FjordEco moored sensors

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Introduction

Mooring data was collected during the *FjordEco* project, which focused on Andvord Bay, a glacial fjord on the West Antarctic Peninsula. Measurements were collected between November 27th, 2015 and April 4th, 2017. Mooring deployment, turnover and recovery were performed during three research cruises: *LMG15-10* on the *R/V L.M. Gould* (Nov-Dec 2015), *NBP16-10* on the *R/V N.B. Palmer* (Apr 2016), and *LMG17-10* on the *R/V L.M. Gould* (Mar-Apr 2017). *Deployment 1* refers to the period between *LMG15-10* and *NBP16-03,* and *deployment 2* to the period between *NBP16-03* and *LMG17-02.* Cruise reports are available from the Marine Geoscience Data System data browser (marine-geo.org).

The data collection was funded by the National Science Foundation under grant OPP1443680. Peter Winsor (University of Alaska Fairbanks) was lead Principal Investigator overseeing the mooring measurements. Data were retrieved from the sensors and processed by Hank Statscewich. Øyvind Lundesgaard (University of Hawaii at Manoa) was responsible for depth corrections and documentation.

Moorings

Data were collected from two ocean moorings, *Mooring A (FJ200),* and *Mooring B (GT200).* Mooring locations are shown in Figure 1.

Mooring A was deployed during LMG15-10. It was located in deep (>500 m) waters in an elongated basin in the inner fjord, with instruments extending up to approximately 200 m water depth. The mooring was recovered and redeployed during NBP16-10. An up-looking 75 kHz ADCP mounted near the bottom of the mooring, and SeaBird temperature sensors (some of which also measuring conductivity and pressure) were attached to the mooring line at various depths. Mooring A was finally recovered during LMG17-02.

The top float of Mooring A was lowered to near 300 m during deployment 2. In addition, the ADCP was reconfigured to higher vertical resolution (from 16 m bins to 8 m bins). During deployment 2, two of the SeaBird sensors were set to sample at high frequency (10 second intervals).

Mooring B was deployed near the junction of the mouth of Andvord Bay and the Gerlache Strait, at a water depth of approximately 313 m. Two ADCPs were mounted near 184 m depth; one looking up (150 kHz), the other looking down (300 kHz). The mooring was also equipped with SeaBird sensors. Mooring B was deployed during LMG15-10, and recovered and redeployed during NBP16-10. Recovery was attempted during LMG17-02, but the mooring did not surface and is presumed lost.

Sensor depths were taken as the best estimated time average depth. Overall corrections relative to target depths were conducted based on pressure records (details for each mooring are shown below), and the same depth corrections were applied to the target depth of all mooring sensors, assuming a vertical mooring line angle.

While salinity values based on conductivity measurements from Mooring B appear reasonable, this is not the case for those from Mooring A. All salinity time series from Mooring A exhibit dramatic drops and other abnormal behaviour. In addition, overall salinity values from Mooring A generally deviate from the ranges measured by CTD profiling (shown in plots below). As a result, all conductivity/salinity data from Mooring A was considered corrupt, and is not included in this data set. Parts of the records may still be valid. Raw conductivity/salinity data is available upon request.

The pressure sensor on the top instrument of Mooring A during deployment 1 has a bean baseline value of 14.7 db, while the expected baseline pressure was 200.5 db. However, the temporal behaviour and variance of the time series otherwise look physically reasonable. As such, we have included data from this mooring, both with *pres_uncorrected* field and a *pres_corrected* field where a fixed offset has been applied to yield an average pressure of 200.5 db.

