

PALMER STATION MONTHLY SCIENCE REPORT

DECEMBER 2017



Midnight sunset as Arthur Harbor filled up with icebergs. *Image Credit: Randy Jones*

NEWS FROM THE LAB

Randy Jones, Summer Laboratory Supervisor

The science work on Station developed a steady rhythm over the past month, punctuated by the arrival of LMG17-12, the LTER Site Review cruise mid-month. Many a familiar face joined us on Station for a short three day period demonstrating the overall LTER research program, visiting field sites, and a short mini-cruise on the ARSV *Laurence M. Gould*. The *Gould* brought the arrival of the B-256-P (Lee) group to Station, here for their final field season studying *Belgica antarctica*, the Antarctic midge. We also welcomed a number of early season tour ships and yacht visits, which gave us all opportunities for outreach and public engagement.

Following the LTER Site Review, the summer solstice brought a short period of breezy, stormy weather, though the end of the month was clear. We were relatively free of sea ice this month, and the region has been visited by a number of icebergs, some with quite majestic shapes and towering heights. Seawater temperatures warmed up rapidly this month to 0.5°C. The glacier face is beginning to calve more frequently, though not yet at a maximum frequency typical of later in the summer season. We had our first humpback whale and fur seal sightings.

DECEMBER 2017 WEATHER

Marissa Goerke, Research Associate

Palmer Monthly Met summary for December, 2017

Temperature
Average: 1.2 °C / 34.1 °F
Maximum: 7.5 °C / 45.5 °F on 20 Dec 23:15
Minimum: -3 °C / 26.6 °F on 13 Dec 05:43
Air Pressure
Average: 975.1 mb
Maximum: 998 mb on 2 Dec 23:17
Minimum: 947.1 mb on 21 Dec 06:15
Wind
Average: 8.4 knots / 9.6 mph
Peak (5 Sec Gust): 59 knots / 67 mph on 21 Dec 05:43 from E (84 deg)
Prevailing Direction for Month: ESE
Surface
Total Rainfall: 19.6 mm / .77 in
Total Snowfall: -45 cm / -17.6 in
Greatest Depth at Snow Stake: 51.8 cm / 20.2 in
WMO Sea Ice Observation: Only ice of land origin is visible, 6-10 bergs with growlers and bergy bits.
Average Sea Surface Temperature: .04 °C / 32.1 °F

Winds peaked at 67 mph on December 21st and the average speed for the month was 9.6 mph. The prevailing wind direction for the month was from the east south east. Temperatures warmed and snow pack diminished by -17.6 inches. Sea ice completely disappeared near the end of the month and only ice of land origin remains.

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, Sheridan, MT

Personnel on Station: Ben Cook, Shawn Farry, and Carrie McAtee

Weather and ice conditions in the Palmer Station area improved dramatically this month allowing boat based field work on 26 days during December. 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 also completed weekly trips to Dream Island to conduct Adélie and chinstrap penguin counts and to Biscoe Island for Adélie and Gentoo penguin counts.



An uncommon sighting of all three penguin species from the Palmer Station area.

Image Credit: Fraser group

A peak egg census was completed during December for chinstrap penguins on Dream Island and for gentoo penguins on Biscoe Island. 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 also prepared for the deployment of satellite transmitters and dive depth recorders on Adélie and gentoo penguins which will begin in early January.

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.



Brown Skua breeding season gets underway with the first chick of the year. *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.

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: Frank McQuarrie and Schuyler Nardelli

This month was very busy for the Schofield lab. Biweekly sampling continued successfully throughout December. Despite a small bloom at the beginning of December, chlorophyll values remained low ($<1.5 \text{ mg/m}^3$) throughout the month (Fig. 1). Primary production and maximum quantum yield (F_v/F_m ; describes how well phytoplankton are photosynthesizing) were variable throughout the month with no distinct trends.

