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CONTRASTING OPTICAL PROPERTIES OF SURFACE WATERS ACROSS THE FRAM STRAIT AND ITS POTENTIAL BIOLOGICAL IMPLICATIONS

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The underwater light regime is strongly affected by the distribution and optical properties of Colored Dissolved Organic Matter (CDOM) and particulate matter in the near-surface water. The Arctic Ocean is a region where information about optical properties of surface waters is still sparse. The Fram Strait is a key region with regards to Subarctic-Arctic exchange, where two contrasting water masses are found flowing past each other near at the surface. Polar water in the East Greenland Current (EGC) and Atlantic water in the West Spitsbergen Current (WSC) differ with regards to temperature, salinity and optical properties. We present data on absorption properties of CDOM and particles across the Fram Strait (along 79 °N), comparing Polar and Atlantic surface waters in September 2009 and 2010. CDOM absorption of Polar Water in the EGC was significantly higher compared to Atlantic Water in the WSC. An opposite pattern was observed for particle absorption with higher absorption found in the eastern part of the Fram Strait. Thus absorption of light in the eastern part of the Fram Strait is dominated by particles, predominantly phytoplankton, and the absorption of light in the western part of the strait is dominated by CDOM, with predominantly terrigenous origin. As a result the balance between the importance of CDOM and particulates to the total absorption budget in the upper 0-10 m, shifts across Fram Strait. In situ data on absorption by CDOM and particles was further assimilated into ECOLIGHT 5.4.1 model to simulate underwater profiles of spectral irradiance and Photosynthetic Active Radiation (PAR, 400-700 nm). The results indicate that the shift in composition between dissolved and particulate material does not substantially influence the penetration of PAR but does result in notable differences in ultraviolet (UV) light penetration, with higher attenuation in the EGC. In the absence of sea ice, PAR euphotic depth in the EGC area is 15% shallower compared to WSC due to high CDOM absorption. Future changes in the Arctic Ocean system will likely affect EGC through diminishing sea-ice cover and potentially increasing CDOM export due to increase in river runoff into the Arctic Ocean. The role of attenuation of light by CDOM in determining the underwater light regime will become more important, with a potential for future increase in marine productivity in the area of EGC due to elevated PAR and lowered UV light exposures.