

GO-SHIP 2018 S04P, NBP 18-02

Week 7 Report – High seas, high spirits,  
high particle flux?

Sunday April 29, 2018

Current position: 69.5°S, 103°W

Winds: from W at 20 knots

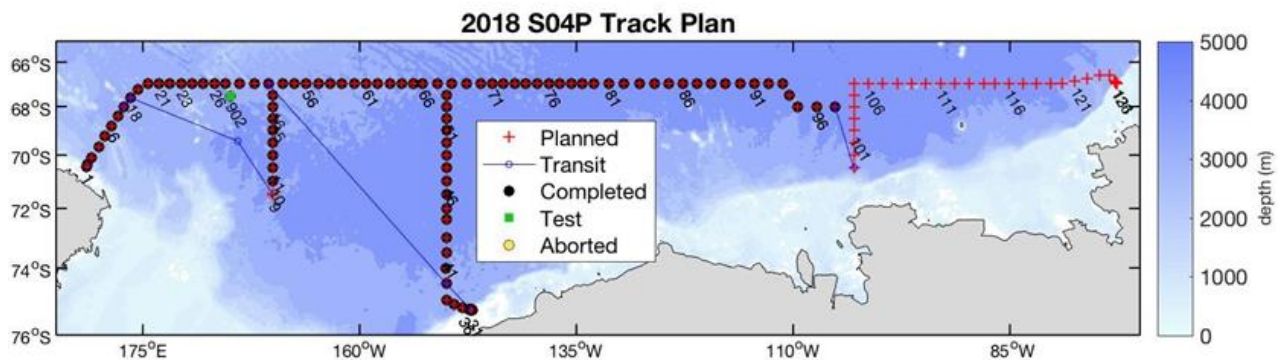
Outside Temp: -6°C, 21.2°F

Wind Chill: -23°C, -9.4°F

Surface Water Temp: -1.8°C, 28.8°F

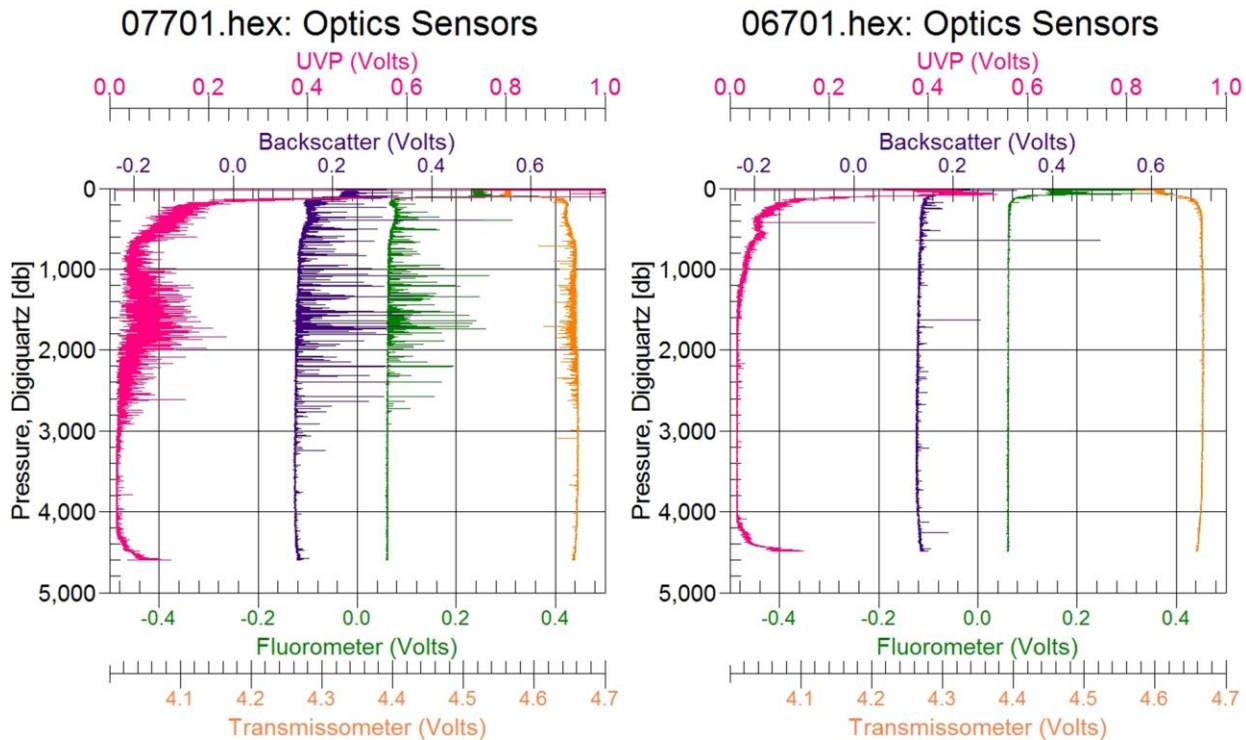


Being that it is austral Fall in the Southern Ocean, we have been very lucky to have some stretches of good weather with calm seas and low winds. These stretches only last a few days, however, and an inevitable storm rolls through. How far south the storm reaches and how long it plans to stay is what drives our decision to stay put and weather the storm or find an alternative plan. Last week we stayed put but this time around we decided to divert to the south to continue the remaining stations over to the 103°W southward excursion at 68°S (see figure below) to avoid the brunt of the storm. The wire was still proving difficult at the start of the week due to loosening of the outer armor in the upper 100 m. So as winds picked up gusting over 40 knots we decided to make use of this time when a CTD cast was not possible by removing another 300 m of wire and re-terminate.



