PALMER STATION MONTHLY SCIENCE REPORT

February 2025

A dendritic snowflake slowly melts after landing amongst local moss species *Chorisodontium* (bottom left) and *Polytrichum* (right, star-shaped from above). *Image credit: Dr. Natasja van Gestel*

NEWS FROM THE LAB

Though February is the shortest month of the year, it was certainly one of the most productive for deployed field teams and our Terra Lab Research Associate. Calm winds allowed on-site grantees to be out on the water and remote islands for most days of the month.

More detail is given by each group below, but to highlight some of the big-picture successes of the science teams: the B-086-P (van Gestel) group began their controlled warming growth chamber excitements in Palmer Station's incubators. The C-013-P (Cimino) seabird team wrapped up their tagging efforts and began weighing Adélie and Gentoo fledglings as they venture out to sea for their first swims. The C-024-P (Friedlaender) whaling group had an incredibly productive month, collecting many biopsy samples and sighting a few species rarely seen in the Palmer Station vicinity. Rounding out the LTER team, the RHIB *Hadar* users of C-019-P (Schofield), C-020-P (Steinberg), and C-045-P (Van Mooy) groups visited Station E for water sampling, net towing, and optical casts on a regular basis, and were able to complete four acoustic transects. Our Research Associate was able to visit all three weather stations for troubleshooting and maintenance.

I would like to thank February's Science Tuesday presenters: Maya Thomas of the C-020-P (Steinberg) group, Palmer Station Doctor Dr. Joe Moriarty, and our Research Associate Ben Rosen-Filardo. Anyone who has spent time at Palmer knows that these weekly presentations provide not only a scientific learning opportunity for the community, but foster wonderful discussions with the presenter throughout the rest of the season. It takes time (and courage!) to present to your friends and colleagues, and I am so grateful for the people who continue to volunteer to give these presentations.

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

February was a busy month in terms of both field and lab work. In the field we continued measuring carbon fluxes about once weekly in the warmed and control plots. In early February we also replaced the "soil fertility" sticks (see last month's report) with fresh ones that will be in the ground for the duration of February. Regarding lab work, in early February we collected soil samples from the field for a growth chamber experiment. We received help from Joe Moriarty, Amanda (Mando) Joy (Figure 1), Barb Krasinski, and Mike Stovall.

Figure 1- Joe Moriarty and Amanda Joy collecting small, intact soil cores using sterile technique for the growth chamber experiment. *Image Credit: Natasja van Gestel*

The collected cores were acclimated to growth chamber conditions for a few days until the warming experiment started. We use a dual stable isotope technique (see Figure 2) to determine how quickly the microbial taxa are growing and how carbon cycles through the community, or how the "baton" (i.e., carbon) is passed from one microbial taxa to another as carbon dioxide is initially taken up by the photosynthesizers and later on taken up by the decomposers. Will warming affect the players in the carbon cycle?

Figure 2- Left: Dr. Natasja van Gestel and Tiego De La Vega adding stable isotopes to the samples at the beginning of the experiment. Right: The samples in the warming chamber. *Image credits: Left– Danny Tropper, Right– Natasja van Gestel*

A subset of samples is measured once-weekly in terms of photosynthesis and respiration measurements using the bryophyte chamber on the LI-6800. These data will then be used to tie growth rates to carbon uptake and loss. We also collect air samples within the mason jars once-weekly. We are now mid-way through the experiment (it ends March 11) and have collected our first time-point by flash freezing the samples and storing them at -80^{o}C. These samples will be sent to Marshall University, to be analyzed in the lab by collaborator Dr. Alicia Purcell – an Assistant Professor in the Department of Biological Sciences.

Outreach/Broader Impacts

In February we had three cruise ships visit, the M/S *Expedition*, and two visits from M/S *Island Sky*. The first M/S *Island Sky* visit hosted women leaders in Science, Technology, Engineering, Math and Medicine (STEMM) that joined the Homeward Bound program, which is based in Australia. I felt an immediate connection with them and was even given a hat by one of the members as a token of friendship. It was such a joy to see how much visitors in general appreciate visiting Palmer Station and to learn more about science, the station itself, and the NSF.

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.

Figure 3 - Wriley Hodge (left) and Allie Northey (right) observe Adélie penguin colony before chicks start fledging. *Image Credit: Liz Smith*

Weather this month allowed us to carry out 26 days of boating field work in February. Adélie penguin studies concluded this month with counts and measurements of Adélie fledglings at Humble Island. Adélie penguin foraging ecology studies also concluded in February with the

completion of our radio transmitter study on Humble Island. We deployed 14 Cell Track tags on Adélie fledglings at Dream Island (n=7) and Torgersen Island (n=7). These tags broadcast both dive and location data. They are deployed for longer than our standard GPS tags, remaining on the birds for the first year of life before molting off the following year. This was our final tagging effort of the season. Satellite tagging Giant Petrels also concluded this month, resulting in 100% tag retention rate for the season, meaning we were able to retrieve every tag we deployed. We started Gentoo penguin fledgling measurements on Biscoe Island and in the Joubin Islands in late February and will continue into March.

Our Skua work continued through February with monitoring survival Brown Skua chicks on local islands as well as on Dream, Biscoe, and the Joubin Islands. We recorded all South Polar Skua sightings on Shortcut Island and will continue this work into March.

We also monitored the Blue-eyed Shag colony on Cormorant Island and collected boli samples that we have started processing in the lab to record data on fish and other prey items. Kelp Gull surveys and chick counts were completed at all local Kelp Gull colonies, and we recorded two banded Snowy Sheathbill adults around Palmer Station. Growth measurements of Giant Petrel chicks on Humble Island continued during February and will continue to April.

Figure 4- Wriley Hodge (left) and Helena Dodge (right) conduct a Kelp Gull chick count in the local boating area.
Image credit: Allie Northey

As always, we are grateful for ASC support. Special thanks to Hannah James for coordinating ASC and grantee field volunteers who assisted with Adélie fledgling measurements. Thank you

to the ASC and grantee volunteers who assisted with this work, the Boat House for launching us for 26 of 28 days this month, and C-024-P (Friedlaender) group for assisting with activities that required two boats.

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

Discrete sampling at Station E has continued as usual for the month of February, with the Schofield group getting out seven times out of the eight possible sampling events during the month along-side the Van Mooy (C-045-P group). One day of intense swell and high winds prevented RHIB *Hadar* users from going on the water during the month. The group wrapped up their seventeenth 14C primary production incubation experiment at the end of the month. These experiments simulate the variable light conditions with depth each that the phytoplankton were living before collection, then the rate of production over a 24-hour period is measured. Primary production is the process by which autotrophic organisms convert inorganic compounds (i.e. 14C Sodium Bicarbonate that samples are spiked with) into organic matter, in this case, through photosynthesis. Over the season, primary production has generally increased at the surface. Mechanisms that can influence primary production are light availability and intensity, nutrient availability, mixing, and upwelling. Enough light is needed to sufficiently photosynthesize; however too much light can cause photoinhibition within cells, damaging them and preventing them from carrying out necessary metabolic processes. Wind and storms create turbulence in the water column, bringing nutrients up from deeper waters.

