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Trends in Arctic Ocean bottom pressure, sea surface height and freshwater content using GRACE and the ice-ocean model PIOMAS from 2008-2012

Cecilia Peralta-Ferriz (1), James Morison (1), Jinlun Zhang (1), and Jennifer Bonin (2)

(1) University of Washington, Polar Science Center, Applied Physics Lab., United States (ferriz@apl.washington.edu), (2) University of South Florida, College of Marine Science, United States

The variability of ocean bottom pressure (OBP) in the Arctic is dominated by the variations in sea surface height (SSH) from daily to monthly timescales. Conversely, OBP variability is dominated by the changes in the steric pressure (StP) at inter-annual timescales, particularly off the continental shelves. The combination of GRACE-derived ocean bottom pressure and ICESat altimetry-derived sea surface height variations in the Arctic Ocean have provided new means of identifying inter-annual trends in StP (StP = OBP-SSH) and associated freshwater content (FWC) of the Arctic region (Morison et al., 2012). Morison et al. (2012) showed that from 2004 to 2008, the FWC increased in the Beaufort Gyre and decreased in the Siberian and Central Arctic, resulting in a relatively small net basin-averaged FWC change.

In this work, we investigate the inter-annual trends from 2008 to 2012 in OBP from GRACE, SSH from the state-of-the-art pan-Arctic ocean model PIOMAS –validated with tide and pressure gauges in the Arctic–, and compute the trends in StP and FWC from 2008-2012. We compare these results with the previous trends from 2005-2008 described in Morison et al. (2012).

Our initial findings suggest increased salinity in the entire Arctic basin (relative to the climatological seasonal variation) from 2008-2012, compared to the preceding four years (2005-2008). We also find that the trends in OBP, SSH and StP from 2008-2012 present a different behavior during the spring-summer and fall-winter, unlike 2005-2008, in which the trends were generally consistent through all months of the year. It seems since 2009, when the Beaufort Gyre relaxed and the export of freshwater from the Canada Basin into the Canadian Archipelago and Fram Strait, via the Lincoln Sea, was anomalously large (de Steur et al., 2013), the Arctic Ocean has entered a new circulation regime. The causes of such changes in the inter-annual trends of OBP, SSH and StP –hence FWC–, associated with the changes in the shape and strength of the Arctic Oscillation (AO) and the wind patterns, as well as with the changes in sea ice conditions will be explored.

References:

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