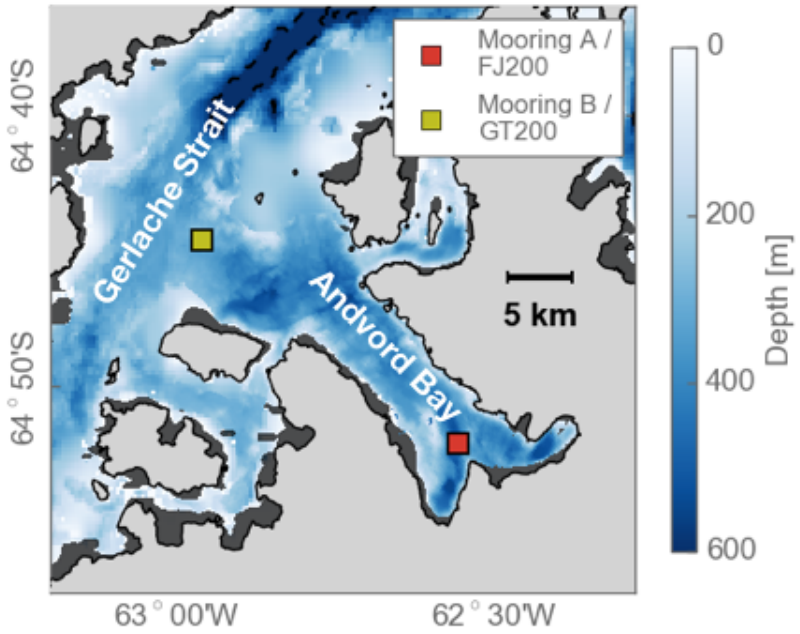

Figure 1: Map of mooring locations. Overlaid on ocean bathymetry (missing data in gray).

Deployment 1

GT200 (Mooring B)
Deployment period: Nov 27, 2015– Apr 5, 2016
Deep mooring, near Gerlache (corrected top float depth 184 m).
Corrected bottom depth: 313 m
Latitude: 64°S 44.613'
Longitude: 62°W 57.728'

150 kHz up-looking ADCP
Corrected transducer depth: 184 m
8 m depth bins
Time intervals: 20 min
File name: *currents_gerlache_strait_deployment1_uplooker.nc*

300 kHz down-looking ADCP
Corrected transducer depth: 184 m
4 m depth bins
Time intervals: 60 min
File name: *currents_gerlache_strait_deployment1_downlooker.nc*

T-S array
Time intervals:
600 seconds (all sensors)

Serial nr	Instrument	Corrected depth	File names
1405	SBE-37SMP	184 m	*conductivity_gerlache_strait_deployment1_184m.nc* *salinity_gerlache_strait_deployment1_184m.nc* *pressure_gerlache_strait_deployment1_184m.nc* *temperature_gerlache_strait_deployment1_184m.nc*
1644	SBE-56	209 m	*temperature_gerlache_strait_deployment1_209m.nc*
0712	SBE-37SM	234 m	*conductivity_gerlache_strait_deployment1_234m.nc* *salinity_gerlache_strait_deployment1_234m.nc* *temperature_gerlache_strait_deployment1_234m.nc*
0253	SBE-37SM	283 m	*conductivity_gerlache_strait_deployment1_283m.nc* *salinity_gerlache_strait_deployment1_283m.nc* *temperature_gerlache_strait_deployment1_283m.nc*
0714	SBE-37SMP	311 m	*conductivity_gerlache_strait_deployment1_311m.nc* *salinity_gerlache_strait_deployment1_311m.nc* *pressure_gerlache_strait_deployment1_311m.nc* *temperature_gerlache_strait_deployment1_311m.nc*

Depth adjustment
Average pressure suggests that the mooring is 16.1 m shallower than target depth at #1405 instrument, 16.8 m at #0714 instrument (mean = 16.45 m). Adjusting all sensors depths by -16 m.

FJ200 (Mooring A)
Deployment period: Nov 29, 2015– Apr 14, 2016
Deep mooring in Inner Andvord (corrected top float depth 198 m).
Corrected bottom depth: 527 m
Latitude: 64°S 51.712'
Longitude: 62°W 33.868'

75 kHz ADCP
Corrected transducer depth: 518 m
Time intervals: 60 min
16 m depth bins
File name: *currents_andvord_bay_deployment1.nc*

T-S array
Time intervals:
600 seconds (all sensors)

