

PALMER STATION MONTHLY SCIENCE REPORT

DECEMBER 2019



A humpback whale fluke rises from the water. Humpbacks started appearing in increased numbers during the month of December. *Image Credit: Nicholas Mehmel*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

Sea ice conditions reduced spatial coverage and shifted south of the region to allow small boat operations to commence in earnest over the second half of this month. Warming temperatures and limited periods of increased winds during the week of December 16th created a rapid decline in sea ice coverage across the boating area. Grantee and recreational users have been out across the standard and extended boating regions as a result of the change, and it has been much appreciated.

The B-027-P (McClintock) group arrived to Palmer Station on 8 December 2019, and setup their laboratory, dive locker, and aquarium spaces for supporting their ocean acidification experiments in the Aquarium Room. The B-198-P (Weissburg) and ASC Hazardous Waste Team departed Station on ARSV Laurence M. Gould on 16 December 2019 after productive seasons. There have been a myriad of preparations for the LTER cruise, which will be occurring in January and February 2020. Also, we are preparing for the arrival of B-005-P (Kohut), C-020-P (Steinberg), and C-024-P (Friedlaender), along with many other personnel for other groups in early January.

Lastly, station members were treated to a Terra Lab open house on 10 December 2019. Research Associate Marissa Goerke hosted the event, with guest appearances of R-938-P (Maughmer) grantees, Kevin Bliss and Rachel Cook. Marissa gave tours through the building and spoke about the many projects supported by her position.

DECEMBER 2019 WEATHER

Marissa Goerke, Research Associate

Temperature
Average: 0.8 °C / 33.4 °F
Maximum: 6.8 °C / 44.2 °F on 22 Dec 18:54
Minimum: -3.9 °C / 25.0 °F on 17 Dec 05:11
Air Pressure
Average: 989.3 mb
Maximum: 999.6 mb on 1 Dec 19:52
Minimum: 966.4 mb on 23 Dec 14:34
Wind
Average: 4.7 knots / 5.4 mph
Peak (5 Sec Gust): 52.0 knots / 60.0 mph on 21 Dec 18:01 from ENE (74 deg)
Prevailing Direction for Month: SE
Surface
Total Rainfall: 17.0 mm / 0.7 in
Total Snowfall: 1.0 cm / 0.4 in
Greatest Depth at Snow Stake: 68.0 cm / 26.5 in
WMO Sea Ice Observation: Over the month, reducing from 8/10 to <3/10 young ice, brash, growlers, bergy bits, and bergs
Average Sea Surface Temperature: -0.04 °C / 31.90 °F

The average temperature in December was 44.2° F and averaged 33.4° F. Sea ice remained in the area until mid-December when a several day north wind event cleared the waters. We lost most of the accumulated snow.

B-027-P: ASSEMBLAGE-WIDE EFFECTS OF OCEAN ACIDIFICATION AND OCEAN WARMING ON ECOLOGICALLY IMPORTANT MACROALGAL-ASSOCIATED CRUSTACEANS IN ANTARCTICA.

James McClintock and Charles Amsler, Principal Investigators, University of Alabama at Birmingham

Personnel on station: Charles Amsler, Margaret Amsler, Hannah Oswald, and Julie Schram.

December was a busy month devoted to preparing for our project's main ocean acidification experiment, which we expect to initiate in mid-January. One major focus of our activities has been setting up for the experiment in the aquarium. This has involved constructing and plumbing 24 sets of mixing tanks and experimental buckets, which we did with expert guidance from Facilities (FMC). The FMC staff constructed supports and provided electrical wiring for our pH control solenoids and computer interfaces, as well as for our water heaters and temperature controllers. They also installed gas-tight acrylic windows in the lids of our experimental buckets. By month's end, we were testing out two alternative water distribution systems to the buckets and preparing to start installing and calibrating the 24 independent pH sensors and controllers.



B-027-P main ocean acidification experiment setup in progress. *Image Credit: McClintock group*

On the outside aquarium deck we plumbed two ‘mesocosm’ tanks with assistance from the Laboratory Supervisor and seeded them with benthic diatoms collected by scuba diving. Once a diatom biofilm was established, we added portions of six individuals of the large brown macroalga *Desmarestia menziesii* as well as additional benthic diatoms. These six individual *D. menziesii* will provide natural structure for amphipods in the experiment and the benthic diatoms (which are becoming established on them in the mesocosm tanks) will serve as a main food source for the amphipods. Additional *D. menziesii* will be collected and serve as the source of the amphipod assemblages for the experiment.

