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Wintertime water dynamics and moonlight disruption of the acoustic backscatter diurnal signal in an ice-covered Northeast Greenland fjord

Vladislav Petrusevich (1), Igor Dmitrenko (1), Sergey Kirillov (1), Søren Rysgaard (1,2,3), Stig Falk-Petersen (4,5), David Barber (1), and Jens Ehn (1)

(1) University of Manitoba, Faculty of Environment and Geography, Centre for Earth Observation Science, Winnipeg, Canada (vlad.petrusevich@umanitoba.ca), (2) Greenland Climate Research Centre, Greenland Institute of Natural Resources, Nuuk, Greenland, (3) Arctic Research Centre, Aarhus University, 8000 C Aarhus, Denmark, (4) UiT The Arctic University of Norway, Faculty of Biosciences, Fisheries and Economics, N-9037 Tromsø, Norway, (5) Akvaplan-niva, Fram Centre for Climate and the Environment, N-9296 Tromsø, Norway

Six and a half month time series of acoustic backscatter and velocity from three ice-tethered Acoustic Doppler Current Profilers deployed in the Young Sound fjord in Northeast Greenland were used to analyse the acoustic signal. During period of civil polar night below the land-fast ice, the acoustic data suggest a systematic diel vertical migration (DVM) of backscatters likely comprised of zooplankton. The acoustic backscatter and vertical velocity data were also arranged in a form of actograms. Results show that the acoustic signal pattern typical to DVM in Young Sound persists throughout the entire winter including the period of civil polar night. However, polynya-enhanced estuarine-like cell circulation that occurred during winter disrupted the DVM signal favouring zooplankton to occupy the near-surface water layer. This suggests that zooplankton avoided spending additional energy crossing the interface with a relatively strong velocity gradient comprised by fjord inflow in the intermediate layer and outflow in the subsurface layer. Instead the zooplankton tended to favour remaining in the upper 40 m layer where also the relatively warmer water temperatures associated with upward heat flux during enhanced estuarine-like circulation could be energetically favourable. Furthermore, our data show moonlight disruption of DVM in the subsurface layer and weaker intensity of vertical migration beneath snow covered land-fast ice during polar night. Using existing models for lunar illuminance and light transmission through sea ice and snow cover we estimated under ice illuminance and compared it with known light sensitivity for Arctic zooplankton species.