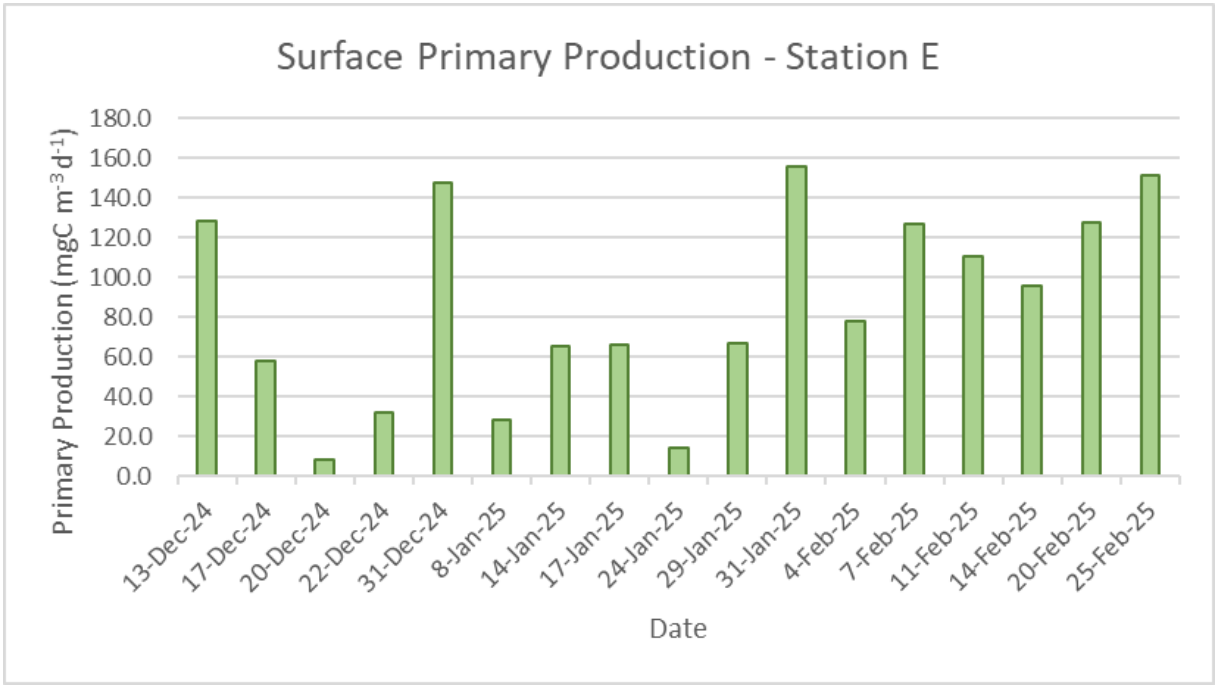

Figure 5- Rates of seasonal primary production (mgC m^{-3} d^{-1}) in surface water from Station E from mid-December 2024 to late February 2025.

There were four acoustic transects completed, two on the track west of the Wauwerman Islands, called the Gentoo, and two on the track south of the Outcast Islands, called the Adélie. Both transect lines are named after the penguin populations that frequently forage in the areas. The acoustic transects are a core measurement of the on-station component of the Palmer LTER that all of the groups work collaboratively on.

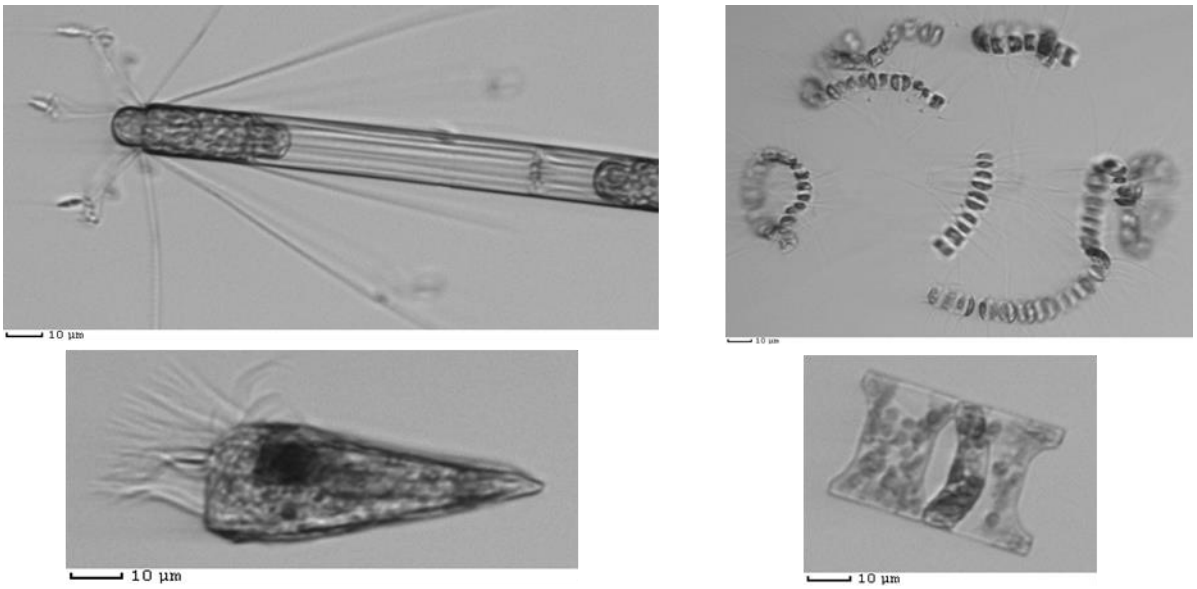

Figure 6- Imagine Flow Cytobot **(**IFCB) images from Station E recent sampling events. Clockwise, from top left: *Corethron* diatom, *Chaetoceros* diatom, *Strombidium Conicum* ciliophora, and *Eucampia* diatom.

Mya carried out two glacial meltwater incubation experiments this month. For the experiment, coastal seawater was collected and distributed into 2L bottles and diluted with either 5% glacial meltwater for the treatment or 5% deionized water for the control. These were incubated for 72 hours, every 24 hour mark samples were taken to understand how these two conditions influence phytoplankton physiology, gene expression and species composition over time. The first experiment was a learning curve and many parameters were refined for the second experiment. The second experiment was successful and will provide reliable data to inform the third experiment. A big thank is extended to everyone who assisted Mya and Abby with zodiac-based sampling at Station E to collect the water for the experiment, as well as those that drove a boat for weekly meltwater sampling events. Thank you to Hannah (Lab Manager) and Danny (Instrument Technician) for assistance with setting up the aquarium room.

The lab looks forward to recovering RU26, the glider that was deployed earlier this season, in mid-March. It has been flying for approximately two months continuously collecting data and sending it back to the team at Rutgers University. This will be Abby and Mya's first recovery of a glider, but they feel comforted to have a suite of helpful people and resources that will assist them in this new endeavor.

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

Figure 7- The C-020-P (Steinberg) lab set up during DOM experiments. Image credit: Maya Thomas.

It's been a gorgeous and successful month for the C-020-P (Steinberg) group! With the change of personnel Maya and Ben have hit the ground running and made good work to continue regular Station E sampling while also completing experiments for Maya's Ph.D. Notably, four dissolved organic matter (DOM) experiments have been successfully completed wherein salps and krill are incubated at differing temperatures in Palmer Station's aquarium flow through tanks. DOM comes from animals in many forms but we will be primarily looking at dissolved carbon, nitrogen, and phosphorous added to the water as animals feed and excrete. These experiments will be a part of Maya's Ph.D. project to quantify the rate and amount of DOM production from zooplankton at current water temperatures and water temperatures increased to projected future levels with global climate change.

Otherwise, in non-lab hours, Maya has also been participating the in the PAL LTER's video teleconference calls hosted by our education and outreach team. Maya has talked to classrooms around the country and taught them about life in Antarctica and the research she does at Palmer Station. This outreach work is imperative in making science accessible to children and breaking barriers when it comes to speaking about science to the public audience.

Figure 8: Maya Thomas (right, C-020-P (Steinberg)) and Abby Tomita (left, C-019-P (Schofield)) participating in an outreach call hosted by the PAL LTER. *Image credit: Natasja Van-Gestel*.

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

February marked the start of the 2025 season for the C-024-P (Friedlaender) group, led by PI Dr. Ari Friedlaender. At Palmer Station this year are field team members Mason Cole and Ricky Robbins. 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 regional boating areas.

