PALMER STATION MONTHLY SCIENCE REPORT

MARCH 2021

Sunset over Torgersen and Litchfield Islands. *Image Credit: Randy Jones*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

The first week and a half of the month, the weather was windy and wet, though there were a few periods of sunshine. March typically brings a period where rain storms and snow storms alternate and successive stages of bare ground and snow cover signal the shift towards an accumulation of snow cover. A storm on 8-9 March brought 6-8cm overnight, starkly shifting our vistas from dark rock to white snow. Within a day or two, the ground was back to bare rock following rain storms. This process continued throughout the month, with bare ground and snow cover playing back and forth.

The wildlife and ecosystem are also shifting towards winter, with the penguin populations completing their fledging this month, and adults moving through the molting process. Elephant seals have reduced their populations at most of their usual haul outs, and fur seals are here in great numbers now (populating many of the islands in the local region). Smaller populations of transiting or resting crabeater seals and Weddell seal have also been observed. Leopard seals are present, though not in large numbers.

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

March proved to be another challenging month in terms of weather, but we were able to conduct field work on 19 of the 31 days of the month.

Adélie penguin work concluded this month with the fledgling of all chicks, which also concluded our presence/absence radio transmitter study on Humble Island. As usual, gentoo penguin breeding was slightly behind Adélie penguin breeding. Work during March focused on obtaining adult diet samples and chick fledging weights at Biscoe Point and in the Joubin Islands from Gentoo penguins.

Gentoo penguin fledglings at Biscoe Point. *Image Credit: Megan Roberts*

Brown skua work also concluded this month with nest monitoring and growth measurements of breeding pairs from Dream Island to Biscoe Point. Brown skua pairs successfully fledged chicks at Biscoe, Humble, Litchfield, Cormorant, and Dream Islands, and on Joubin Island Number 7. Our south polar skua study on Shortcut Island also continued into, and concluded in March.

Giant petrel chick banding on all local islands was conducted in March.

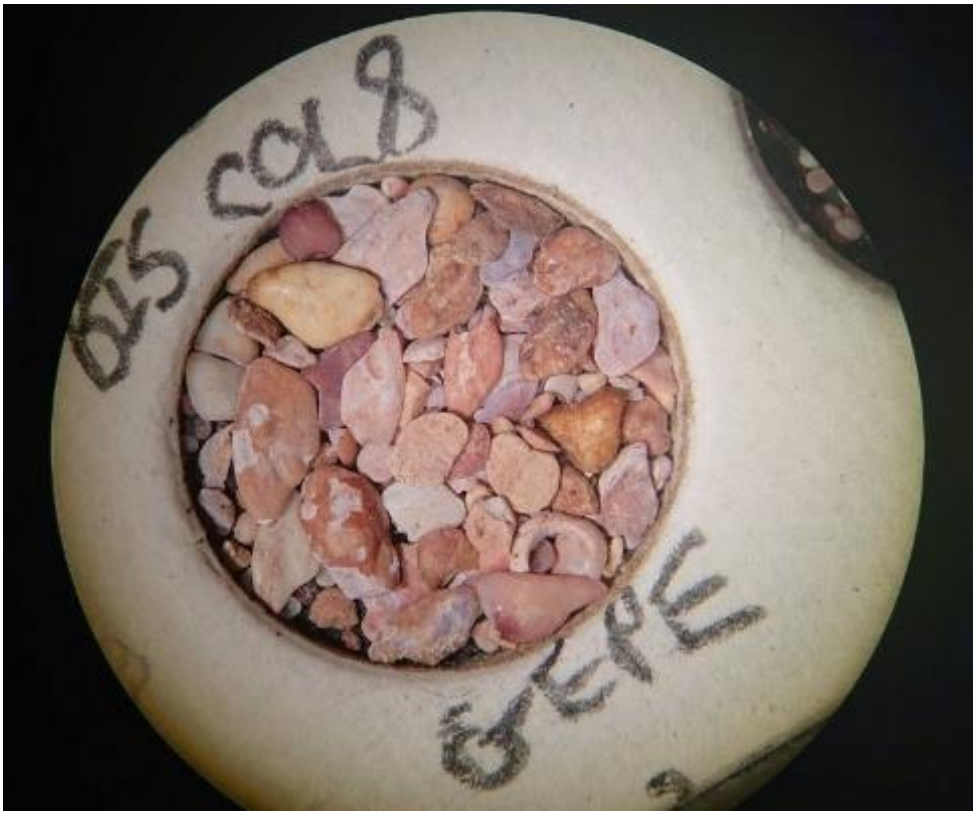
Giant petrel chick during a banding visit. *Image Credit: Megan Roberts*

Marine mammal monitoring continued with observations of large numbers of fur seals, rapidly declining elephant seal numbers, and sporadic leopard seal, crabeater seal, and Weddell seal sightings. Humpback and minke whale observations in the Palmer area decreased at the beginning of the month, with a slight increase in sightings and biopsy samples towards the end of the month. We observed a fin whale in the local area in late March, which is a relatively rare sighting.

A Fin whale sighted near Outcast Island. *Image Credit: Cimino group*

Sediment trap contents were collected from Adélie colonies on Torgersen Island, gentoo colonies on Biscoe Point, and chinstrap colonies on Dream Island in February. Processing of these traps continued into March. Sediment from the initial collection was brought into the lab where we began the process of extracting otoliths.

Sediment trap processing from start to finish. *Image Credit: Megan Roberts and Marissa Goerke*



After sorting, otoliths are collected for later processing. *Image Credit: Marissa Goerke*

We would like to thank Rebecca Shoop for the help and support she has offered as Station Manager to our group this season.

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

March was a productive month for science. As we wrapped up the summer season and dove into Fall, we continued to regularly sample Station E. After sampling aboard RHIB *Rigil* on 2 and 8 March, an abbreviated (0-35m) LTER sampling was conducted with an inflatable Zodiac on 19 and 22 March. On 29 March, sampling was achieved with the Landing craft (Fig. 1), our new primary sampling vessel.

Fig. 1 – C-019-P (Schofield) and C-045-P (Van Mooy) transitioned to sampling aboard the Marine Landing Craft to continue performing CTD and C-Ops casts to depths of 0-65m.

CTD profiles (Fig. 2) indicate that water temperatures from the surface to approximately 65m dropped towards the end of the month and fluorescence levels remained low at <1 mg m^{-3}. Chlorophyll values followed similar trends to the fluorescence data (Fig. 3).