Serial nr	Instrument	Corr. depth	File names

0450	SBE-37SMP	199 m	*pressure_andvord_bay_deployment1_199m.nc* * *temperature_andvord_bay_deployment1_199m.nc*
1642	SBE-56	223 m	*temperature_andvord_bay_deployment1_223m.nc*
2141	SBE-37SM	248 m	*temperature_andvord_bay_deployment1_248m.nc*
0255	SBE-37SM	298 m	*temperature_andvord_bay_deployment1_298m.nc*
2480	SBE-37SM	348 m	*temperature_andvord_bay_deployment1_348m.nc*
1645	SBE-56	398 m	*temperature_andvord_bay_deployment1_398m.nc*
0272	SBE-37SM	498 m	*temperature_andvord_bay_deployment1_498m.nc*

* *"p_corrected" field is adjusted to a new baseline value of 200.5 db (original baseline value 14.7 db).*

Depth adjustment
Seabird pressure sensor is bad throughout. ADCP pressure sensors suggest a mean transducer depth of 518.3 m (Target depth 520 m). This is on the order of the difference between predicted and actual depth on the mooring diagram (529 m - > 533 m), although the deviation is in the opposite direction. Choosing to trust the ADCP sensor. Adjusting all sensors depths by -2 m.

Deployment 2

FJ200 (Mooring A)
Deployment period: Apr 17, 2016– Mar 5, 2017
Deep mooring in Inner Andvord (corrected top float depth 291 m).
Corrected bottom depth: 508 m
Latitude: 64°S 52.068'
Longitude: 62°W 33.499'

75 kHz ADCP
Transducer depth 501 m
Time intervals: 60 min
8 m depth bins
File name: *currents_andvord_bay_deployment2.nc*

T-S array
Time intervals:
10 seconds (301 m and 391 m sensors)
600 seconds (all other sensors)

Serial nr	Instrument	Corr. depth	File names
5361	SBE-37SMP	292 m	*pressure_andvord_bay_deployment2_292m.nc* *temperature_andvord_bay_deployment2_292m.nc*
1642	SBE-56	301 m*	*temperature_andvord_bay_deployment2_301m.nc*
0255	SBE-37SM	316 m	*temperature_andvord_bay_deployment2_316m.nc*

2141	SBE-37SM	341 m	*temperature_andvord_bay_deployment2_341m.nc*
1645	SBE-56	391 m*	*temperature_andvord_bay_deployment2_391m.nc*
2480	SBE-37SM	441 m	*temperature_andvord_bay_deployment2_441m.nc*
0272	SBE-37SM	491 m	*temperature_andvord_bay_deployment2_491m.nc*

**High-frequency sampling (10 s)*

Depth adjustment
ADCP pressure sensors suggest a mean transducer depth of 501.4 m (Target depth 510 m). Opposite of difference between predicted and actual depth on the mooring diagram (517 m - > 531 m). Consistent with the mean pressure from sensor 5361 (Target depth 301 m, measured mean depth 293.9 m). Choosing to trust the ADCP sensor. Adjusting all sensors depths by -9 m.

Processing and validation

ADCP processing

ADCP data was processed using the WinADCP software from RD Instruments. The following parameters were used for all profilers:

Beam correlation limit = 64
Error amplitude limit = 80
Percent Good 3-beam solution = 40
Percent Good 4-beam = 40
Out of range limit = 5000
Min bin count limit = 50

Magnetic declination angles were obtained from http://www.ngdc.noaa.gov/geomag-web/ and applied as a correction to the current vectors.

SeaBird sensor processing

Sea-Bird sensor data was downloaded from the instruments using the proprietary Sea-Bird Electronics, Inc. SeaSoft programs and saved as ASCII files. Conversion of the data to calibrated oceanographic units, calculations of salinity and density and post-processing of these data sets was accomplished using software tools developed in the Matlab programming language. The sensor data time series were edited for spikes and truncated to remove out of water samples pre- and post-deployment.

SeaBird sensor validation against CTD

Plots show comparison of temperature and salinity from mooring sensors (red dots) to adjacent CTDs near deployment and recovery (black lines).

Temperatures generally look within a reasonable range of CTDs, with the exception of the recovery of Mooring B. In this case, the CTD profile was taken relatively far away from the mooring site.

Salinities look reasonable for Mooring B, but poor for Mooring A. Some individual sensors may perform well.