The station team conducted daily visual surveys aboard the SOLAS RHIB *Avior*, primarily in the local boating area around Palmer Station. As opportunity permitted, we additionally utilized the regional and distant boating areas whenever possible to expand our spatial range of observation. For each survey we collected photo-ID, biopsies, behavioral observations, and seabird co-occurrence. As of February 28th, we have conducted over 140 hours of surveying across 23 days, during which time we have observed 143 humpback whales (Fig. 9; 98 non-mother adults, 17 juveniles, 14 mother calf pairs) and collected 80 biopsy samples (52 non-mother adults, 14 juveniles, 14 mothers, 0 calves). We have 115 individual animal flukes for individual ID (85 non-mother adults, 12 juveniles, 14 mothers, 4 calves). We do not have animal-borne tags to deploy this field season. The C-013-P (Cimino) group turned over one passive acoustic mooring prior to our arrival from Station H. We attempted to recover our second mooring at the Wauwermans, but this mooring never surfaced despite good acoustic communication, likely due to damage to the attached buoys. See summary statistics for sampling in Table 1.

	Adults	Juveniles	Mothers	Calves	Total
Observations	98	17	14	14	143
Photo-IDs	85	12	14	4	115
Biopsies	52	14	14	0	80

Table 1 - Summary of sightings observations, photo-identification (fluke only), and biopsy sampling. Samplings have been broken down by age class (note that 'Adults' does not include mothers).

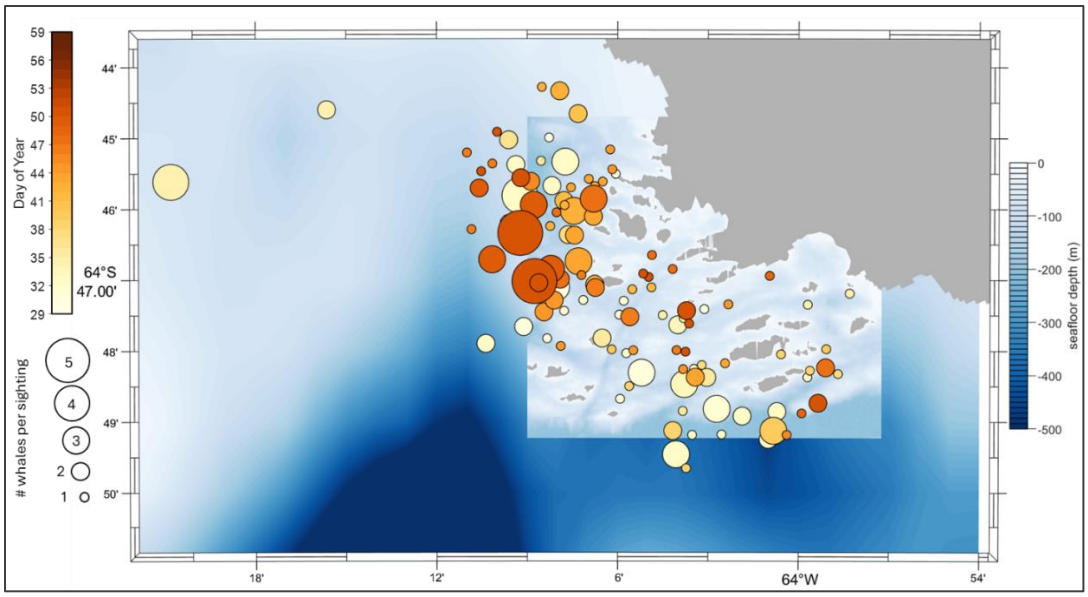

Figure 9- A map of all humpback whale sightings between January 29th and February 28th by the C-024-P (Friedlaender) team. Circle size indicates group size, and the circle color represents the day of the year (starting at Jan 1st=1) of that sighting. Local bathymetry around Palmer Station is from the PRIMO project (2005), and the coarser-resolution bathymetry of the surrounding area is from publicly available 1-minute ETOPO data. *Figure credit: Mason Cole.*

In addition to humpback whales, we have sighted 24 Antarctic minke whales (though distinguishing individuals is more difficult than in humpback whales), 3 killer whales, and 2 fin whales in the local boating area (Fig. 10). 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. One group of three killer whales was seen in late January off Laggard Island, an uncommon occurrence locally. An exceedingly rare sighting for this nearshore area occurred on February 27th, when we encountered a mother and (non-dependent) calf fin whale toward the western limit of the local boating area. We observed this pair for over an hour, and obtained a biopsy from the mother (Fig. 10). Fin whale calves remain dependent on their mother until weaning (~6-7 months), only after which the pair travels to their summer feeding grounds, e.g. Palmer Station and the Western Antarctic Peninsula.

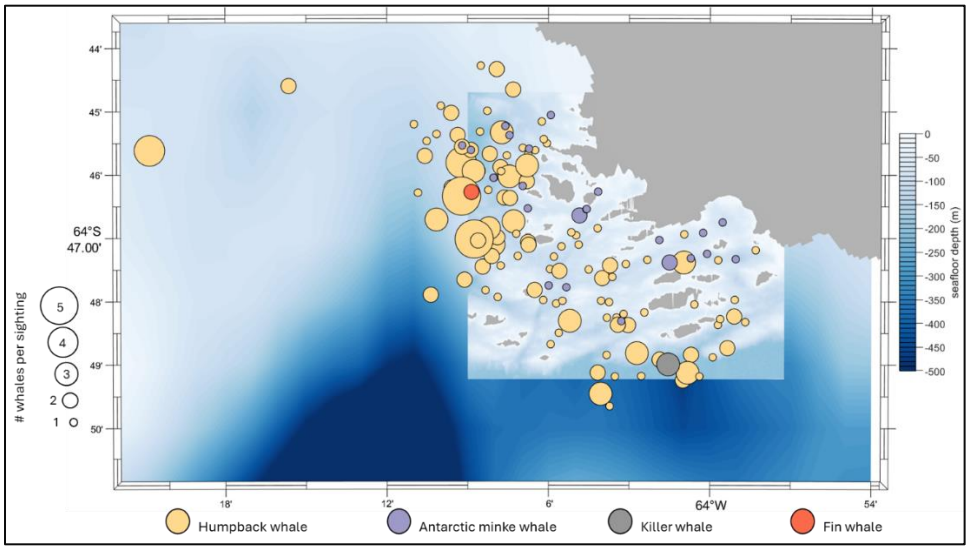

Figure 10- Map of February 2025 cetacean sightings by species and group size. *Figure credit: Mason Cole*

Figure 11- Biopsy of the mother fin whale on February 27th, 2025, in the Palmer Station local boating area. ACA-2025-019, NMFS Permit No. 27911, IACUC Frie2305dn. *Image credit Ricky Robins.*

We have noticed anecdotally that whale abundance and behavior seemed to vary as a function of time (e.g. a few days of plentiful whales, a few days without) and location (e.g. "hotspots" that move around the local area). We have not yet run statistical models to explain the variance of spatial patterns, but the occurrence of spatial hotspots appears evident in Fig. 9, for example. Temporal patterns in local boating area whale abundance appear evident as well (Fig. 12), with relative peaks in humpback whale abundance in early February and late February, with fewer sightings and less feeding in the interim.