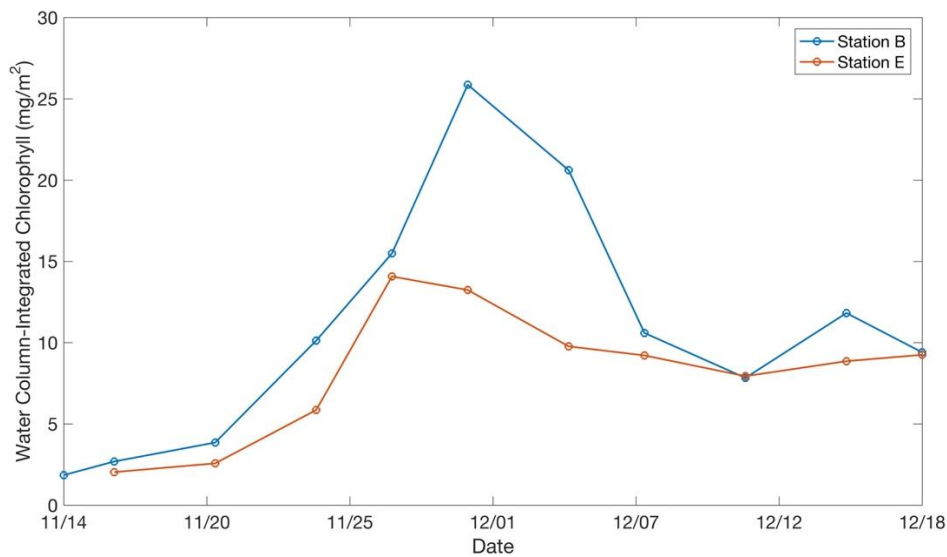


Fig. 1 – Water column-integrated chlorophyll values from November 14, 2017 to December 18, 2017 at Stations B and E.

Two gliders were also deployed this month. RU26 was deployed December 11th and began its journey north to the tip of the western Antarctic Peninsula. Once there, it will continue back to Palmer Station to be picked up in late January. RU25 was deployed December 22nd and is headed south to the British Rothera Research Station on Adelaide Island, pending ice conditions (Fig. 2). It will likely be picked up by the ARSV *Laurence M. Gould* during the January 2018 LTER Cruise. Spanning the majority of the Western Antarctic Peninsula, these two gliders will give a