In the laboratory, with assistance from the Instrument Technician, we have setup and calibrated the two main instruments which will be used for daily monitoring of seawater carbonate chemistry during the experiment. These are a titrator to measure alkalinity and a spectrophotometer with water-jacket-temperature-control to measure pH.

Although heavy brash ice prevented boating for our first week or so on station, we were able to make our gear-checkout SCUBA dives from the floating dock on 15 December 2019. During the month, we made a total of 15 dives over eight days for the *Desmarestia* and diatom collections noted above, as well as to scout sites for these and subsequent collections and to familiarize a new project member with our dive tending protocols.

We are grateful for the generous and professional assistance of numerous ASC staff in assisting with our activities. Laboratory Supervisor Randy Jones and Instrument Technician Carolyn Lipke have provided outstanding support as well as insightful experimental setup ideas in the aquarium and lab. The entire FMC staff has provided valuable ideas for the construction of our experiment, but Carpenter Ian Mannix in particular and also Electrician Jeff Deckard provided substantial hands-on construction and wiring support, respectively. The Palmer MTs, Mike Burns, Patrick Riley, and Otto Neumuth, facilitated our boat diving activities.

C-013-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

Dr. William R. Fraser, Principal Investigator, Polar Oceans Research Group

Personnel on station: Megan Roberts, Darren Roberts, Anne Schaefer, Leigh West

Ice conditions improved throughout December allowing for boat based field work on 19 days of the month. We continued the daily monitoring of nesting Adélie penguins on Humble and Torgersen Islands, as well as maintaining regular censuses of all local Adélie colonies. We completed several trips to Dream Island to conduct Adélie and chinstrap penguin counts, and to Biscoe Island for Adélie and Gentoo penguin counts.



Giant petrel surveys on Laggard Island. *Image Credit: Fraser group*

A full island census was completed during December for chinstrap penguins on Dream Island and for gentoo and Adélie penguins on Biscoe Point. Preparations for the Humble Island Adélie penguin radio transmitter project continued; equipment was installed on Humble Island and remote data collection and transfer was tested. We prepared for the deployment of satellite transmitters and dive depth recorders on Adélie and gentoo penguin, and began tagging Adélie penguins at Humble Island. Diet sampling began at Torgersen Island.

Skua work continued this month as we began checking nests for newly hatched brown skua chicks on local islands as well as on Dream and Biscoe Islands. Our south polar skua mark-recapture and breeding monitoring study on Shortcut Island continued with nest initiation checks and band recording. Our census of the Blue-eyed shag colony on Cormorant Island continued with the first chicks of the season observed in early December. A gull survey was completed at all local kelp gull colonies as well as on Dream Island.



Gentoo penguin surveys at Biscoe Point. *Image Credit: Fraser group*

Our all-island census of giant petrel nests was started in December; breeding pairs were identified and new breeders were banded. Foraging ecology studies of giant petrels were also conducted in December with satellite transmitter deployments at Shortcut and Humble Islands.

We would like to thank Electrician Jeff Deckard for his expertise, enthusiasm, and assistance insuring that the Humble Island receiver was in working order for the 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 currently on station: Katherine Hudson and Rachael Young

On 9 December 2019, University of Delaware Ph.D. candidate, Katherine Hudson, joined the C-019-P (Schofield) Lab. She will be with C-019-P and assisting B-005-P (Kohut) until mid-March 2020.

December was an incredibly productive month for us despite the ice preventing us from sampling 8-15 December. Since the beginning of the season, Station B has been sampled seven times and Station E five times due to dense ice. Figure 1 illustrates the integrated chlorophyll concentrations observed during December sampling events. Just before the holidays, we observed the start of the summer phytoplankton bloom on 23 December 2019 (Fig. 2).

