PALMER STATION MONTHLY SCIENCE REPORT

APRIL 2021

Research Associate Marissa Goerke services the Amsler Island deep borehole for Portuguese Antarctic Program (PROPOLAR) researcher Dr. Gonçalo Vieira. The borehole measures permafrost temperatures at intervals along the approximately 10 m deep borehole. *Image Credit: Randy Jones*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

As the season winds down, it seems appropriate to reflect on this unusual season. With the pandemic affecting our operations, our smaller-than-usual grantee and support teams accomplished much in terms of science and operations. Many thanks go out to Research Associate Marissa Goerke for her assistance with a myriad of projects that required team efforts and thoughtful consideration. Many thanks to Peninsula Laboratory Manager Jamee Johnson for her vision and support of our team.

Many projects and operations were also not possible without the assistance and support from other departments across Station. Thank you to the Communications, FMC, Galley, IT&C, Logistics, Marine, Managers, Powerplant, and Haz Waste/Waste departments for their professional support of the science groups.

Over the month as the daylight waned and darkness became more dominant, there were some extraordinary starry nights and wonderful sunrises and sunsets. Wildlife continues to taper off in population numbers. The winter crew is preparing to arrive and is slated to be at Palmer on the ARSV *Laurence M. Gould* in the second week of May. We look forward to their arrival as we wrap up our duties and enjoy a few last moments here at Palmer.

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

In April, we were able to complete boat based field work on 15 out of the 30 days of the month.

All lab processing was concluded in April. This included finalizing sediment trap samples, processing of Adélie penguin chick toenails, and processing of limpet traps.

Giant petrel chick banding was completed in April. Additionally growth measurements of giant petrel chicks continued throughout April at Humble Island. Giant petrels began fledging at the end of April, which will continue into May. Figure 1 shows the growth achieved in about 3.5 months. The newly hatched giant petrels usually weigh between 200-300 grams, while the fledgling is between 4 and 6 kilograms.

Fig. 1 - Giant petrel chick shortly after hatch (top panel), and just prior to fledging (bottom panel). Image Credit: Megan Roberts

Our team is not usually here this late in the season. It has been interesting to see increases in incidental sightings of species that earlier in the summer we observe frequently when offshore on the LTER cruise, but are not common near station. Sightings from station in April have included southern fulmars, cape petrels, Antarctic petrels, and snow petrels.

A southern fulmar near Palmer Station. *Image Credit: Darren Roberts*

Marine mammal monitoring continued with fur seal, elephant seal, crabeater seal, and Weddell seal numbers declining in the area. Humpback whale numbers were relatively low, but transient animals moved through the area consistently throughout April. Minke whale observations were sporadic throughout the month. Humpback whale biopsy efforts continued successfully through April, and we are excited to get late season samples from these animals.

A Humpback whale breaching near Christine Island. *Image Credit: Megan Roberts*

The remainder of April was spent preparing samples and cargo for the seasons end. We would like to thank Laboratory Supervisor Randy Jones, and Logistics Supervisor Ben Bonnett for their help and patience with the complicated logistics involved in getting our samples north to our institutions.

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

April concludes another exciting science-filled month. LTER Station E was sampled three times resulting in CTD (Fig. 2) and chlorophyll (Fig. 3) profiles showing a small bloom on 13 April at 6.1 µg L^{-1}. The CTD profiles also show that water temperatures have declined considerably throughout the month of April.

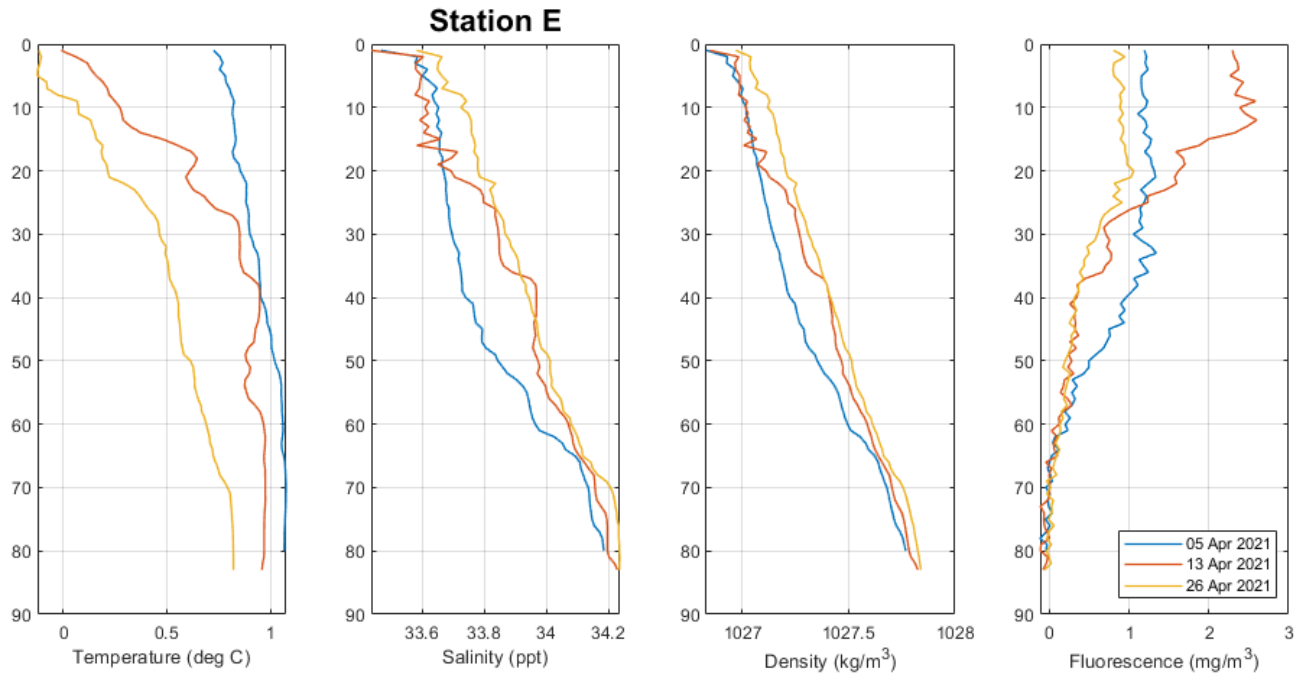


Fig. 2 – CTD profiles from LTER Station E on 5 April (blue line), 13 April (orange line), and 26 April (yellow line).

