Geophysical Research Abstracts, Vol. 7, 05797, 2005
SRef-ID: 1607-7962/gra/EGU05-A-05797

Investigation of the Beaufort Gyre system: hypothesis, conceptual model, observational approach and first results

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The Beaufort Gyre (BG) of the Canadian Basin is the largest freshwater reservoir in the Arctic Ocean. The BG's upper 400 m low salinity waters, surrounded by the relatively saltier waters, rotate anticyclonically following contours of geostrophically balanced dynamical height distribution. Proshutinsky et al. [2002] argued that this portion of the BG dynamics acts as an oceanic flywheel that regulates seasonal and interannual variability of sea ice drift and, respectively, influences processes regulating sea ice concentration and thickness distribution. From this view point, the BG thermohaline structure is an important element regulating circulation of the Arctic Ocean. Hence, climatic changes in the BG temperature and salinity fields could be used for analyses of the Arctic Ocean change recorded during last decades. Here we focus on the analysis of changes of the BG integral parameters such as freshwater and heat content, and the BG circulation driven by oceanic thermohaline structure and atmospheric winds. We also analyze possible causes of these changes and formulate several scientific questions for future studies in relation to the BG phenomenon and its role in the Arctic climate system. Additionally, seasonal variability of freshwater and heat content in the Beaufort Gyre will be presented, and causes of interannual changes will be discussed based on data from the Beaufort Gyre Freshwater Experiment (BGFE; http://www.whoi.edu/beaufortgyre), a prototype Ice-Tethered Profiler (ITP), and using CTD and XCTD data collected between 2001 and 2004. As part of the BGFE and in combination with the JWACS cruises on the CCGS Louis S. St. Laurent, three bottom-tethered moorings were deployed in August 2003 at coordinates 75N and 150W, 78N and 150W and 77N and 140W, and were recovered in August 2004. Year-long time

series of sea ice draft (from upward looking sonars mounted at the top mooring float), temperature, salinity, and currents in the 50-2000m layer (from moored profilers), and bottom pressure (from pressure tide gauges) were retrieved from the instruments. Information in the upper ocean above 50 m, were also obtained from four drifting ice beacons which were also installed during the 2003 cruise and have telemetered temperature and salinity data at 10, 25, and 40 m for more than a full year. In order to continue collecting data from the Beaufort Gyre to study multiannual variability, the moorings were refurbished and redeployed in 2004 at the same locations and the buoy array was augmented with an ITP (providing CTD data with 1 meter vertical resolution and 6 hours temporal resolution down to 750 m) establishing the Beaufort Gyre Observing System (BGOS).