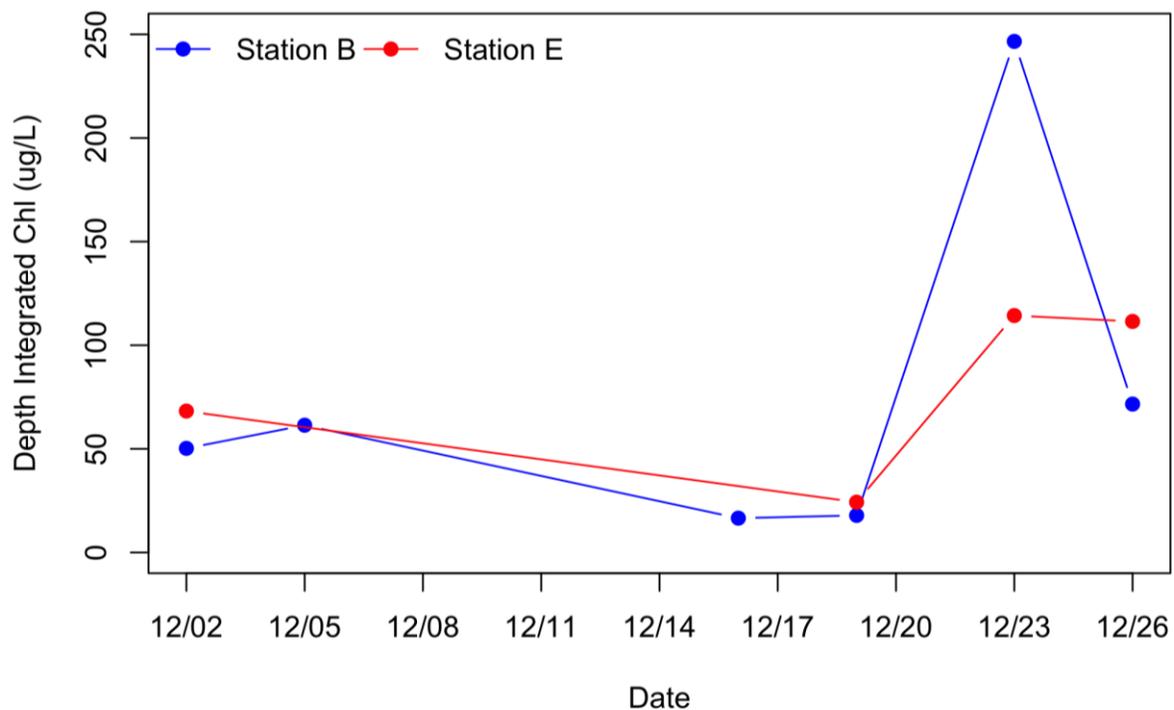


Fig. 1 – Depth-integrated chlorophyll concentrations ($\mu\text{g L}^{-1}$) for each sampling event at Stations B (blue) and E (red) during the month of December 2019.