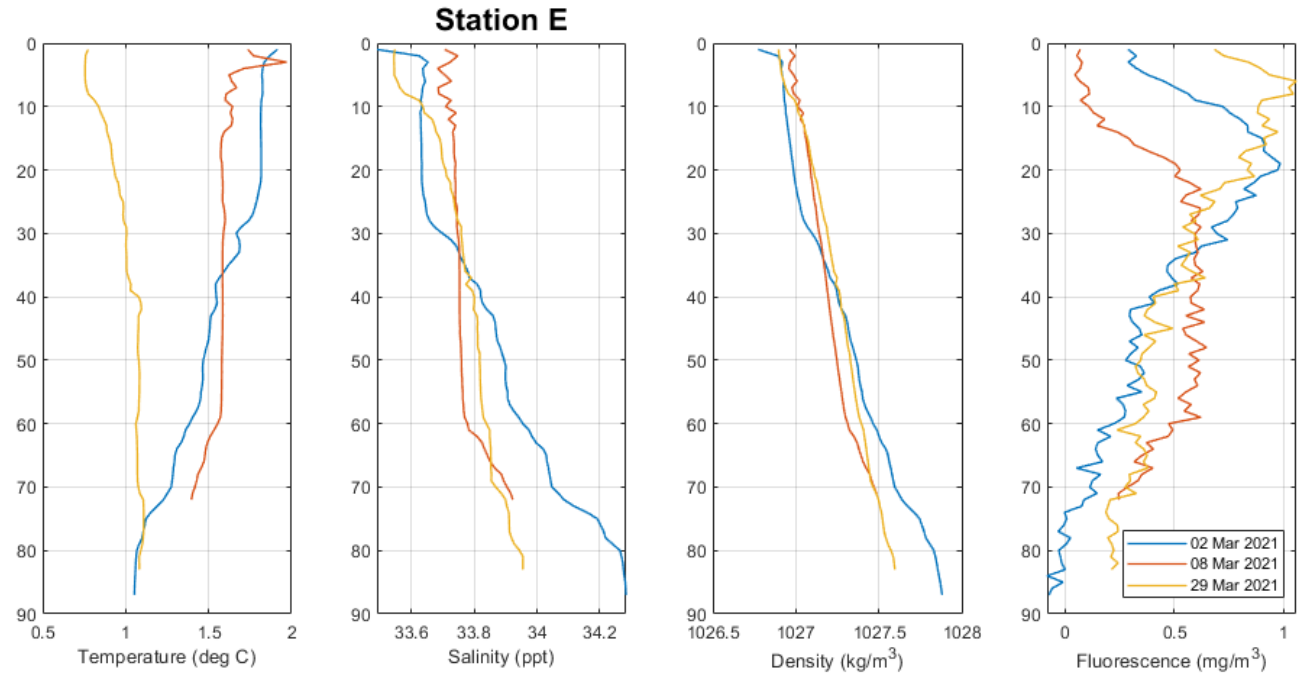


Fig. 2 – CTD profiles from LTER Station E on 2 March (blue line), 8 March (orange line), and 29 March (yellow line). From left to right, temperature (°C), salinity (ppt), density (kg m^{-3}), and fluorescence (mg m^{-3}).

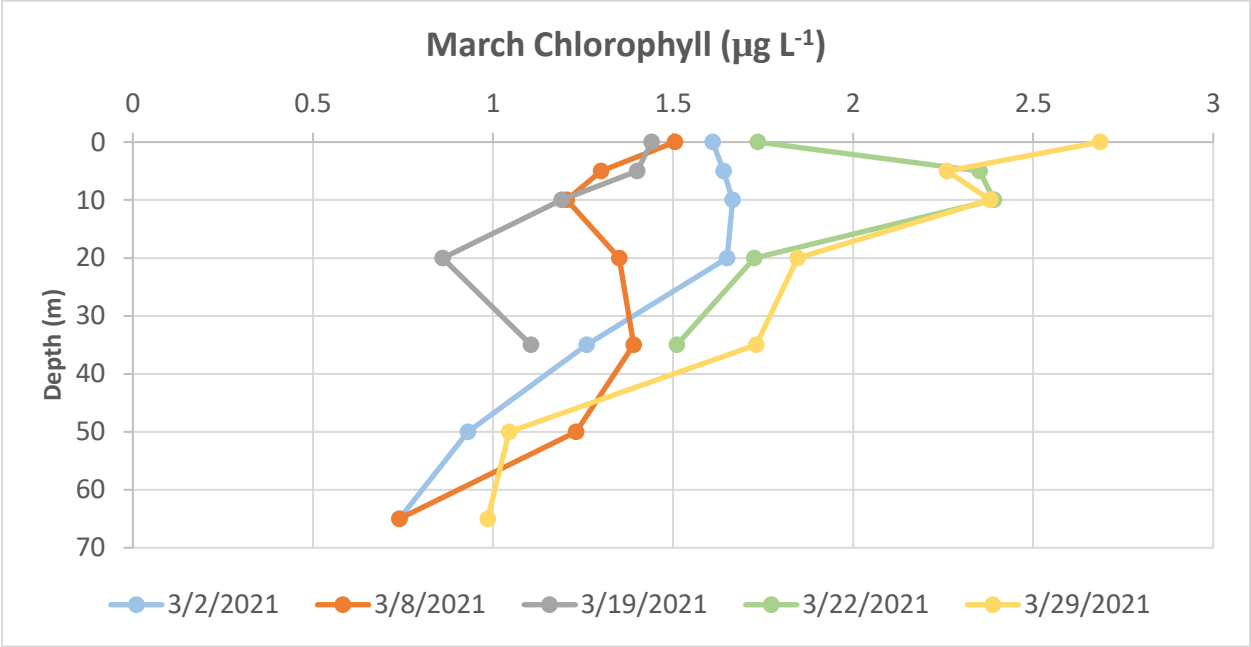


Fig. 3 – LTER Station E chlorophyll profiles for 2 March (blue line), 8 March (orange line), 19 March (gray line), 22 March (green line), and 29 March (yellow line).

Before we said goodbye to the RHIBs for the season, an Adélie transect (Palmer Canyon) and Gentoo transect (Bismarck Strait between Biscoe Point and the Wauwermans Islands) acoustic surveys were performed. Accompanying the acoustic surveys, net tows were performed throughout both regions, which resulted in very different zooplankton population counts than from the previous net tows in January (Fig. 4). Typically, the dominant krill species near Palmer Station is *Euphausia superba*, however, there were none found in these tows. Since we did not see any krill aggregates on the EK80 acoustic echosounder indicating *E. superba*, we performed

five untargeted net tows. These tows collected numerous *Thysanoessa macura*, two amphipods, and one polychaete. In addition, two 24-hour incubations and one 7-day incubation were performed in the month of March.

Fig. 4 – The metro net prepared to tow on the back deck of RHIB *Rigil*. *Image Credit: Mike Burns*

All of ASC are vital to our success, and we are thankful for their hard work. Again, our Lab Manager, Randy Jones, and our Marine Technicians, Ken Block and Mike Burns, are exceptional and allow science to keep going.

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

March was a stormy month as winter approaches Palmer, but we were able to maintain weekly LTER sampling at Station E despite the weather. Cell counts via flow cytometry show relatively stable populations across all depths, indicating a well-mixed water column and that the summer bloom is mostly over (Fig. 5). We look forward to seeing how this is reflected in the chemistry of the water column once we get the samples back to Woods Hole.