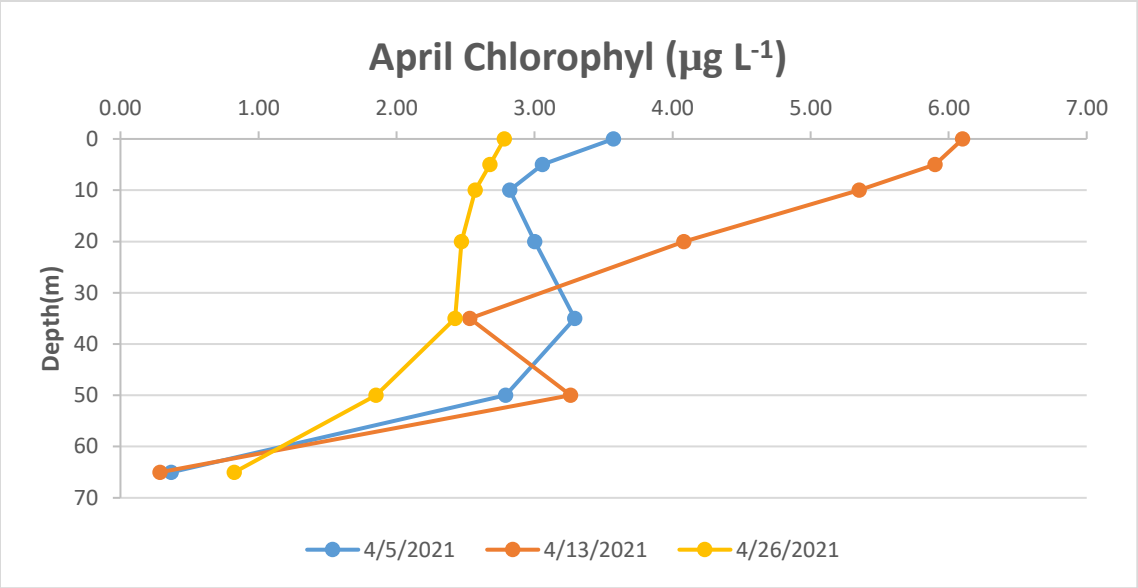


Fig. 3 – Fluorescence profiles from LTER Station E on 5 April (blue line), 13 April (orange line), and 26 April (yellow line).

Since the metro net is incompatible with the Marine Landing Craft, a 1m bongo net was used to perform untargeted net tows at LTER Station E, the inshore line of the Adélie transect, and near Jacobs Island (Fig. 4). Similar to the previous net tows in March, *Euphausia superba* was not present, and instead, *Thysanoessa macura* was the dominant species. Additional zooplankton present included amphipods, a gammarid amphipod, and a pteropod, *Spongiobranchaea* (Fig. 5). Finally, C-019-P (Schofield) and C-045-P (Van Mooy) wrapped up incubations with two 24-hour incubations and one 7-day incubation.

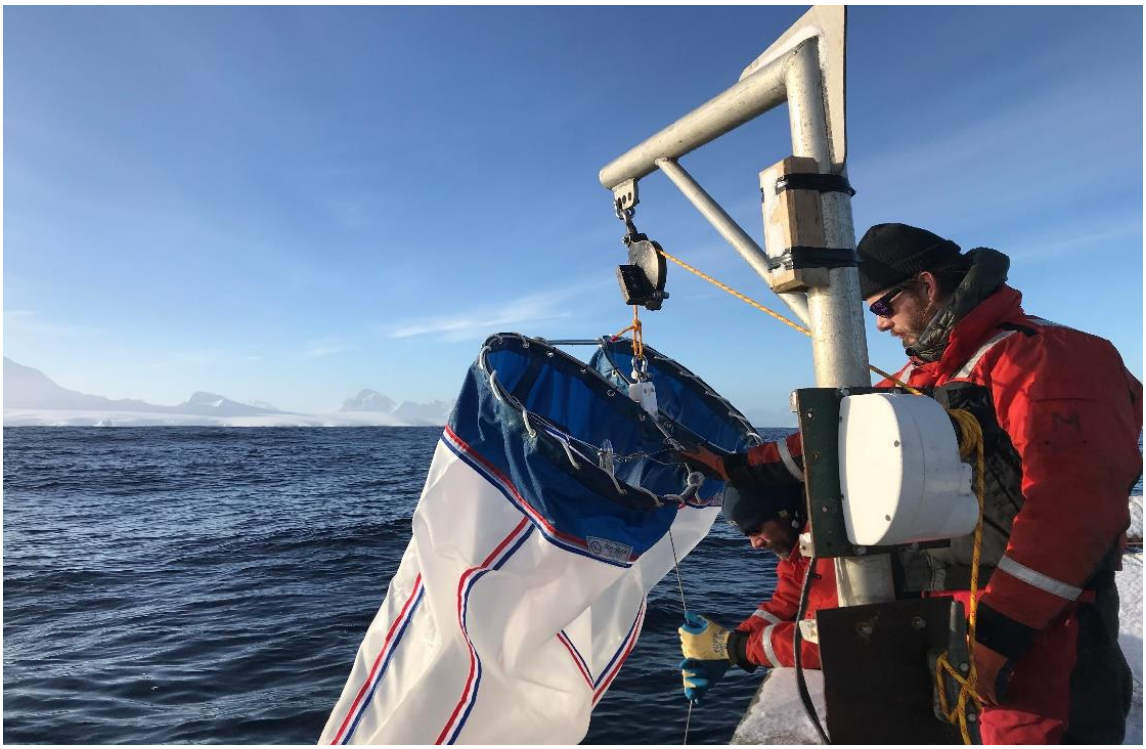


Fig. 4 – Marine Technicians, Ken Block and Mike Burns, deploying the bongo net from the Marine Landing Craft. Image Credit: Schofield group

Fig. 5 – Microscopic images of a gammarid amphipod (left panel) and an amphipod, *Themisto* (right panel) from untargeted bongo net tows. Image Credits: Research Associate Marissa Goerke

All of science would not be feasible without the endless support of ASC staff including our Lab Supervisor Randy Jones, and our Marine Technicians Ken Block and Mike Burns.

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

Though nature supplied us with ample bad weather, we were able to complete three weeks of LTER water column sampling at Station E in April. Our flow cytometry data show a gradual decline in upper water column phytoplankton populations, with relatively stable bacterial populations (Fig. 6). We look forward to analyzing these population dynamics through chemical analysis when we get our samples back to the lab.