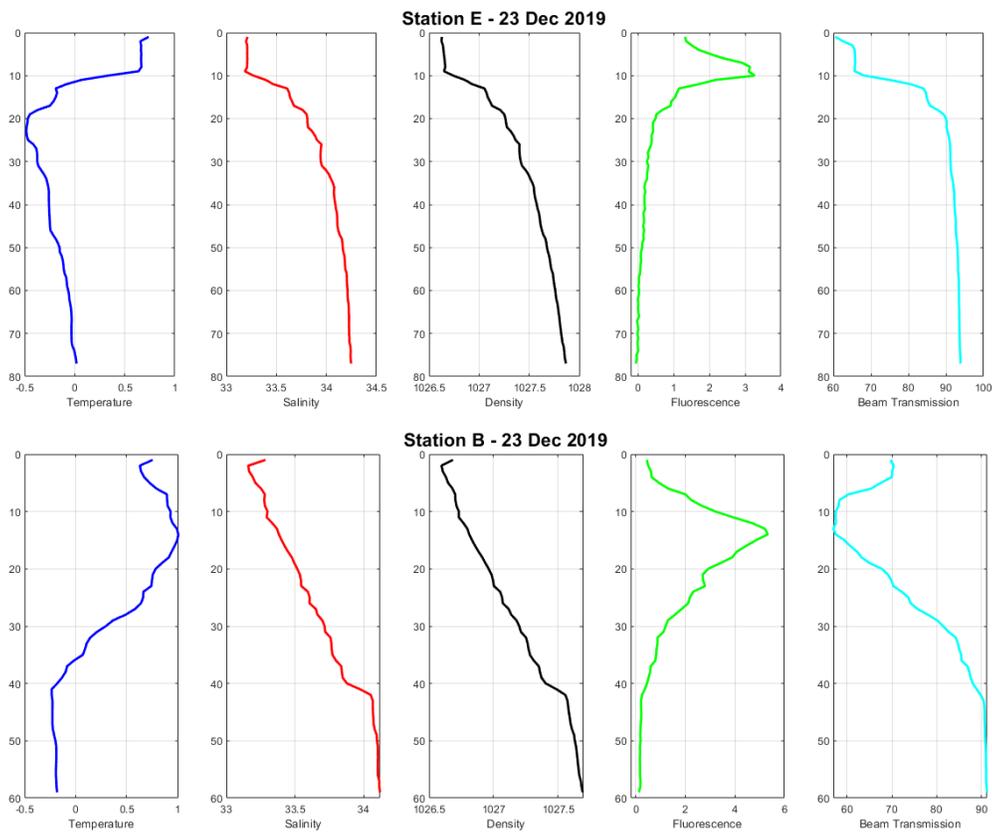


Fig. 2 – CTD profiles from Stations E (top row) and B (bottom row) from 23 December 2019. This date corresponds to the start of the phytoplankton bloom observed in Figure 1.

In addition to bi-weekly sampling at Stations E and B, the first collaborative acoustic surveys of the season were performed this month (Fig. 3). A total of three surveys were conducted. Two surveys were conducted on 25 December 2019 and 1 January 2020 within the Adélie penguin foraging region at Palmer Canyon. The third survey at between Biscoe Island and Wauwermans Islands was conducted on 31 December 2019 within the gentoo penguin foraging region. Over each transect, five CTD casts were collected along with data from the EK80 echosounder to measure krill abundance combined with predator observation surveys. Humpback whales, in addition to gentoo and Adélie penguins, were abundant during these surveys. The goal of these surveys is to examine the link between mixed layer dynamics and krill and predator distributions.



Fig. 3 – Chart of the two different acoustic survey lines occupied (left image). The magenta line illustrates the transect line in the Adélie penguin foraging region over Palmer Canyon and the green line illustrates the transect line in the gentoo penguin foraging region between Biscoe Point and Wauwermans Islands. White squares represent CTD stations for each transect line. Rachael Young, Katherine Hudson, and Marine Technician Mike Burns deploy a CTD on the first transect of the season in the Adélie penguin foraging area (right image; Image Credit: Patrick Riley).

Daily Imaging FlowCytobot (IFCB) samples continue to illustrate the great diversity of phytoplankton near the pumphouse. Several diatom species were observed in daily samples (Fig. 4), and diatom densities have increased in the past two weeks, illustrating the beginning of the summer diatom bloom.

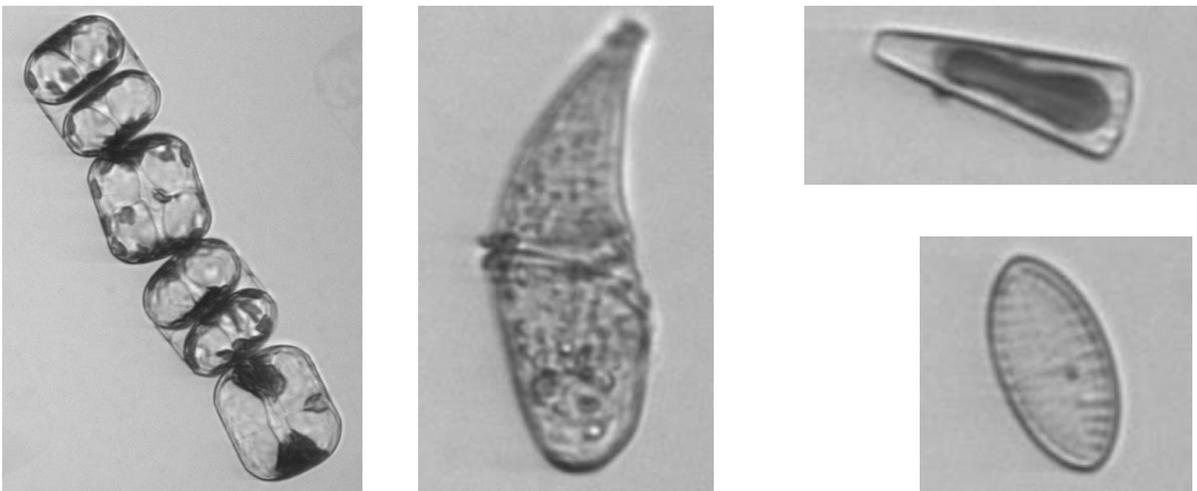


Fig. 4 – A subsample of species observed in IFCB samples from the pumphouse: *Thalassiosira* chain (left), *Gyrodinium* spp. (center), *Cocconeis* spp. (top right), and *Licmophora* spp. (bottom right).