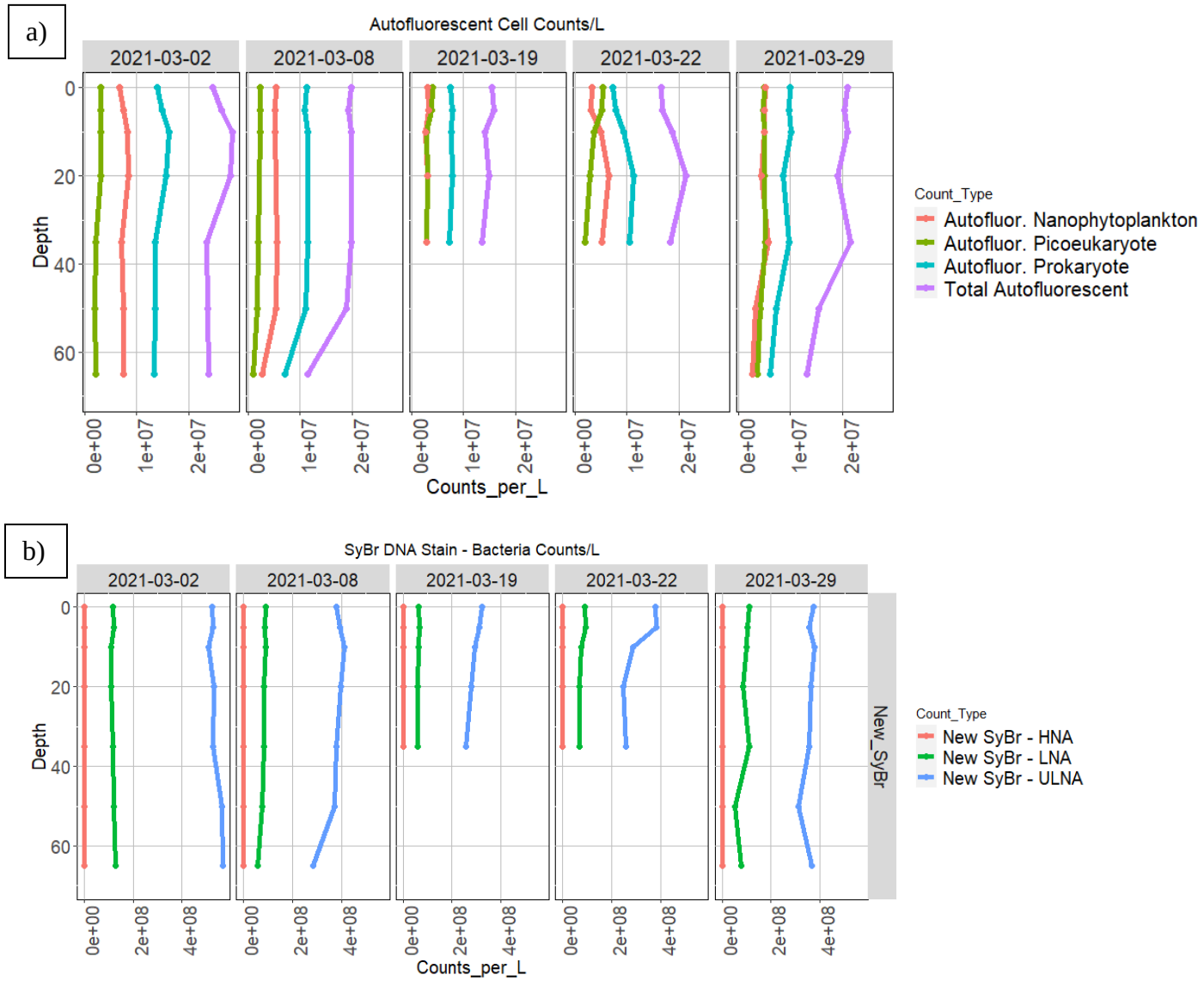


Fig. 5 – Autofluorescent (a) and bacterial (b) flow cytometric profiles (cell counts L^{-1}) in March at Palmer LTER Station E during weekly sampling via CTD and Niskin bottle.

Working with the C-019-P (Schofield) lab, we ran two 24-hour incubation experiments this month, collecting samples for cell counts, lipids, carbohydrates, photosynthetic efficiency, Imaging Flow CytoBot plankton identification, and pigments. The cell counts from these

experiments reflect different trends than those of our previous two experiments during February, possibly indicating different life strategies as the microbial communities overturn during shorter days, or reflective of community adaptations to disparate light levels at different sampling depths (Fig. 6). Disparities at later timepoints (48 and 72 hours, Fig. 6) indicate it may take more than one day for treatment-induced physiological and biochemical responses to have a significant effect on total cell counts.

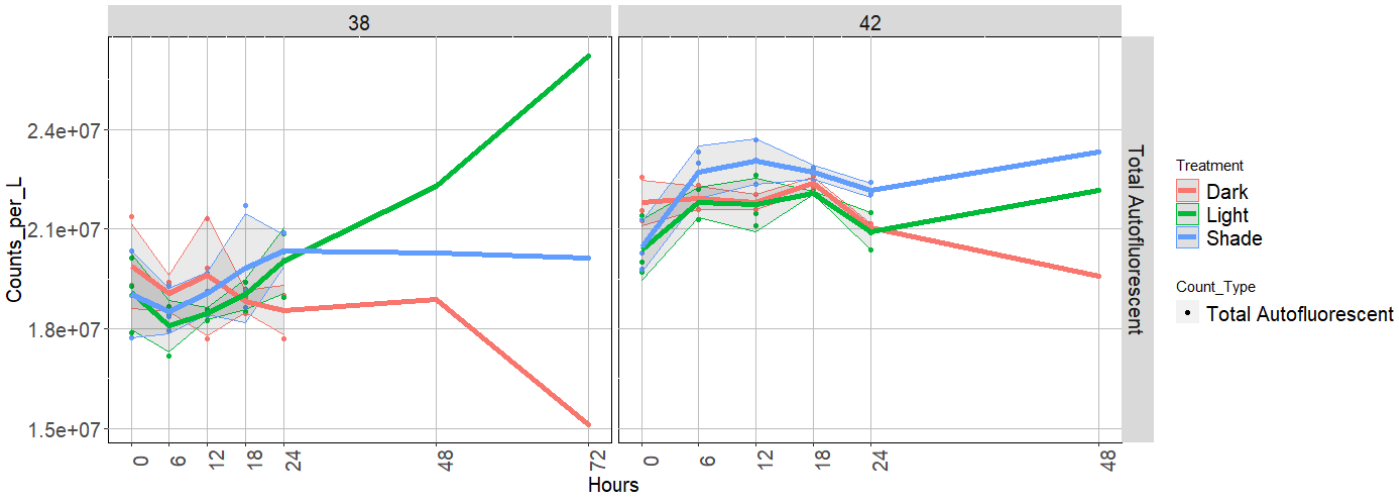


Fig. 6 – Autofluorescent flow cytometric cell counts (cell counts L^{-1}) from light-level incubation experiments run over 48 and 72-hour time scales. Water for Event 38 (left panel) was collected at the surface; water for Event 42 (right panel) was collected from 20m via monsoon pump.

We have maintained our paired sampling with C-019-P (Schofield) Imaging Flow Cytobot samples. We are excited to investigate the lipid, carbohydrate, and macronutrient biochemistry reflected in the dynamic flow cytometric cell counts of phytoplankton and bacterial populations observed throughout the month (Fig. 7). These fast-changing populations show that the Southern Ocean remains a dynamic and productive environment, even as the sunlight declines for the season.

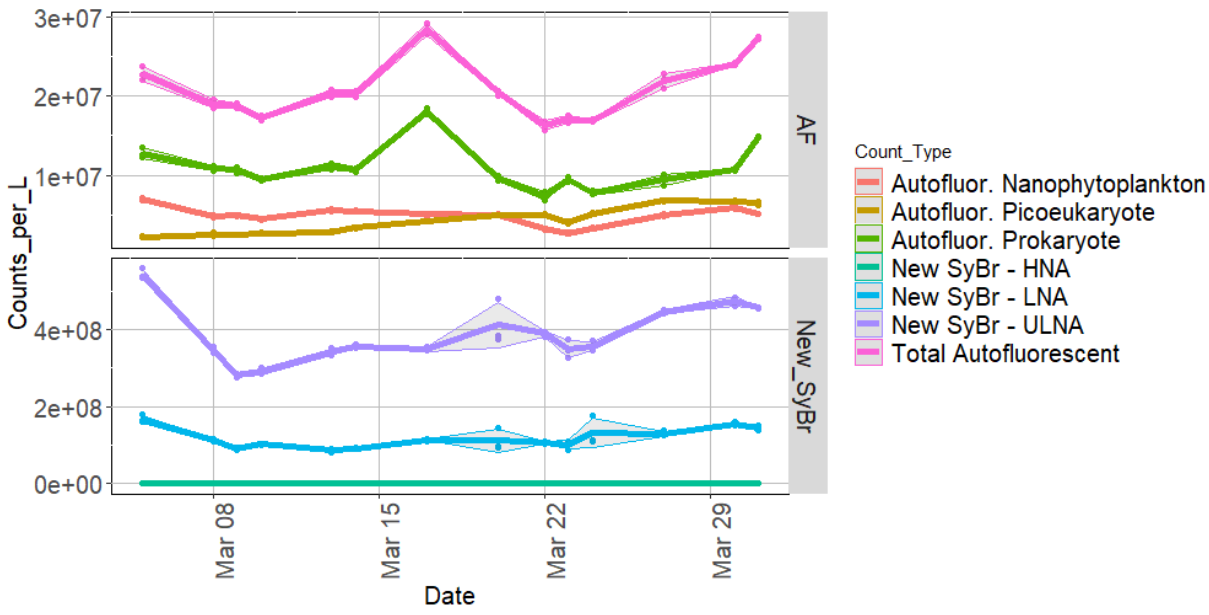


Fig. 7 – Flow cytometric cell counts (cell counts L^{-1}) of autofluorescent phytoplankton (AF) and bacteria (New_SyBr DNA stain) in Arthur Harbor during March 2021.

