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Forcing, variability, and pathway of a freshwater-driven current in the Eurasian Arctic

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Siberian river water is a first-order contribution to the Arctic freshwater budget, with the Ob, Yenisey, and Lena supplying nearly half of the total surface freshwater flux. However, few details are known regarding where, when and how the freshwater transverses the vast Siberian shelf seas. This paper investigates the mechanism, variability and pathways of the fresh Kara Sea outflow through Vilkitsky Strait towards the Laptev Sea. We utilize a high-resolution ocean model and recent shipboard observations to characterize the freshwater-laden Vilkitsky Strait Current (VSC), and shed new light on the little-studied region between the Kara and Laptev Seas, characterized by harsh ice conditions, contrasting water masses, straits and a large submarine canyon. The VSC is 10-20 km wide, surface-intensified, and varies seasonally (maximum from August-March) and interannually. Average freshwater (volume) transport is 500 $\pm$ 120 km3 a-1 (0.53 $\pm$ 0.08 Sv), with a baroclinic flow contribution of 50-90%. Interannual transport variability is explained by a storage-release mechanism, where blocking-favorable summer winds hamper the outflow and cause accumulation of freshwater in the Kara Sea. The year following a blocking event is characterized by enhanced transports driven by a baroclinic flow along the coast that is set up by increased freshwater volumes. Eventually, the VSC merges with a slope current and provides a major pathway for Eurasian river water towards the Western Arctic along the Eurasian continental slope. Kara (and Laptev) Sea freshwater transport is not correlated with the Arctic Oscillation, but rather driven by regional summer pressure patterns.