PALMER STATION MONTHLY SCIENCE REPORT

JANUARY 2021

Research Associate Marissa Goerke services the G-094-P (Beilman) microclimate station on Amsler Island on 23 January 2021. These stations measure weather conditions, solar irradiation, and soil temperature, and include infrared sensors and a time lapse camera. This system is part of a larger study to utilize late Holocene peat deposits as proxies to reconstruct ecosystem and climactic changes in coastal areas on the western Antarctic Peninsula. *Image Credit: Randy Jones*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

Following the departure of the ARSV *Laurence M. Gould* on Christmas Eve, the Station population decreased to 24 people, and January brought on the peak of the summer season. The weather was warmer, windier, and wetter than historical January data (see Meteorological section). This included a 24 hour period where more rain fell than the average rainfall for the month of January. Nevertheless, there were periods of sunnier weather during the first half of the month and a few periods of sun in the second half of the month.

This anomalous weather pattern resulted in increased water column mixing due to the number of wind events throughout the month of January. This appears to have affected water column stratification and resulted in lower chlorophyll concentrations as measured by the instrumented flowing seawater system in the Aquarium Room. Chlorophyll blooms have been limited and lower in magnitude than an average season. The system measured an early season phytoplankton bloom in November 2020 (up to 5µg L^{-1}), and a second brief bloom up to 5µg L^{-1} in the first week of this month. Otherwise, chlorophyll levels have remained between 1.0 and 2.5µg L^{-1}.

C-013-P and C-024-P: PALMER, ANTARCTICA LONG TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – APEX PREDATOR COMPONENT

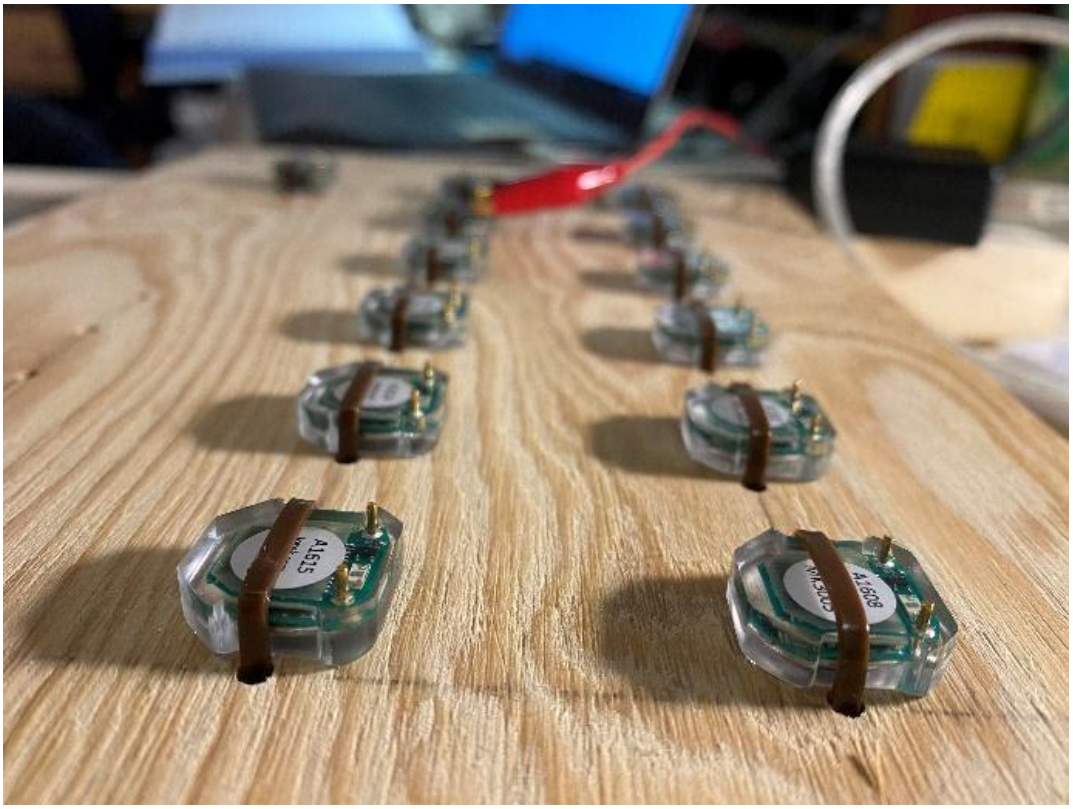
Personnel on station: Darren Roberts and Megan Roberts

High winds and precipitation made field work slightly more difficult at the beginning of the month, but thankfully we were able to conduct boating field work on 25 days in January. Monitoring of Adélie, gentoo, and chinstrap penguin breeding chronology continued this month with indicator colony counts as well as an all-colony chick census on local islands as well as on Dream Island and Biscoe Point. Adélie chick measurements also were conducted locally. Foraging ecology studies of Adélie and gentoo penguins continued with the deployment of presence/absence radio transmitters, GPS tags, and dive depth recorders at Torgersen Island, Humble Island, and Biscoe Point. We began diet sampling Adélie penguins on Torgersen Island and gentoo penguins on Biscoe Point. In total we were able to deploy a total of 42 tag packages on penguins. Fourteen of those were radio transmitters that are a part of our presence absence study.

Gentoo penguin chick census at Biscoe Point. *Image Credit: Cimino group*

Skua work continued this month documenting hatches and monitoring chick growth of brown skuas on local islands as well as on Dream, and at Biscoe. South polar skua nesting was also documented on Shortcut Island. Monitoring of the blue-eyed shag colony on Cormorant Island also continued this month. In January, we maintained GPS tagging effort on giant petrels and continued our local island giant petrel census and banding project that was initiated in December. Additionally we deployed 12 GLS tags (global location sensor) on giant petrels. This will help us track their movements over the winter. Our annual Humble Island giant petrel study began in January, which closely records petrel chick survival and growth from hatching through fledging.

Brown skua chick at Humble Island. *Image credit: Cimino group*



GLS tags being calibrated for giant petrel deployment. *Image Credit: Cimino group*

A very tired, newly-hatched giant petrel chick at Humble Island. *Image Credit: Cimino group*

Monitoring of marine mammals continued in January with increasing numbers of molting elephant seals, as well as an increase of Antarctic fur seals to the Palmer area. We also observed humpback and minke whales. Lab work this month was dominated by penguin diet sample processing.

Our whaling efforts continued collecting more Humpback whale biopsies for the C-024 group.

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

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

Personnel on station: Rachael Young

January was an incredibly productive and collaborative month for the Schofield lab. Once per week, Station E was sampled with a CTD rosette and a C-OPS radiometer to capture the physical parameters in the water column. The CTD data in Figure 1 displays a relatively well-mixed water column persisting throughout January. On 8 January, there was a slight increase in fluorescence to around 1.5 mg m^{-3} between 10 and 20 meters. Similarly, the chlorophyll data shows a small chlorophyll bloom on 8 January increasing to 4.3 µg L^{-1} (Fig. 2).

