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Why has the Arctic river discharge been increasing?

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To analyze the increase in discharge from Lena watershed, a land surface model was applied over 1986 to 2004. The relationship between river discharge and land surface processes (i.e., snow water equivalent, active layer depth, soil water, etc) was analyzed for Lena watershed, especially for two small watersheds (Aldan and Upper Lena) within the watershed. Discharge and precipitation in the small watersheds have been increased during the 20-year. Simulation also indicated the increasing trends in active layer depth (ALD), snow water equivalent (SWE), and evapotranspiration (ET). The increase was especially significant in southern mountainous region of Lena watershed. In the two small watersheds, SWE was highly correlated with discharge, which suggests that the melted snow does greatly affect to the peak discharge in the early spring. The increased ALD also indicated similar pattern with discharge variation in the small watersheds. Because the ALD does not have the direct relation to the discharge, the melted ice water in terms of the thawed ALD was compared with river discharge. They indicated good correlation in the two small watersheds. The melted ice water had also higher correlation to ET. This suggests that water produced by the thawed ALD was useful to ET and discharge during the summer season. During the simulation period, precipitation in Lena watershed was in increasing trend. However, soil water storage did not indicate any characteristic trend, although there was interannual variation in soil water storage corresponding to precipitation. The trend in soil water storage indicates that the increased precipitation did contribute to discharge and ET. In conclusion, the increase of discharge during the period of 1986-2004 in Lena watershed could explain with both the increased precipitation and the increased ground ice melt.

Keywords: river discharge, Arctic river, active layer depth, snow water equivalent, evapotranspiration, land surface model