We were happy to be able to support a trip by the C-013-P (Cimino) group out to the Joubin Islands to assist with gentoo penguin fledgling measurements, and are very thankful for their support during two of our LTER Station E sampling days via Zodiac. Before RHIB *Rigil* was winterized for the season, we were also able to complete two more acoustic krill population surveys in collaboration with the C-013-P (Cimino), C-019-P (Schofield), and C-020-P (Steinberg) groups, gathering valuable late season data to enable year-to-year analyses.

We would like to thank Laboratory Manger Randy Jones, and Marine Technicians Ken Block and Mike Burns, all of whom worked tirelessly to enable science operations this month, and were always quick to adapt to changing weather and logistical needs to help us get on the water.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT
March 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. 8) 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.

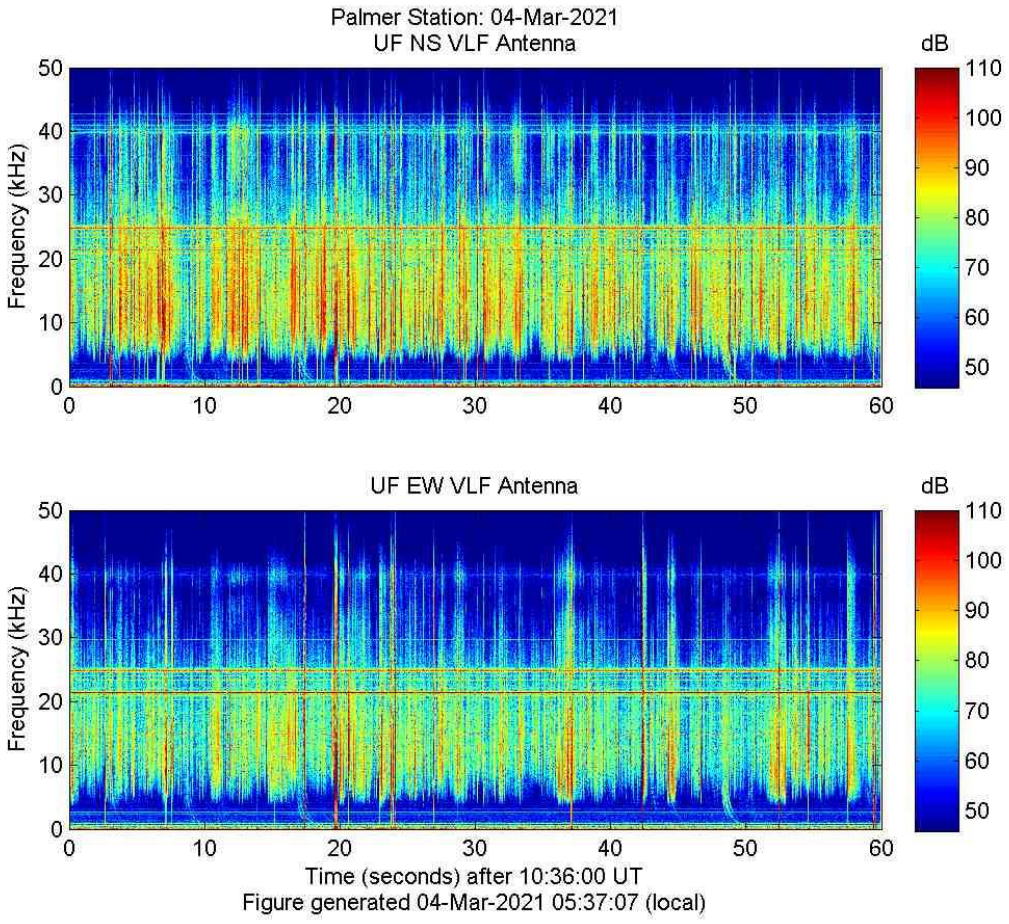


Fig. 8 – Real-time broadband ELF/VLF spectrogram from 4 March 2021. *Image Credit: University of Florida*

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.

Neither site was visited this month. One more trip is necessary to recover the SeaSonde (CODAR transmitter and receiver) from the Wauwerman Island location before the winter. 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.

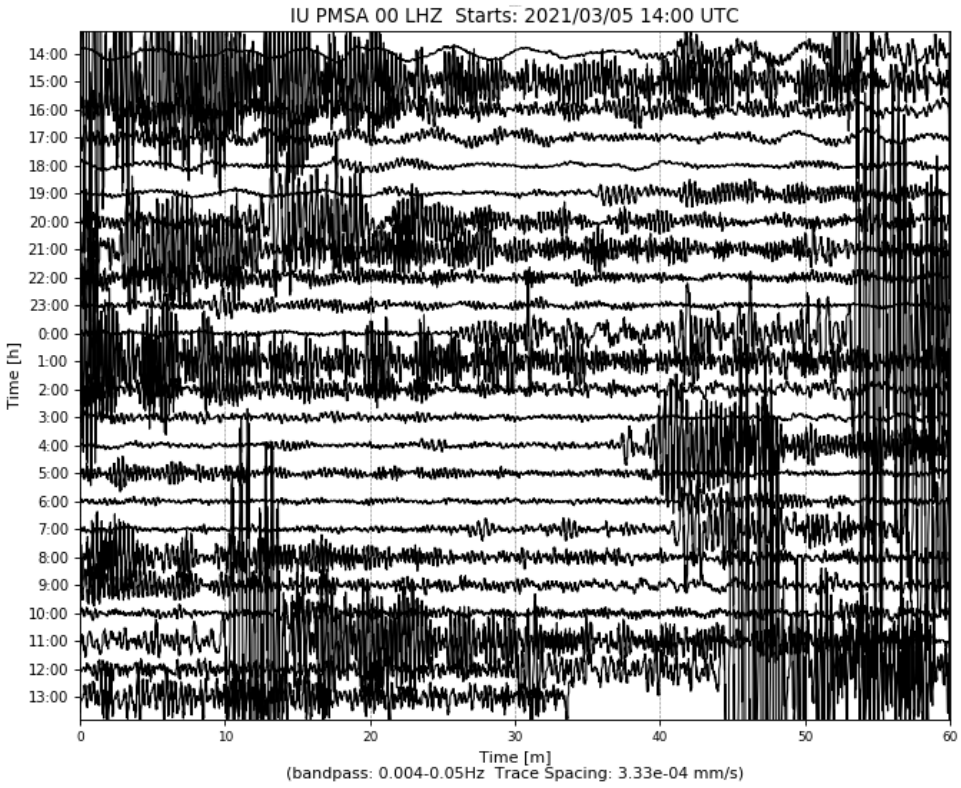


Fig. 9 – Several 6.0-6.5 magnitude earthquakes in the Kermadec Islands region (South Pacific Ocean, 800-1000km northeast of New Zealand's North Island) on 6 March 2021. *Image Credit: NASA Earthquake Hazards Program*

The system operated consistently throughout the month. The time stamp and seismic activity found on the heliplot was checked daily; see example in Figure 9. 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. 10).

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.