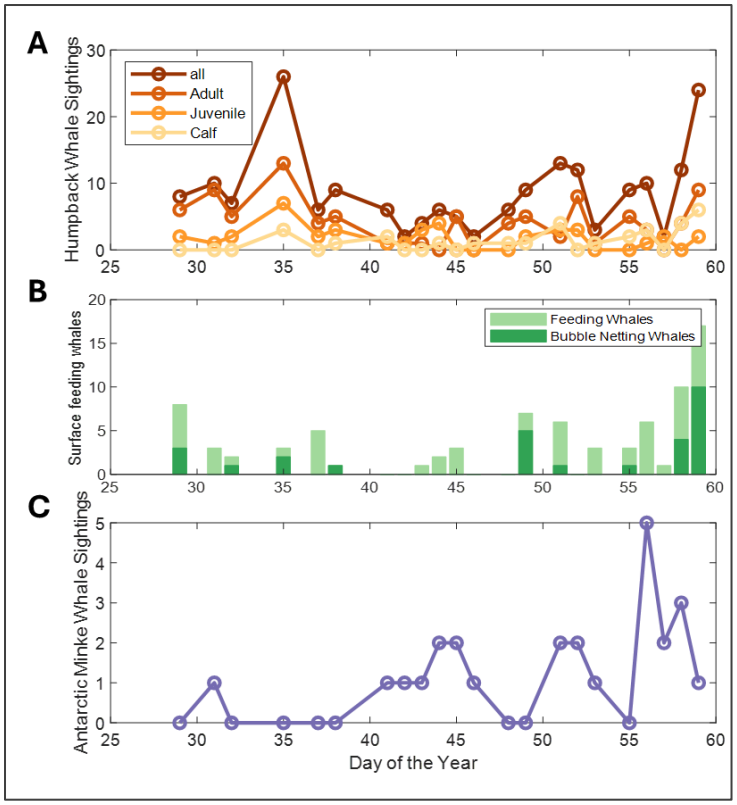

Figure 12- 2025 sighting phenology for (A, B) humpback and (C) minke whales. Humpback and minke whale abundance in the local boating area has been variable but seemingly with temporal autocorrelation, with similar patterns seen in humpback whale surface feeding observations (B)**.** *Figure credit: Mason Cole*

Photo-Identification

Photo-identification is done using the markings, scarring, and coloration on the fluke of the animal (Fig. 13). 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. There seems to be a slightly higher rate of resighting than in previous seasons, as 38 individuals were observed in multiple sightings. A few individuals were resighted less than two weeks after their initial observation. Generally, though, this matches our understanding from previous seasons that most humpback whales do not reside within the Palmer Station survey area for extended periods of time. This low residency time is also corroborated by our historic tag data that shows whales using extended spatial areas for feeding during summer months before moving inshore and decreasing their home range sizes towards the end of the feeding season. When individuals were resighted, it was sometimes in association with different individuals than the initial sighting. This is consistent with the fission-fusion social structure typical of baleen whales, which consists of short-term associations that switch frequently.

Figure 13- A humpback whale fluke photo-ID shot taken during our 2025 surveys, showing clear black and white identifying marks. *Image credit: Mason Cole.*

Biopsy Tissue Sampling

The biopsy samples (Fig. 14) 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, 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. This is done by comparison of haplotype frequencies with those collected from animals in Southern Hemisphere breeding grounds. Currently, we estimate that ~95% of the whales encountered around Palmer Station are from Breeding Stock G that winters on the west coast of Central and South America. Blubber samples are used for hormone and pollutant detection and analyses. 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 14- Biopsy dart with biopsy visible at the time of sample collection on a Humpback whale. ACA-2025-019, NMFS Permit No. 27911, IACUC Frie2305dn. *Image credit: Ricky Robbins.*

Acoustic Moorings

Since 2021, our group has maintained two submerged acoustic moorings around the local and distant Palmer area. Each mooring is equipped with an underwater acoustic recorder (hydrophone), a temperature logger, and an acoustic release. In December 2024, prior to our arrival, the C-013-P (Cimino) group recovered one mooring, which had been recording since March 2024. We downloaded those recovered data in February, and have prepared the recovered mooring for redeployment in early March. The hydrophones record 60% of the deployment duration and are capable of recording frequencies up to 48 kHz (96kHz sampling rate), well within the range of most vocalizations of humpback whales, minke whales, killer whales, and beaked whales. The goals of these recorders are to measure the acoustic landscape ('soundscape') of the local Palmer area and the greater Palmer canyon. This includes the sounds and vocalizations made by animals such as whales, seals, and birds, but can also include sounds of the abiotic system, including sea ice, storms and glacial calving. Additionally, these moorings will be recording any sources of anthropogenic noise, caused by ship traffic, construction, or sonar. These moorings will help establish the baseline acoustic environment of the Palmer area, and to help identify seasonal whale presence throughout the entire year, and how human disturbance and abiotic factors may influence that acoustic presence.

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 C-045-P (Van Mooy) lab arrived to Palmer Station in mid-January and spent the first week setting up the lab. By January 24th, Station E sampling began with the C-019-P (Schofield) group, who has been sampling since November. During each twice weekly 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 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 -80°C freezer. In addition to Station E samples, we are also collecting twice weekly pump house samples for our same standard parameters.

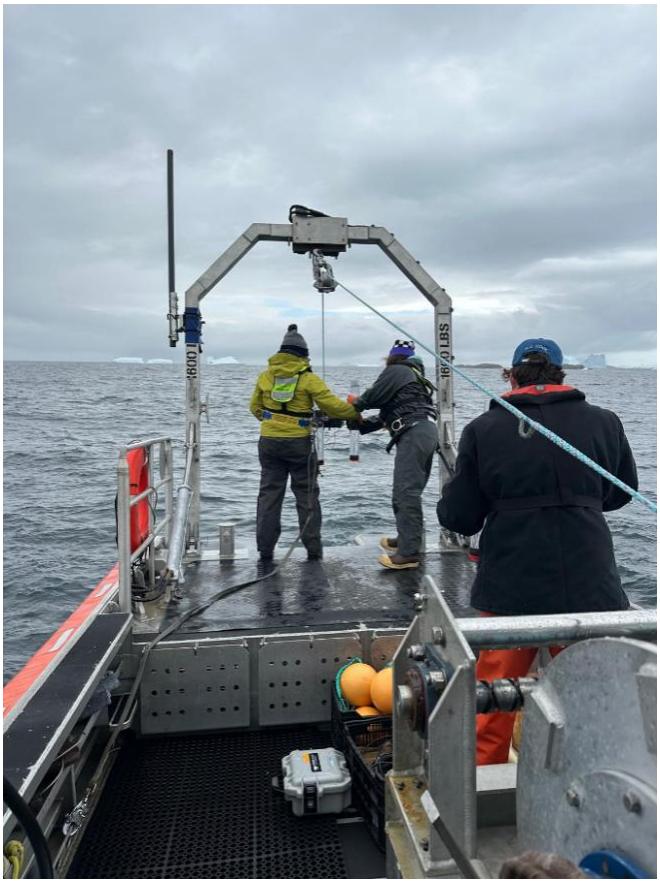

Figure 15: From left to right, Maya Thomas, Christina Rorres, and Benjamin Klempay recovering the sediment trap. *Image credit: Stephen Root*

In collaboration with the C-020-P (Steinberg) lab, we are continuing the particle interceptor trap (PIT) project that began last summer season. The PIT collects sinking particles which we filter for lipids, carbohydrates and POC. The C-020-P (Steinberg) group uses one of the four tubes for a gel trap as well as imaging the sediment from the three tubes of the C-045-P (Van Mooy) group. This month we successfully deployed and recovered two sediment traps at Station E. The first trap was deployed for about 28 hours at 123 meters. The second trap was deployed for about 149 hours at 112 meters. We were originally hoping to keep this trap out for only 72 hours, but an ice berg settled right above the trap which delayed recovery. We hope to deploy one sediment trap per week for the rest of the season.

Thank you to our Station Lab Manager (Hannah James) and Instrument Technician (Danny Tropper) for ensuring a smooth transition to Palmer Station. A big thanks as well to the Boat House personnel (Barb Krasinski, David Goldman, and Matt Gosselin) for keeping science on RHIB *Hadar* running efficiently.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
February 2025
Ben Rosen-Filardo

A late-summer snowfall blankets Palmer Station before melting in the afternoon sun, February 10, 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).