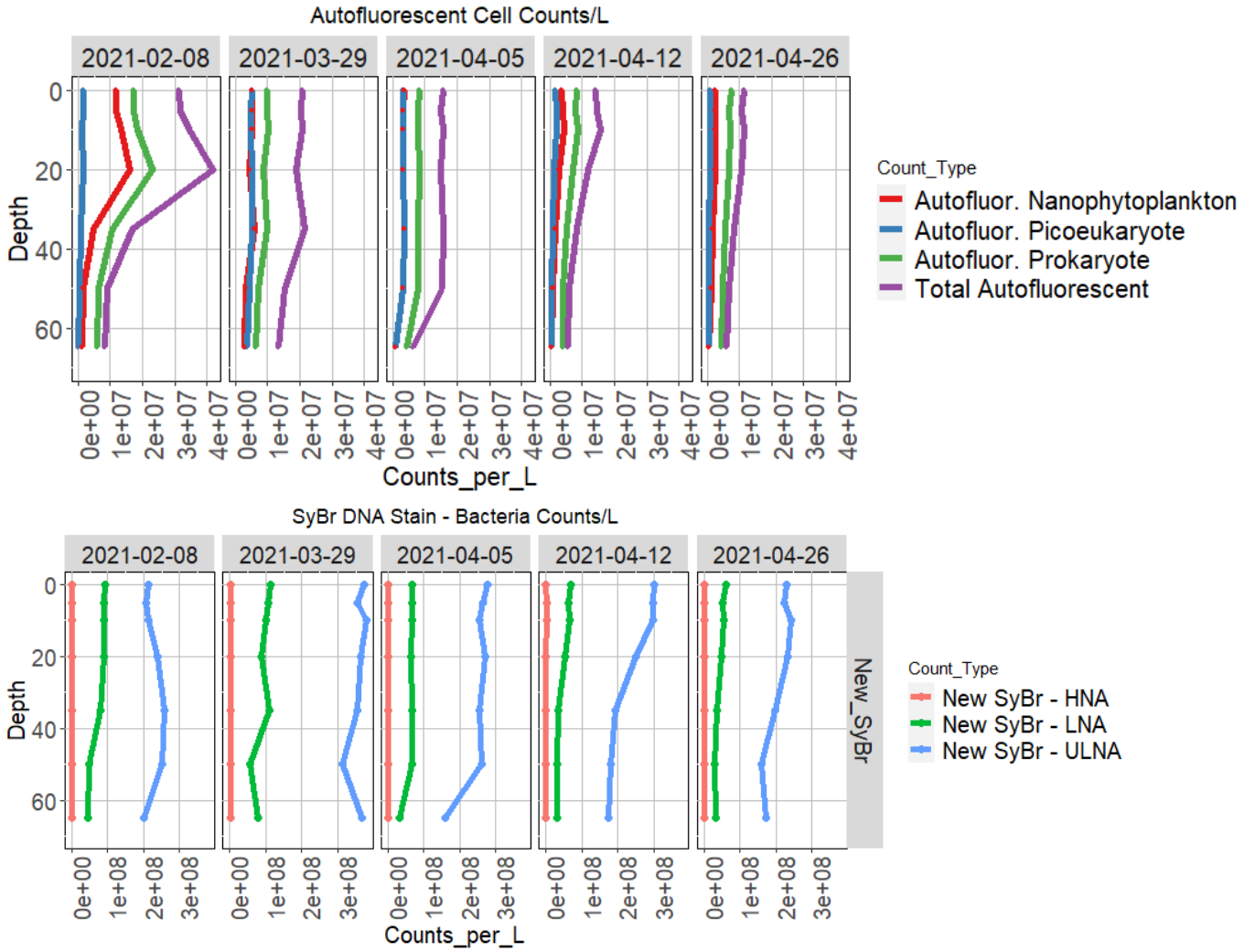


Fig. 6 – Flow cytometric cell counts at LTER Station E from selected dates, including all CTD casts in April. Data indicate gradually decreasing autofluorescent micro-algal cell counts through the summer-fall transition (top panel), with relatively consistent bacterial population (bottom panel).

Working with Rachael Young in the C-019-P (Schofield) lab, we were able to run two disparate light-level incubations to investigate microbial chemical energy storage (Figs. 7 and 8), sampling water from 5 m and 20 m at Station E with the Monsoon pump. The algal populations reacted very differently when exposed to our experimental light treatments (Light Treatment: ~50%

Photosynthetically Active Radiation, PAR; Shade Treatment: ~5% PAR), possibly due to their immediate adaptation to *in situ* light levels at their respective depths. In contrast, the bacterial populations showed much greater similarity between treatments and depths (Fig. 8).

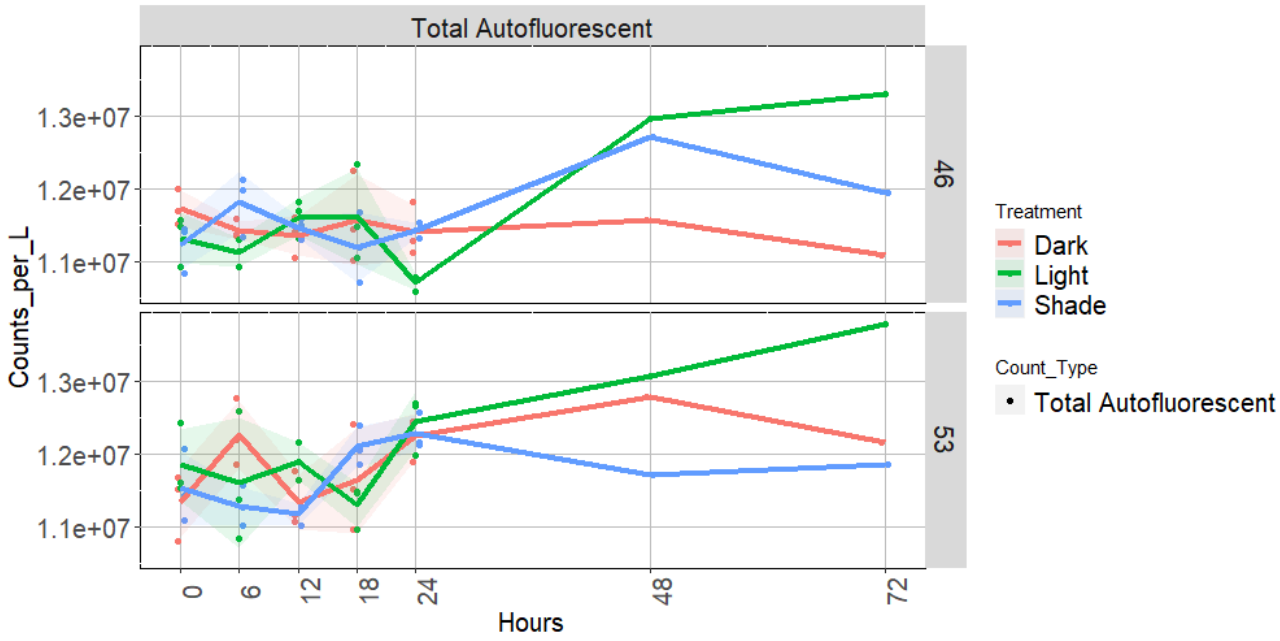


Fig. 7 – Autofluorescent cell counts during a light-level incubation with water collected at LTER Station E at 20 m (Event 46, top panel) and 5 m (Event 53, bottom panel).

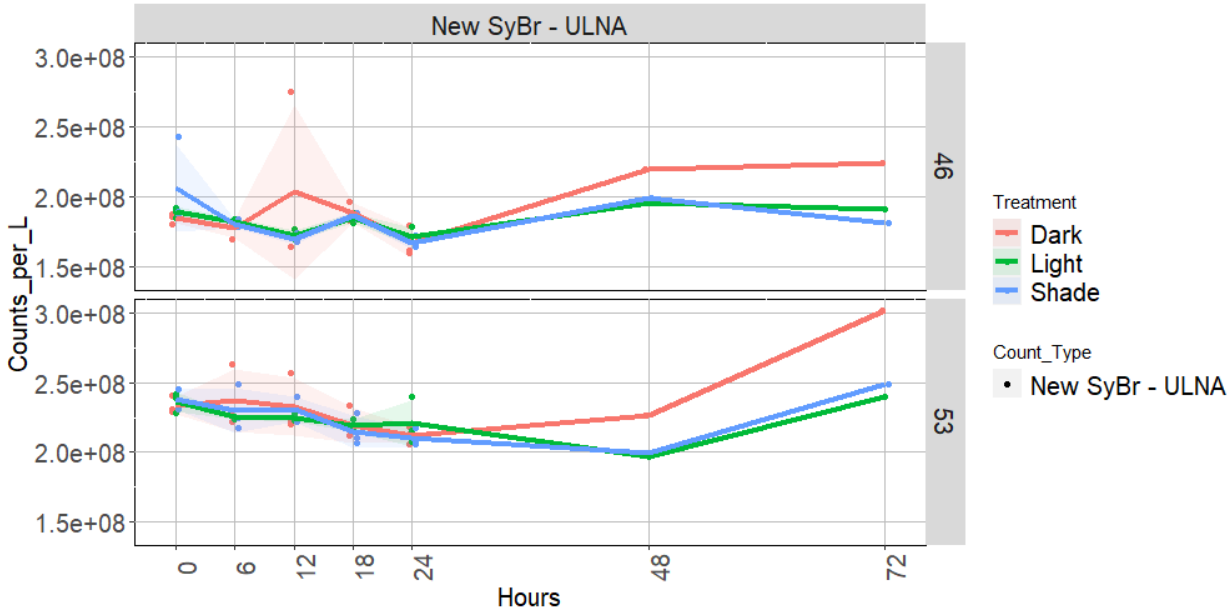


Fig. 8 – Bacterial cell counts during a light-level incubation with water collected at LTER Station E at 20 m (Event 46, top panel) and 5 m (Event 53, bottom panel).

