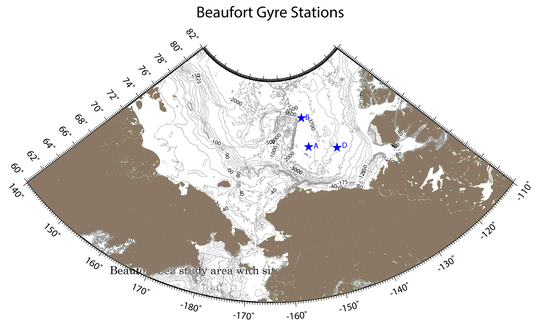
Vertical Structure and Dynamics of the Beaufort Gyre Subsurface Layer from ADCP Obervations

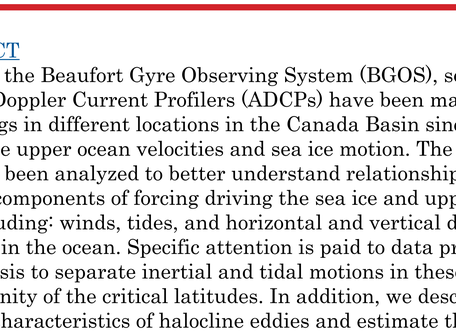
Daniel J. Torres[a], Richard Krishfield[a], Andrey Proshutinsky[a], Mary-Louise Timmermans[b]

[a]Woods Hole Oceanographic Institution, Woods Hole, MA, [b]Yale University, New Havem, CT

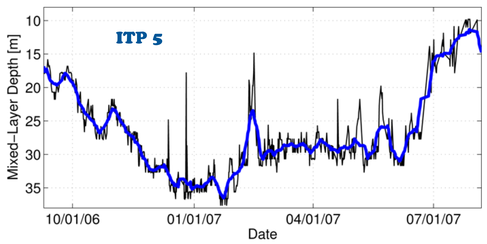
ABSTRACT

As part of the Beaufort Gyre Observing System (BGOS), several Acoustic Doppler Current Profilers (ADCPs) have been maintained at moorings in different locations in the Canada Basin since 2005 to measure upper ocean velocities and sea ice motion. The ADCP data have been analyzed to better understand relationships among different components of forcing driving the sea ice and upper ocean layer including: winds, tides, and horizontal and vertical density gradients in the ocean. Specific attention is paid to data processing and analysis to separate inertial and tidal motions in these regions in the vicinity of the critical latitudes. In addition, we describe the dynamic characteristics of halocline eddies and estimate their kinetic energy and their role in the total energy balance in this region. Ice-Tethered Profiler (ITP) data are used in conjunction with the ADCP measurements to identify relationships between T-S and vertical velocity structures in the mixed layer and deeper. Comparisons of mixed layer depth (MLD) determined from ITPs and ADCPs show MLD can be determined from ADCP data. We also describe the relationship between the seasonal cycle of ice thickness and sub-surface ocean velocity and its implication in a changing climate.

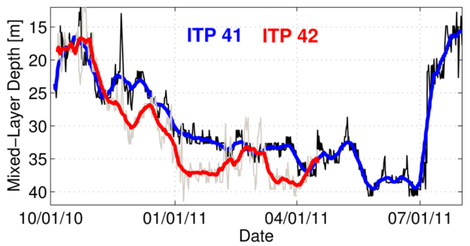




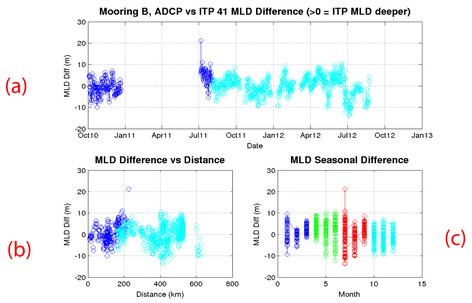
Beaufort Gyre mooring locations with drift tracks of ITPs 5, 41, and 42.



