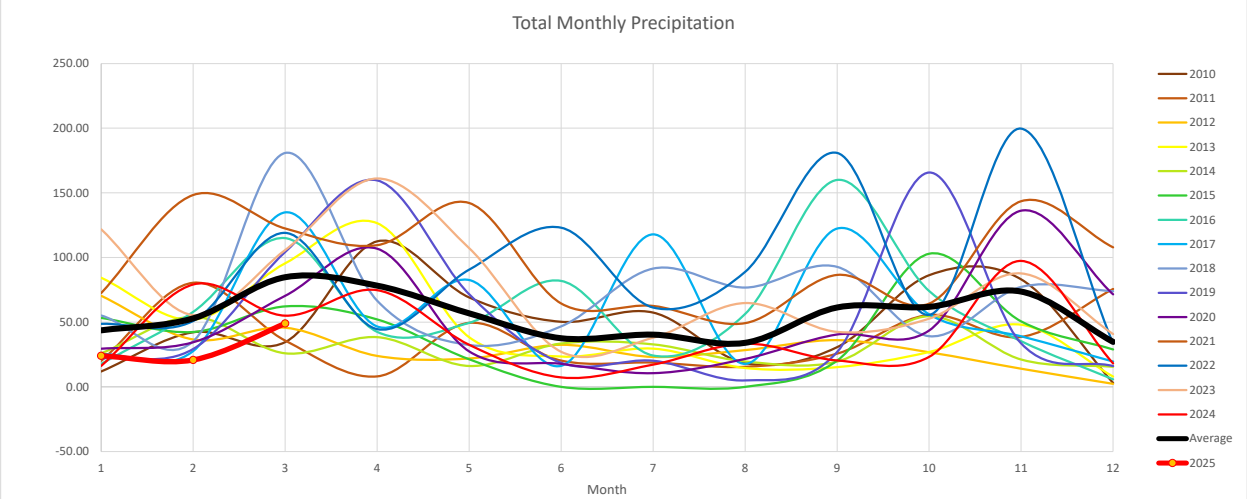

Figure 23. Palmer Station monthly precipitation, 2010-present.

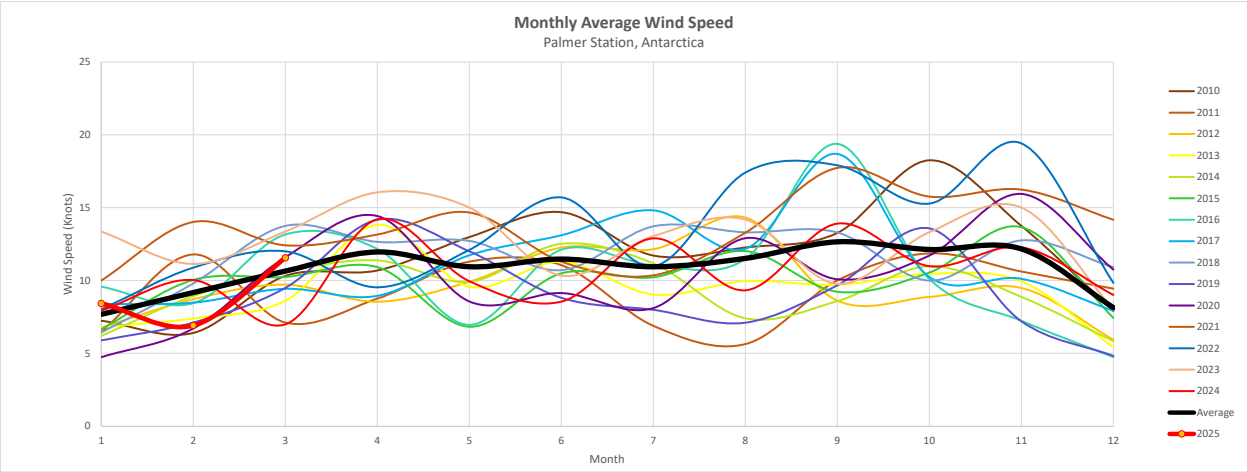

Figure 24. Palmer Station monthly average wind speed, 2010-present.

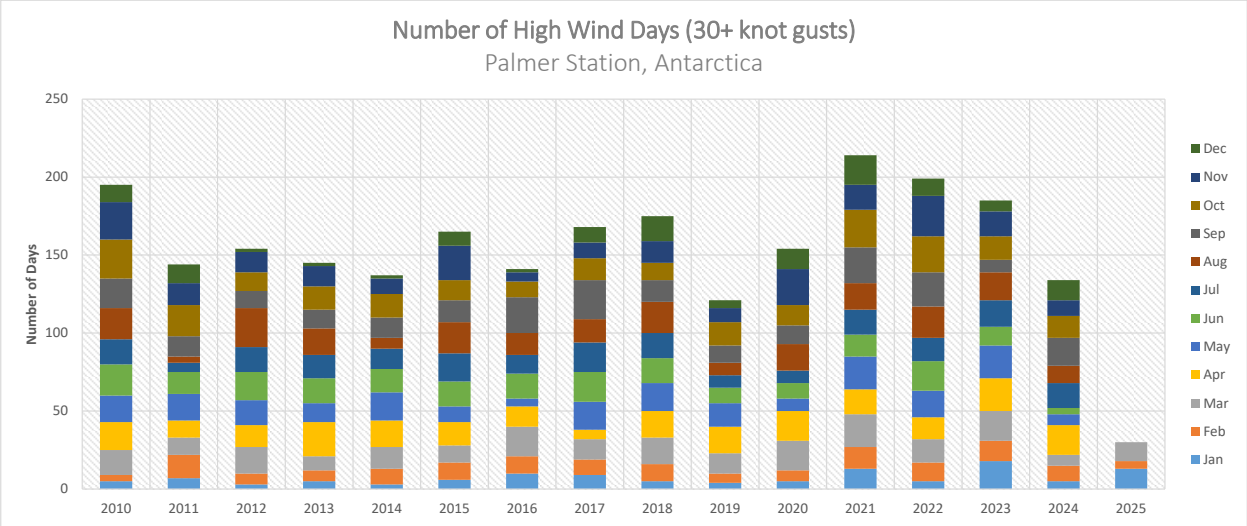

Figure 25. Number of high wind days (gusting 30+ knots) at Palmer Station, 2010-present.