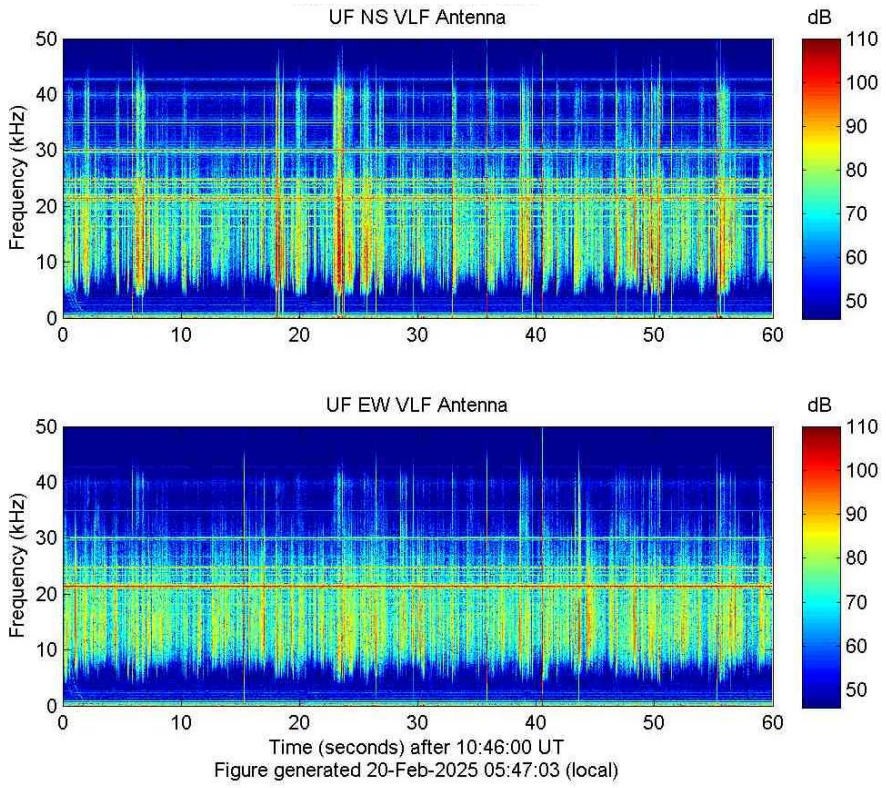

Figure 16. Real-Time broadband VLF and ELF Spectrogram from Palmer Station, Antarctica.

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. The spectrograms were reviewed daily and bi-weekly antenna inspections were done as weather allowed.

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.

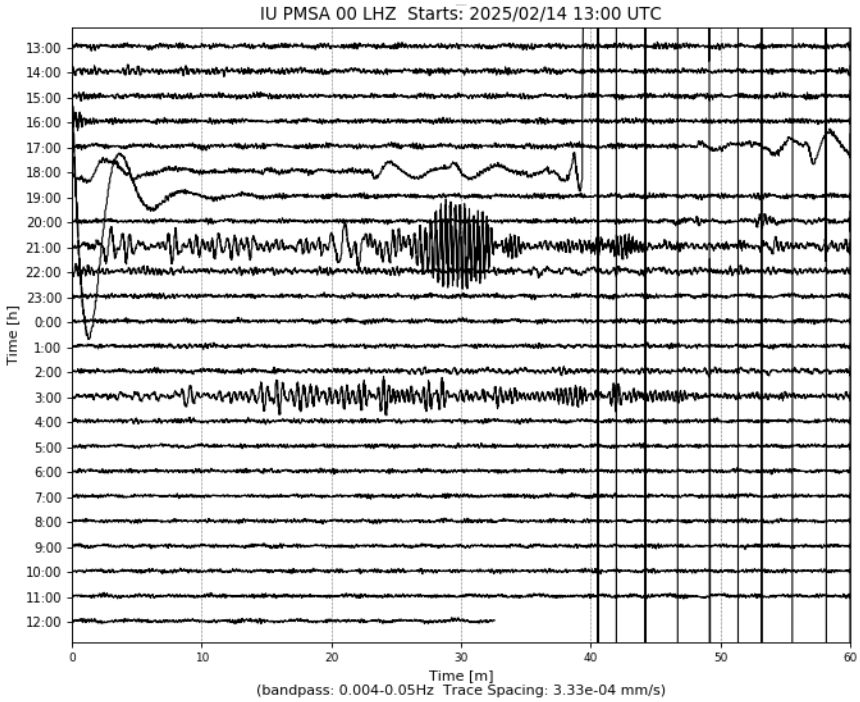

Figure 17. A February 14th magnitude 6.0 earthquake in Ethiopia, as recorded from the Palmer seismic station. No injuries or damage reported. The very high amplitude signal shortly before the earthquake was caused by pulling vacuum on the STS-1 bell jars.

Figure 18. Pulling vacuum on the STS-1 north-south seismometer bell jar, February 14th, 2025.
Image credit: Ben Rosen-Filardo

The system performed normally during the month. The time stamp and seismic activity found on the Heliplot was checked daily. This month, ASL noticed low vacuum levels in the STS-1 seismometer bell jars. On February 14, vacuum was pulled on the all three bell jars to restore appropriate levels. 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.

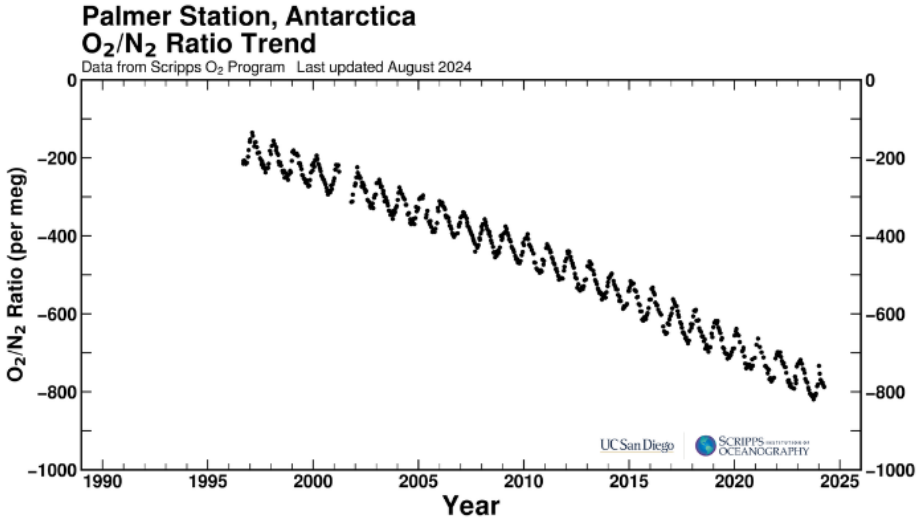

Figure 19. Historical plot of $\mathbf{O_2/N_2}$ ratio per meg and $\mathbf{CO_2}$ ppm, updated August 2024.

Air samples were collected on February 15th. 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 February 1st, 7th, 15th, 20th, and 28th during favorable wind conditions. More information and data for the Carbon Cycle group can be found at: https://gml.noaa.gov/ccgg/.

