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Model simulations of Arctic fresh water balance variability

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The study of Arctic freshwater balance variations becomes more important because of dramatic changes in Arctic climate system occurring during last 2-3 decades. The major freshwater sources in the Arctic are the Pacific waters, river discharges, precipitation and ice melting. The study of freshwater balance perturbation is motivated by significant uncertainty of its component observations and also by their temporal variability. According to Peterson et al. (2002) the average annual discharge of fresh water from the six largest Eurasian rivers to the Arctic Ocean increased by 7% from 1936 to 1999. Besides significant part of river discharges corresponding to small rivers are not known. The uncertainty of precipitation which is another component of freshwater balance reaches a factor of about 1.5 according to Serreze et al. (2006) and Yang (1999). Therefore we aimed at estimation of consequences of freshwater balance disturbance caused by different factors.
After examining the freshwater pathways derived from ICMMG 1948-2009 model run, we suggest that most significant part of Eurasian river discharge contribute to the North Atlantic via the Fram Strait and play a minor role in Beaufort Gyre (BG) accumulation of Arctic freshwater. The proposed scheme suggests that Mackenzie river runoff and ice melting water can be accumulated during negative NAO (AO) periods (Proshutinsky et al., 2002), while Pacific water gathered in the peripheral of BG driven by subsurface component of Ekman pumping.
The analysis of dynamical response of the Arctic and North Atlantic to the variations of Arctic rivers reveals that, according our model results, any reduction in river discharge causes the increase of Fram Strait export along with corresponding Barents Sea import and vise versa. The suggested links between the Siberian river discharge and an intensity of the Arctic upper ocean circulation is introduced and has been examined statistically.
The Arctic freshwater sources are balanced by freshwater export to northern North Atlantic. The formation of low salinity anomalies known as "Great Salinity Anomalies" (GSA) was recorded sequentially in northern North Atlantic in 70s, 80s and 90s; (Belkin, 2004) and were caused mostly by an enhanced Arctic outflow of low-salinity waters and ice through the Fram Strait and straits of Canadian Arctic Archipelago. According to our model results, another salinity anomaly was produced in 1989-1995 which propagated around northern North Atlantic in 2000s.

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