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Assessing bio-physical feedbacks in the Arctic Ocean under Arctic amplification

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Optically active water constituents can strongly attenuate in-water penetrative radiation and affect the upper ocean heat content. Arctic rivers supply the Arctic Ocean with a considerable amount of highly-absorbing organic material which is expected to increase, as a result of thawing permafrost in Siberia. Here, we investigate the effect of the variability of optically active water constituents on the heat budget of the Arctic Ocean. As a first step, we simulate locally the radiative heating by means of coupled atmosphere-ocean radiative transfer modelling (RTM SCIATRAN). By using satellite remote sensing retrievals of Coloured Dissolved Organic Matter (CDOM), Total Suspended Matter (TSM), Chlorophyll-a (Chl-a) and sea surface temperature data as input to the RTM simulations, we present the spatial distribution of potential radiative heating in the Laptev Sea. For upscaling, we use an ocean biogeochemical model coupled to a general circulation model (Darwin-MITgcm) to simulate the dynamics of the different constituents in response to Arctic amplification. We further set up the general circulation model to take into account the biogeochemical processes so that their feedback on Arctic Ocean's surface heating, stratification and sea ice melting can be assessed. Results show that high concentration of CDOM, TSM and Chl-a in Arctic waters increase the heating rate at the surface of the ocean and affect the heat fluxes to the atmosphere. The induced surface heating result in higher ice melting rates with potential implications to upper ocean stratification and primary production.