We also ran a week-long incubation in collaboration with the Schofield lab, and a series of krill net tows throughout the boating area. We did not catch any of the typical Palmer area keystone species, *Euphausia superba*, but instead only caught the smaller krill species, *Thysanoessa* spp. It appears *E. superba* populations are likely gone from the area for the season.

We greatly appreciate the efforts on the part of Marine Technicians Ken Block and Mike Burns, and Lab Supervisor Randy Jones, to keep us out sampling in this bad weather, and we look forward to a few more sampling opportunities this May while we wrap up our season.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT
April 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. 9) 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.

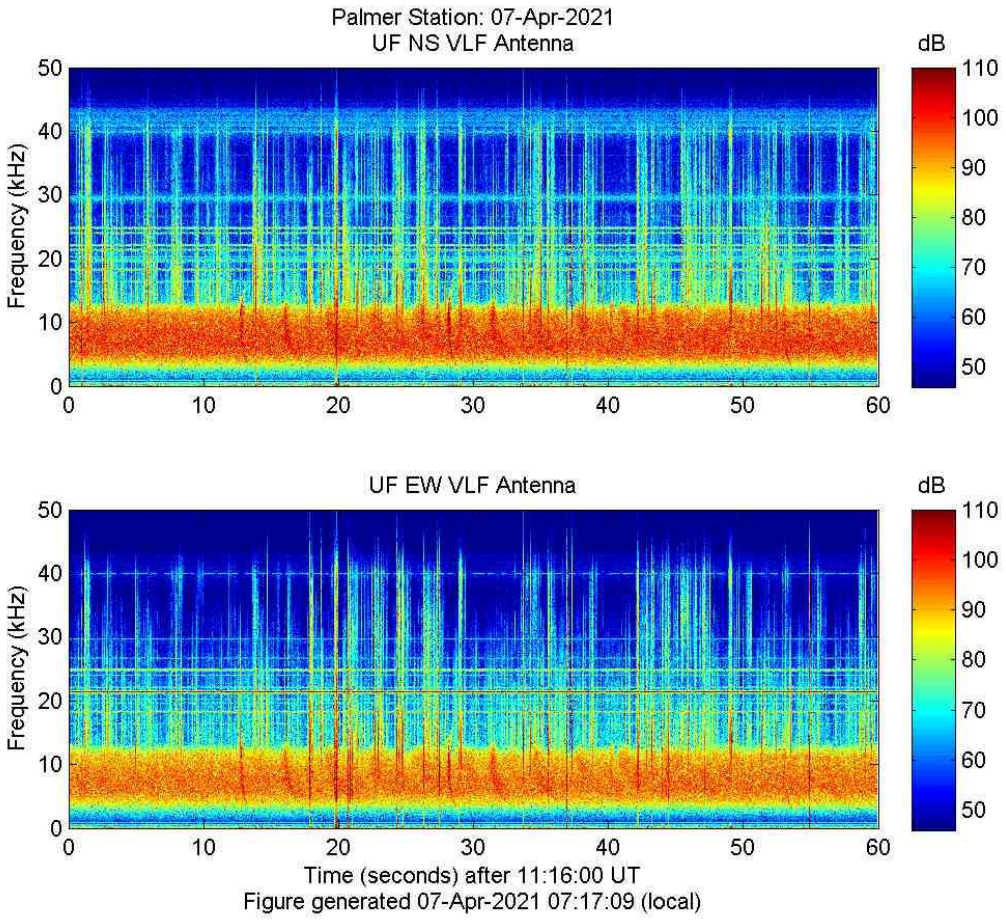


Fig. 9 – Real-time broadband ELF/VLF spectrogram from 7 April 2021. *Image Credit: University of Florida*

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 completed 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-N/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 SeaSonde (CODAR transmitter and receiver) from the Wauwerman Island location was recovered on 28 April. The computers at the Wauwermans and Joubin sites are not sending data.

Data will be available in the future at: https://marine.rutgers.edu/~codaradm/.

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.

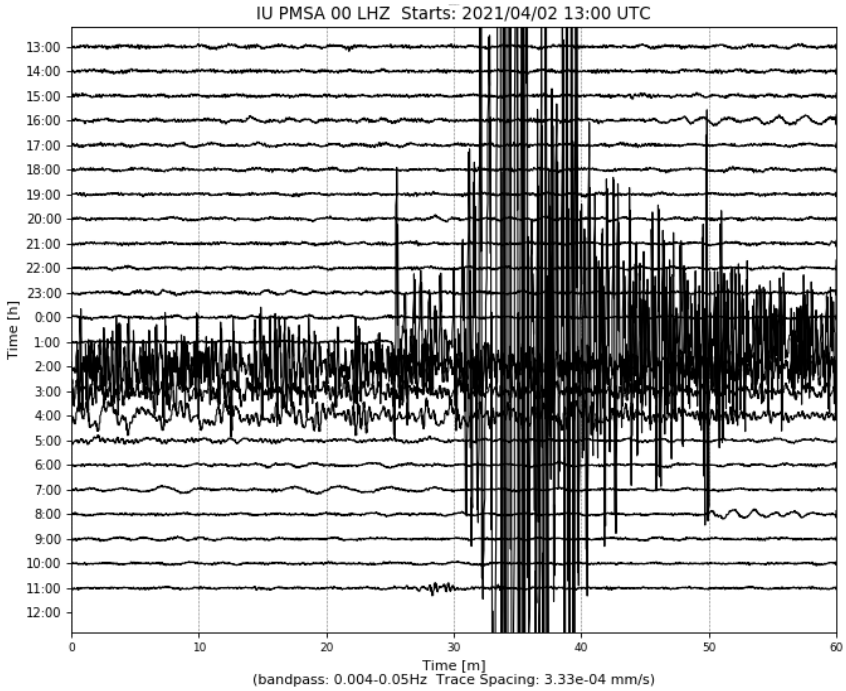


Fig. 10 – A 7.9 magnitude earthquake east of the South Sandwich Islands (South Atlantic Ocean, 2000km east-northeast of Palmer Station) on 2 April 2021. *Image Credit: NASA Earthquake Hazards Program*

The system operated consistently throughout the month. The time stamp and seismic activity found on the heliplot was checked daily; see example in Figure 10. 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. 11).

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.