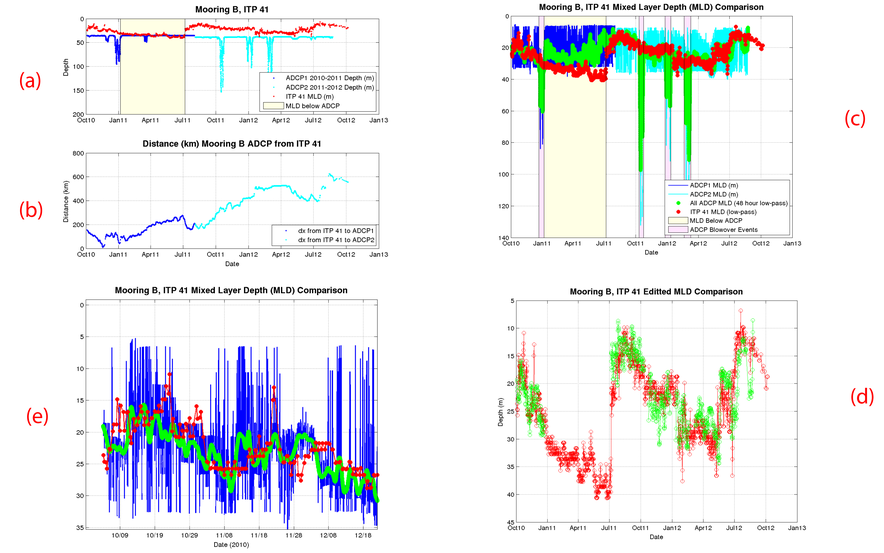
Time series of mixed layer depth (MLD) from 9/2006 - 9/2007 from ITP-5 showing typical annual cycle of MLD with maximum extent in the winter.



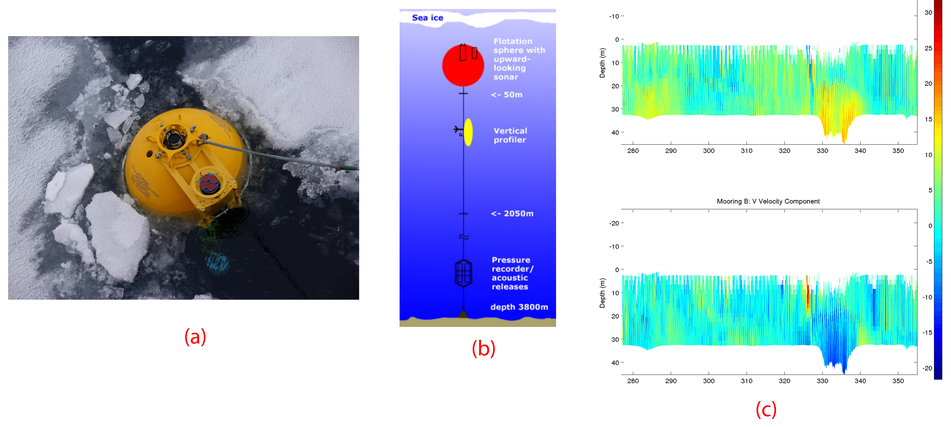
Time series of mixed layer depth (MLD) from 10/2010 - 9/2011 from ITP-41 and ITP-42 showing annual cycle of MLD. Maximum MLD in different seasons can be attributed to regional differences.



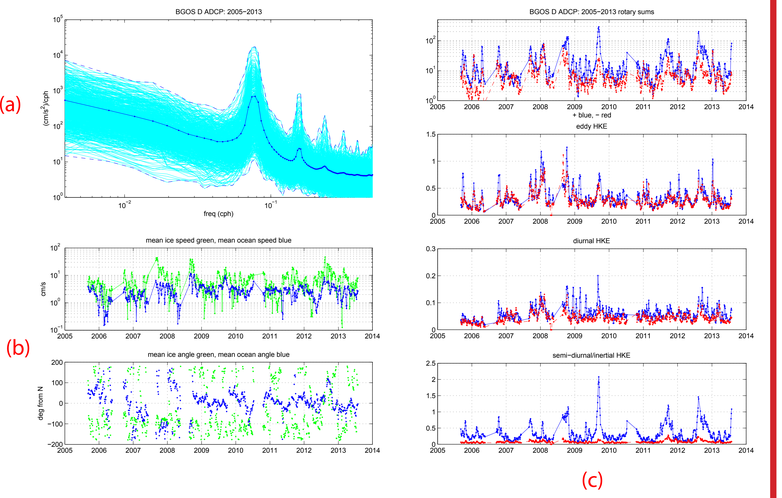
Differences in MLD between ADCP and ITP. (a) Time series (b) Differences as a function of distance between ADCP and ITP. (c) Seasonal differences in MLD