In addition to regular sampling efforts, we conducted a trial run of an incubation experiment for Ph.D. student, Quintin Diou-Cass, who will be conducting experiments on the LTER cruise and at Palmer Station following the cruise. These experiments will test the effect of light levels on phytoplankton community dynamics.

We want to say a huge thank you to our Marine Technicians, Michael Burns, Otto Neumuth, and Patrick Riley, for assisting us in getting safely to our sampling locations and helping to bring Katherine Hudson up to speed on boating operations! We are also thankful to Laboratory Supervisor, Randy Jones, and Instrument Technician, Carolyn Lipke, for being a constant support and without whom sampling would not be possible. We are so grateful for the rest of the ASC staff as well, who keep the station and science operations running smoothly. We are excited to enter peak sampling season and for team members Schuyler Nardelli and Quintin Diou-Cass to join us on the ice soon!

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

Dr. Hugh Ducklow, Principal Investigator, Columbia University, Lamont Doherty Earth Observatory

Personnel on Station: Nick Mehmel

C-045-P (Ducklow) finally got reliable access to Stations B and E following a very icy November 2019. Seas were notably calm and ice-free for the majority of the month, with the exception of Monday, 23 December 2019 which brought 25+ knot winds and ~2 meter swells. Total abundance counts (of SYBR Green stained cells) remained relatively constant throughout the month, hovering between 100,000 and 700,000 cells per mL (Fig. 5). Seasonal variability in years past often ranged from 100,000 to 2,000,000 cells per mL. A spike in total abundance is still expected to occur within the next few weeks, following a local phytoplankton bloom. On most sampling days, the total abundance and total autofluorescence counts peak at 5-10m, and dip once again at the surface (Fig. 6).

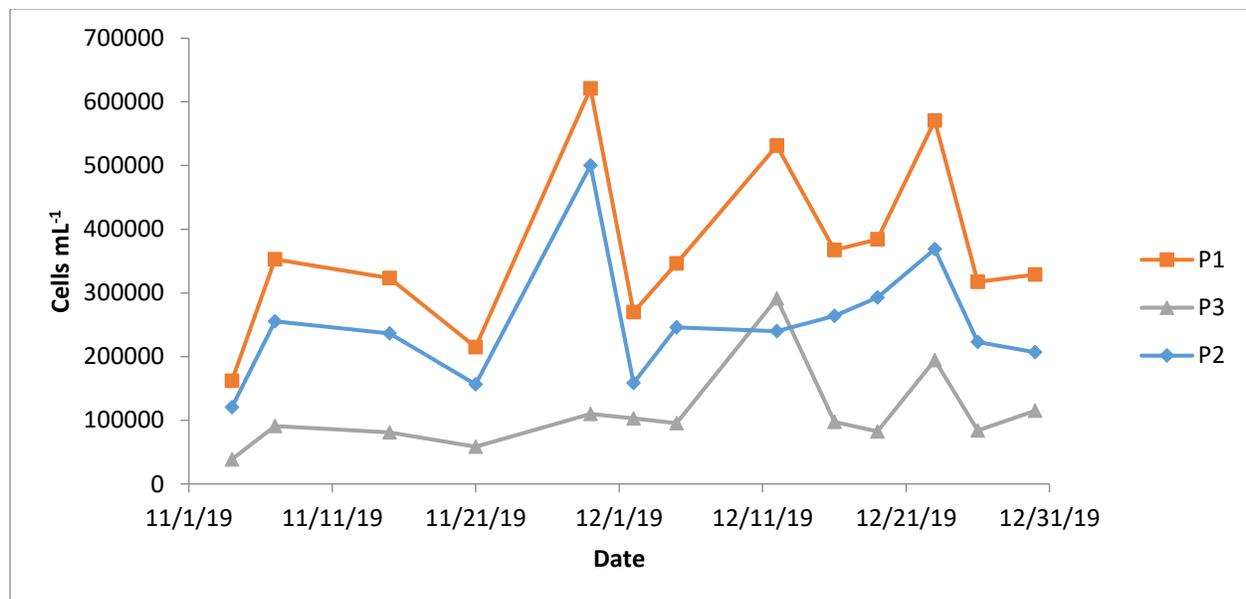


Fig. 5 – Total abundance counts (SYBR Green; cells mL⁻¹) at Station B from FCM experiments. P1= total cell count, P2= high HNA cells, P3= low HNA cells. The total abundance at Station B remained relatively constant throughout the month.

