Measuring the Effects of Climate Change on Arctic Rivers

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The Arctic is warming three times faster than the rest of the world, causing decreased sea ice and permafrost, changing ecosystems, and threatening the livelihoods of indigenous people. In this research, a method was developed to compute key dates of the Arctic rivers' spring thaw and evaluate how these dates have been changing. Daily observational data sets were obtained for air temperature, river discharge, and sea ice cover for all six major Arctic rivers. Satellite imagery was used to compute the fractional sea ice cover over Arctic river outlets into the ocean. The key dates of the Arctic spring thaw, including when the air temperature rose above freezing, the river ice breakup, and the sea ice breakup, were computed from 1978 to 2022. In the Spring, warming air temperatures cause a surge in melt water and river flow rates. This, in turn, causes a breakup of the frozen river and eventually the breakup of sea ice at the river’s mouth extending into the ocean. The results show that melt dates have become progressively earlier since 1978 for all six rivers. Overall, the sea ice cover changed the fastest with rates up to 0.94 days earlier per year at the Yenesei River outlet. For other variables and locations, the change in dates of the spring thaw varied from 0.1 to 0.4 days earlier per year. This study underscores the need to monitor changes in sensitive Arctic regions in order to prepare for a warming Arctic and its global consequences.

Awards Won:

First Award of $5,000

National Geographic Society: Excellence in Geography and Geospatial Science Award

National Oceanic and Atmospheric Administration - NOAA: Judges' Award