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Phytoplankton spring bloom beneath heavily snow-covered arctic sea ice during the N-ICE2015 cruise

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The arctic icescape is rapidly transforming from a thick multi-year ice cover to a thinner and largely seasonal first-year ice cover with significant consequences for Arctic primary production. Recent studies have reported extensive phytoplankton blooms beneath ponded sea ice during summer, indicating that satellite-based arctic net primary production estimates may be significantly underestimated.
We studied phytoplankton seasonal dynamics under changing sea-ice and snow conditions in the drifting pack-ice north of Svalbard from 11 January to 24 June 2015 during the Norwegian Young Sea ICE cruise (N-ICE2015). N-ICE2015 provided a unique time-series of under-ice bloom dynamics during the winter-spring transition in the high Arctic pack-ice ecosystem. Phytoplankton productivity stayed low throughout winter and early spring. By late May a large under-ice bloom (>300 mg Chl a m-2) dominated by Phaeocystis pouchetii developed over the Yermak plateau underneath 1.1 – 1.3 m thick sea ice and 0.3 – 0.5 m thick snow cover. The circulation characteristics over the plateau indicate that the bloom developed in situ and was not advected. The high lead activity, characteristic for the area, apparently provided enough open or thin ice covered area for sufficient light to penetrate into the underlying water column and initiate and sustain the bloom, despite the thick snow cover. Our observation of a spring under-ice phytoplankton bloom extends the spatial and temporal scale of under-ice blooms and indicates that these phenomena might become increasingly important in the future Arctic under changing sea-ice but also snow dynamics.