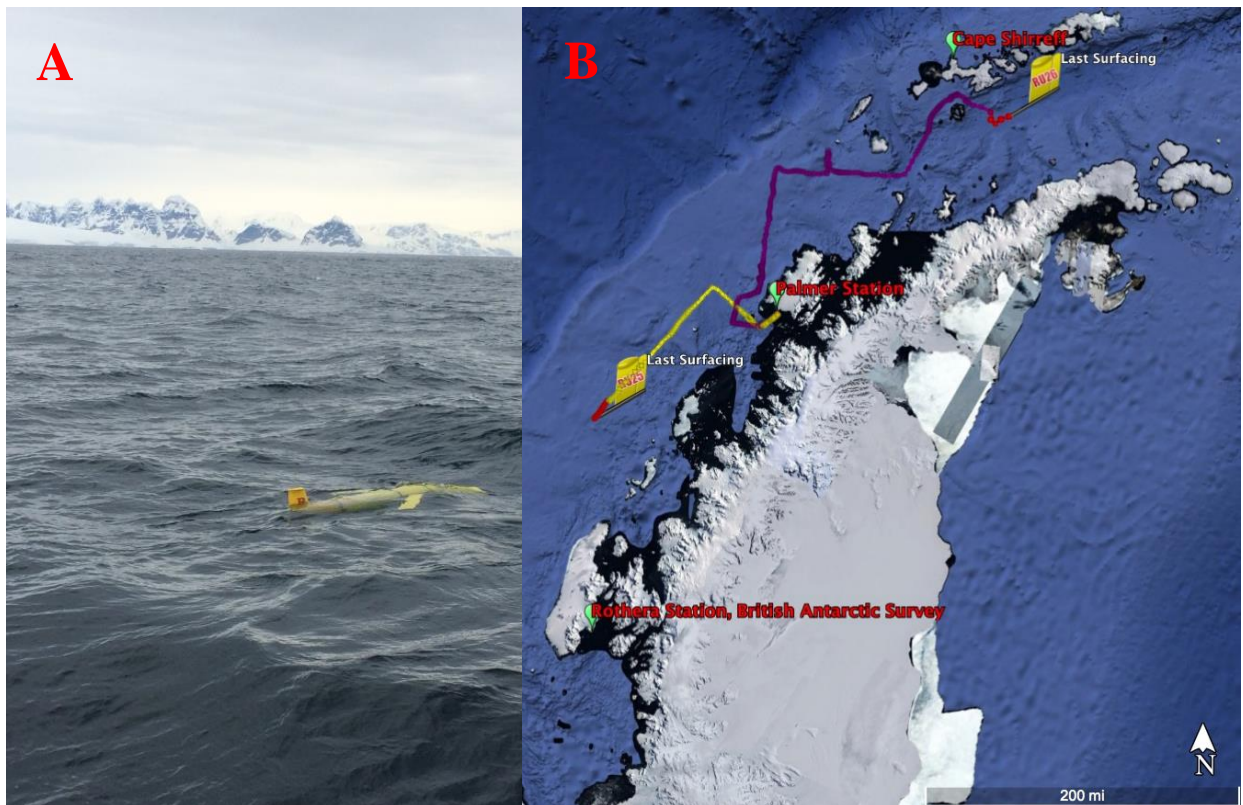


Fig. 2 – Photo (A) of RU25 at deployment on December 11, 2017. Map (B) of glider tracks as of January 1, 2018.

better spatial picture of phytoplankton dynamics. Both are equipped with a CTD sensor to measure temperature, salinity, and depth; an oxygen optode; and an optics puck measuring backscatter, colored dissolved organic matter, and chlorophyll fluorescence.

Additional work this month included the start of Schuyler Nardelli's transect studies. Three transects, in the northern boating region, from Palmer Station out to station E, and in the southern boating area, were sampled three times this month (Fig. 3). Discrete water samples collected along each transect were analyzed for chlorophyll, pigments, fluorescence quantum yield, and species identification, and will allow us to better characterize phytoplankton dynamics in the greater Palmer region. In addition, EK80 acoustics were paired with a towed undulator off the stern of RHIB *Rigil* to collect chlorophyll, temperature, salinity, and turbidity data. Schuyler is hoping to get a better temporal and spatial picture of phytoplankton and krill interactions. She will continue to conduct weekly transect surveys throughout January and early February.