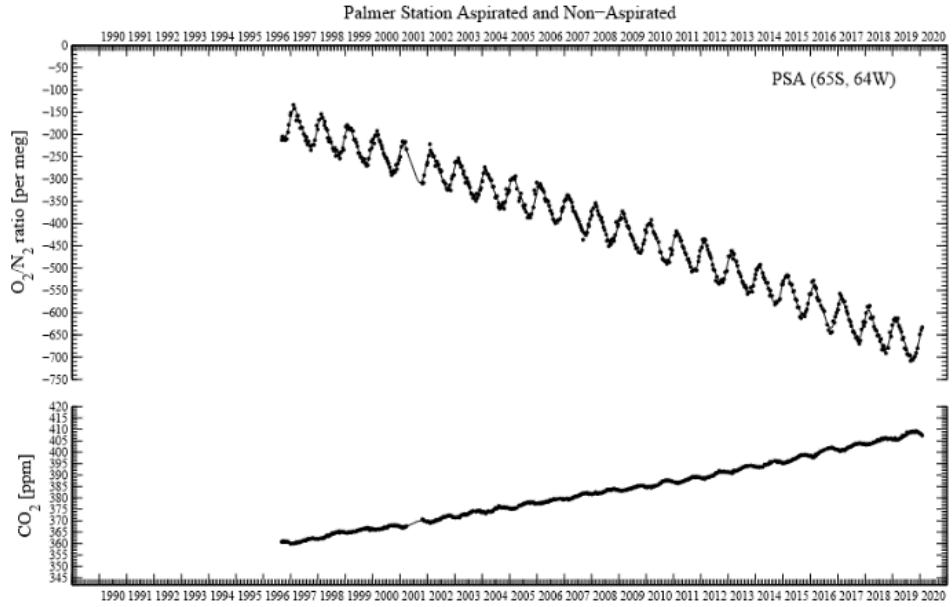


Fig. 11 – Historical plot of O_2/N_2 ratio per meg and CO_2 ppm updated on 29 July 2020. *Image Credit: UCSD Scripp's O_2 Program*

Air samples were collected on 14 April at 0859 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. 12 and 13). 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 5 April at 0838 local time, 12 April at 0741 local time, 19 April at 1950 local time, and 26 April at 0755 local time (all UTC−03:00) during favorable wind conditions. More information and data for the Carbon Cycle group can be found at: https://www.esrl.noaa.gov/gmd/ccgg/trends/.

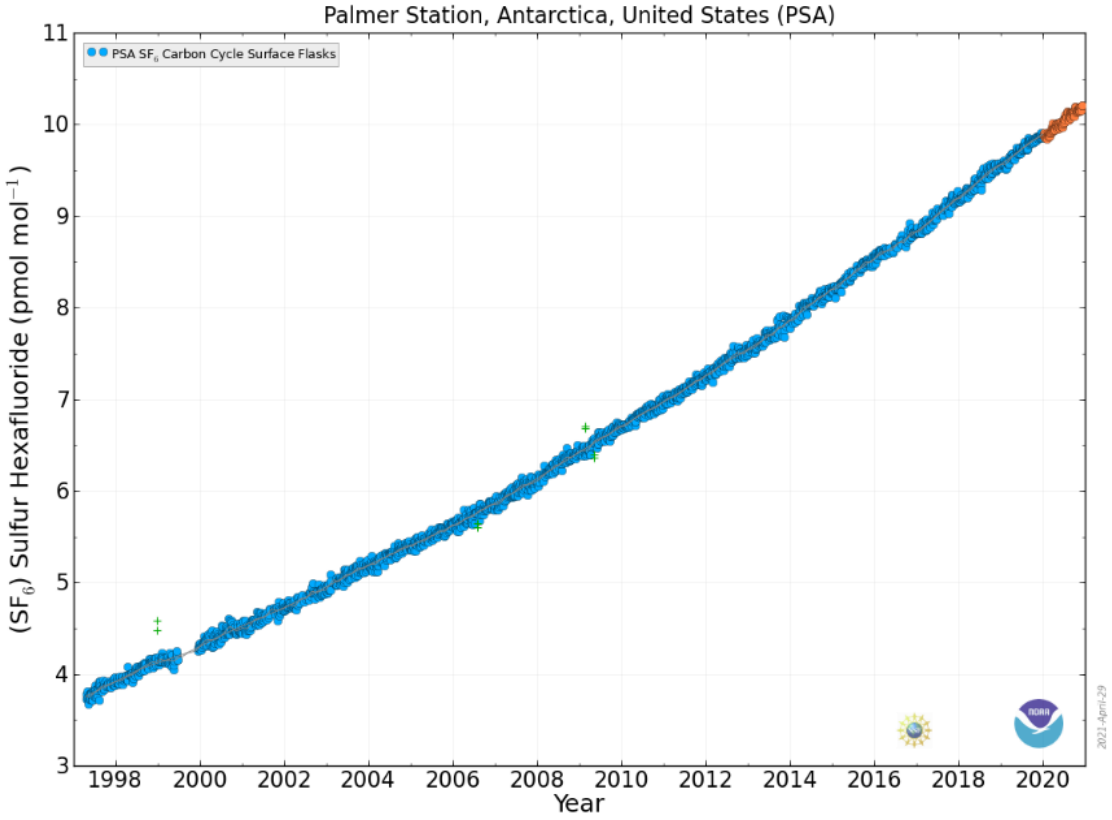


Fig. 12 – Historical SF_6 Levels (pmol mol^{-1}, ppt) at Palmer Station dating back to 1997. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

The Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on 7 April at 1658 local and 24 April at 0833 local (all UTC−03:00) during favorable wind conditions. More information about the Halocarbons and other Atmospheric Trace Species group available at: https://www.esrl.noaa.gov/gmd/hats/.

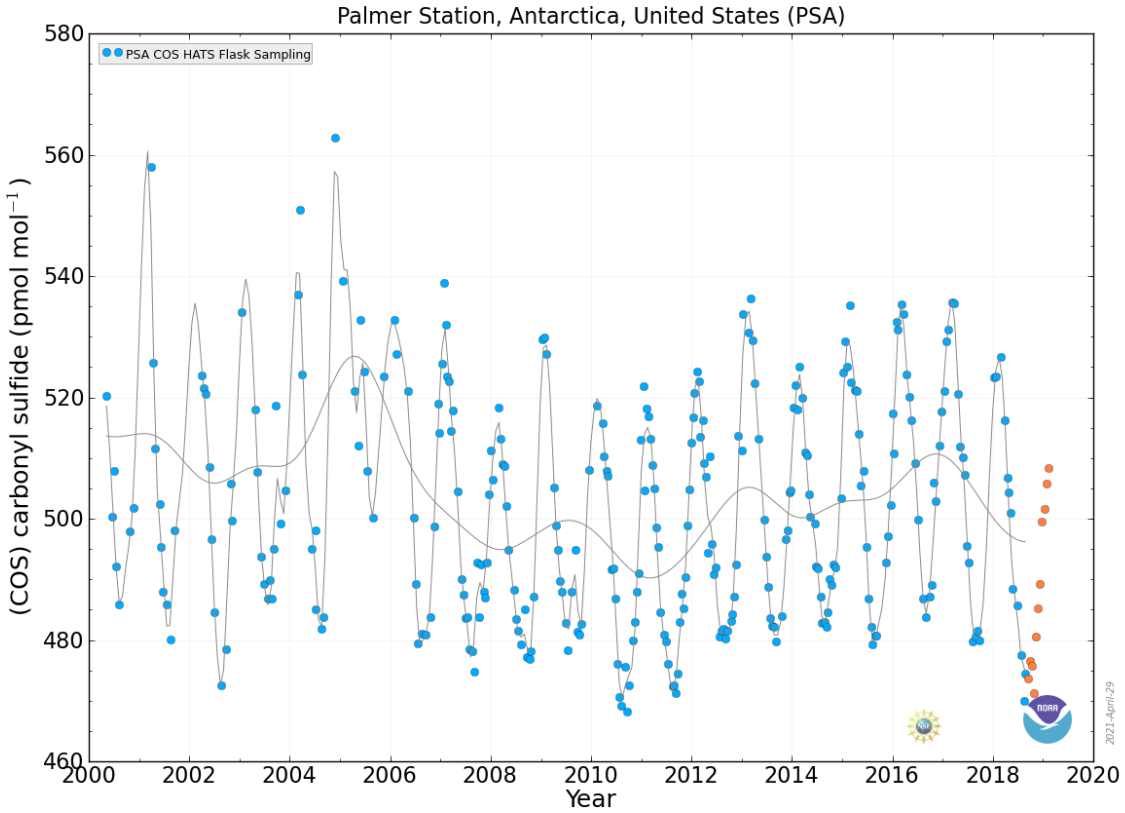


Fig. 13 – Historical measurements of carbonyl sulfide (COS) dating back to 2000, one of the halocarbon and trace gases measured at Palmer Station. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

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. 14).