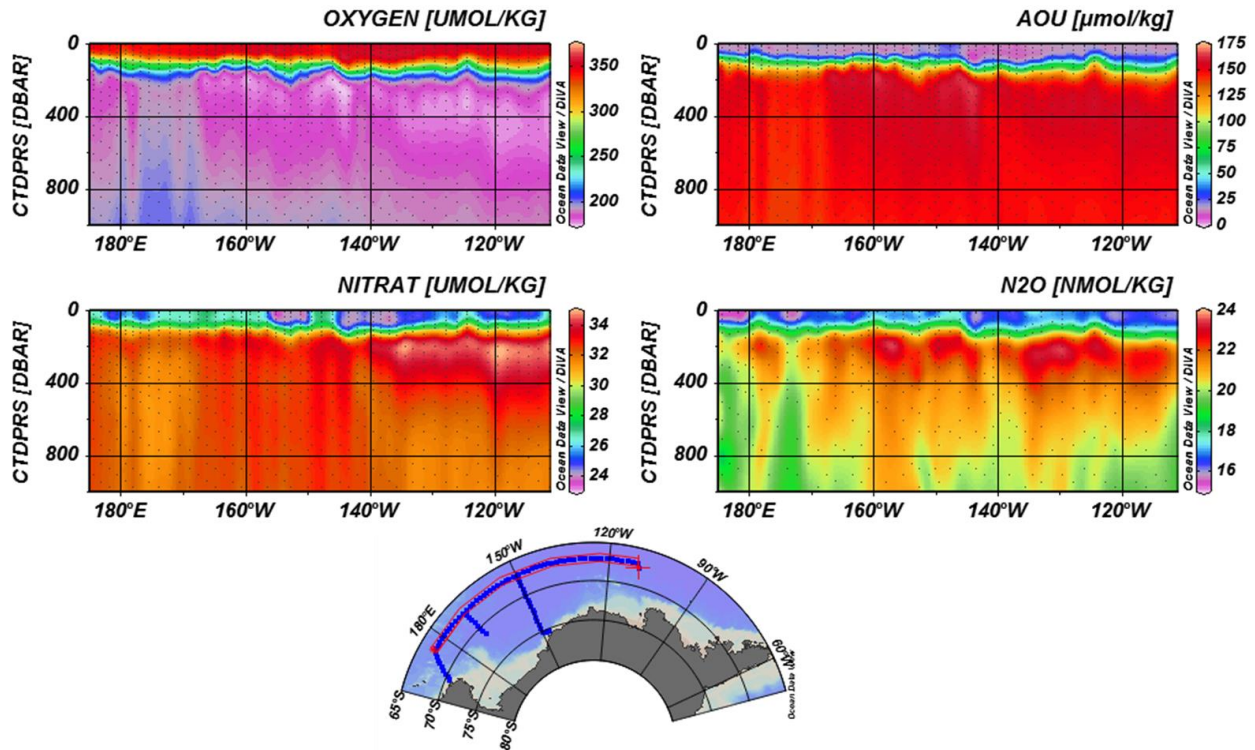
Nevertheless we have completed nearly 100 stations and there is much to be said about the data. What caught our eye this week was an increased optical signal observed in backscatter, transmittance, fluorescence, and the UVP (Underwater Vision Profiler, an in situ flow cytometer) from the surface down to below 2000 m across stations 73-82 (142-129.5°W) on the 67°S line (see figure below, left). These stations are right at the eastern edge of the Ross Gyre near where the Antarctic Circumpolar Current meanders southward. For comparison, the optical profiles at

station 67 (151°W 67°S) are shown below (right) and are more representative of typical optical profiles on this cruise. This elevated optical signal at greater depths was not observed on the previous occupation of S04P in this region in 2011, and these optical parameters were not measured on the 1992 occupation. After consulting with experts on ship and on shore we are more convinced than ever that this is an actual signal reflective of elevated levels of marine snow or aggregates deep in the water column and not instrumental noise. The question still remains as to what caused this increased particle flux into the deeper ocean in this region.



Profiles from optical sensors (courtesy of Joseph Gum) giving evidence for increased aggregates deeper in the water column (left) relative to what is typically observed (right).

Another interesting dataset that is new for shipboard analysis on a GO-SHIP cruise is nitrous oxide ( $N_2O$ ). By adding an additional separation column to the rig for measuring CFC's and  $SF_6$  (inert tracers), the  $N_2O$  concentration can also be measured without requiring any additional samples or analysis time (credit to John Bullister, PMEL).  $N_2O$  is a greenhouse gas and in marine environments it is produced during nitrification where ammonia is biologically oxidized to nitrite, and then further oxidized to nitrate. Nitrification is an important process in the ocean because nitrate is an essential nutrient for primary production but is often in limited supply. On the 67°S line we observe supersaturation of  $N_2O$  below the mixed layer shown in the figure below and  $N_2O$  reaches a maximum near the apparent oxygen utilization (AOU) maximum.



Plots of the upper 1000 m water column of  $\text{N}_2\text{O}$  (bottom right), as well as apparent oxygen utilization (AOU, top right), oxygen (top left), and nitrate (bottom left) for reference on the 67°S line.

We have less than two weeks of science operations left as we head south back into the ice on 103°W. Excitement has been building to catch one last glimpse of an emperor penguin perhaps? Or the moon balancing atop a growler?



Send thoughts of calm seas our way,

Alison Macdonald (Chief Scientist) and Ellen Briggs (Co-chief Scientist)