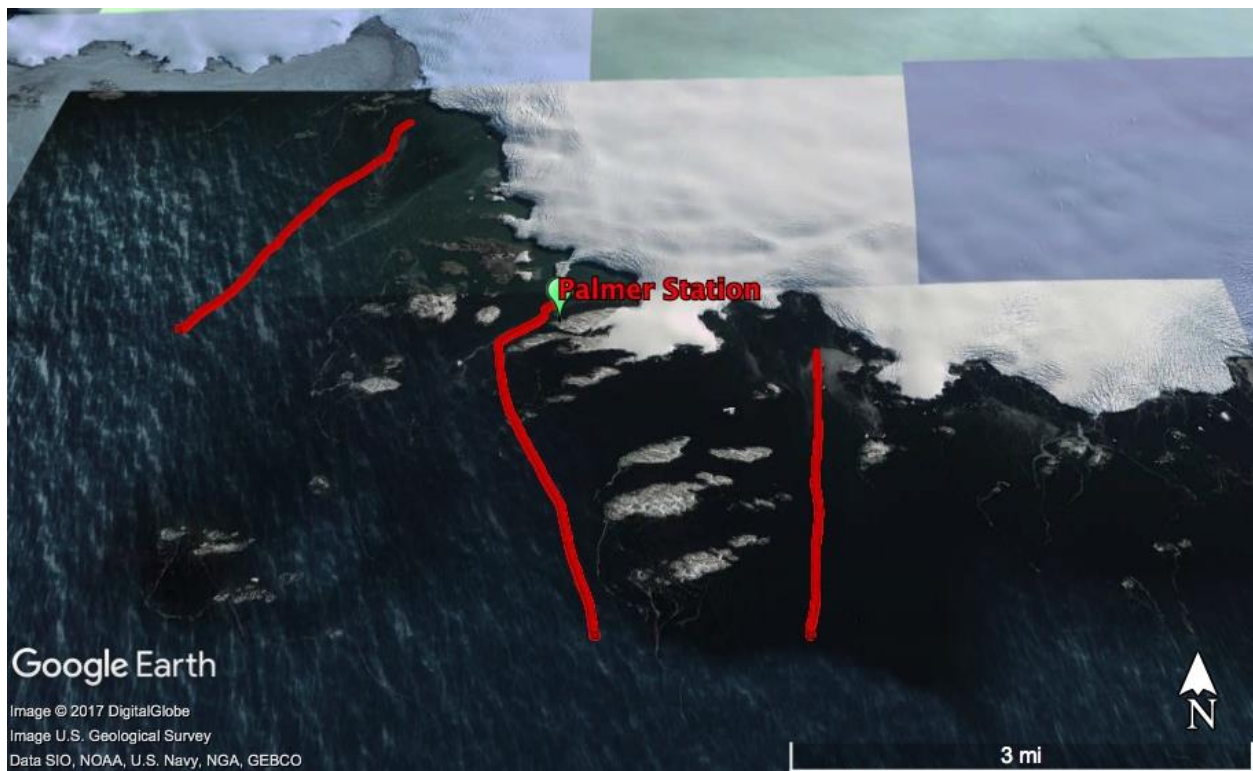


Fig. 3 – Map of the three transects run weekly for Schuyler's surveys.

Thanks to ASC for all their help throughout the month. Special thanks to the boathouse for helping get Schuyler's transects up and running, and to the Ducklow lab for helping out with our glider deployments!

C-020-P: PALMER, ANTARCTICA LONG-TERM ECOLOGICAL RESEARCH (LTER): LAND-SHELF-OCEAN CONNECTIVITY, ECOSYSTEM RESILIENCE, AND TRANSFORMATION IN A SEA-ICE INFLUENCED PELAGIC ECOSYSTEM – ZOOPLANKTON COMPONENT

Dr. Deborah Steinberg, Principal Investigator, Virginia Institute of Marine Science, College of William & Mary

Personnel on Station: Jack Conroy, Andrew Corso, and Leigh West

Biweekly zooplankton sampling at LTER Stations B and E is meshing well with the long-running phytoplankton (C-019-P), nutrient, and bacteria (C-045-P) projects. The Antarctic krill *Euphausia superba* and the pteropod *Limacina helicina* are dominating the macrozooplankton community. There is a bimodal distribution of krill lengths, with ~20mm animals dominating the population (Fig. 4). This is suggestive of successful recruitment after last year's favorable ice and phytoplankton conditions. The herbivorous calanoid copepods *Rhincalanus gigas* and *Calanoides acutus* are numerically abundant, although dwarfed by macrozooplankton in terms of biomass. Additionally, copepods have been relatively scarce in tows with high densities of krill.

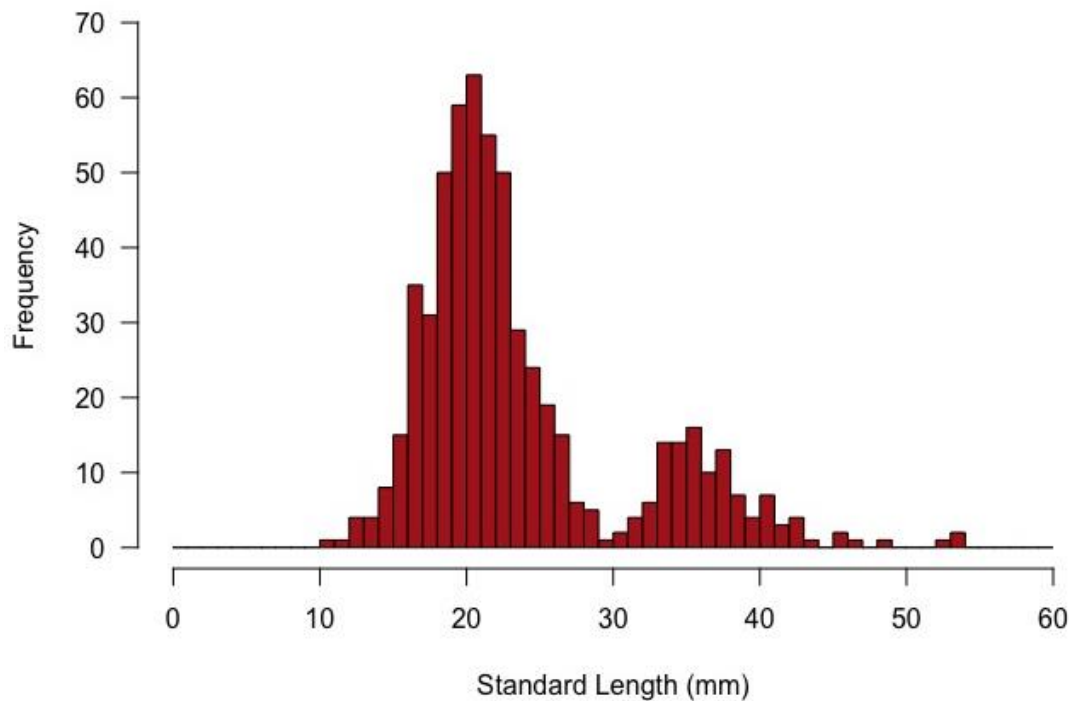


Fig. 4 – Histogram of *Euphausia superba* standard length (mm) from 17 net tows.