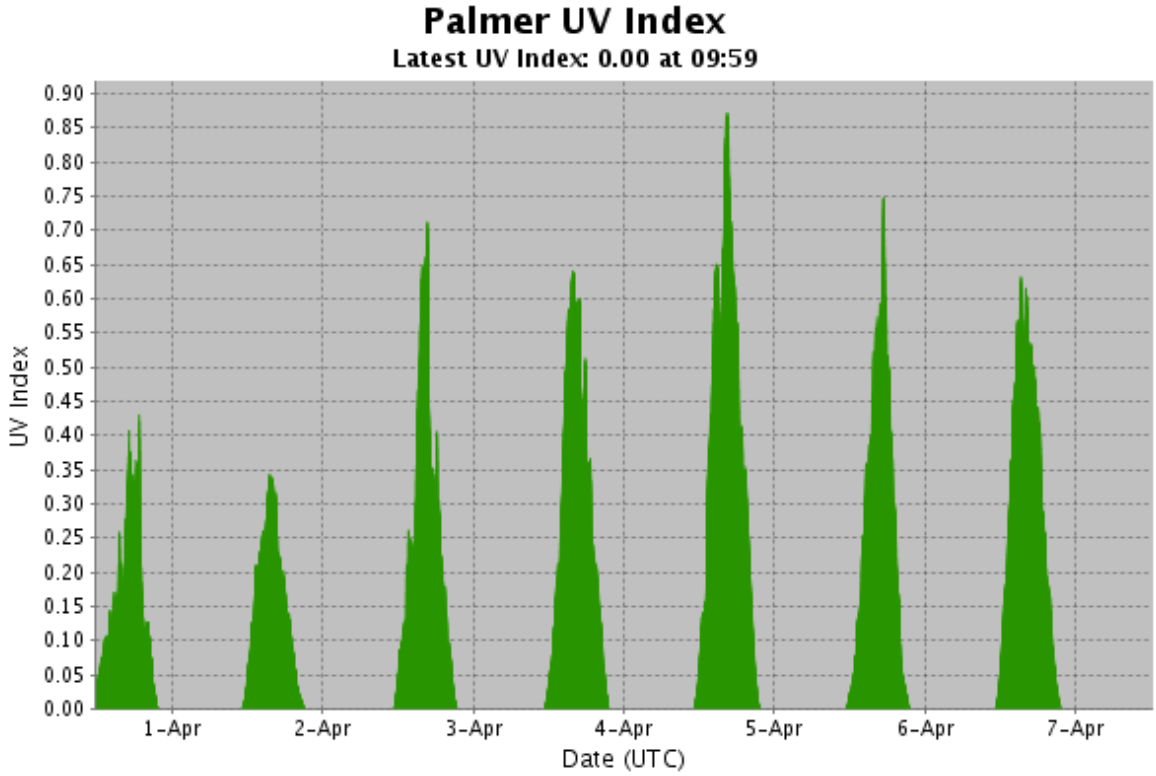


Fig. 14 – UV index generated from the GUV-511 radiometer in real time between 31 April and 6 April. *Image Credit: NOAA Earth Systems Research Laboratory*

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 bi-weekly SUV-100 UV absolute scans were performed on 9 April and 23 April as scheduled without issues.

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. 15).

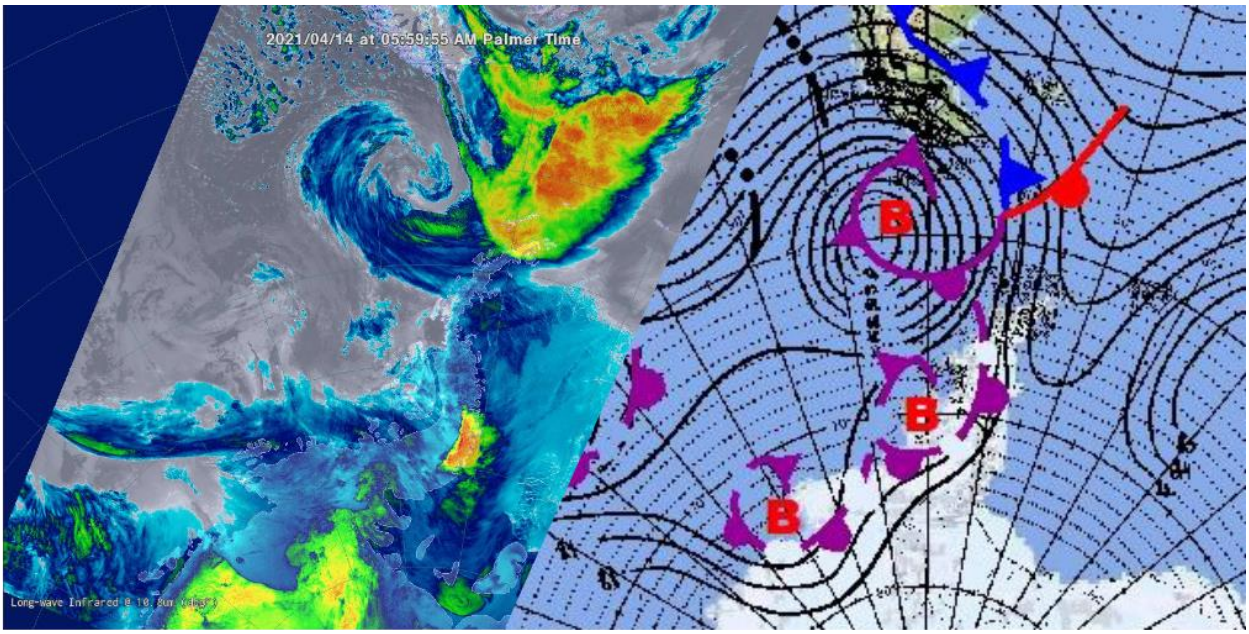


Fig. 15 – NOAA-19 satellite pass from 14 April 2021 (left panel) compared with the Chilean Army Meteorological Chart (right panel).

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.