MOORING B

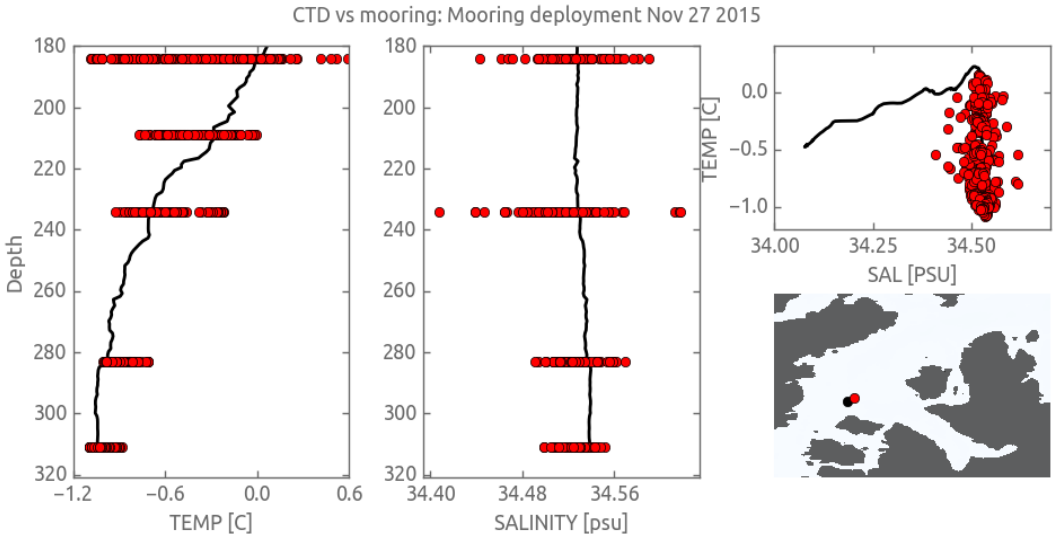

Figure 2: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring B within a 2-day window centered around the CTD time near mooring deployment on November 27 2015. Locations of mooring and profile (in red and black, respectively) show in map.

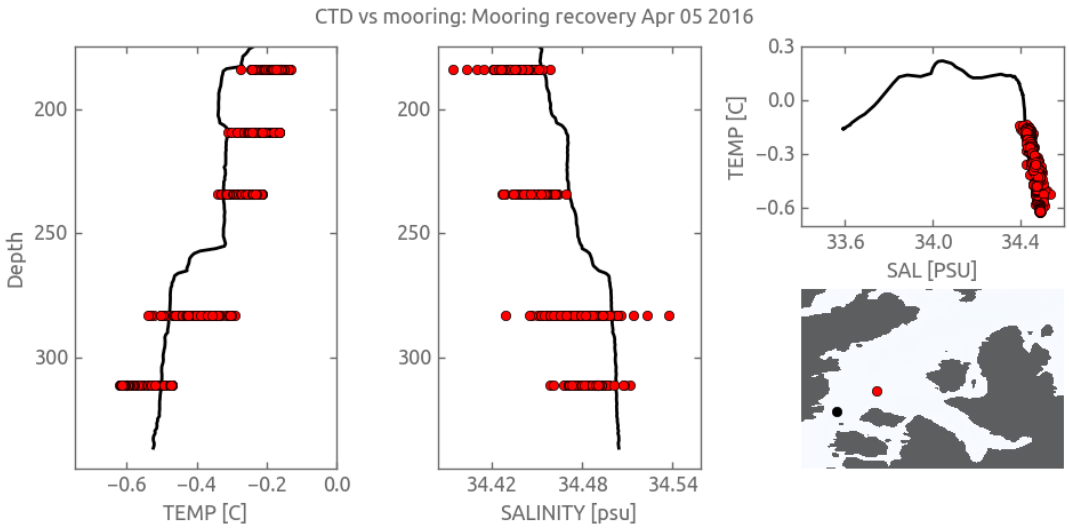

Figure 3: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring B within a 2-day window centered around the CTD time near mooring recovery on April 5 2016. Locations of mooring and profile (in red and black, respectively) show in map.