We carried out three krill feeding experiments throughout December. Animals were collected in net tows and acclimated to experimental conditions for 24 hours. Water was then collected from the same sampling site the following day. Krill were added to half of the sample bottles while half were left as controls. Initial and final water samples were collected for chlorophyll analysis and run on C-019-P's Imaging Flow Cytobot to identify changes in phytoplankton biomass and microbial community composition. Chlorophyll measurements from the first experiment suggest a substantial krill grazing impact (Fig. 5). Alterations to the second and third experiments should more clearly reveal this feeding signal.

Finally, collaborative field work with C-019-P has demonstrated the new RHIBs' scientific potential. We surveyed large krill swarms using RHIB *Rigil*'s hull-mounted EK80 echosounder and successfully sampled water from within the krill swarms using the ECO Rosette. "In swarm" samples will be compared to nearby "out of swarm" samples to detect differences in phytoplankton biomass, community composition, and photosynthetic efficiency. Net tows through the swarms will allow accurate abundance and biomass estimates. Individual animals

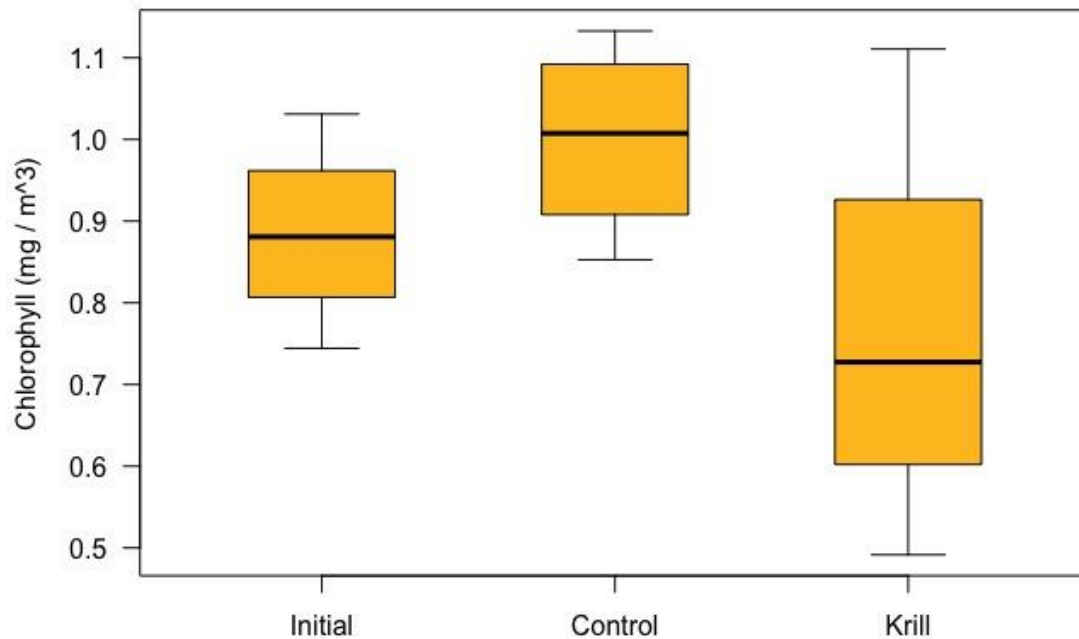


Fig. 5 – Relative to initial samples, final chlorophyll concentrations (mg/m^3) were higher in the control bottles and lower in krill bottles.

were removed to assess *in situ* grazing rate. Thank you to the Palmer science and marine staff for supporting this exciting work!

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: Rebecca Trinh, Anna Wright, and Marie Zahn

The month of December brought many warm and calm sampling days, and with that, we were able to sample at both station B and E biweekly, with the exception of one day due to high winds. At the beginning of the month, we also had the arrival of Hugh Ducklow's PhD student Rebecca Trinh. She will help with biweekly station B and E sampling and start her first season of field work comparing bacterial production and community structure between free-living bacteria in the water column and particle-associated bacteria on krill fecal pellets.

