Impact of riverine carbon and nutrient fluxes on the Arctic Ocean biogeochemistry

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The Arctic Ocean is more than any other ocean influenced by riverine delivery of carbon and nutrients. Moreover, this riverine delivery of carbon and nutrients is projected to experience profound changes during the 21st century. Here we quantify the impact of Arctic riverine delivery on marine primary production, air-sea CO_2 fluxes, and ocean acidification with the eddy resolving ocean circulation-biogeochemical model NEMO-PISCES. Therefore we developed a monthly riverine forcing set for all Arctic riverine delivery of carbon and nutrients based on observed river delivery from the six largest Arctic rivers. We find that riverine delivery of nutrients sustain 13-19% of basinwide Arctic Ocean net primary production (NPP) and up to 100% locally. This riverine sustained NPP reduces surface ocean dissolved inorganic carbon and thus increases the aragonite saturation state locally by up to 50%, a significant attenuation of coastal ocean acidification. In addition to nutrient fluxes, the riverine carbon fluxes reduce the Arctic Ocean air-to-sea CO_2 flux by 17% and turn the Laptev Sea from a sink of atmospheric carbon into a source. To quantify the effect of future changes, we performed idealized sensitivity tests with increasing riverine delivery by 1% per year. When riverine dissolved organic carbon fluxes are doubled, the Kara Sea, the East-Siberian Sea, and the Beaufort Sea also become sources of carbon to the atmosphere. Moreover, doubling of riverine nutrients leads to an increase in basinwide NPP by 11% and by up to 100% locally.

Oral preference