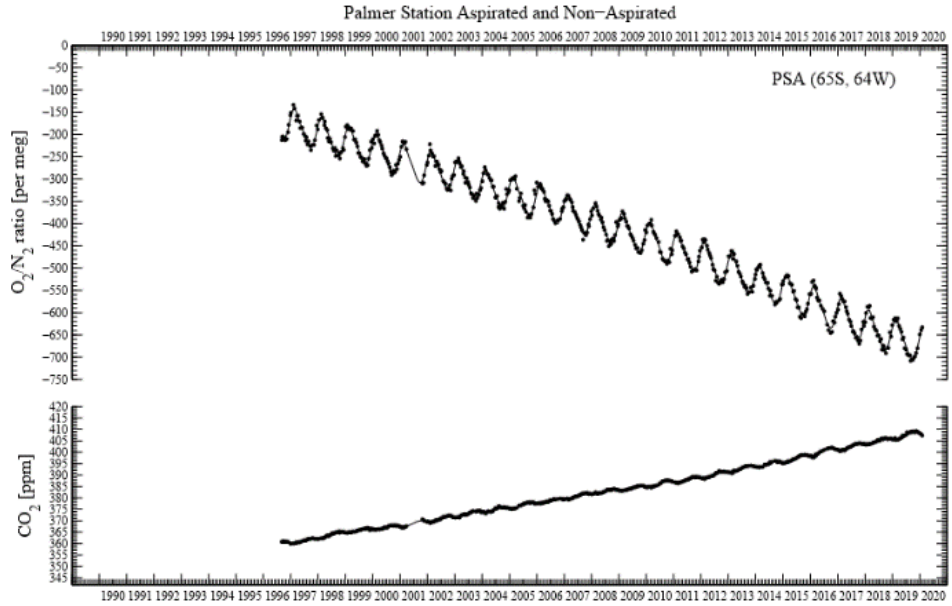


Fig. 10 – Historical plot of O_2/N_2 ratio per meg and CO_2 ppm updated on 29 July 2020. *Image Credit: UCSD Scripp's O_2 Program*

Air samples were collected on 15 March at 0923 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. 11 and 12). 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 March at 1226 local time, 8 March at 0742 local time, 15 March at 0735 local time, 23 March at 0809 local time, and 29 March at 0842 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/.

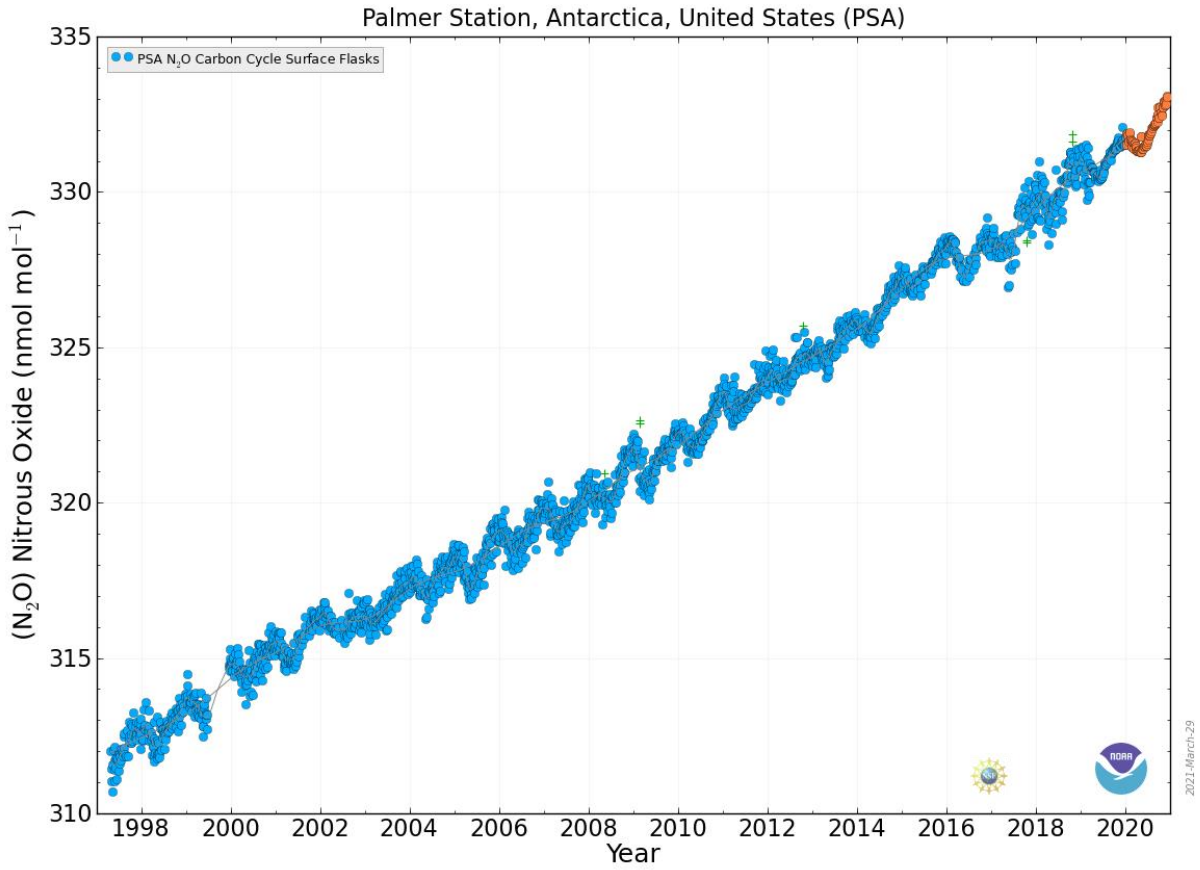


Fig. 11 – Historical NO_2 Levels (nmol mol^{-1}, ppb) at Palmer Station dating back to 1997. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

The Halocarbons and other Atmospheric Trace Species (HATS) samples were collected on 8 March at 0854 local and 24 March at 0825 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/.