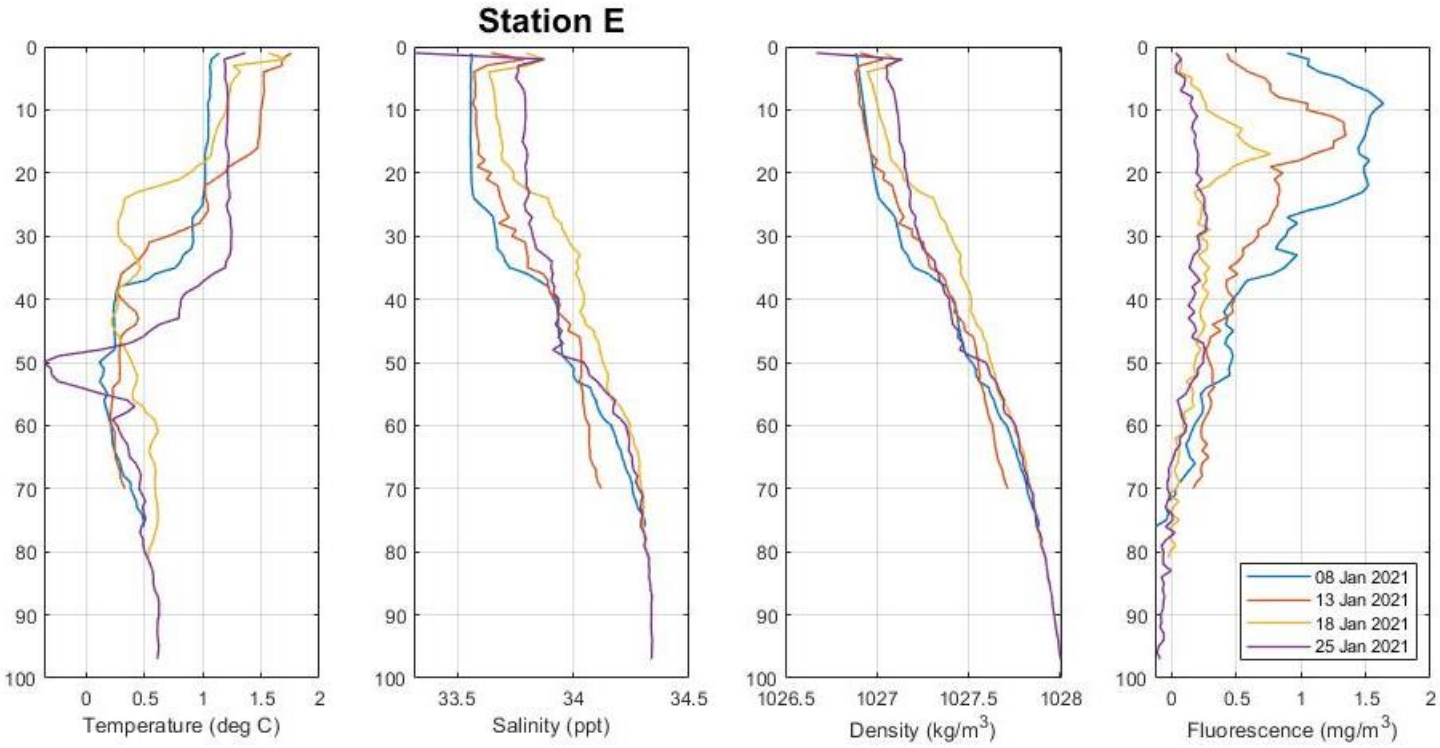


Fig. 1 – CTD profile data at LTER Station E on 8, 13, 18, and 25 January 2021. Temperature, salinity, density, and fluorescence show a relatively well-mixed water column.

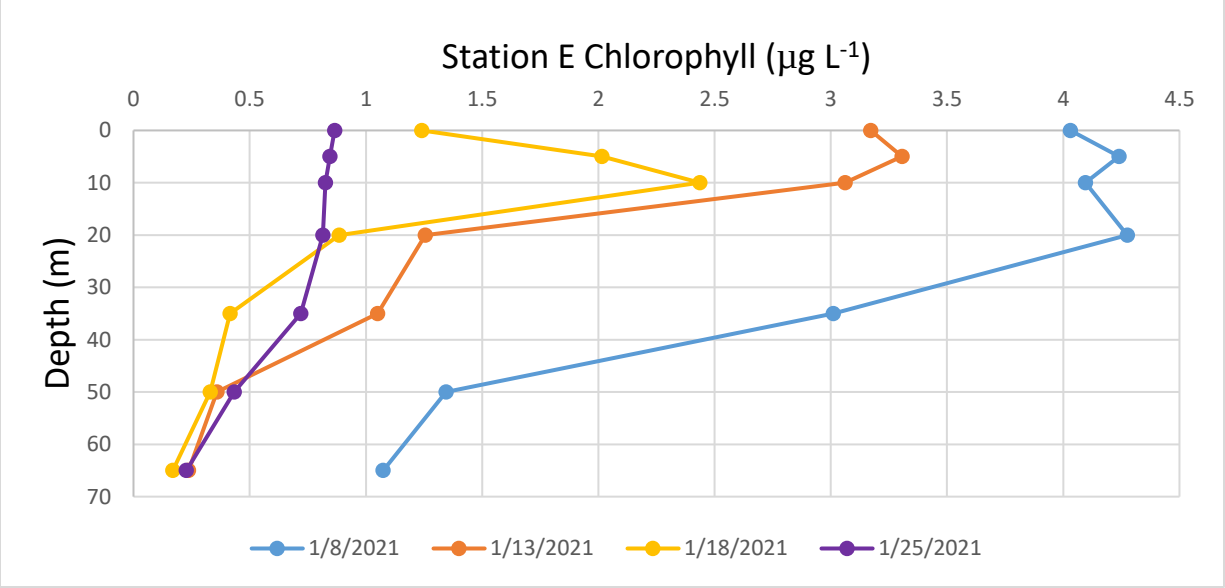


Fig. 2 – LTER Station E chlorophyll data on 8, 13, 18, and 25 January. There was a slight bloom in the first 20m on 8 January.

As a part of a collaborative effort with the other LTER science groups, three transects were performed in the Palmer Canyon region (Fig. 3A, magenta line), and two transects were performed in the Biscoe Point region (Fig. 3A, green line). To ground truth the EK80 acoustic echosounder data, the first net tows of the season were performed on 19 January. A total of eight net tows were performed in both regions with a $1m^2$ metro net. The dominant zooplankton species were *Euphausia superba* and *Thysanoessa macura* (Fig. 3B). Compared to last season, the zooplankton community composition was less diverse and contained zero salps.

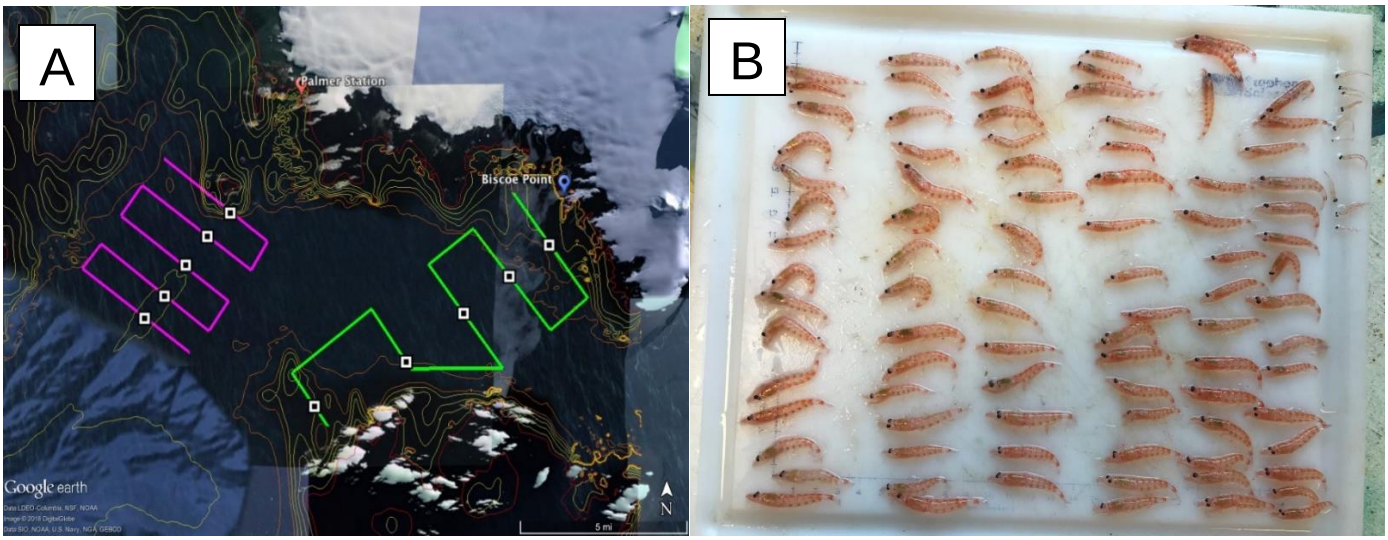


Fig. 3 – (A) Acoustic survey transect lines across Palmer Canyon (magenta line) and Bismarck Strait (green line). (B) *Euphausia superba* and *Thysanoesaa macura* (smaller species in upper right hand corner) prepared for standard length measurements, frequencies, and biovolumes.

The Schofield and Van Mooy labs combined forces to complete a 24-hour time series sampling every four hours from the seawater intake. With support from both science and ASC staff, additional operations were achieved including weather and B-005-N/P (Kohut) CODAR station maintenance at the Wauwermans Islands and a successful retrieval of the B-005-N/P (Kohut) Long Range mooring (Fig. 4).

Fig. 4 – A successful Long Range mooring retrieval via RHIB *Rigil*. Crew from left to right: Marine Technician Ken Block, Daniel Lowenstein, Rachael Young, and Marine Technician Mike Burns.

As always, we are tremendously thankful for ASC staff and everyone here at station for their support. A huge shout out goes to our Lab Supervisor, Randy Jones, as well as our Marine Technicians, Ken Block and Mike Burns, for facilitating an awesome start to the season!

