Understanding the impacts of reservoir regulation on streamflow characteristics is extremely important to our efforts of examining climate and hydrology changes over the high latitude regions. This bibliography briefly summarizes recent papers addressing observed changes in arctic river discharge. The emphasis is on dam operation and regulation to hydrologic regimes and changes at regional and seasonal scales. Selected papers mostly deal with streamflow changes over the largest Siberian rivers and the Mackenzie basin. Suggestions to include additional papers are welcome.


This study systematically analyzes long-term (1936-1999) monthly discharge records for the major sub-basins within the Lena River watershed in order to document significant streamflow hydrology changes induced by human activities (particularly reservoirs) and by natural variations/changes. The results demonstrate that reservoir regulations have significantly altered the monthly discharge regime in the lower parts of Lena river basin. Because of a large dam in west Lena river, summer (high) flows at the outlet of the Vilui valley have been reduced by up to 55% and winter (low) flows have been increased by up to 30 times. These alterations, plus streamflow changes in the upper Lena regions, lead to strong upward trends (up to 90%) in monthly discharge at the basin outlet during the low flow months and weak increases (5-10%) in the high flow season.

Yang, D., B. Ye, and D. Kane, 2004a: Streamflow changes over Siberian Yenisey River basin, J. Hydrology, 296, pp. 59-80.

More than six large reservoirs exist in the Yenisey watershed. Analyses of long-term (1935-99) monthly discharge data for the major sub-basins show that the reservoir regulation has significantly altered the monthly discharge regimes in the northeast and the upper portions of the Yenisei basin. Constructions of four large dams in the northeast Yensiey regions reduced the summer peak flows in the Angara valley by 15-30% and increased the winter low flows by 5-30%. Operations of two large reservoirs in the upper Yenisey regions enhanced the winter flows by 45-85% and reduced the summer flows by 10-50%. These alterations lead to a streamflow regime change toward less seasonal variation over the eastern and lower Yenisey basin. Because of reservoir regulations, discharge records collected at the Yenisey basin outlet do not always represent natural changes and variations, they tend to underestimate the natural streamflow trends in summer and overestimate the trends in winter and fall seasons. Cold season discharge increase over the Yenisey river is not natural-caused, but mainly the effect of reservoir regulations.


This study systematically analyzes long-term (1936-1994) monthly and yearly discharge records over the Ob River watershed. The results show that human activities affect regional hydrologic regimes and changes. For instance, over the upper Ob basin, runoff decreases in summer months and increases in winter season. The decreases in summer are mainly due to potential water uses along the river valley for agricultural and industrial purposes, and reservoir regulation to reduce the summer peak floods. The
increases in winter streamflow are caused by reservoir impacts to release water for power generation over winter months. Due to reservoir regulations and water uses in the upper parts of the Ob basin, discharge records observed at the Ob basin outlet do not always represent natural changes and variations. Reconstruction of discharge data is necessary to reduce the human impact on streamflow changes.


This study systematically analyzes long-term (1950–1992) stream temperature records for the major sub-basins within the Lena River watershed in order to describe water temperature regimes over the various parts of the Lena watershed and document significant stream temperature changes induced by reservoir regulation, and by natural variations/changes. With regards to dam impact, the results clearly demonstrate that the reservoir regulation has a strong influence on the regional water temperature regime and change in the regulated sub-basin. Reservoir regulation has increased (decreased) the downstream water temperatures in the Vilui valley during the early (mid) open water season. Stream temperatures over the regulated Vilui tributary have significantly increased in the early and late parts of the warm season due to combined effects of natural changes and reservoir regulation.


Historical data analyses show that the Lena River and its major tributaries experienced an extended low water period over 1936–1957 and high water periods over 1974–1983 and 1988–2001. Higher than normal river discharge and annual precipitation is particularly pronounced since the late 1960s due to large-scale changes in atmospheric circulation patterns. The trend in runoff observed in the Lena River basin increased by 10% from 1936 to 2001 due to extended wet periods during the second part of last century. The trend is weakened for the Vilui sub-basin since it experiences reservoir regulation, which causes additional water losses through reservoir filling and increased evaporation. Runoff regulation strongly affects the winter runoff regime of both the Vilui valley and the lower reaches of the Lena River, causing winter discharge increase by about 33% at the Lena river outlet.


The headwaters of the Peace River, Canada became regulated in 1968 by a major hydroelectric facility and associated reservoir located in the Rocky Mountains. This paper examines the change to the downstream hydrographs that have resulted from regulation. To facilitate the comparison, a naturalized (without regulation effects) flow regime (1972-1996) was generated using a combination of hydrologic and hydraulic flow models. The results showed that even some 1100 km downstream, there have been significant changes to the hydrograph. Specifically, average winter flows were 250% higher, annual peaks (1-day, 15-day, 30-day highs) were in the order of 35-39% lower, and overall variability in daily flows decreased. Despite the reduction in peaks and variability, however, the downstream hydrograph is far from flat and has retained the
basic shape of the pre-regulation hydrograph. This is primarily due to the strong influence of tributary inflow below the point of regulation. Recommendation for improvements to the model and future application of these data are also discussed.


Rivers of the Mackenzie Basin exhibit several seasonal flow patterns that include the nival (snowmelt dominated), proglacial (influenced by glacier melt), wetland, prolacustrine (below large lakes), and regulated flow regimes. The Mackenzie amalgamates and moderates these regimes to deliver spring peak flows, followed by declining summer discharge and low winter flows, to the Arctic Ocean. The mountainous sub-basins in the west (Liard, Peace, and northern mountains) contribute about 60% of the Mackenzie flow, while the interior plains and eastern Canadian Shield contribute only about 25%, even though the two regions have similar total areas (each occupying about 40% of the total Mackenzie Basin). The mountain zone is the dominant flow contributor to the Mackenzie in both high-flow and low-flow years. A case study of the Great Slave system demonstrates the effects of natural runoff, regulated runoff, and lake storage on streamflow, as well as the large year-to-year variability of lake levels and discharge. Despite a warming trend in the past three decades, annual runoff of the Mackenzie Basin has not changed. Significant warming at most climatic stations in April (and at some, also in May or June) could have triggered earlier snowmelt. The first day of hydrograph rise for the main trunk of the Mackenzie (seen as a proxy for breakup) has advanced by about three days per decade, though the trend was not statistically significant for the mountain rivers. Peak flows do not reveal any trend, but the arrival of the spring peaks has become more variable. More evidence is needed to interpret these flow phenomena properly.