Our single team member, along with C-019-P (Schofield; phytoplankton LTER group) began bi-weekly scheduled echosounder transects to monitor krill pods and predator behavior in the local marine environment. These transects take place within the Palmer Station extended boating area and are intended to cover known Adélie and gentoo foraging regions. Each transect covers 20 nautical miles at 5 knots using an EK-80 echosounder, and deploys 5 CTD casts, making up a full 8 hour day on the RHIBs. The Palmer Station LTER group will not be performing any work in the Radioisotope Laboratory during the 2019-20 season, so they may allocate more time towards transect work.

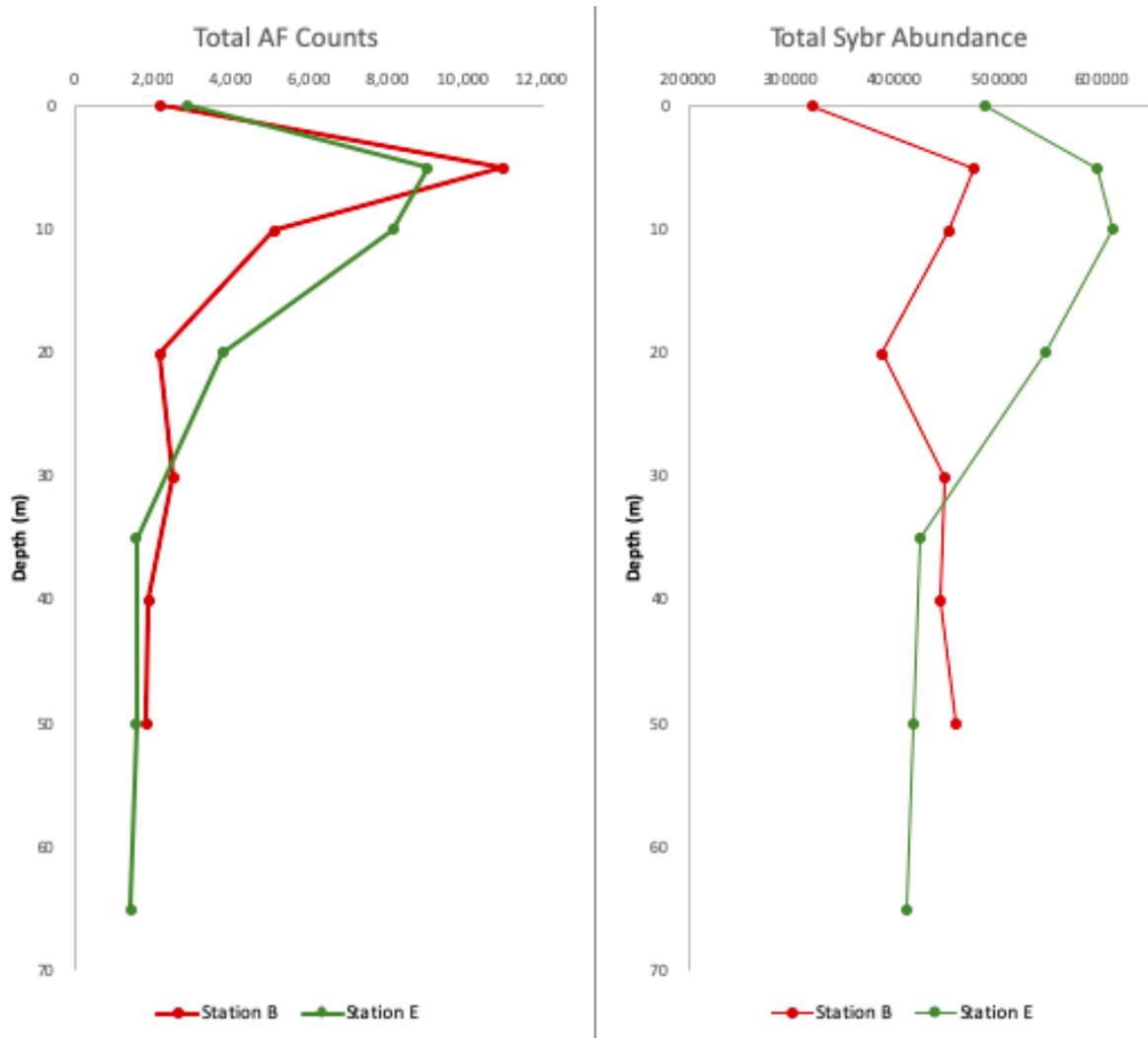


Fig. 6 – Typical depth profiles for both autofluorescence (left), and SYBR Green total abundance (cells mL⁻¹) from Stations B and E (right).