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

Personnel on station: Daniel Lowenstein

January was a great month for collaborative research at Palmer Station. After encountering engine trouble on RHIB *Hadar*, the Marine Techs shifted the EK80 acoustic echosounder and oceanographic winch from *Hadar* to RHIB *Rigil*. This has enabled us to fill our docket with interdisciplinary sampling through the rest of the month, accomplishing many of the goals of the LTER and across Palmer's scientific community.

Since RHIB Rigil was brought online, Rachael Young (C-019-P) and I have been able to continue the LTER water column sampling at Station E via CTD each week. Our preliminary flow cytometry results show a distinct population decrease of the primary producer community in the upper water column, possibly due to shortening hours of daylight; as these phytoplankton dissipate, the dependent heterotrophic bacterial community has also decreased (Fig. 5). We expect to see this trend continue as daylight hours continue to decline.

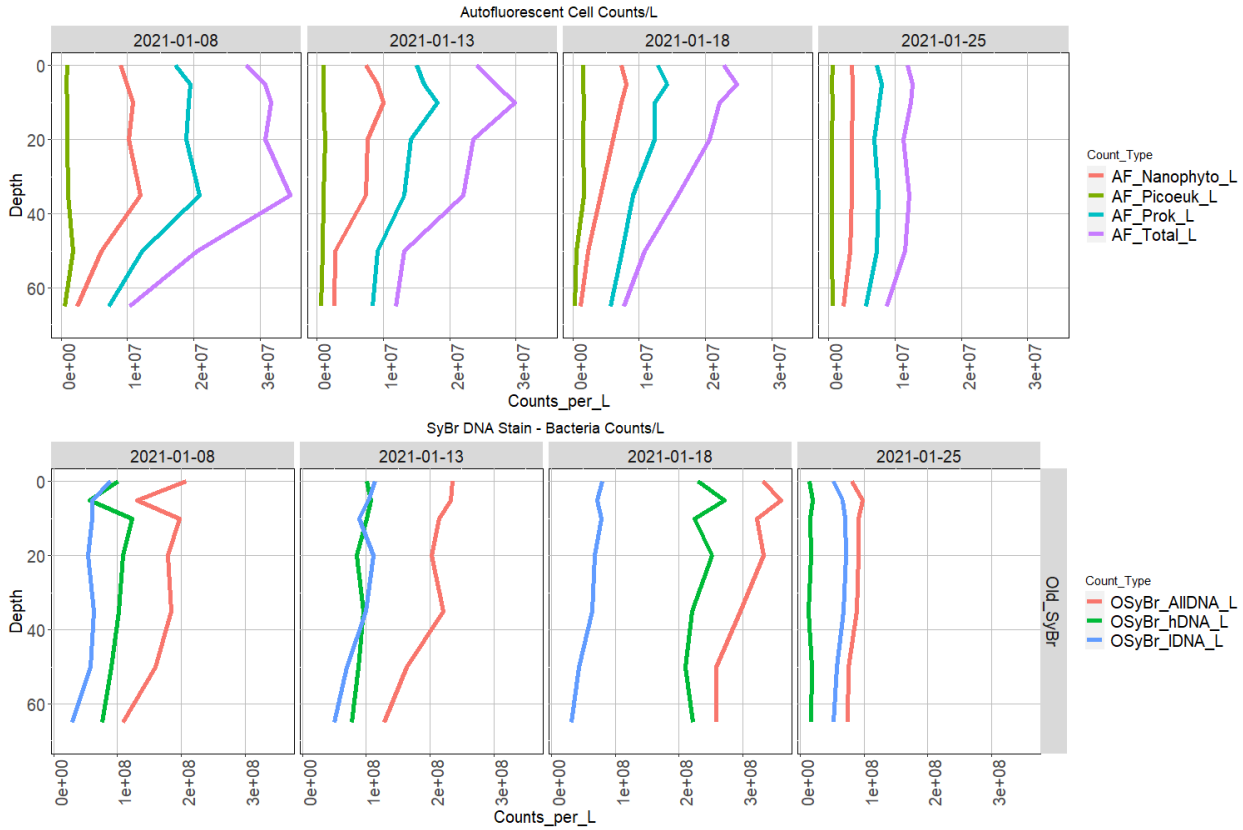


Fig. 5 – Autofluorescent microalgal (nanophytoplankton, picoeukaryotes, and prokaryotes in cells L^{-1}; upper panel) and heterotrophic bacterial cell counts using SyBr DNA stain (All DNA, "hDNA" high DNA, "lDNA" low DNA in cells L^{-1}; lower panel) from LTER Station E CTD sampling in January 2021.

In the last ten days, we have begun pairing daily sampling with C-019-P (Schofield) long-running Imaging FlowCytobot (IFCB) time series, which identifies microalgae species in Arthur Harbor. This sampling regimen includes all of C-045-P (Van Mooy) standard water column

methods: lipid and carbohydrate filtration, flow cytometry, macronutrients, and particulate carbon samples. At such a high resolution (i.e., sampling frequency), these parameters will enable us to perform computational network analyses to separate individual species contributions to macronutrient and elemental reservoirs in the regional microbial community, which will give us a better understanding of how the region's ocean chemistry changes throughout the summer season (Fig. 6).

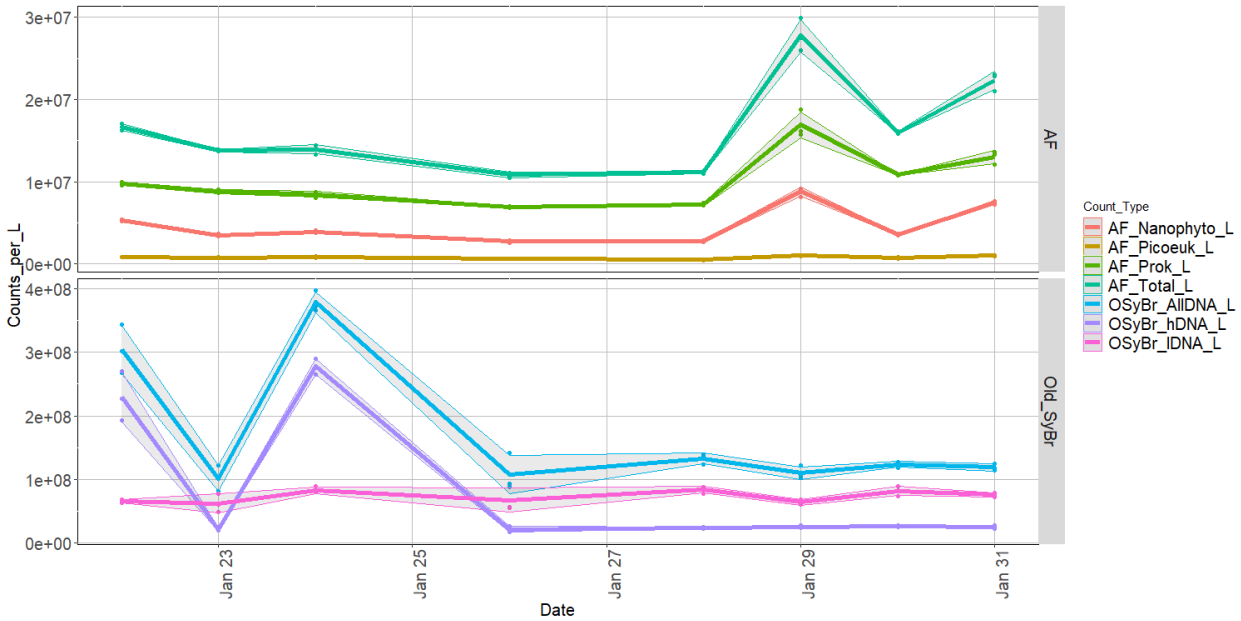


Fig. 6 – Autofluorescent (AF) and bacterial (SyBr DNA stained) cell counts (cells L^{-1}) in daily samples collected from Arthur Harbor between 22 through 31 January 2021.

We have run one more 24-hour time series from seawater collected at the Palmer Pumphouse, and plan another incubation in early February to investigate light controls on primary production and pigmentation.

We have also been able to assist in several collaborative research objectives both within and apart from the LTER. For the Steinberg group (C-020-P), we deployed a $1m^2$ metro net in tandem with the EK80 acoustic echosounder to sample the Adélie and Gentoo survey transects for krill, followed by body length measurements from each net tow sample. We saved krill from different size classes from each net tow in tandem with penguin diet sampling by Megan and Darren Roberts (C-013-P), who collected krill from every size class as well as penguin fecal samples. These samples will give us information about penguin prey quality relative to average krill quality, as well as enabling us calculate how efficiently penguins extract chemical energy from their diet. We have also performed bi-weekly transects in collaboration with the Steinberg lab, collecting acoustic datasets with the EK80 for krill biomass estimates.

