Geophysical Research Abstracts,
Vol. 11, EGU2009-11281, 2009
EGU General Assembly 2009

New estimates of annual and seasonal variability in river discharge across the Eurasian pan-Arctic

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River runoff is an important integrator of hydrological behavior across large regions and it plays a significant role in the fresh-water budget of the Arctic Ocean. Ocean salinity and sea ice formation are critically affected by river input. Changes in the fresh water flux to the Arctic Ocean may slow down global ocean circulation by affecting North Atlantic deep water formation. Eurasia contributes 75% of the total terrestrial runoff to the Arctic Ocean and has three of the four major arctic rivers. Observations of combined river discharge from the six largest Russian arctic rivers (N.Dvina, Pechora, Ob, Yenisei, Lena and Kolyma) have demonstrated an increase of 7% over the period 1936-1999. Our more recent estimates have shown this increase has continued into the 21st Century with a new historical maximum observed in 2007 when a record minimum in Arctic Ocean sea ice was observed. Analysis of the long-term sea-ice and discharge records showed a significant correlation between sea ice minimum extent and Russian river discharge (r = -0.7), which suggests an increase in atmospheric moisture transport to land surface due to extension of ice free Arctic Ocean during summer-fall.

To better understand the physical mechanisms driving the observed runoff changes we explore alterations due to both global climate change and local anthropogenic influences. To estimate the contribution of each of these factors we used reconstructions of naturalized hydrographs with a newly developed Hydrograph Transformation Model. A combined analysis of observed and naturalized river discharge characteristics showed a significant redistribution of seasonal discharge along the Yenisei River due to reservoir regulation. However, naturalized discharge records also demonstrate a significant increase during the winter. This suggests that natural causes such as permafrost changes, increasing number and magnitude of winter snowmelt events, and an increase in the ground water table may be important contributing factors to the winter discharge change.