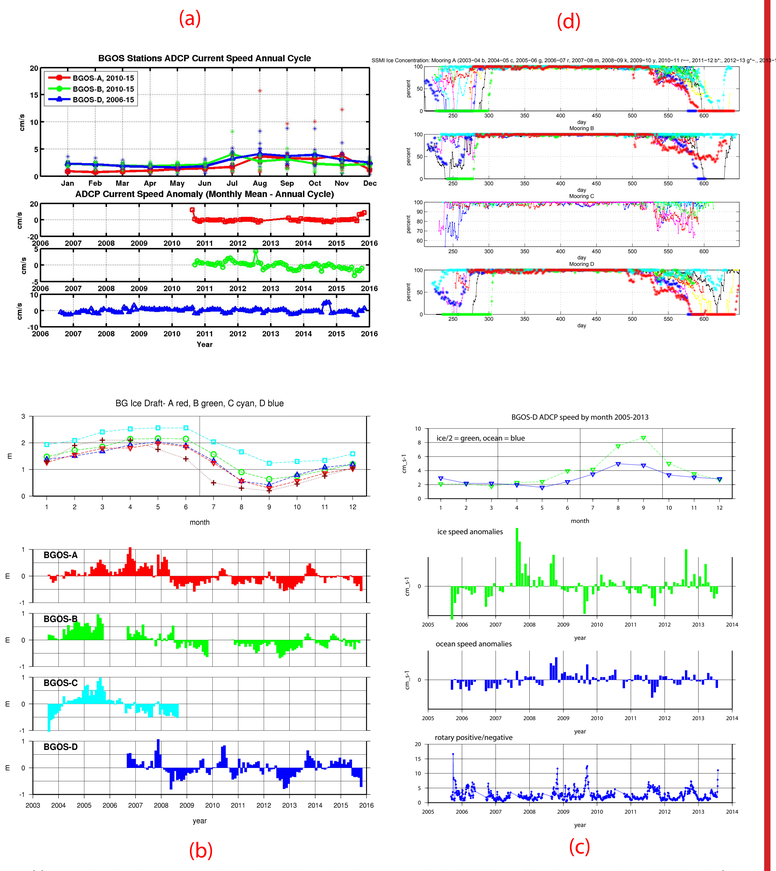
(a) Mooring B ADCP deployment depth compared to MLD from ITP. Highlighted is time period when MLD was deeper than ADCP depth. (b) Distance from mooring B to ITP-41. (c) Comparison of MLD as determined from ITP and from ADCP. Highlighted are periods where ADCP MLD calculations are not included in (d). (d) is MLD comparison. (e) MLD comparison from 10/1/2010 - 12/31/2010.



(a) ADCP as deployed in subsurface mooring. (b) Mooring diagram. (c) Time evolution of velocity from 10/1/2010 - 12/31/2010. Same time period as (e) above.



(a) Mean ocean spectra from mooring D over 8 year time period. (b) Ice and ocean velocities (speed and direction). (c) HKE energy summed within the different band ranges.



(a) Annual cycle of current speed at each BGOS station from mean of all ADCP bins. Depth range is from ADCP depth (20 - 30 m) to just below the surface.

(b) Annual cycle of ice thickness from ULS data at each station. (Updated through 2014)

(c) Annual cycle of ice and current speed. Associated anomalies (monthly mean minus annual cycle) and rotary spectra.

(d) Sea-Ice concentration from NSIDC SSMI at each mooring location 2003-2015.

Annual cycle of current speed was found to be anti-correlated with ice thickness.

Session HE14B: Vertical Structure and Dynamics of the Beaufort Gyre Subsurface Layer from ADCP Observations. Ocean Sciences Meeting, New Orleans, LA, Feb., 2016