Finally, we assisted the Marine Technicians in recovering an underwater mooring deployed last year by Project SWARM (B-005-N/P), and have acted as support crew for a trip to the Wauwermans Islands to repair a Project SWARM CODAR station and Palmer's automated weather station.

Returning from a successful trip to the Wauwermans. *Image Credit: Van Mooy group*

We would like to thank all of the Palmer personnel for their support, and especially thank Lab Supervisor Randy Jones; and Marine Technicians Ken Block and Mike Burns, without whom we could not do our research safely and effectively.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT
January 2021
Marissa Goerke

A-111-P: THE NEXT GENERATION OF GEOSPACE RESEARCH FACILITIES AT PALMER STATION: ELF/VLF RADIO WAVE OBSERVATIONS

Dr. Andrew Gerrard, Principal Investigator, New Jersey Institute of Technology

Extremely Low Frequency/Very Low Frequency (ELF/VLF) radio wave observations at Palmer Station (Fig. 7) 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.

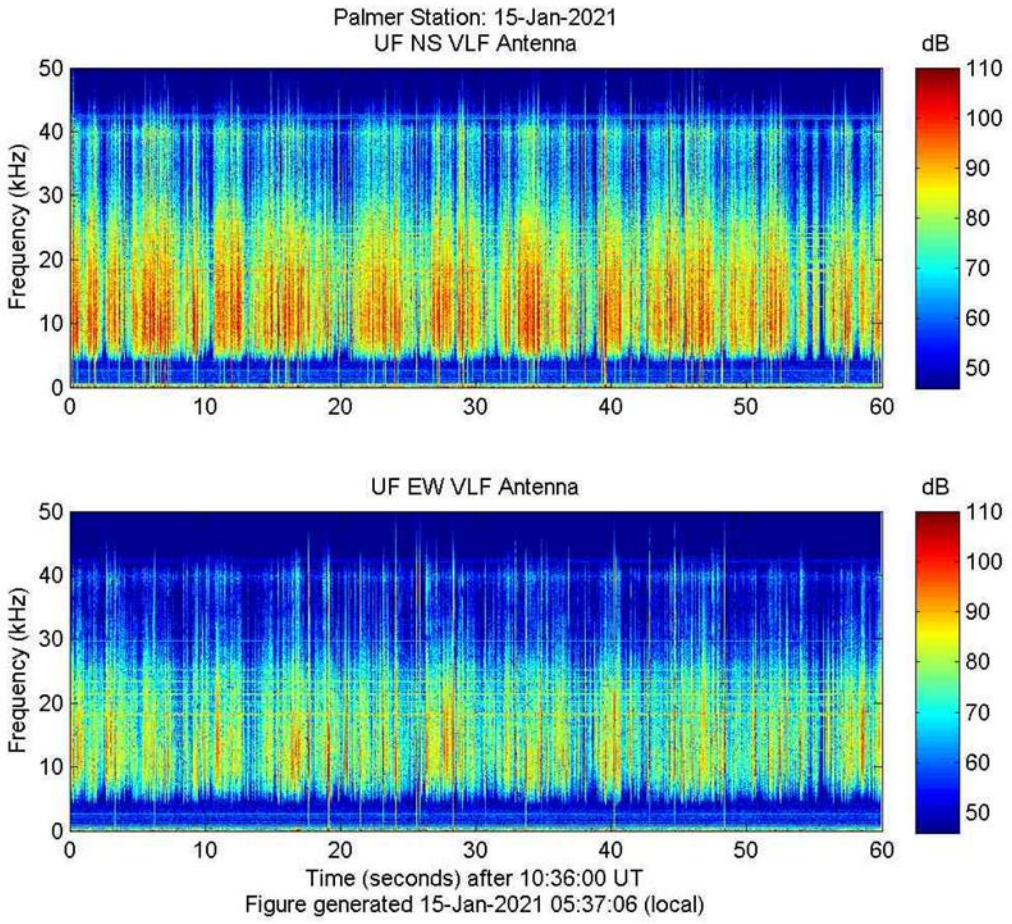


Fig. 7 – Real-time broadband ELF/VLF spectrogram from 15 January 2021. *Image Credit: University of Florida*

Both the Extremely Low Frequency and Very Low Frequency systems operated well this month. The spectrograms were reviewed daily and bi-weekly antennas inspections were done as weather allowed. Current VLF/ELF data from Palmer Station can be observed at:

http://halo.ece.ufl.edu/realtime_palmer_nb.php and
http://halo.ece.ufl.edu/realtime_palmer_bb.php.

A-111-P: THE NEXT GENERATION OF GEOSPACE RESEARCH FACILITIES AT PALMER STATION: SAMBA MAGNETOMETER
Dr. Andrew Gerrard, Principal Investigator, New Jersey Institute of Technology

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

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

The magnetometer was originally installed at Palmer in 2005, and a replacement installed in April of 2008. In 2017 the project was taken over by Andrew Gerrard. On 27 February 2017, USAP IT blocked all northbound VPN magnetometer traffic, as the magnetometer was determined to be a security vulnerability. The Research Associate has been working with the home institution at the University of California, Los Angeles to resolve this issue. As of 30 September 2020 at 0745 local (UTC−03:00), the magnetometer was removed from the network fully. The instrumentation and computer are still operational. Data will continue to be collected and stored locally. The RA is working with the IT department to send out the data to UCLA. More information can be found at: http://magnetometers.bc.edu/index.php/palmer.

B-005-P: COASTAL OCEAN DYNAMICS APPLICATIONS RADAR (CODAR)
Dr. Josh Kohut, Principal Investigator, Rutgers University, Institute for Marine and Coastal Sciences; Dr. William R. Fraser, Co-PI, Polar Oceans Research Group; Dr. Kim Bernard, Co-PI, Oregon State University; Dr. Harper Simmons, Co-PI, University of Alaska, Fairbanks; Dr. Matthew Oliver, Co-PI, University of Delaware; Dr. John Klinck, Co-PI, Old Dominion University

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

The system was not operational this month and last month. The computers at the Wauwermans and Joubin sites are not sending data. Site visits have been requested by the Principal Investigator to troubleshoot possible problems. The Wauwermans site was visited and the inverter was found to be not providing power to the computer that runs the CODAR system. Three of the four wind turbines were not in operational condition, but this should not prevent the station from functioning. The inverter was brought back to Palmer and was repaired by the Electrician. The Wauwermans site remains down; a second trip will be necessary to replace the inverter and continue with troubleshooting the system. The hard drive at the Wauwermans site was swapped. A visit to the Joubin site was attempted, but was aborted due to rough sea state. Data will be available in the future at: https://marine.rutgers.edu/~codaradm/.

Wauwermans CODAR site on 27 January 2021. *Image Credit: Marissa Goerke*

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

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

A standard seismic station consists of three seismometers oriented to detect ground motion along three mutually perpendicular lines. Most of the time the directions chosen are north-south, east-west, and up-down. The seismometers in the Palmer Station installation are “forced balanced” instruments, which means that they work by keeping an inertial mass stationary with respect to

the instrument (and the earth). When a seismic wave arrives, the ground moves, carrying along the housing of the seismometer. The inertial mass tends to remain stationary and not move with the instrument, but it is electronically "forced" to travel along with the instrument (and the earth). The amount of "force" necessary to make it move with the rest of the instrument is proportional to the ground acceleration and is recorded as the raw data from the seismometer.