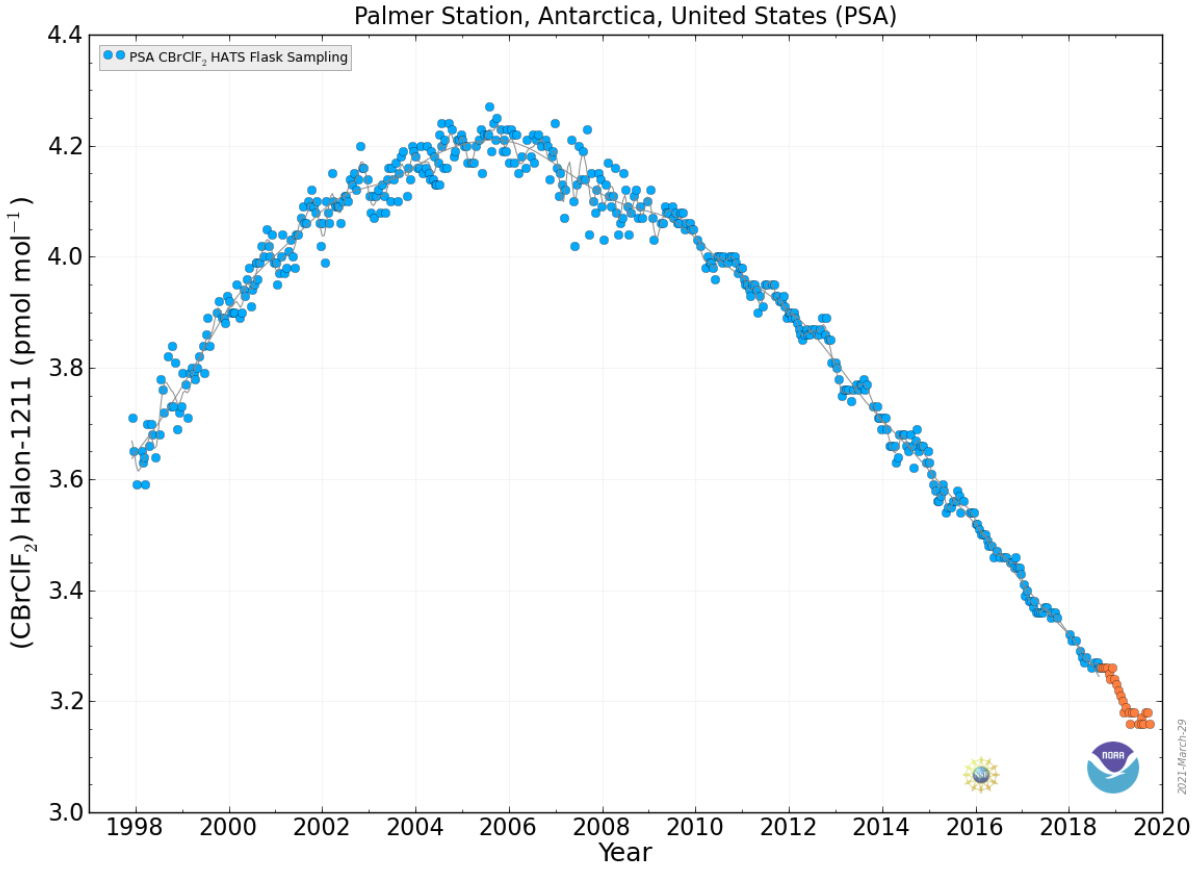


Fig. 12 – Historical measurements of Halon 1211 (CBRCLF2) dating back to 1997, one of the halocarbon and trace gases measured at Palmer Station. Orange dots are preliminary data. *Image Credit: NOAA Global Monitoring Laboratory*

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. 13).

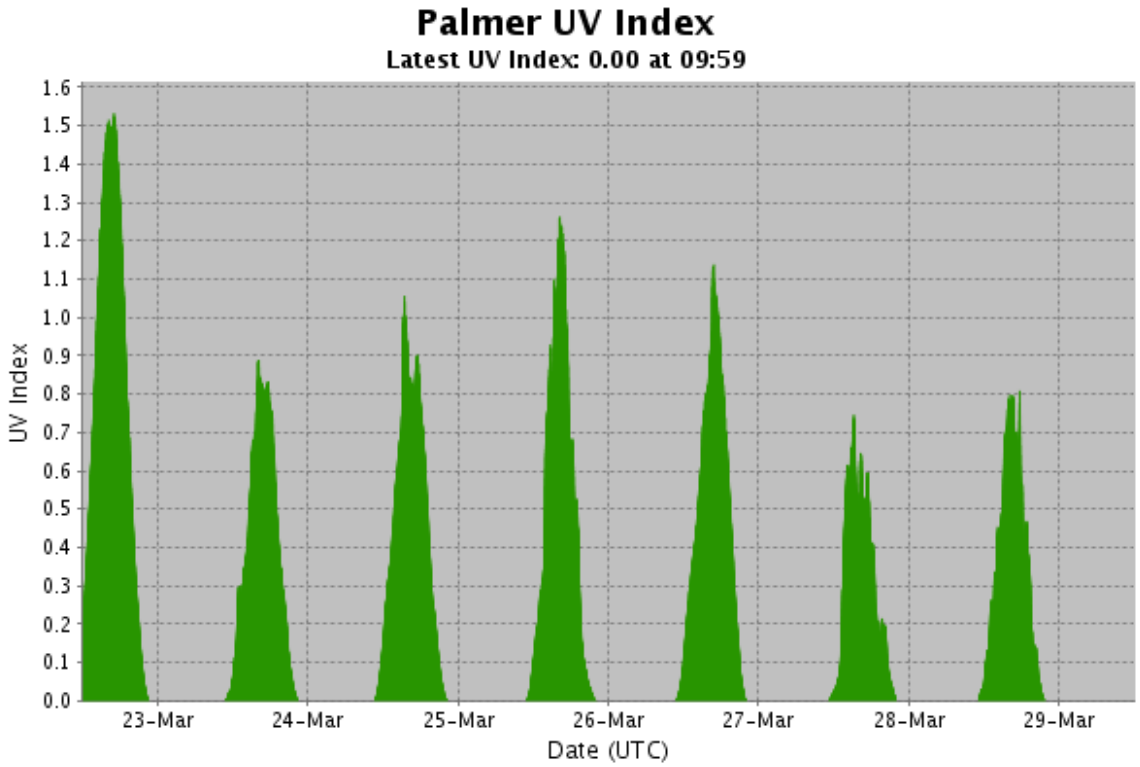


Fig. 13 – UV index generated from the GUV-511 radiometer in real time between 22 March and 29 March. *Image Credit: NOAA Earth Systems Research Laboratory*

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 was performed on 12 March 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. 14).

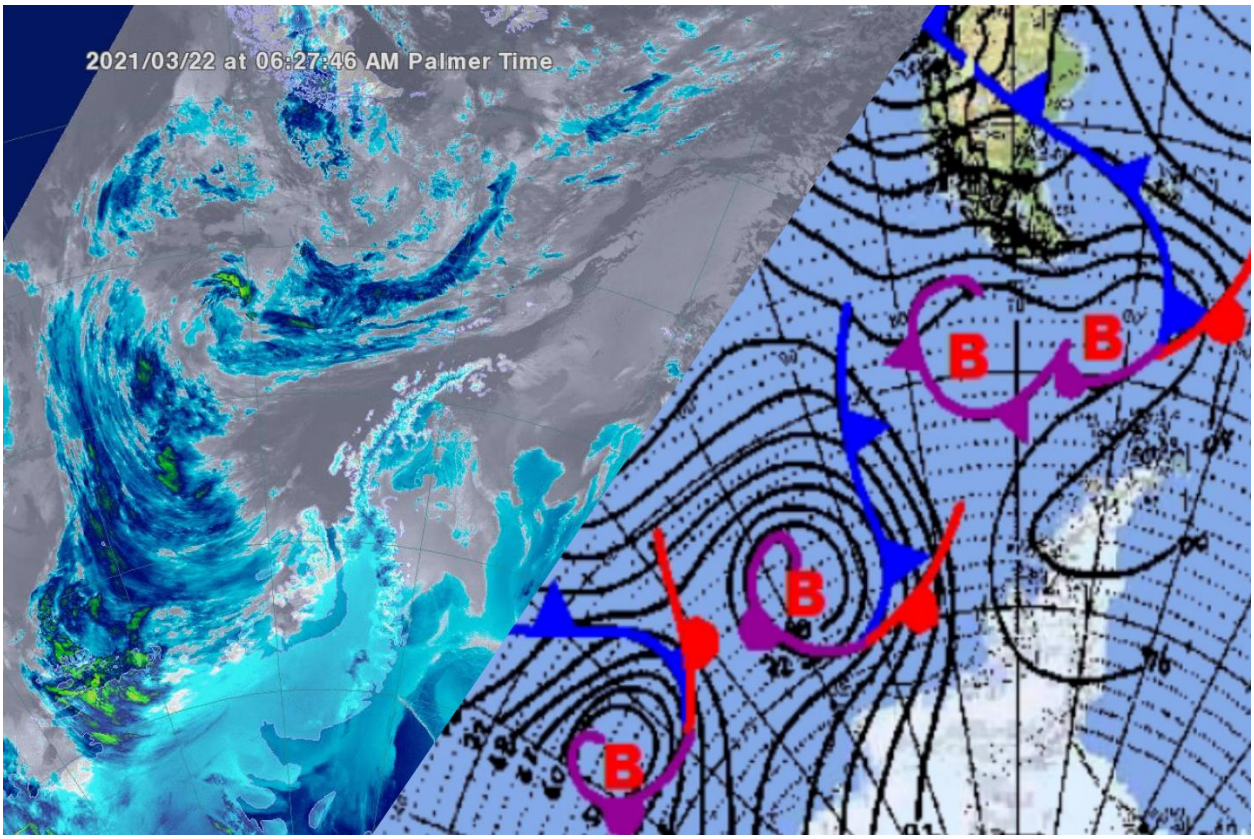


Fig. 14 – NOAA-19 satellite pass from 22 March 2021 (left panel) compared with an occluded front passing over Palmer Station (right panel; Chilean Army Meteorological Chart).

