LMG 20-01: 30 Dec. 2019 – 05 February 2020
Weekly Science Report I
Palmer Long Term Ecological Research Project: Looking Back in Time Through Ecological Space.

Cruise Overview (O. Schofield, Chief Scientist):

The overall long term objective of Palmer LTER is to understand the mechanistic linkages by which climate, physical oceanographic forcing and sea ice extent and duration control ocean productivity, food web processes, krill and penguin recruitment and carbon biogeochemistry in the marginal sea ice zone of the western Antarctic Peninsula (WAP) region. The WAP is one of the most rapidly-warming regions on the planet, and we have documented responses throughout the food-web from phytoplankton to penguins. The annual oceanographic cruise provides a large scale regional view of physical trophic biogeochemical processes in the region, and contributes to a time series of ecosystem transformation in response to regional warming and sea ice loss.

This ~5 week cruise is about equally divided between 1) occupying standard LTER stations along the regional grid extending from Palmer Station to Charcot Island and from the inshore coastal region to deep (>3000 m) water off the continental shelf break in the Antarctic Circumpolar Current, and 2) conducting three, 3 day mechanistic process studies along the Peninsula.

The transit from Punte Arenas (departing on December 30th) was smooth and RV Gould operations on the crossing consisted of deploying NCAR xbts and a NOAA drifter was deployed. All this went smoothly and the time was also spent planning joint operations between the SWARM project and LTER in the first days of the cruise. The first focus of the cruise will be assisting SWARM with the deployment of HF Radar equipment at the Joubins. The next phase will be deployment of the SWARM/NOAA AMLR moorings near Palmer.

The crossing was also used to test new optical equipment that will be used on the LTER cruise. The equipment was being provided by Dr. Steve Ackelson of the Naval Research Laboratory who is joining the Schofield team for the 20-01 cruise. The equipment provides a means for holographic imaging of suspended particles.

A submersible holographic camera (Sequoia Scientific LISST-HOLO) will be used throughout the LTER survey to image marine particles within the size range 15 – 500 μ and compute cumulative particle size distribution. These include phytoplankton, zooplankton, aggregates, and fecal pellets. During the LTER survey the system will be attached to the optical profiling system. However, during the Drake Passage crossing (DPC) the system was plumbed into the ship seawater system (Fig 1.) to monitor particle populations along the transit.

Each data set is comprised of a diffraction image (Fig. 2) that represents the combined forward scatter from all particles suspended within the sampling volume. Software supplied by the manufacturer is used to invert each diffraction image to yield 3-D images of particle distribution. The system can collect images at a maximum rate of 25 Hz. However, due to the large size of each image (2 MB) and the amount of time required to invert each image (10 min) for monitoring purposes along the DPC the system was programmed to collect one image each hour.

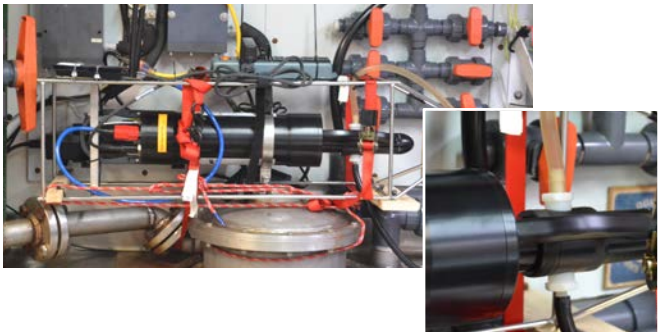

Figure 1. A Sequoia Scientific LISST-HOLO holographic camera was plumbed into the ship's seawater delivery system for the transit across the Drake Passage. The flow was sampled before bubble removal and after the flow passed through a coarse mesh that prevented large particles from making it to the camera.

A quick look at the imagery reveals a southward shift in particle type from larger diatoms and chain-forming cells in the north to smaller cells in the southern portion of the transit (Fig. 3).