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

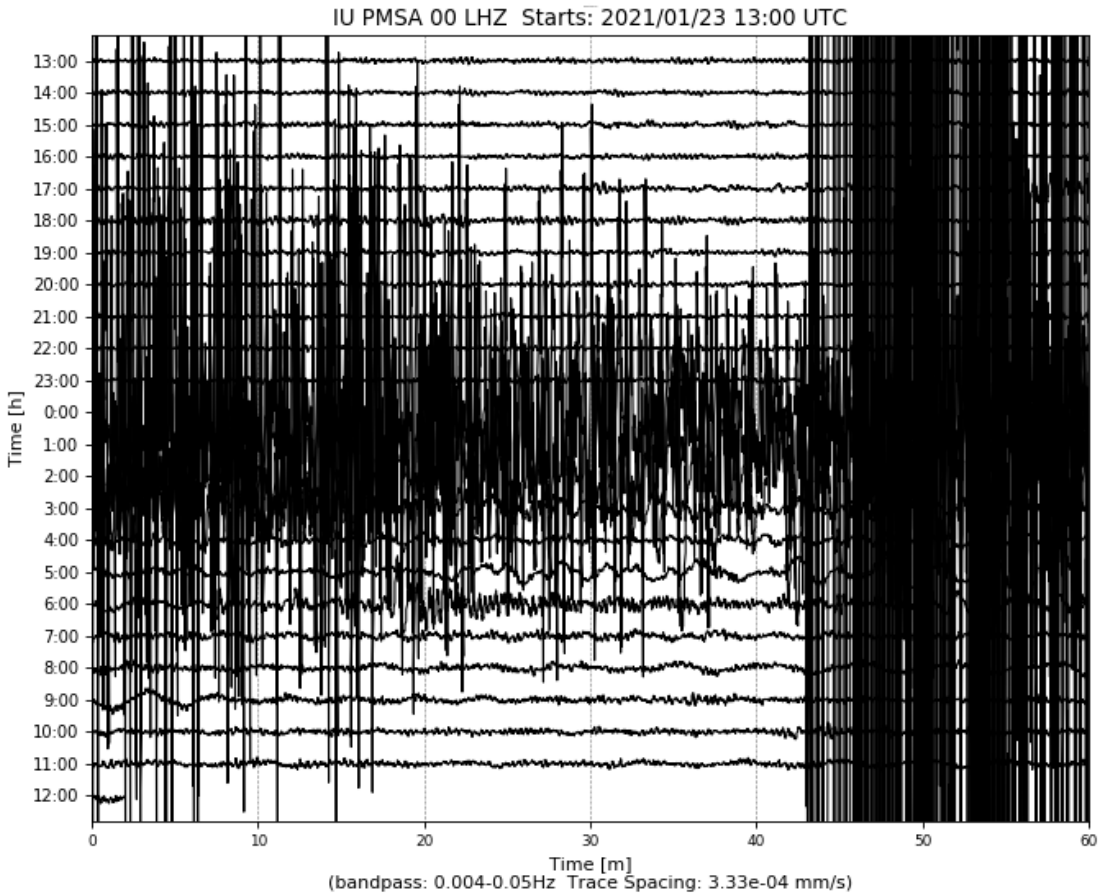


Fig. 8 – A 7.0 magnitude earthquake near the South Shetland Islands 24 January 2021. *Image Credit: NASA Earthquake Hazards Program*

The system operated consistently throughout the month. The time stamp and seismic activity found on the heliplot was checked daily; see example in Figure 8. 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
Dr. Ralph Keeling, Principal Investigator, Scripps Institution of Oceanography

The goal of this project is to resolve seasonal and inter-annual variations in atmospheric O_2 (detected through changes in O_2/N_2 ratio), which can help to determine rates of marine biological productivity and ocean mixing as well as terrestrial and oceanic distribution of the global anthropogenic CO_2 sink. The program involves air sampling at a network of sites in both the Northern and Southern Hemispheres.

The Scripps Institution of Oceanography flask sampling project analyzes air samples to assess variations in the atmospheric oxygen content caused by exchanges of O_2 between the atmosphere and the southern ocean. The oceans tend to be a source of oxygen to the air in the spring and summer, and a sink for oxygen in the fall and winter. The spring emissions are mostly due to photosynthesis in the water, while the winter uptake is due to mixing process, which bring oxygen depleted waters from depth up to the surface. These exchanges lead to variations in the oxygen content of the air above the water, and these changes are rapidly mixed around the latitude band by zonal winds. Measurements of the seasonal variations in oxygen content at Palmer and other sites may be valuable for documenting changes in the biological productivity of the southern oceans over time (Fig. 9).

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. Due to a low flask inventory, the RA has been instructed by the Principal Investigator to only sample once a month starting this month.

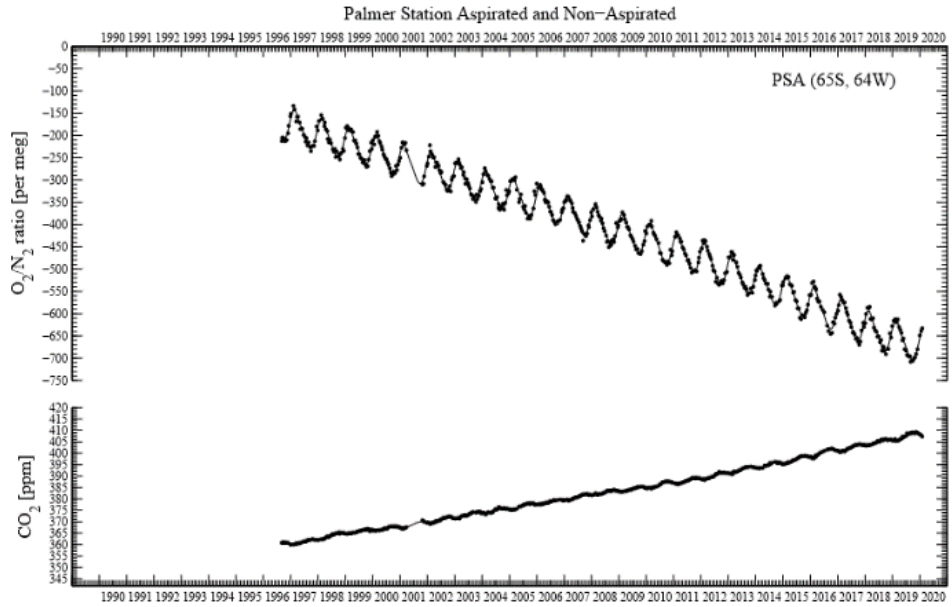


Fig. 9 – Historical plot of O_2/N_2 ratio per meg and CO_2 ppm updated on 29 July 2020. *Image Credit: UCSD Scripp's O_2 Program*

Air samples were collected on 16 January at 0558 local (UTC−03:00). Wind conditions must equal or exceed 5 knots from a direction between 5° to 205° constantly for over an hour with no

interference from human traffic on foot or in vessels. Due to a low flask inventory, the grantee has asked for a single sample on or near the 15th of each month, beginning this month and continuing until cargo can be shipped more often than twice a year. These air samples will be shipped to Scripps Institution of Oceanography in California for analysis. More information and data can be found at: https://scrippso2.ucsd.edu/osub2sub-data.html.

This data was shared with the onsite LTER grantees because it has interesting collaboration potential.

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

Dr. James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division
Mr. Don Neff, and Dr. Steve Montzka, National Oceanic and Atmospheric Administration / Global Monitoring Division

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 (Figs. 10 and 11). 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 1 January at 0923 local time, 7 January at 1154 local time, 13 January at 0746 local time, 19 January at 0746 local time, and 26 January at 0842 (all UTC−03:00) during favorable wind conditions. This data was shared with the onsite LTER grantees because it has interesting collaboration potential. More information and data for the Carbon Cycle group can be found at: https://www.esrl.noaa.gov/gmd/ccgg/trends/.

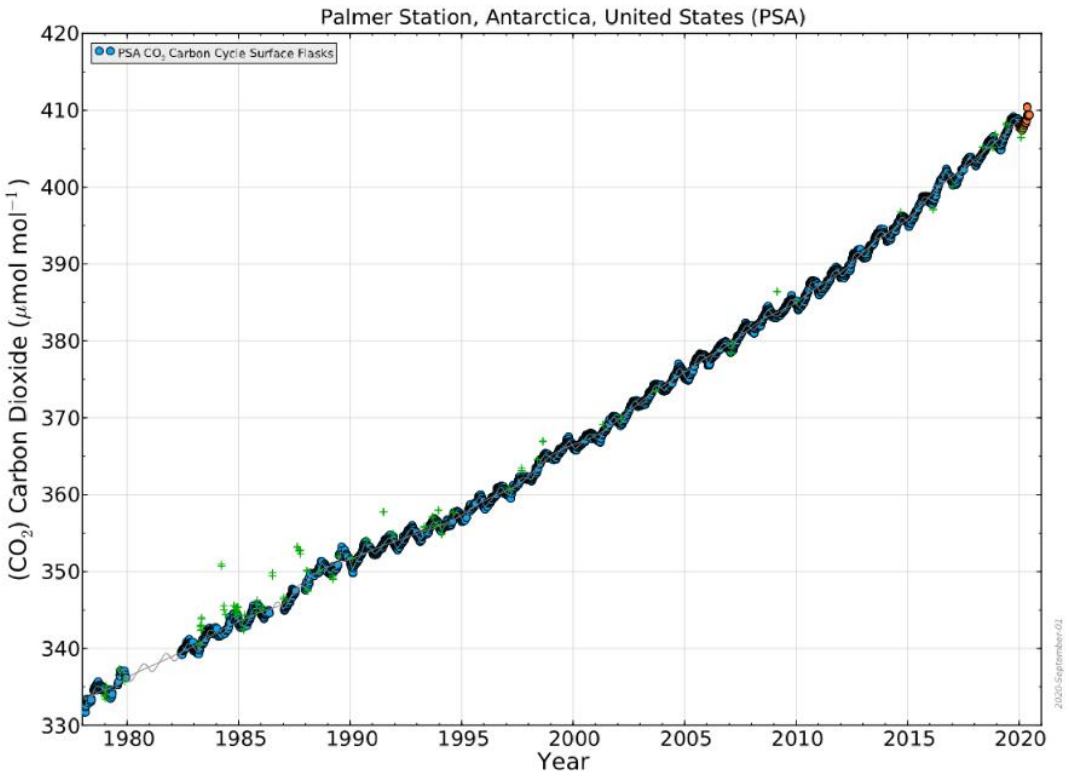


Fig. 10 – Historical CO_2 Levels at Palmer Station dating back to 1978. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

The Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on 5 January at 1240 local and 23 January at 0847 local (all UTC−03:00) during favorable wind conditions. Samples were collected a day or two early this month due to adverse wind predictions. More information about the Halocarbons and other Atmospheric Trace Species group available at: https://www.esrl.noaa.gov/gmd/hats/.

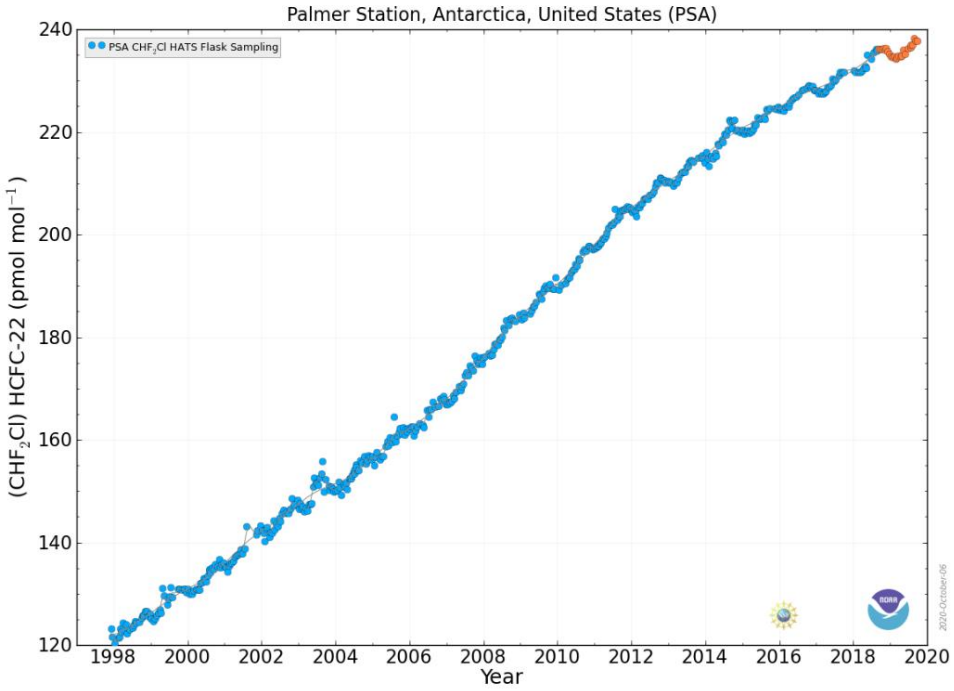


Fig. 11 – Historical measurements of HCFC-22, one of the halocarbon and trace gases measured at Palmer Station. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

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. James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division
Mr. Scott Stierle, National Oceanic and Atmospheric Administration / Global Monitoring Division

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 (Fig. 12).

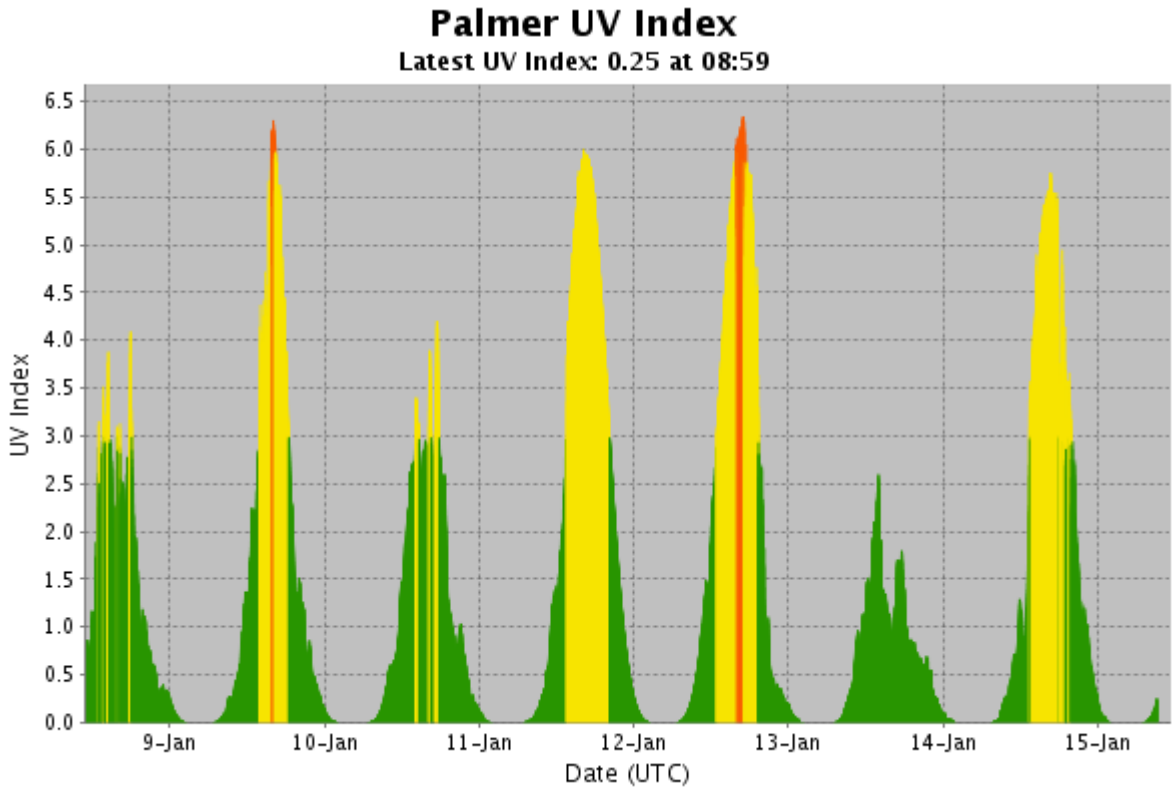


Fig. 12 – UV index generated from the GUV-511 radiometer in real time between 8 January and 16 January. *Image Credit: NOAA Earth Systems Research Laboratory*

The system is having issues with the wavelength offset on the SUV-100 UV spectroradiometer. The Principal Investigator is aware of the issue and has provided a procedure to follow when this occurs. The log was completed and collectors were cleaned on a daily basis. Weekly instrument level checks were performed to confirm that the instrumentation was within +/- 0.2 degrees. The weekly log was sent out each Monday and a bi-weekly SUV-100 UV absolute scans were performed on 1, 15, and 28 January as scheduled without issues. The electrical short in the SUV closet early in the morning of 21 January did not cause any data loss for the system. Sheathbill guano on the roof has continued to be a notable problem this month.

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

R-938-P: TERASCAN SATELLITE IMAGING SYSTEM

Mr. Kevin Bliss and Mr. Justin Maughmer, Principal Investigators, System Administrators, 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 (Fig. 13).

