Geophysical Research Abstracts
Vol. 20, EGU2018-17467, 2018
EGU General Assembly 2018


# Hydrologic and morphodynamic change of the middle Lena River (Eastern Siberia)

Emmanuèle Gautier (1), Thomas Dépret (2), Francois Costard (3), Alexander Fedorov (4), Clément Virmoux (2), Pavel Konstantinov (4), and Delphine Grancher (2)

(1) Université Paris 1, CNRS Lab. Physical Geography, France , (2) CNRS, Lab. Physical Geography, Meudon - France , (3) Lab. GEOPS-Geosciences Paris Sud, CNRS - Université Paris Sud, Orsay, France, (4) Permafrost Institute, RAS Siberian branch, Yakutsk - Russia

Recent observations indicate that over the last decades, climate change has increasingly influenced the frequency, intensity and duration of extreme climatic and hydrologic events. The main aim of this study is to determine the hydrologic and morphodynamic response of the Lena River in Eastern Siberia to ongoing climate change. Draining the coldest region of the Northern Hemisphere, the Lena River may be impacted by global warming, which is particularly pronounced in periglacial areas characterized by deep and continuous permafrost. The immoderate regime of the Arctic rivers is dominated by the spring flood peak. Many sub-arctic and arctic rivers cross extensive continental areas and the flood wave generated by the snowmelt in the upper basin arrives in still frozen areas, creating a specific river process called river outburst. The outburst causes a very rapid rise in water level, with the dislocation of the river ice cap that covered the river during the winter. Flooding, ice jams and brutal ice breaks are common features of the breakup. Data on mean monthly discharge and flood peaks of the Middle Lena River are available since 1936 and daily discharges since 1954. The magnitude of the flood, the dates of the flood beginning and of the flood peak are determined. Our results provide evidence for a net hydrologic change with an increase in the intensity and duration of floods in the two decades. The frequency of high floods is unprecedented, and small floods no longer occur. The tail of the temporal distribution of the flood peak are also changing. More frequent early floods are occurring in spring with secondary flood peaks in summer. Furthermore, the changes have been accelerating since 2004.
The second aim of the study is to evaluate the impact of floods on changes in the morphology and sedimentation of the fluvial forms. The Lena riverbanks are sensitive to mechanical and thermal erosion because of the permafrost. The impact of hydrologic changes is examined at a pluri-decadal scale (since 1967) on the basis of satellite images. Annual erosion and sedimentation (2008-2013) were measured on different river islands on the basis on precise topographic survey and sediment trapping system. At an annual scale, both erosion of the banks and the thickness of deposits are correlated with the duration of flooding and the period of flooding also influenced the bank retreat. Secondary flood peaks occurring in late summer, together with a warm stream temperature, are also responsible for destabilizing the river bed. The pluri-decadal morphodynamic evolution of the river dynamics appears to be mainly related to the increasing duration of efficient discharge.
The increasing mobility of the channels and islands threatens numerous activities: navigation, and river infrastructure is destabilized or on the contrary, sedimentation increases. These developments will certainly disrupt economic activities in Siberia, which partly depend on the strategic role played by the river, river infrastructure and navigation playing a key role. Both infrastructure and activities can be threatened not only by flooding, but also by a change in river dynamics.