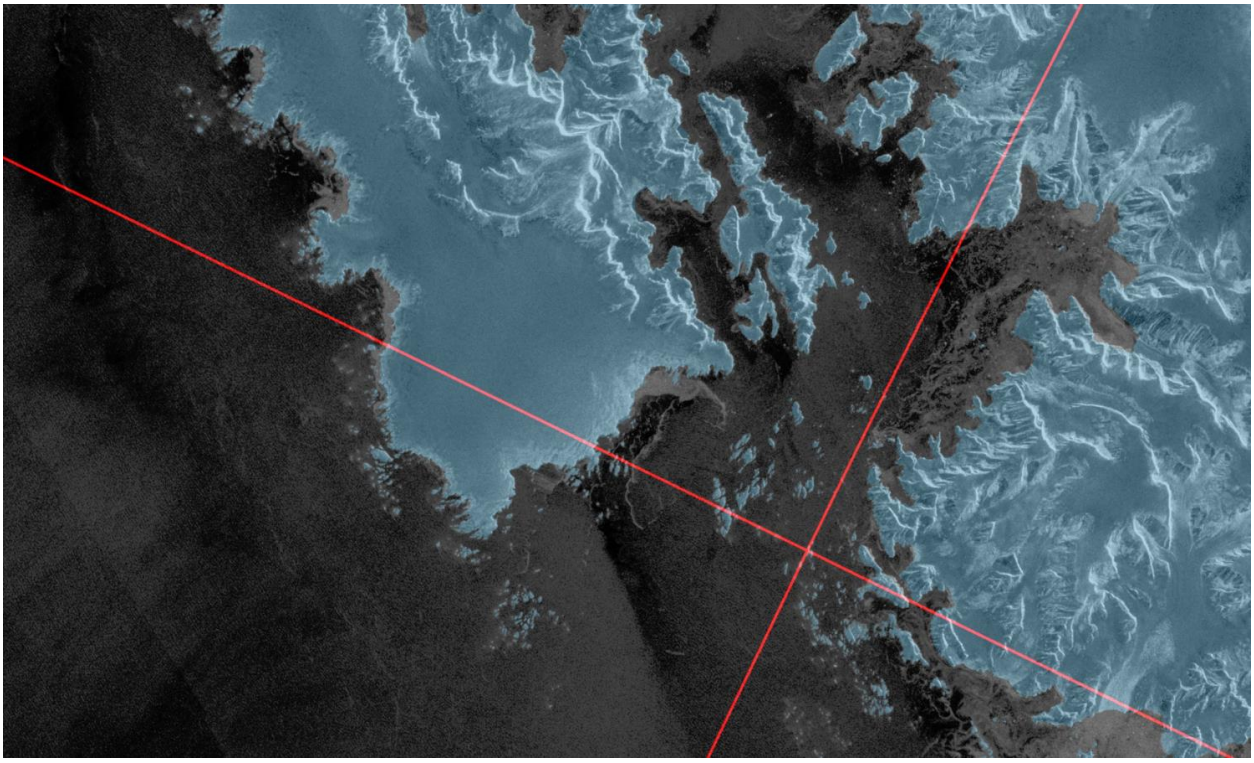
Data collected by Palmer's RASA unit is relayed in real-time via a virtual private network (VPN) back to the CTBT Organization (CTBTO) in Vienna. As of August 2006, both the RASA and seismic systems have been certified by CTBTO. Palmer is now officially part of the IMS. The automated RASA continually 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. The annual preventative maintenance was completed during the last week of April. 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 26 April 2021. *Image Credit: EC Copernicus data/ESA/CMEMS/Polar View*

METEOROLOGY

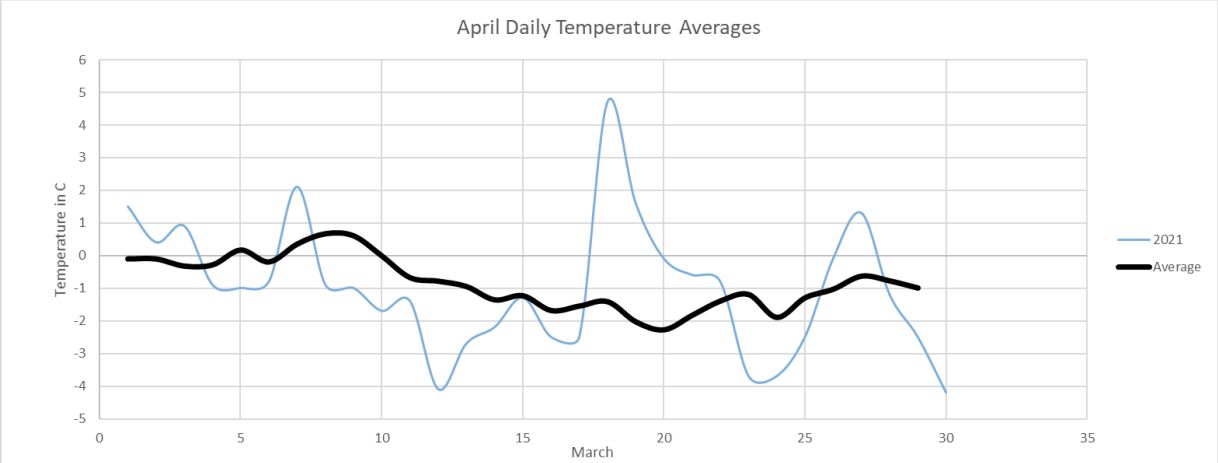
Mike Carmody, Principal Investigator, United States Antarctic Program

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.

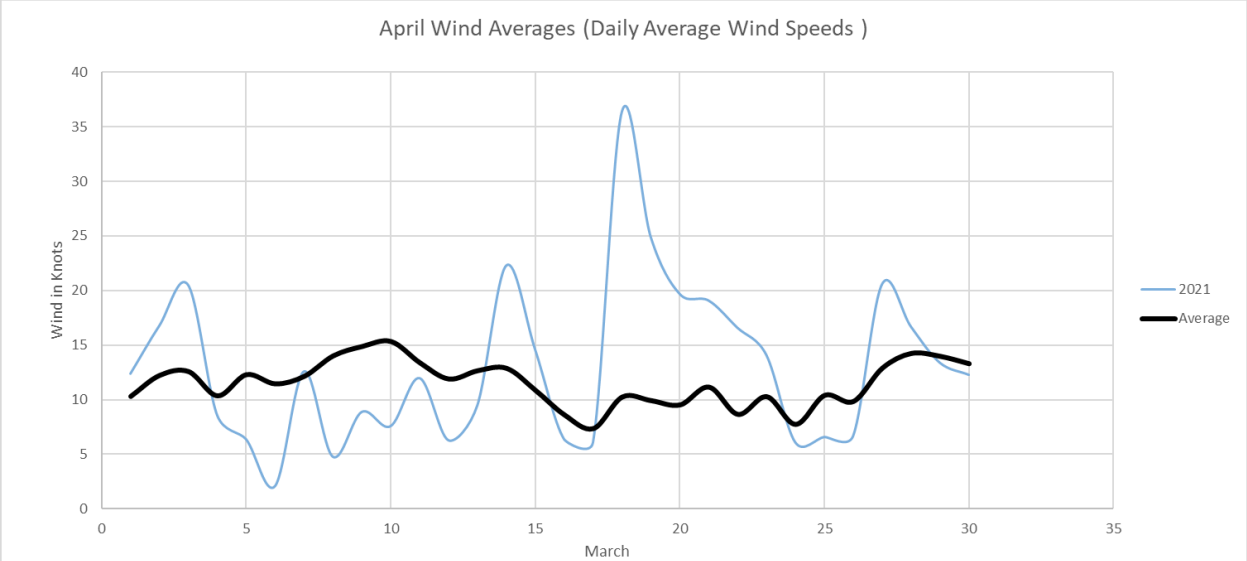
The Research Associate acts as Chief Weather Observer on station measuring, compiling, and distributing all meteorological data. Snow accumulations are physically observed by taking an average of five accumulation stakes found near the PAWS system. All weather data is archived locally and forwarded once 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. AWS2 at the Joubin Islands has been found to only operate during rainy conditions, so further troubleshooting is necessary. There is an issue with AWS3 at 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/.