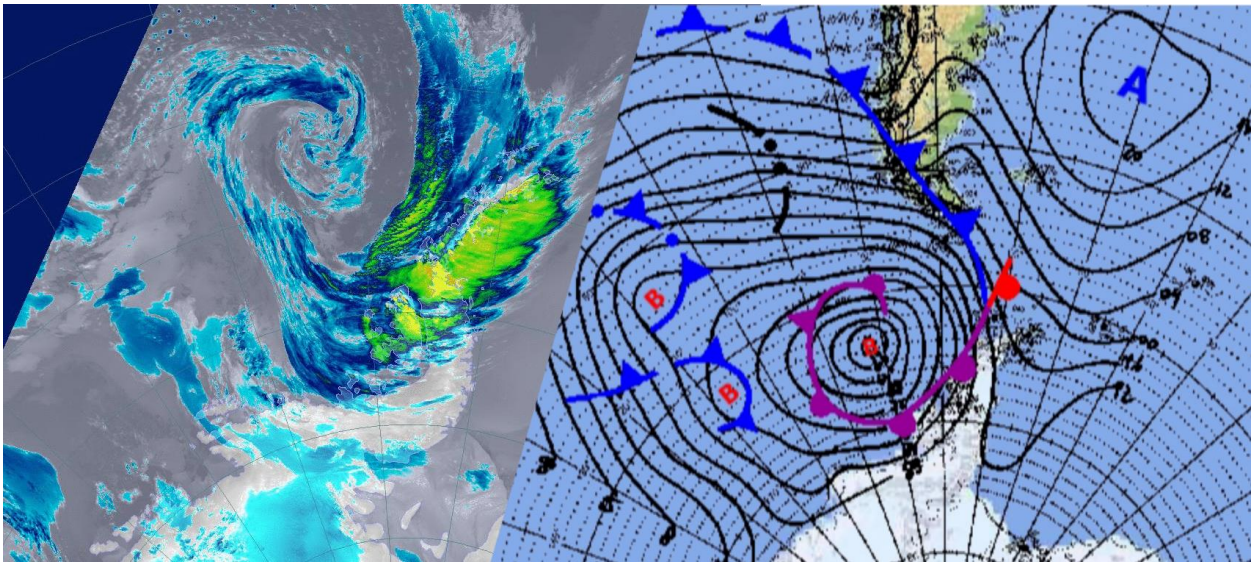


Fig. 13 – NOAA-19 satellite pass from 20 January 2021 (left panel) compared with an occluded front passing over Palmer Station (right panel; Chilean Army Meteorological Chart).

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

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

The National Science Foundation (NSF) tasked and funded the USGS Antarctic Program to establish a Global Positioning System (GPS) 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.

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

The system operated consistently throughout the month. The lights on the Trimble, Javad, and Ashtech Receivers were all illuminated in the correct pattern and showed no signs of interruption. Data flow was monitored and was normal throughout the month. More information

can be found at the following website: https://www.unavco.org/projects/project-support/polar/base_stations_and_survey_systems/palmer/base.html.

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

The Comprehensive Nuclear Test Ban Treaty (CTBT) bans all nuclear explosions. Although not ratified, the U.S.A. is following through with the treaty, including the installation 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 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.

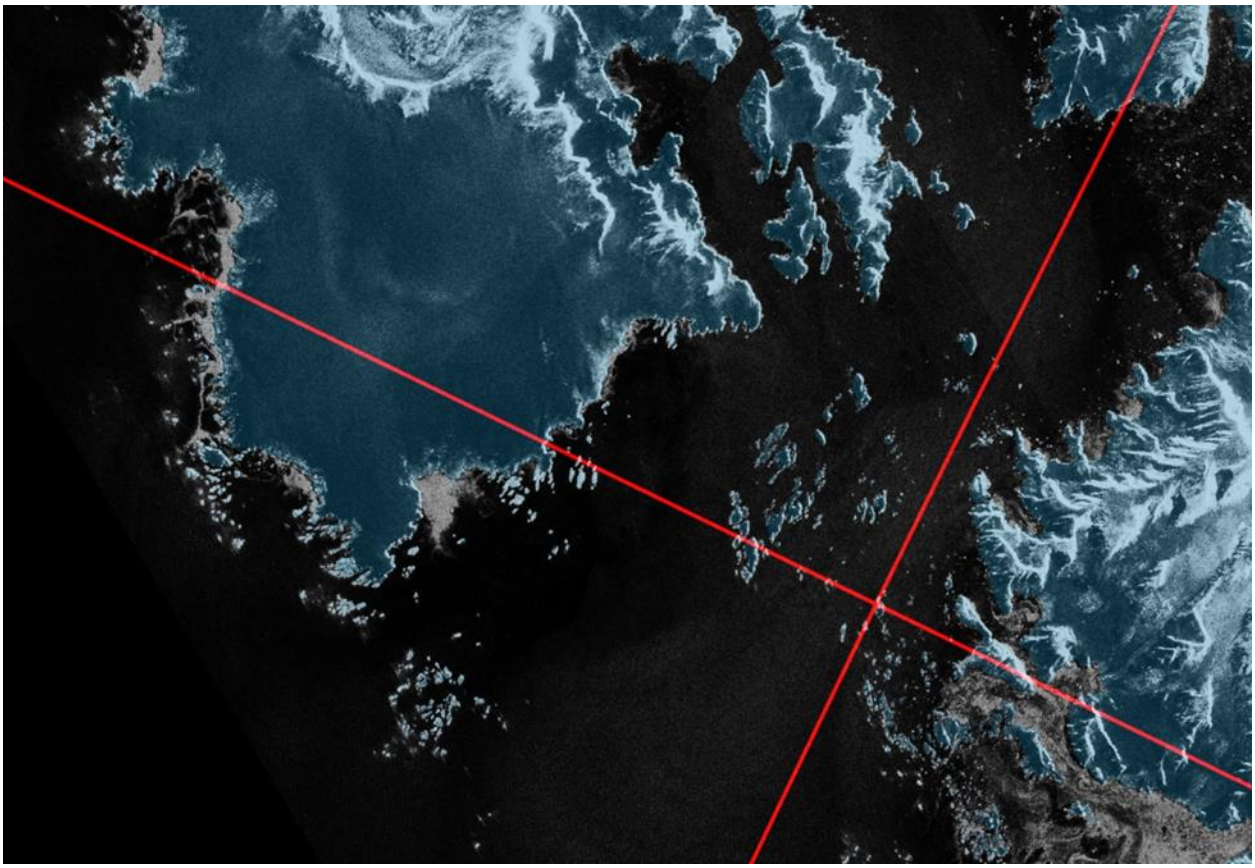
Data collected by Palmer's RASA unit is relayed in real-time via a virtual private network (VPN) back to the CTBT Organization (CTBTO) in Vienna. As of August 2006, both the RASA and seismic systems have been certified by CTBTO. Palmer is now officially part of the IMS. The automated RASA continually filters ambient air and tests for particulates with radioisotope signatures indicative of a nuclear weapons test. The Research Associate operates and maintains the instrument.

The system operated consistently this month. The RASA GUI was checked daily. The amount of filter material was checked as needed and no anomalies were heard coming from the blower. Daily filters were processed as needed and the monthly log was sent. Additional details about the treaty and monitoring stations can be found on the CTBTO web site, https://www.ctbto.org/.

PHYSICAL OCEANOGRAPHY
Palmer Station has a tide and conductivity gauge located on the pier at 64.774563°S 064.054837°W at a height of (base datum) 12.13 meters. It was installed in 2018 as the previous location was not adequate for tide or temperature measurements.

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

Observations of sea ice around station were made daily. The tide data was monitored continuously. Tide data is archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/tidegauge/.



Sentinel-1 satellite image of the sea ice around Anvers Island 3 January 2021. *Image Credit: EC Copernicus data/ESA/CMEMS/Polar View*

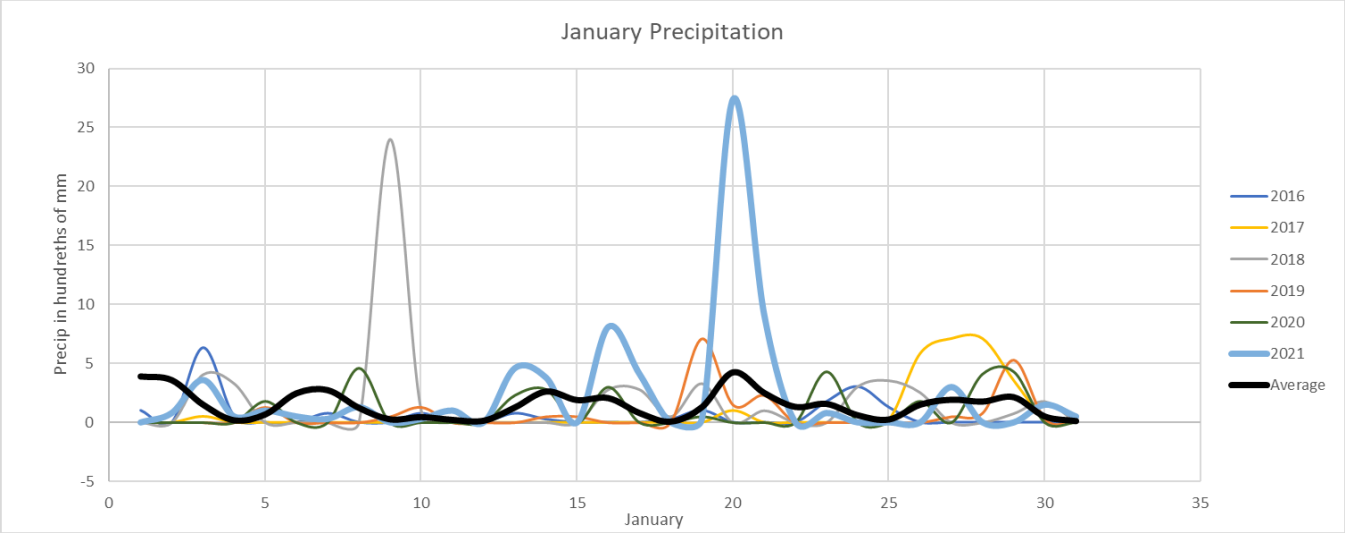
METEOROLOGY

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 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°S 064.047440°W 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.

