

Are Cyanobacterial Blooms Common in the Arctic Coastal Waters of Alaska?

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The community of Kotzebue, located on the coast of Kotzebue Sound, which is northeast of the Bering Straits adjacent to the Chukchi Sea, is reliant on the waters of Kotzebue Sound for food and economy. There have been reports of cyanobacterial blooms in these waters around Kotzebue but they have not been systematically studied yet, mainly because the region is vast and sparsely populated, and hence has very little in-situ observations. Cyanobacteria often forms surface blooms in freshwater and coastal ecosystems which can be detected using remote sensing techniques. Cyanobacteria are found to have low nutritional value which affects the food web. Many cyanobacteria also produce cyanotoxins, which are harmful to aquatic life and can cause public health hazards. In addition, the consumption of cyanobacteria by microbes depletes oxygen level which can lead to hypoxia and adversely impact the benthic community. As the Arctic is warming twice as fast as the rest of the planet due to climate change, thawing permafrost is releasing nutrients that might be enhancing cyanobacterial blooms in the coastal, marine and lacustrine waters of Alaska. In this study, we used remote sensing to study phytoplankton biomass, turbidity and cyanobacterial blooms between mid-June until the end of September, each year from 2013 to 2019 when the waters around Kotzebue are ice-free. Using images from Landsat-8 and Sentinel-2, processed using ACOLITE software, we documented where and when blooms occur. We also observed how water quality parameters such as turbidity and chlorophyll concentration change spatially and temporally between June and September. There were about two scenes from Sentinel-2 and about one scene from Landsat-8, for a total of about three scenes every week between June and September. Among them, 49% of the images were cloud-free. Between August and September, 29% of cloud-free images were found to have a cyanobacterial bloom although one bloom was detected in July of 2016. Using a combination of true-color images and fai (floating algal index) in SeaDAS, cyanobacterial blooms were detected in an average of two to four scenes every year. Most of the cyanobacterial blooms were detected in Kobuk Lake near Kotzebue, and nearby sites in Hotham Inlet and Selawik Lake. In 2013, 68% of the images were cloudy which was the highest in the observed years and no cyanobacterial blooms were detected. Cyanobacterial blooms were observed in the coastal waters around Kotzebue when the wind speed was less than 10 knots.