Other than flow cytometer data, several quantitative and qualitative observations this month indicate significant changes to the marine environment surrounding Palmer Station. Water temperatures have increased significantly, reaching as high as 2°C. Sea ice has almost entirely disappeared from the boating area, and calving of the local Piedmont has increased in frequency. In late December 2019, humpback whales appeared in the boating area, and have been frequently observed feeding (lunge and bubble-net feeding) within boating limits. Finally, filters from CN/POC experiments have shifted from a greenish-yellow tint in early December 2019, to a reddish-brown tint in late December (Fig. 7). C-045-P will welcome a new lab member, Pablo Cardenas, in early January 2020.

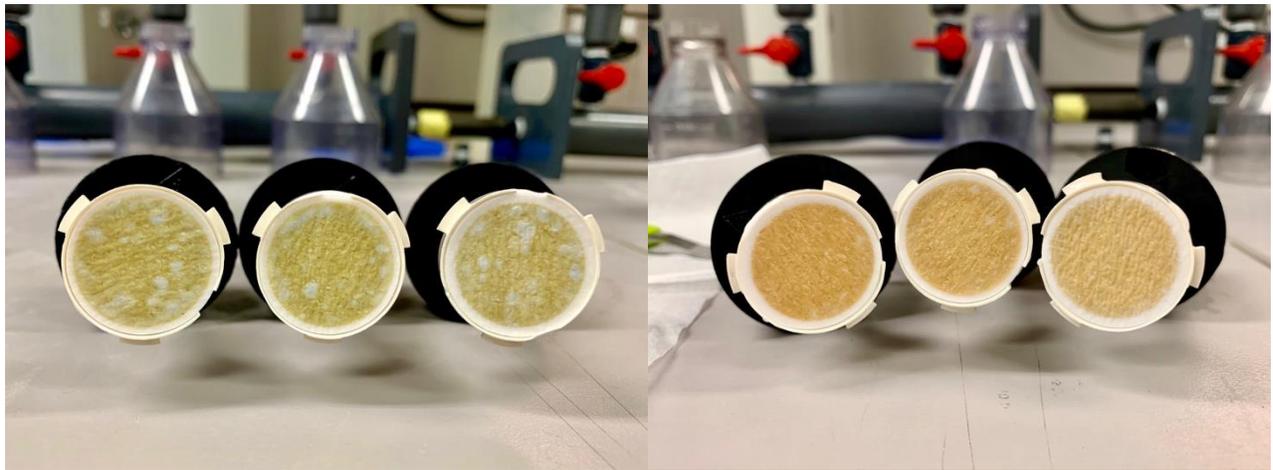


Fig. 7 – POC/CN filters from Station B; depths of 10, 5, and 0 m. Left image is 5 Dec 2019, and right image is 26 Dec 2019.

PALMER STATION RESEARCH ASSOCIATE MONTHLY REPORT

December 2019

Marissa Goerke

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

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

The ionosphere-thermosphere-magnetosphere (ITM) region of Earth's atmosphere, which is part of the larger geospace environment, is the portal through which the solar wind can enter and impact our planetary system. Though space weather research over the past decades has greatly increased our understanding of a wide variety of phenomena associated with ITM physics, the sum of these individual processes occurring in the geospace environment does not replicate the rich diversity and scope of this complex region. Thus, a more holistic approach to ITM research is necessary, one that integrates clustered instrumentation at multiple locations to simultaneously look at the interactions within the entire system. Using coordinated and collaborative instrumentation currently installed in Antarctica, researchers will study interrelated ITM phenomena observed at high latitudes. The goal of this research effort is a better understanding of the energy transfer and modulation of the geospace system.

Both the ELF/VLF operated normally through the month.