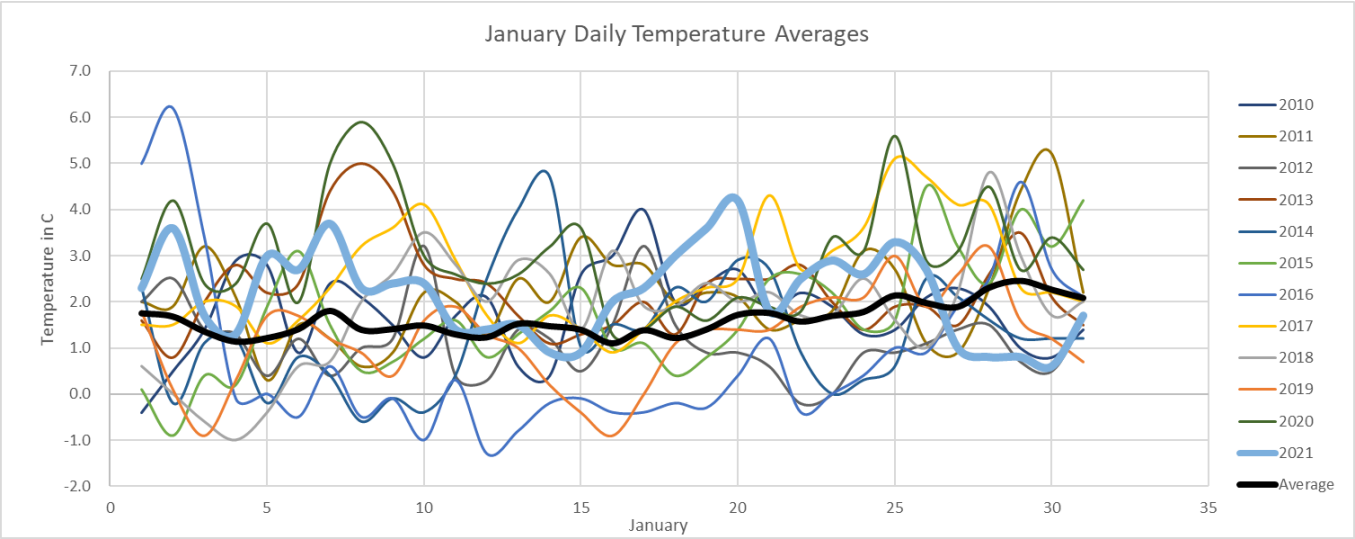
The Research Associate acts as Chief Weather Observer on station measuring, compiling, and distributing all meteorological data. Snow accumulations are physically observed by taking an average of five accumulation stakes found near the PAWS system. All weather data is archived locally and forwarded once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

The local weather station (PAWS) operated well throughout the month. The ceilometer malfunctioned and the power cord was found to be unplugged. Systems returned to normal after the power cable was reinstalled. AWS1 in the Wauwermans Islands was visited and inspected. The malfunctioning temperature sensor was replaced. The AWS1 wind anemometer was replaced with the original one that was returned from offsite repairs with a new wire assembly, which will prevent future corrosion problems. AWS2 in the Joubin Islands remains down, most likely due to a battery charger fault which will need to be addressed during the next site visit. There is an issue with AWS3 in the Gossler Islands that will need to be addressed during a site visit. One minute weather data is archived on the AMRC website: ftp://amrc.ssec.wisc.edu/pub/palmer/observations/.



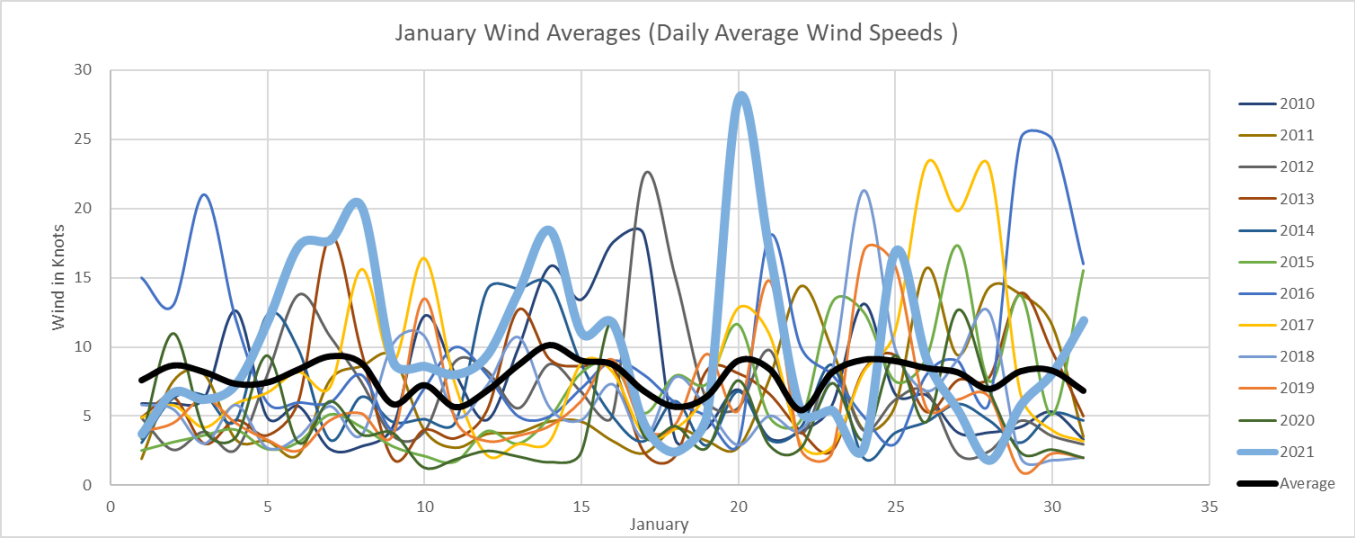
Daily precipitation totals for January 2021 and how they compare with the last five years. *Image Credit: Marissa Goerke*

Precipitation at Palmer has been exceptionally high in January. On 20 January, the precipitation total was equivalent to the historical average for the entire month. Total precipitation for January was almost twice the ten year January average.



Daily average tempertures for January 2021 and how they compare with the last ten years. *Image Credit: Marissa Goerke*

Our daily temperature averages maintained above average temperature for the majority of the month and dropped to colder than average for the last week.



Daily average wind speeds for January 2021 and how they compare with the last ten years.
Image Credit: Marissa Goerke

It was a windier than the ten year average this January.

Palmer Monthly Met summary for January, 2021

Temperature
Average: 2.2 °C / 35.9 °F
Maximum: 8.6 °C / 47.5 °F on 2 Jan 14:10
Minimum: -1.0 °C / 30.2 °F on 30 Jan 09:41
Air Pressure
Average: 982.2 mb
Maximum: 1002.3 mb on 15 Jan 19:09
Minimum: 958.2 mb on 31 Jan 22:48
Wind
Average: 10 knots / 11.5 mph
Peak (5 Sec Gust): 53 knots / 61 mph on 20 Jan 07:22 from NE (45 deg)
Prevailing Direction for Month: SE
Surface
Total Rainfall: 72.4 mm / 2.85 in
Total Snowfall: 7 cm / 2.7 in
Greatest Depth at Snow Stake: 21 cm / 8.2 in
WMO Sea Ice Observation: 1-6 icebergs with growlers and bergy bits
Average Sea Surface Temperature: 1.32 °C / 34.4 °F