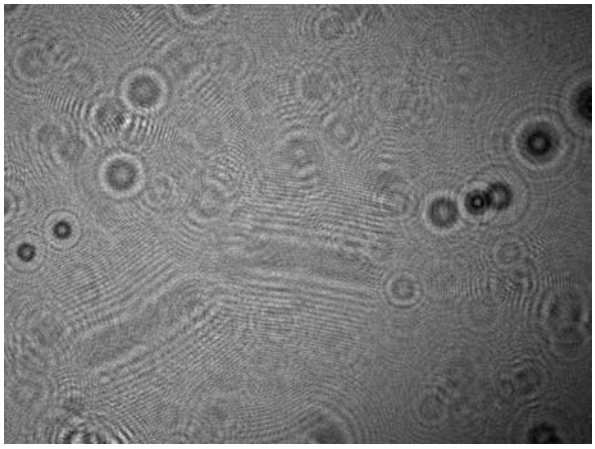

Figure 2. The LISST-HOLO holographic camera measures the diffraction interference pattern created from forward light scatter from all particles suspended within the sample volume.

Of notable absence from the imagery are larger zooplankton cells. This could be the result of a pre-filter within the seawater delivery system that could have prevented such particles from reaching the holographic camera. In addition, the imagery contains a large number of micro-bubbles, likely injected by the wake of the ship. While the ship seawater system does include a de-bubbler, the stream could only be sampled before the bubble removal. A final attribute of the inline imagery is the absence of particle aggregations, all of which are disrupted by turbulence produced by the pump and pipe flow. Thus, only individual particles are represented within the imagery. These issues should not be manifested in the data when the system is deployed in profiling mode since the interrogation region of the instrument will be open to the ambient water.

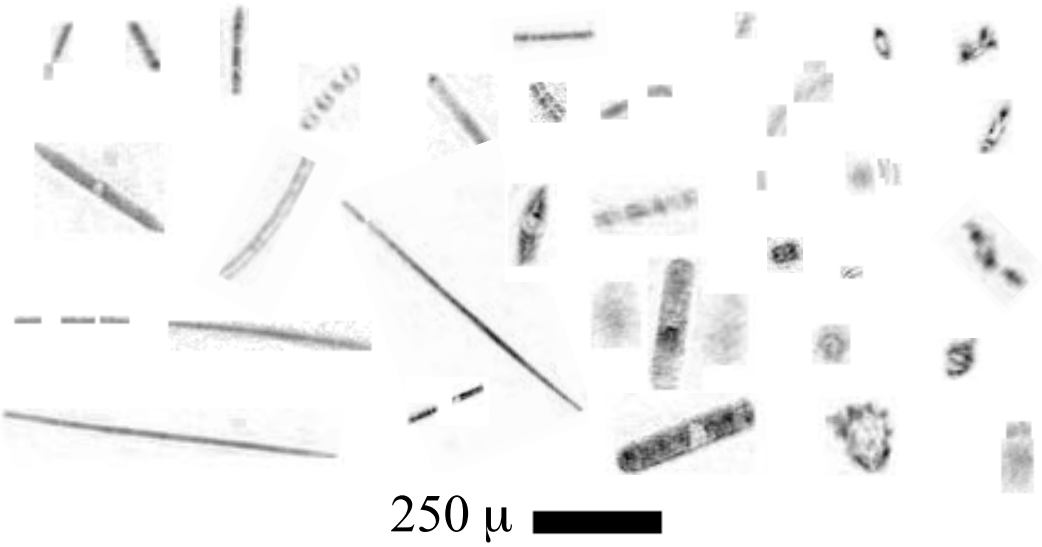

Figure 3. Examples of non-bubble particles that were encountered along the southbound Drake Passage crossing. Particles characteristic of the northern portion are shown on the left and southern examples are shown on the right. Note that there are no larger zooplankton due to pre-filtering of the seawater stream or particle aggregates due to turbulence-induced breakup.