A-119-P: CONTINENTAL-SCALE STUDIES OF MESOSPHERIC DYNAMICS USING THE ANTARCTIC GRAVITY WAVE INSTRUMENT NETWORK (ANGWIN)

Dr. Michael Taylor, Principal Investigator, Utah State University

The Antarctic Gravity Wave Imaging Network (ANGWIN) is a cooperative effort of six international Antarctic programs to collect continent-wide gravity wave measurements. This network capitalizes on existing optical and radar measurement capabilities at McMurdo, Palmer, South Pole, and six other research stations: Halley (UK), Syowa (Japan), Davis (Australia), Rothera (UK), and Ferraz (Brazil). Infrared (IR) all-sky mesospheric OH (hydroxyl) imagers are installed at Davis, McMurdo, and Halley stations. The network quantifies the properties, variability, and momentum fluxes of short-period (less than one hour) mesospheric gravity waves and their dominant sources and effects over the Antarctic continent. An all-sky near-IR imager is also installed at Palmer Station to augment the existing instrumentation and create a capability for studying gravity wave properties at each site.

The camera and laptop have been shipped to Logan, UT for repair during the summer season.

G-090-P: GLOBAL SEISMOGRAPH NETWORK (GSN) SITE AT PALMER STATION

Mr. Kent Anderson, Principal Investigator, Incorporated Research Institutions for Seismology (IRIS)

Station PMSA is one of more than 150+ sites in the GSN, monitoring seismic waves produced by events worldwide. Real-time telemetry data is sent to the U.S. Geological Survey (USGS). The Research Associate operates and maintains on-site equipment for the project.

The system operated normally throughout the month.

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 interannual variations in atmospheric O₂ (detected through changes in O₂/N₂ 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 CO₂ sink. The program involves air sampling at a network of sites in both the Northern and Southern Hemispheres. The Research Associate collects samples fortnightly from Terra Lab.

Air samples were successfully taken twice this month.

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

Mr. Don Neff and Dr. Steve Montzka, Principal Investigators, 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 (N₂O) and halogen containing compounds. The Research Associate collects weekly air samples for the CCGG group and fortnightly samples for the HATS group.

CCGG samples were taken once a week during favorable winds and HATS Air samples were taken every other week.

O-264-P: ULTRAVIOLET (UV) SPECTRAL IRRADIANCE MONITORING NETWORK

Dr. James Butler, Principal Investigator, 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 GUV-511 filter radiometer, an Eppley PSP Pyranometer, and an Eppley TUVR radiometer also continuously measure hemispheric solar flux within various spectral ranges. The Research Associate operates and maintains on-site equipment for the project.

The system operated normally this month. Bi-weekly absolute scans were completed as necessary. Quarterly absolute scans were complete without complications.

R-938-P: TERASCAN SATELLITE IMAGING SYSTEM

The TeraScan system collects, processes, and archives DMSP and NOAA satellite telemetry, capturing approximately 25-30 passes per day. 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.

The system received a full upgrade during a site visit. It operated normally throughout the month except for a few periods that required some on-site troubleshooting after the site visit.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION.

Mr. Joe Pettit, Principal Investigator, UNAVCO

Continuous 15-second epoch interval GPS data files are collected at station PALM, compressed, and transmitted to the NASA-JPL in Pasadena, CA. The Research Associate operates and maintains on-site equipment for the project.

The system operated normally throughout the month.

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

Managed by General Dynamics

The IMS Radionuclide Aerosol Sampler and Analyzer (RASA) is part of the CTBTO verification regime. 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 normally throughout the month. Processed filters and sent logs as needed.

OCEANOGRAPHY

Daily observations of sea ice extent and growth stage are also recorded, along with continuous tidal height, ocean temperature, and conductivity at Palmer's pier.

Observations of sea ice around station were made daily.

METEOROLOGY

The Research Associate acts as chief weather observer, and compiles and distributes meteorological data. Weather data collected using the automated electronic system is archived locally and forwarded once per month to the University of Wisconsin for archiving and further distribution. Synoptic reports are automatically generated every three hours by the Palmer

Meteorological Observing System and emailed to the National Weather Service for entry into the Global Telecommunications System.

The local weather station (PAWS) operated normally throughout the month. The power system for the Wauwermans AWS was replaced due to water damage. The station is now operational. Observations are archived on the AMRC website: <ftp://amrc.ssec.wisc.edu/pub/palmer/>.