MOORING A, Deployment 1

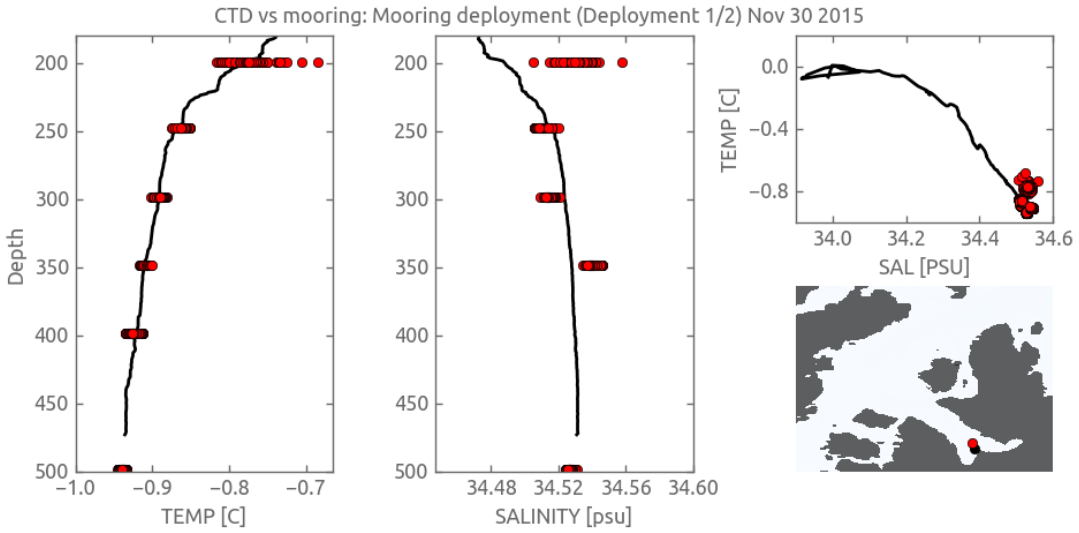

Figure 4: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring A within a 2-day window centered around the CTD time near mooring recovery on November 30 2015. Locations of mooring and profile (in red and black, respectively) show in map.

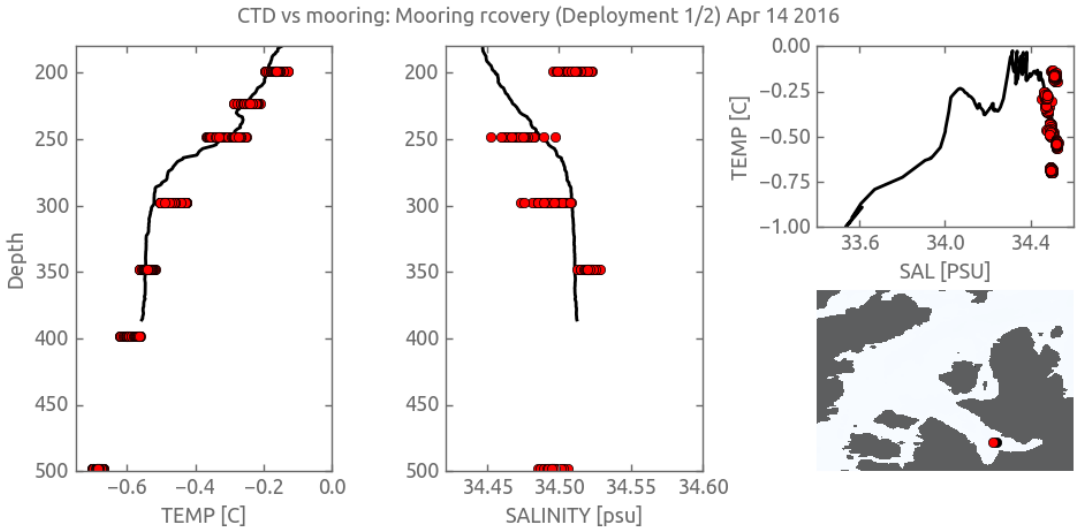

Figure 5: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring A within a 2-day window centered around the CTD time near mooring recovery on April 14 2016. Locations of mooring and profile (in red and black, respectively) show in map.

