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Arctic sea-ice melting: Effects on hydroclimatic variability and on UV-induced carbon cycling

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Since 1980 both the perennial and the multiyear central Arctic sea ice areas have declined by approximately 13 and 15% per decade, respectively (IPCC, 2013). Arctic sea-ice melting has led to an increase in the amplitude of the Northern Hemisphere jet stream and, as a consequence, in more slowly moving Rossby waves which results in blocking of weather patterns such as heat waves, droughts, cold spells, and heavy precipitation events (Francis and Vavrus, 2012). Changing Rossby waves account for more than 30% of the precipitation variability over several regions of the northern middle and high latitudes, including the US northern Great Plains and parts of Canada, Europe, and Russia (Schubert et al., 2011). From 2007 to 2013, northern Europe experienced heavy summer precipitation events that were unprecedented in over a century, concomitant with Arctic sea ice loss (Screen, 2013). Heavy precipitation events tend to increase the runoff intensity of terrigenous dissolved organic matter (tDOM) (Haaland et al., 2010). In surface waters tDOM is subject to UV-induced oxidation to produce atmospheric CO_2. Mineralization of DOM also occurs via microbial respiration. However, not all chemical forms of DOM are available to bacterioplankton. UV-induced transformations generally increase the bioavailability of tDOM (Sulzberger and Durisch-Kaiser, 2009). Mineralization of tDOM is an important source of atmospheric CO_2 and this process is likely to contribute to positive feedbacks on global warming (Erickson et al., 2015). However, the magnitudes of these potential feedbacks remain unexplored.

This paper will discuss the following items: 1.) Links between Arctic sea-ice melting, heavy precipitation events, and enhanced tDOM runoff. 2.) UV-induced increase in the bioavailability of tDOM. 3.) UV-mediated feedbacks on global warming.

References

Erickson, D. J. III, B. Sulzberger, R. G. Zepp, A. T. Austin (2015), Effects of stratospheric ozone depletion, solar UV radiation, and climate change on biogeochemical cycling: interactions and feedbacks, Photochemical & Photobiological Sciences, 14(1), 127-148.

Francis, J. A., S. J. Vavrus (2012), Evidence linking Arctic amplification to extreme weather in mid-latitudes, Geophysical Research Letters, 39, doi: 10.1029/2012GL051000.

Haaland, S., D. Hongve, H. Laudon, G. Riise, R. D. Vogt (2010), Quantifying the drivers of the increasing colored organic matter in boreal surface waters, Environmental Science & Technology, 44(8), 2975-2980.

IPCC Climate Change 2013 – The Physical Science Bases (2013).

Schubert, S., H. Wang, M. Suarez (2011), Warm season subseasonal variability and climate extremes in the Northern Hemisphere: The role of stationary Rossby waves, Journal of Climate, 24(18), 4773-4792.

Screen, J. A. (2013), Influence of Arctic sea ice on European summer precipitation, Environmental Research Letters, 8(4), doi: 10.1088/1748-9326/8/4/044015.

Sulzberger, B., E. Durisch-Kaiser (2009), Chemical characterization of dissolved organic matter (DOM): A prerequisite for understanding UV-induced changes of DOM absorption properties and bioavailability, Aquatic Sciences, 71(2), 104-126.