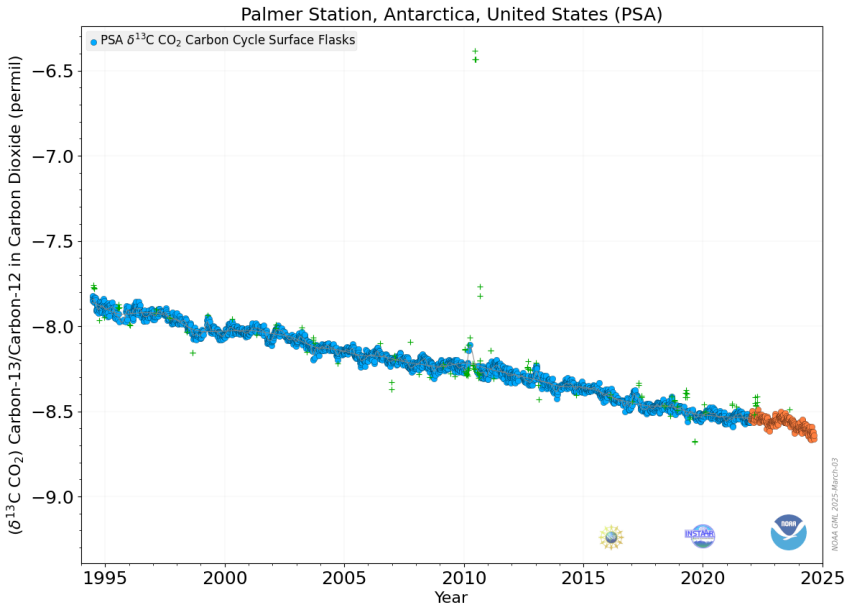

Figure 20. Carbon-13/Carbon-12 in Carbon Dioxide (δ13C-CO2) levels at Palmer Station dating back to 1994. Orange dots are preliminary data and green pluses are poorly mixed air masses, which should not indicate background conditions.

HATS samples were collected on February 15th 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/

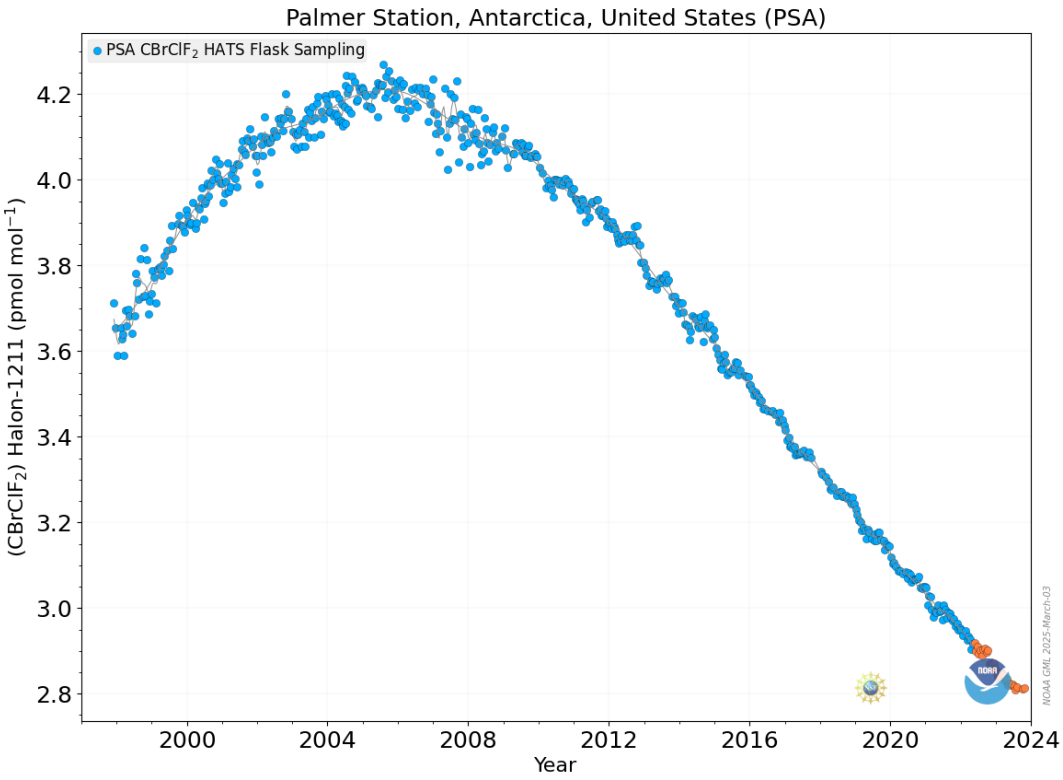

Figure 21. Halon-1211 ($CBrClF_2$) levels dating back to 1997, one of the Halocarbon and Trace Gases measured at Palmer Station. Orange dots are preliminary data.

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.

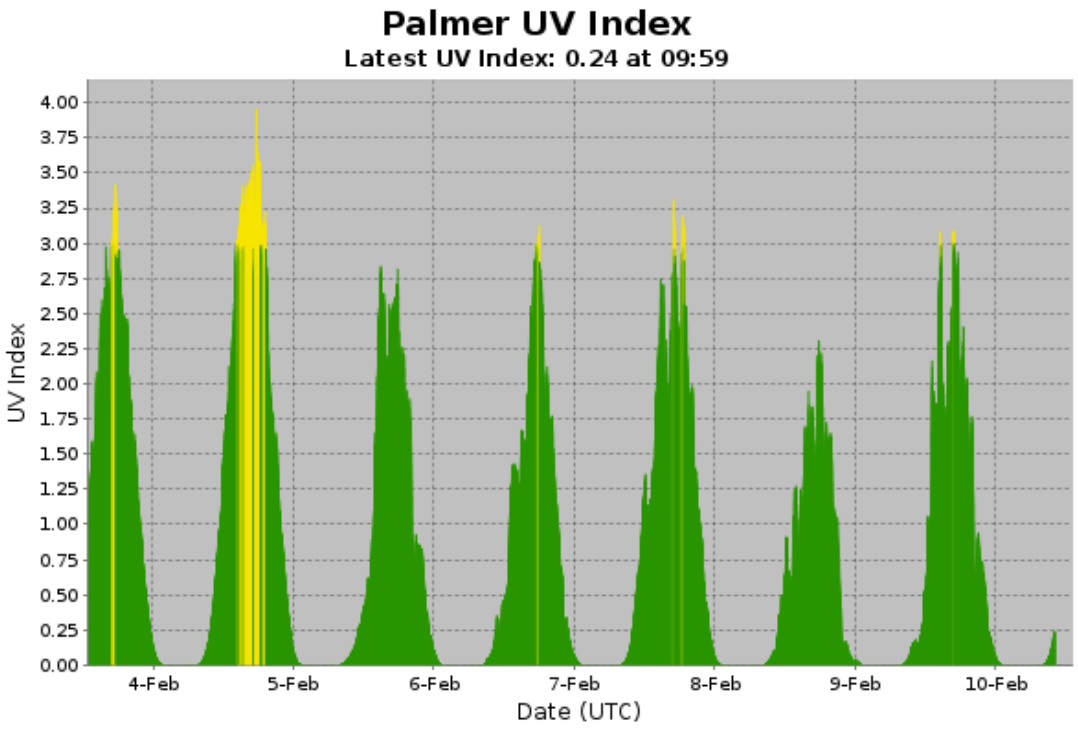

Figure 22. UV index generated from the GUV-511 radiometer in real time.

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 February 12th and 27th 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.

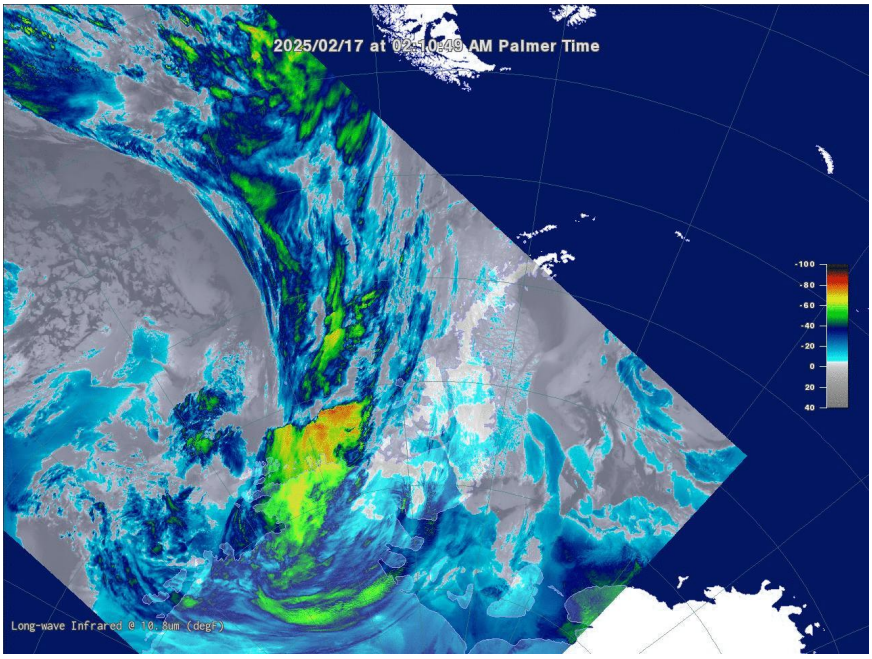

Figure 23. MetOp-3 February 17th satellite pass.