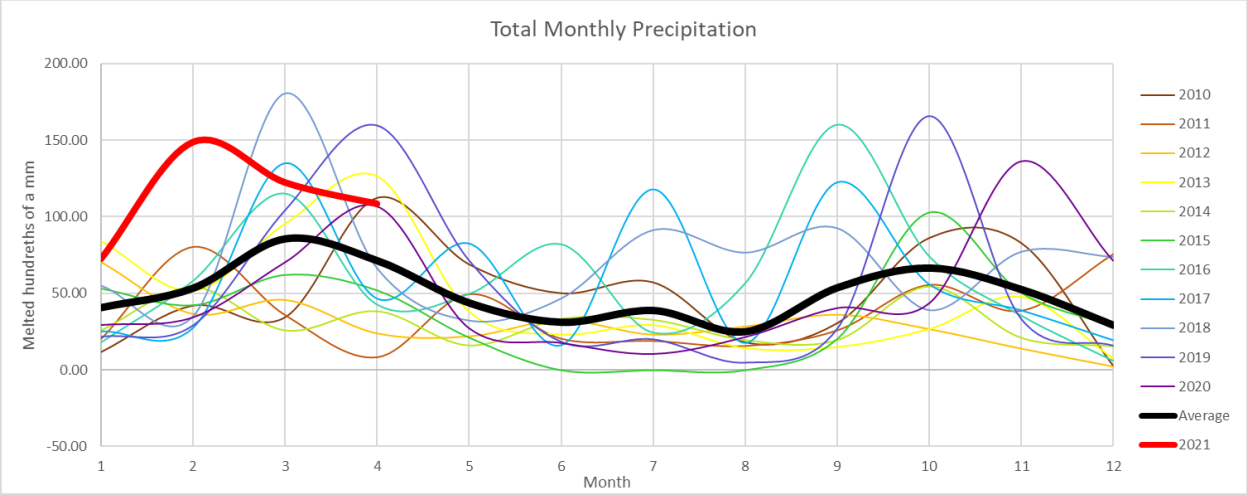
Daily temperature averages for April 2021 (blue line) and how they compare with the average for the last ten years (black line). *Image Credit: Marissa Goerke*

April was a relatively average month as compared with the ten year average temperature with the exception of the unseasonably warm wind event on 18 and 19 April.



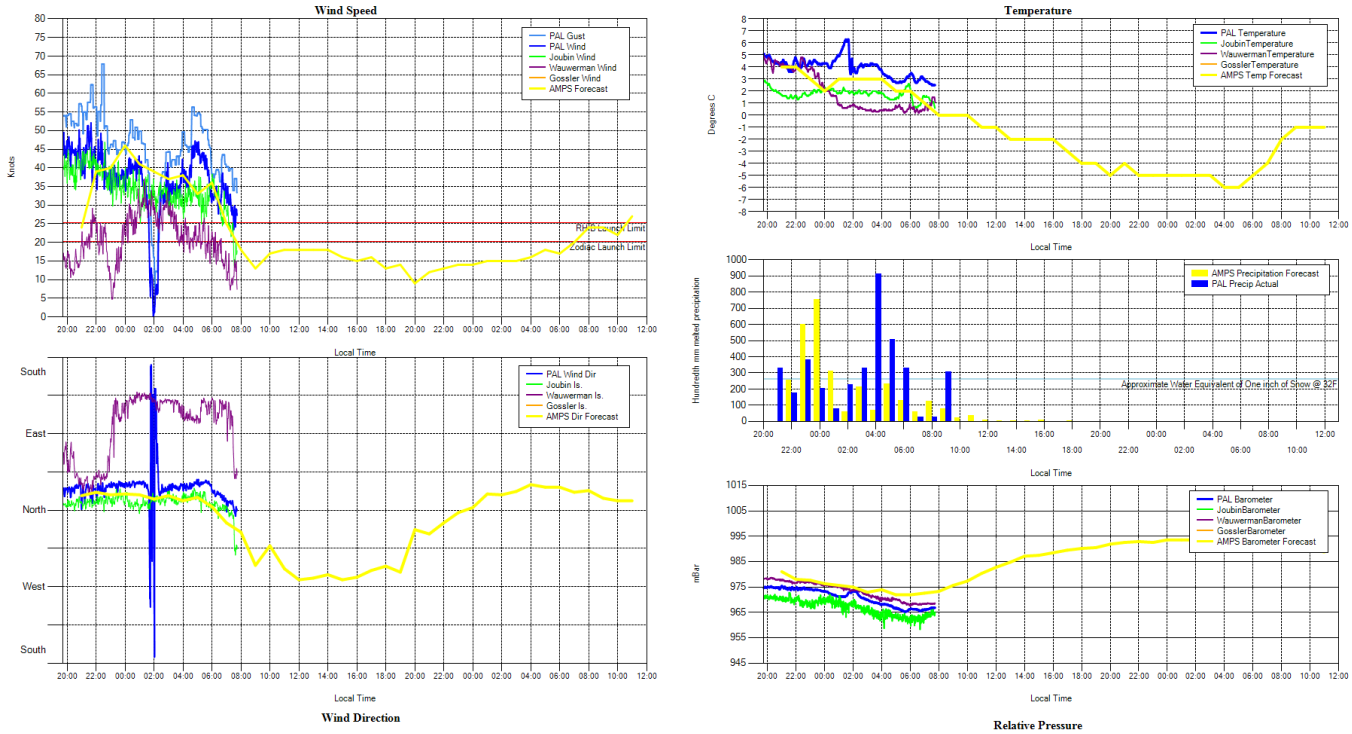
Daily average wind speeds for April 2021 (blue line) and how they compare with the average for the last ten years (black line). *Image Credit: Marissa Goerke*

April was not as uniformly higher than average wind speed as the previous few months have been. The major exception here is a three day storm starting on 18 April with sustained winds more than twice the ten year average.



Total precipitation per month through April 2021 (red line), as compared to the last ten years (various color lines) and the ten year average total precipitation (black line). *Image Credit: Marissa Goerke*

April received above the ten year average amount of precipitation, keeping with this season's trend. The April precipitation levels could be considered within the normal range. The 18-19 April storm brought 2.3 inches of rain in one night, amounting the single largest 24 hour precipitation event all season. The five chart plots for this storm are displayed below.



Palmer Station Automated Meterological Station data from the Backyard station from 2000 local time (UTC−03:00) on 18 April through 0750 local time (UTC−03:00) on 19 April. Clockwise from top left panel: wind speed (kts), air temperature (°C), precipitation (hundreths of mm), barometric pressure (mBar), and wind direction (cardinal directions). *Image Credit: Marissa Goerke*

Palmer Monthly Met summary for April, 2021

Temperature
Average: -1.0 °C / 30.2 °F
Maximum: 6.9 °C / 44.4 °F on 18 Apr 07:48
Minimum: -6.1 °C / 21.0 °F on 25 Apr 03:35
Air Pressure
Average: 982.4 mb
Maximum: 1002.9 mb on 24 Apr 08:00
Minimum: 949.2 mb on 14 Apr 23:22
Wind
Average: 13.1 knots / 15.0 mph
Peak (5 Sec Gust): 68 knots / 78 mph on 19 Apr 01:30 from NNE (20 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 124.7 mm / 4.91 in
Total Snowfall: 36 cm / 14 in
Greatest Depth at Snow Stake: 18.8 cm / 7.3 in
WMO Sea Ice Observation: 1-6 icebergs with growlers and bergy bits, occasional grease and shuga
Average Sea Surface Temperature: 0.1 °C / 32.2 °F