Towards the end of the month, we also saw an increase in water temperatures, as all of the depths were over 0°C for the first time this year. Along with successful sampling days came a lot of trouble-shooting in the lab. We replaced the filament on the equilibrator inlet mass spectrometer (EIMS). The end of the month included preparation for the LTER cruise as we organized supplies and made solutions.



Fig. 6 – Graph depicting the oxygen to argon ratio in water collected from the sea water intake from the pumphouse at Palmer Station.

For flow cytometry, we saw an increase of over 100% in sybr green counts on December 22 at Station B and on December 26 at Station E, which may correlate to a small bloom at those stations on those dates. For the EIMS, we continued to monitor the oxygen to argon ratio over time. Figure 6 shows one day of data and a declining trend in oxygen saturation and O^2/Ar ratio. The dips and pulses in the red O^2/Ar curve are calibrations with atmospheric oxygen.

In the rad lab, we saw an overall trend of higher 3H-leucine incorporation rates at Station B than Station E (Fig. 7). We also witnessed an overall increase in Station E’s leucine incorporation rates, whereas Station B showed a small increase with the exception of a strong peak around December 10.

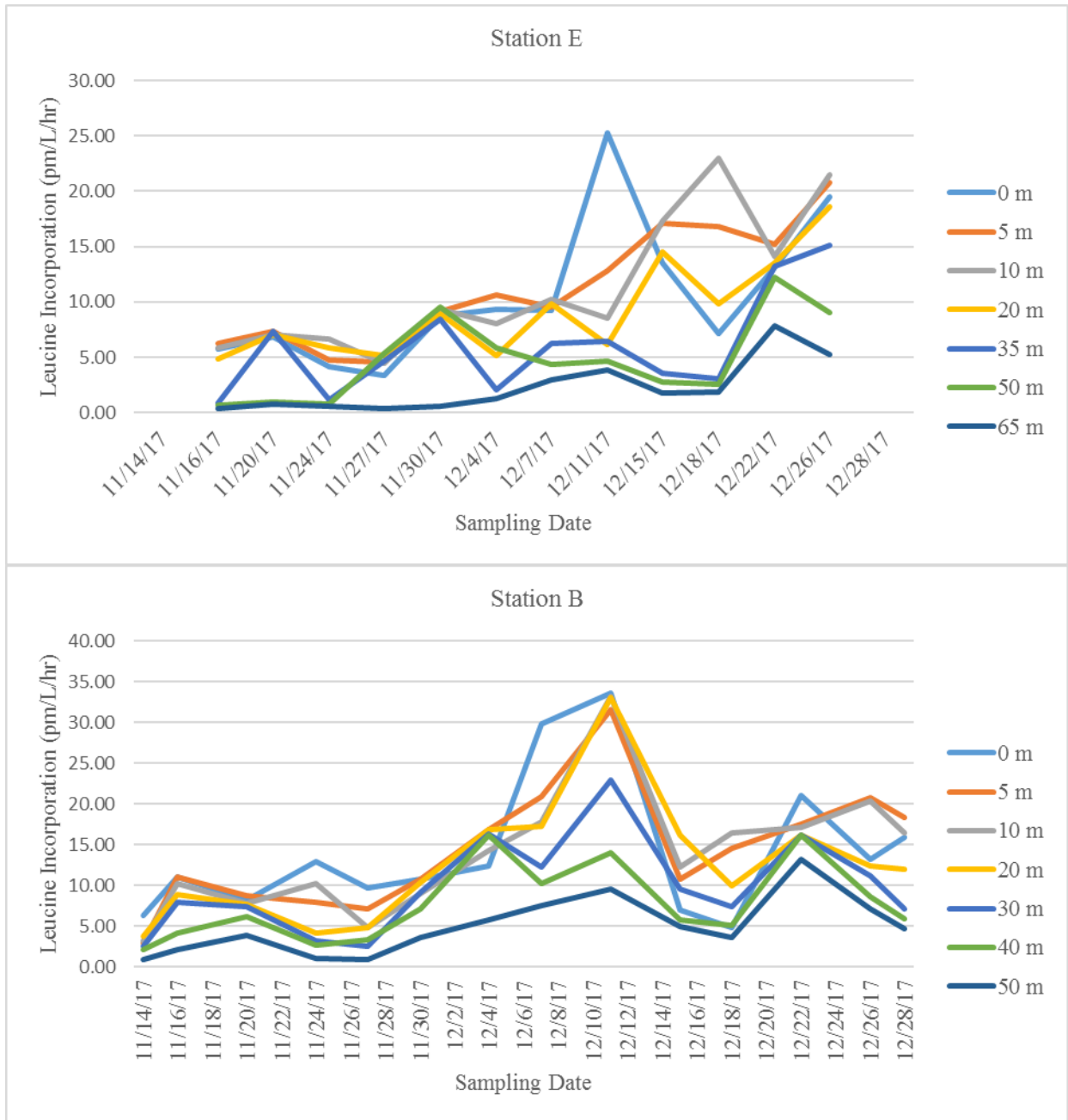


Fig. 7 – Graphs showing 3H-leucine incorporation rates for seven depths at each station—Station E (top) and Station B (bottom) from mid-November to the end of December 2017.

PALMER STATION
RESEARCH ASSOCIATE MONTHLY REPORT
December 2017
Marissa Goeke

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

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

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.

The system operated normally throughout the month.

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

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 IR camera has been shut down for the remainder of the summer season due to a lack of dark sky conditions.

A-373-P: TROPOSPHERE-IONOSPHERE COUPLING VIA ATMOSPHERIC GRAVITY WAVES

Vadym Paznukhov, Principal Investigator, Boston College

The goal of this project is to enhance the comprehensive research understanding of troposphere-ionosphere coupling via Atmospheric Gravity Waves (AGWs) in the Antarctic region. Both experimental and modeling efforts will be used on the Antarctic Peninsula to investigate the efficiency and main characteristics of such coupling and will address several questions remaining in the current understanding of this coupling process.

The system operated well throughout the month.

O-202-P: ANTARCTIC METEOROLOGICAL RESEARCH CENTER (AMRC) SATELLITE DATA INGESTOR

Mathew Lazzara, Principal Investigator, University of Wisconsin