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 NBP25-02, in May. 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. Troubleshooting is ongoing to identify the source of unexpected noise in the data. The amount of filter material was checked as needed. Daily filters were processed on February 6th, 10th, 18th, and 21st. 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).

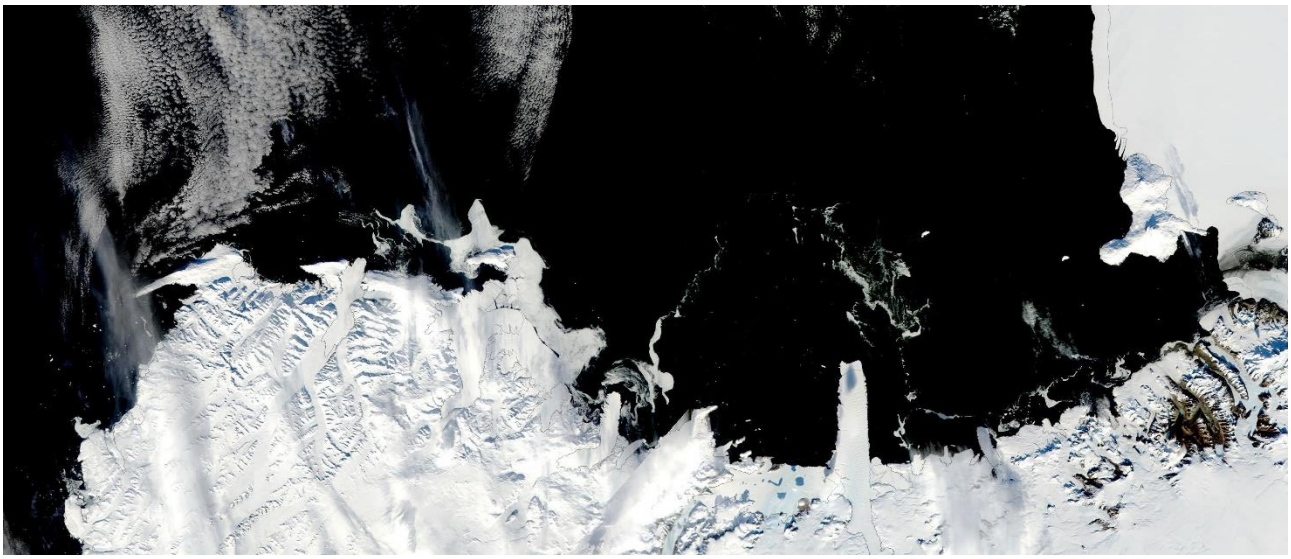

Figure 24. February 17th satellite imagery of the Drygalski Ice Tongue area, where NBP25-01 is operating until April. Source: NASA/MODIS Aqua

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 three AWSs were visited this month. On February 7th, the Research Associate returned to AWS #1 to install the spare DCP. The station is now fully operational. On February 11th, the RA visited AWS #3 to tighten a loose battery terminal. Lastly, on February 26th, the loose connectors at AWS #2 were re-sealed in preparation for another winter. AWS #2, located on Howard Island

in the Joubin Islands group, has been inoperative since February 2024 due to radio communication issues. Troubleshooting with the manufacturer, Mesotech, is ongoing.

One-minute weather data is archived on the AMRDC website: https://amrdcdata.ssec.wisc.edu/dataset?q=Palmer+Station.

Figure 25. A sunny day at AWS #3 on Island #412 in the Gosslers island group, February 11th, 2025.
Image credit: Ben Rosen-Filardo

Palmer Monthly Met summary for February, 2025

Conditions this month continued to be calm and dry, which made for ample outdoor recreation opportunities. With only 20.6 mm of melted precipitation, 2025 saw the driest February on record (1990-present). It was also less windy than average. There were only 5 days with 30 knot gusts or higher, compared to the February average of 10 days (2010-present). This follows a trend of decreasingly frequent high wind events over the last four years.

Lastly, February saw cooler than usual air temperatures, with a monthly average of 1.0 °C, high of 5.5 °C, and low of -3.5 °C, compared to historical February averages of 1.9 °C, 7.8 °C, and -2.1 °C, respectively (1990-present).

Temperature
Average: 1.0 °C / 33.8 °F
Maximum: 5.5 °C / 41.9 °F on 23 Feb 17:34
Minimum: -3.5 °C / 25.7 °F on 28 Feb 02:10
Air Pressure
Average: 981 mb
Maximum: 997.2 mb on 16 Feb 23:39
Minimum: 943 mb on 19 Feb 17:17
Wind
Average: 6.9 knots / 8 mph
Peak (5 Sec Gust): 45 knots / 51 mph on 19 Feb 13:16 from SE (134 deg)
Prevailing Direction for Month: SE
Surface
Total Melted Precipitation: 20.6 mm / 0.81 in
Total Snowfall: 15 cm / 5.9 in
Greatest Depth at Snow Stake: 12.8 cm / 5 in
WMO Sea Ice Observation: 11-20 bergs, bergy bits, growlers, brash ice
Average Sea Surface Temperature: 1.32 °C / 34.4 °F

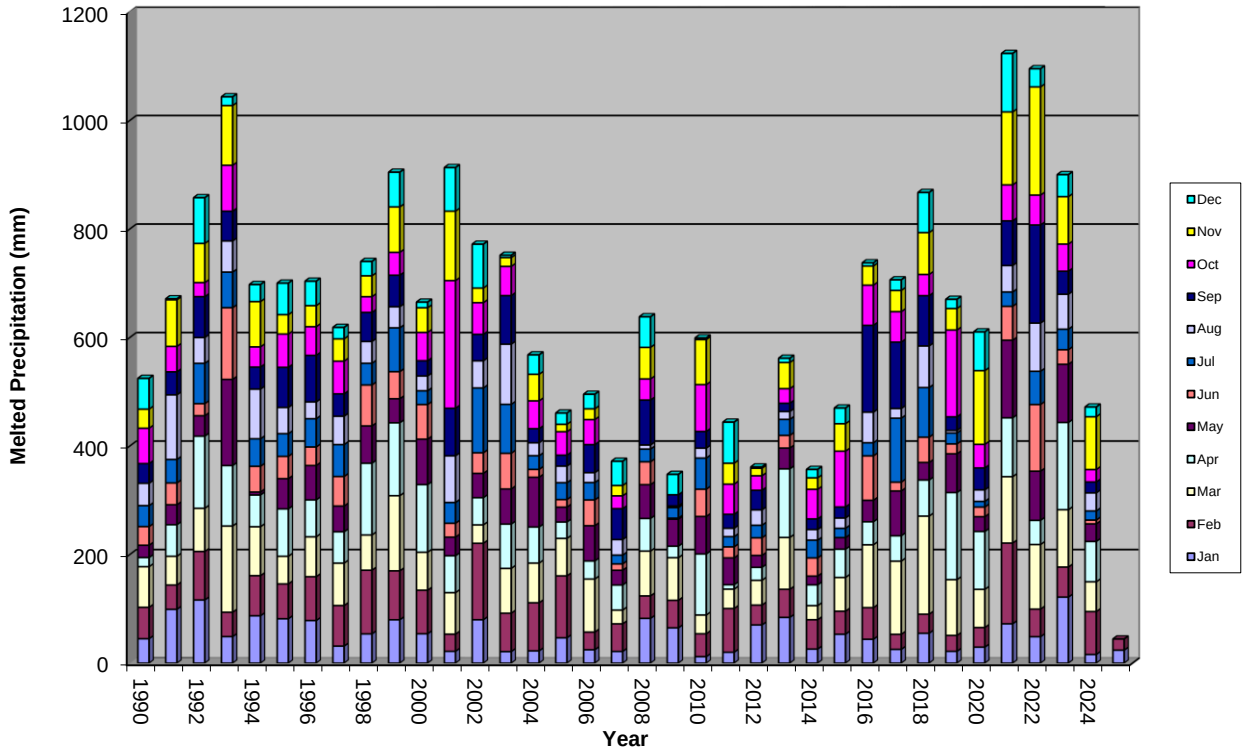

Figure 26. Palmer Station melted precipitation, 1990-present.