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.

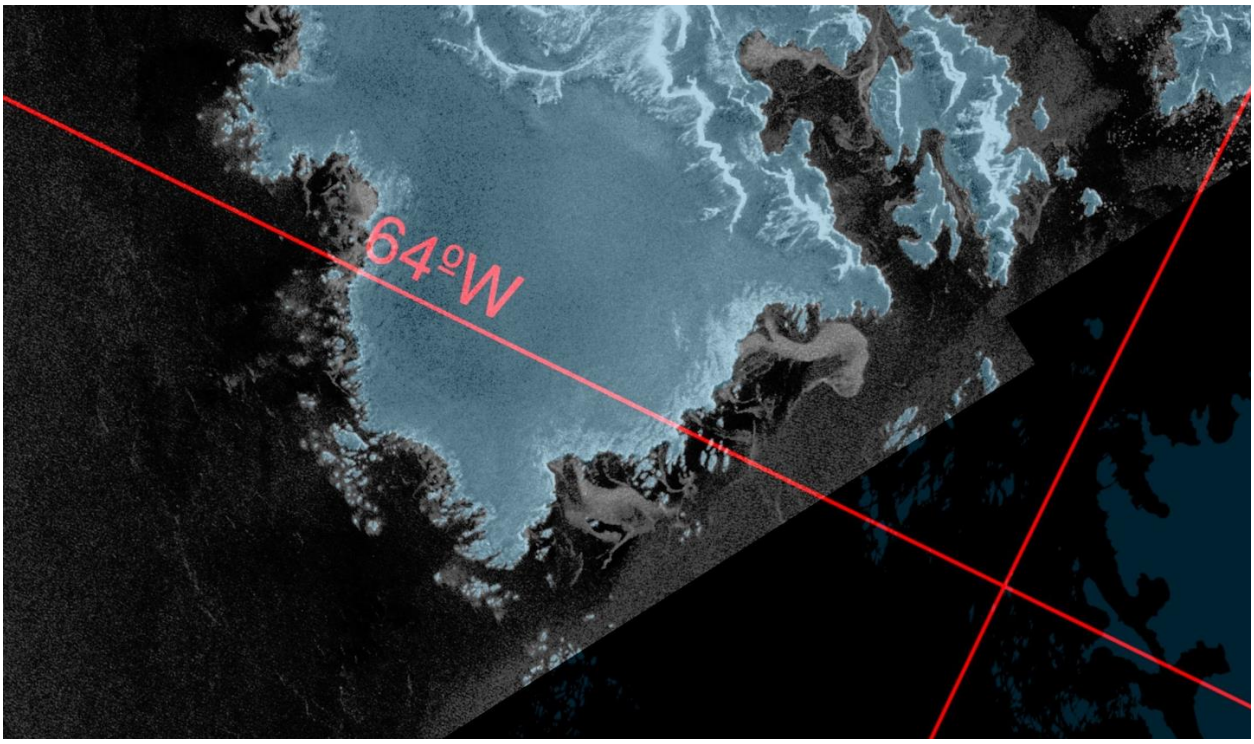
Data collected by Palmer's RASA unit is relayed in real-time via a virtual private network (VPN) back to the CTBT Organization (CTBTO) in Vienna. As of August 2006, both the RASA and seismic systems have been certified by CTBTO. Palmer is now officially part of the IMS. The automated RASA continually 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 21 March 2021. *Image Credit: EC Copernicus data/ESA/CMEMS/Polar View*

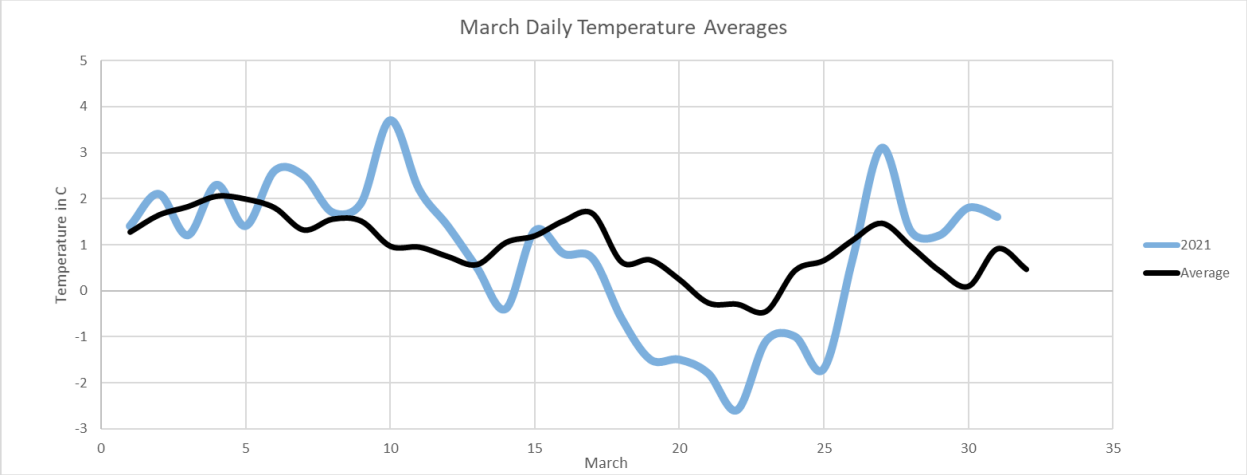
METEOROLOGY
Mike Carmody, Principal Investigator, United States Antarctic Program

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.

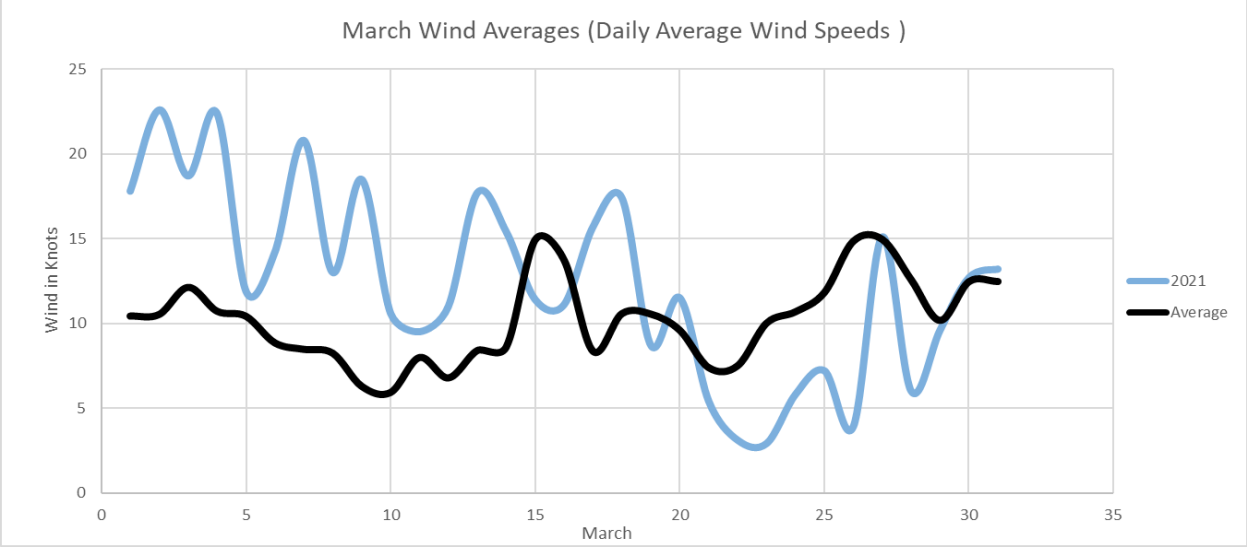
The Research Associate acts as Chief Weather Observer on station measuring, compiling, and distributing all meteorological data. Snow accumulations are physically observed by taking an average of five accumulation stakes found near the PAWS system. All weather data is archived locally and forwarded once 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 operated intermittently throughout March for unknown reasons. AWS2 was visited, during which time the station would not communicate and was not fixable in the field. A spare was prepped to replace AWS2, but issues arose in the radio configuration setup step and have not been resolved yet. 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/.



