Impacts of terrestrial river heat flux on the declining Arctic sea ice

*Hotaek Park[1], Kazuhiro Oshima[1], Yasuhiro Yoshikawa[2], Eiji Watanabe[1]

1. Japan Agency for Marine-Earth Science and Technology, 2. Kitami Institute of Technology

In the Arctic, the recent warming speed of surface air temperatures are the fastest among the past historical records. The consequent influences are found in changes in the Arctic freshwater system, such as increasing river discharge, changing river-ice phenology, and warming of river water temperature. The warming water temperature can result in higher heat flux flowing into the Arctic Ocean, combining with the larger river discharge, which likely enhances the melt of sea ice in the shelf area. However, very few studies quantitatively assessed influences of the river heat flux on the Arctic sea ice are available. A land surface model (CHANGE) coupled with models of river discharge, ice-cover, and water temperature through channel network was applied to the Arctic river basins over the period 1979–2013, and then we assessed influences of the river processes on sea ice, including trends of river discharge, water temperature, and heat flux. The simulation indicated obvious increases in river discharge and water temperatures over the pan-Arctic rivers, consequently flowing considerable amount of heat to the ocean. The heat fluxes were significantly correlated with changes of sea surface temperature and sea ice concentration in the coastal areas of the Arctic Ocean, especially in the spring season when the sea ice begins to melt. This emphasizes that the heat flux of terrestrial freshwater is an important factor influencing the melting process of sea ice at specifically seasonal and local scales.

Keywords: river heat flux, sea ice retreat, land surface mode, sea ice concentration