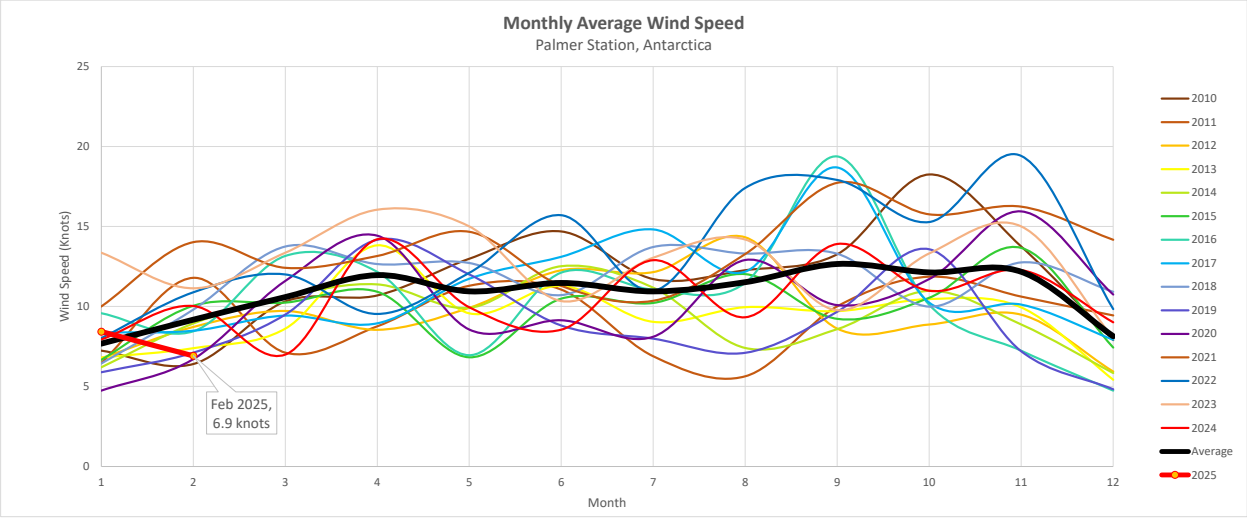

Figure 27. Palmer Station monthly average wind speed, 2010-present.

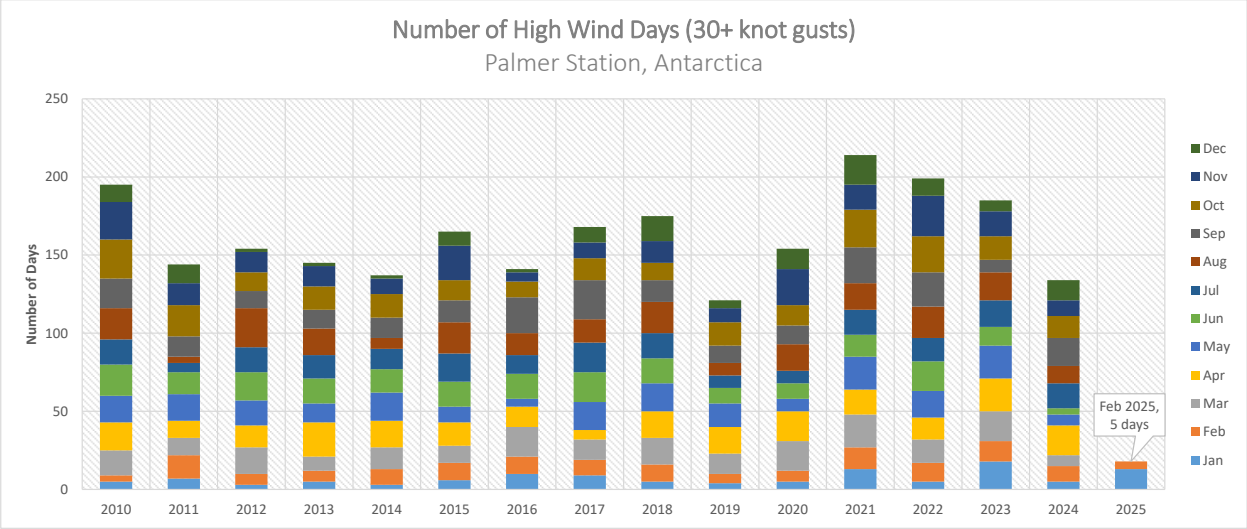

Figure 28. Number of high wind days (gusting 30+ knots) at Palmer Station, 2010-present.

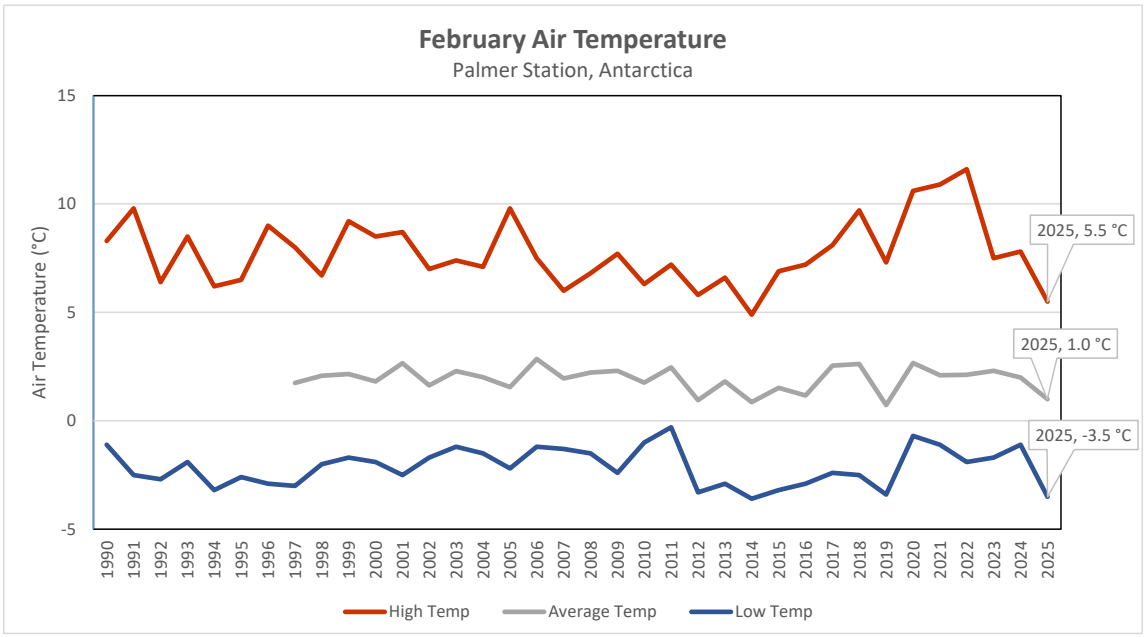

Figure 29. Palmer Station February air temperature, 1990-present.