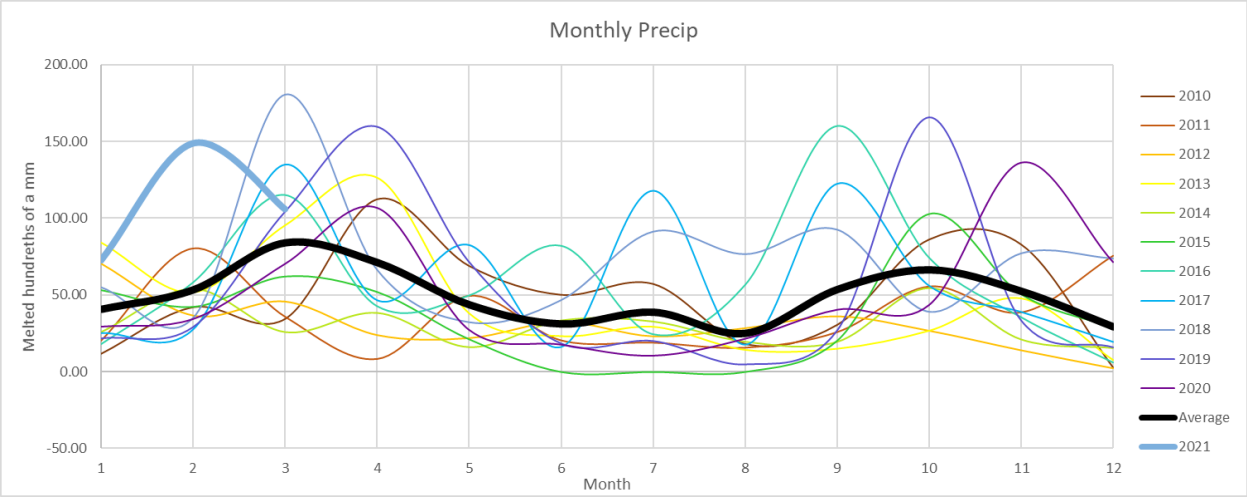
Daily temperature averages for March 2021 (blue line) and how they compare with the average for the last ten years (black line). *Image Credit: Marissa Goerke*

March was a relatively average month as compared with the ten year temperature average.



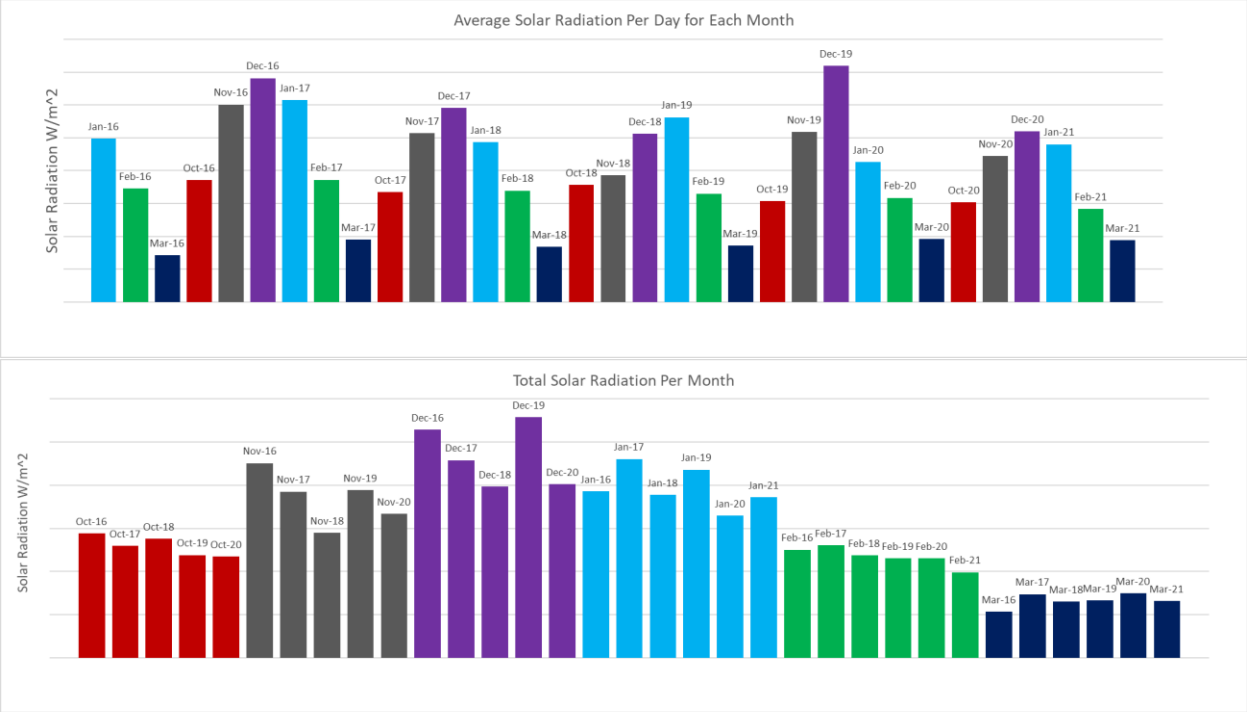
Daily average wind speeds for March 2021 (blue line) and how they compare with the average for the last ten years (black line). *Image Credit: Marissa Goerke*

Daily average wind speed was higher than the ten year average during the first half of the month.



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

March received slightly above the ten year average amount of precipitation. Unlike the previous month of February, this was not record setting.



Average monthly solar radiation between January 2016 and March 2021 (including summer months); top panel organized chronologically and bottom panel organized by month. *Image Credit: Marissa Goerke*

The above figures depicts the average monthly solar radiation measured at Palmer Station (measured daily and averaged to the monthly). This graph shows the past five and half summer seasons since the pyranometer was installed in the meteorological suite.

Palmer Monthly Met summary for March, 2021

Temperature
Average: 0.8 °C / 33.5 °F
Maximum: 6.5 °C / 43.7 °F on 10 Mar 17:02
Minimum: -5.2 °C / 22.6 °F on 22 Mar 08:36
Air Pressure
Average: 979.9 mb
Maximum: 1004 mb on 24 Mar 12:12
Minimum: 948.3 mb on 11 Mar 02:39
Wind
Average: 12.4 knots / 14.3 mph
Peak (5 Sec Gust): 48 knots / 55 mph on 4 Mar 01:11 from NNE (29 deg)
Prevailing Direction for Month: NNE
Surface
Total Rainfall: 105.9 mm / 4.17 in
Total Snowfall: 23 cm / 9 in
Greatest Depth at Snow Stake: 7.0 cm / 2.7 in
WMO Sea Ice Observation: 1-6 icebergs with growlers and bergy bits
Average Sea Surface Temperature: 0.88 °C / 33.6 °F