The AMRC computer processes satellite telemetry received by the Palmer Station TeraScan system, extracting Automated Weather Station information and low-resolution infrared imagery and sending the results to AMRC headquarters in Madison, WI. The Research Associate operates and maintains on-site equipment for the project.

The data ingestor computer system operated normally until November 22, 2017 when the TeraScan system was upgraded and the two systems became incompatible. The AMRC data ingestor will remain down until further notice.

O-264-P: A STUDY OF ATMOSPHERIC OXYGEN VARIABILITY IN RELATION TO ANNUAL DECADAL VARIATIONS IN TERRESTRIAL AND MARINE ECOSYSTEMS

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 taken twice this month.

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

Don Neff and Steve Montzka, Principal Investigators, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

The NOAA ESRL Carbon Cycle Greenhouse Gases (CCGG) group makes ongoing discrete measurements to document the spatial and temporal distributions of carbon-cycle gases and provide essential constraints to our understanding of the global carbon cycle. The Halocarbons and other Atmospheric Trace Species (HATS) group quantifies the distributions and magnitudes of the sources and sinks for atmospheric nitrous oxide (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 in favorable winds and HATS Air samples were taken every other week.



Mt. Français (2761m) peeking over the Marr Ice Piedmont Glacier. *Image Credit: Randy Jones*

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

James Butler, Principal Investigator, National Oceanic and Atmospheric Administration / Global Monitoring Division; Boulder, CO

A Biospherical Instruments (BSI) SUV-100 UV spectroradiometer produces full sky irradiance spectra ranging from the atmospheric UV cutoff near 290nm up to 605nm, four times per hour. A BSI GUV-511 filter radiometer, an Eppley PSP Pyranometer, and an Eppley TUVB 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 throughout the month. Bi-weekly calibrations were completed as necessary.

T-295-P: GPS CONTINUOUSLY OPERATING REFERENCE STATION

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-312-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 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 filter rolls were swapped on December 22, 2017. The system experienced an accidental shut down during filter roll change and returned to normal operation on December 26, 2017.

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 and the tide gauge worked well throughout the month.

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) is working well. Both the Joubin site and the Wauwermans site have come back online. The observations are archived on the AMRC website:

<ftp://amrc.ssec.wisc.edu/pub/palmer/>.