MOORING A, Deployment 2

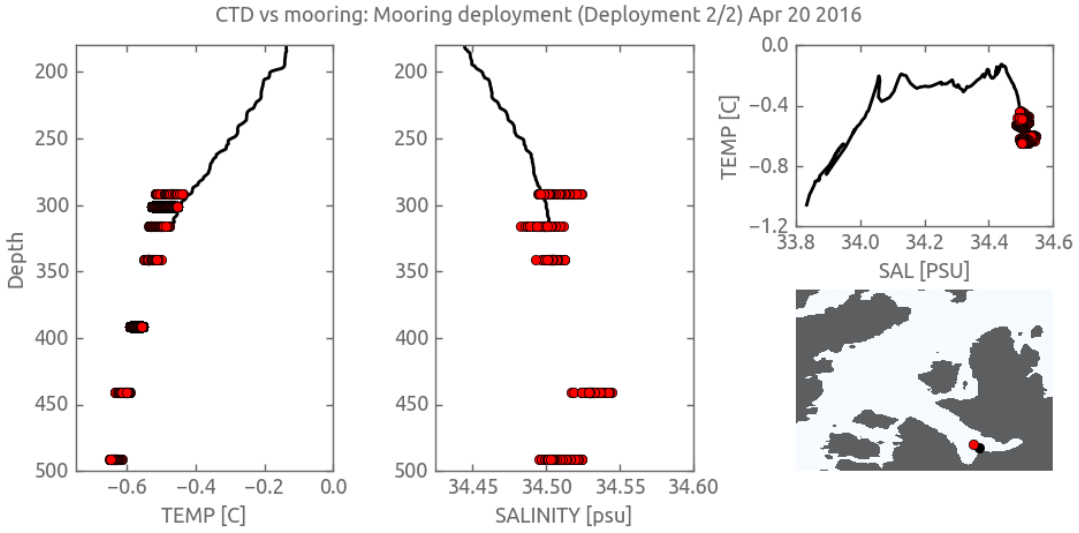

Figure 6: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring A within a 2-day window centered around the CTD time near mooring deployment on April 20 2016. Locations of mooring and profile (in red and black, respectively) show in map.

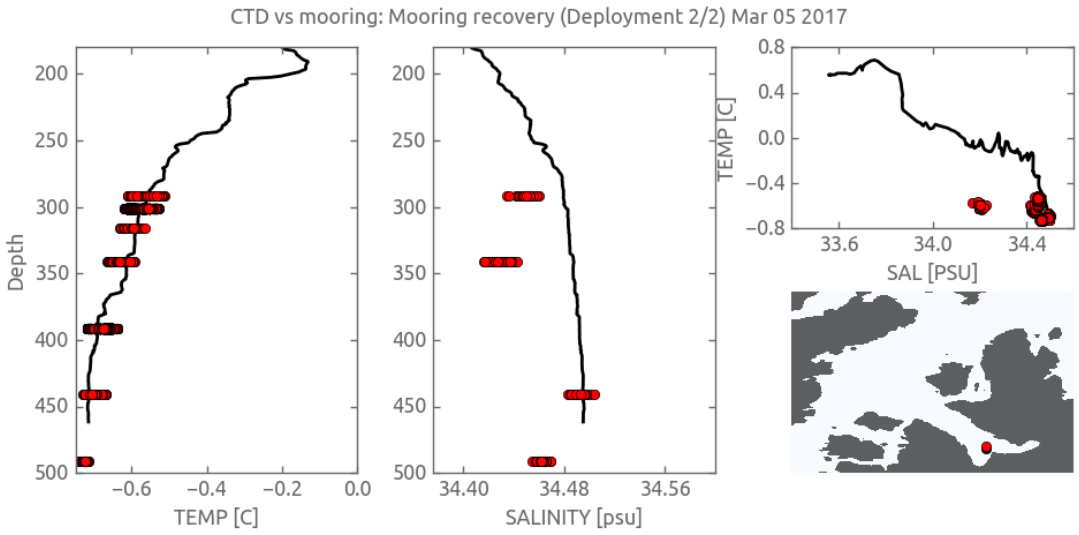

Figure 7: Comparison of CTD temperature and salinity (black) with mooring temperature and salinity from Mooring A within a 2-day window centered around the CTD time near mooring recovery on March 5 2017. Locations of mooring and profile (in red and black, respectively) show in map.

Acknowledgements

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