

Supplementary Materials for

Use of an Autonomous Surface Vehicle reveals small-scale diel vertical migrations of zooplankton and susceptibility to light pollution under low solar irradiance

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Supplementary Materials

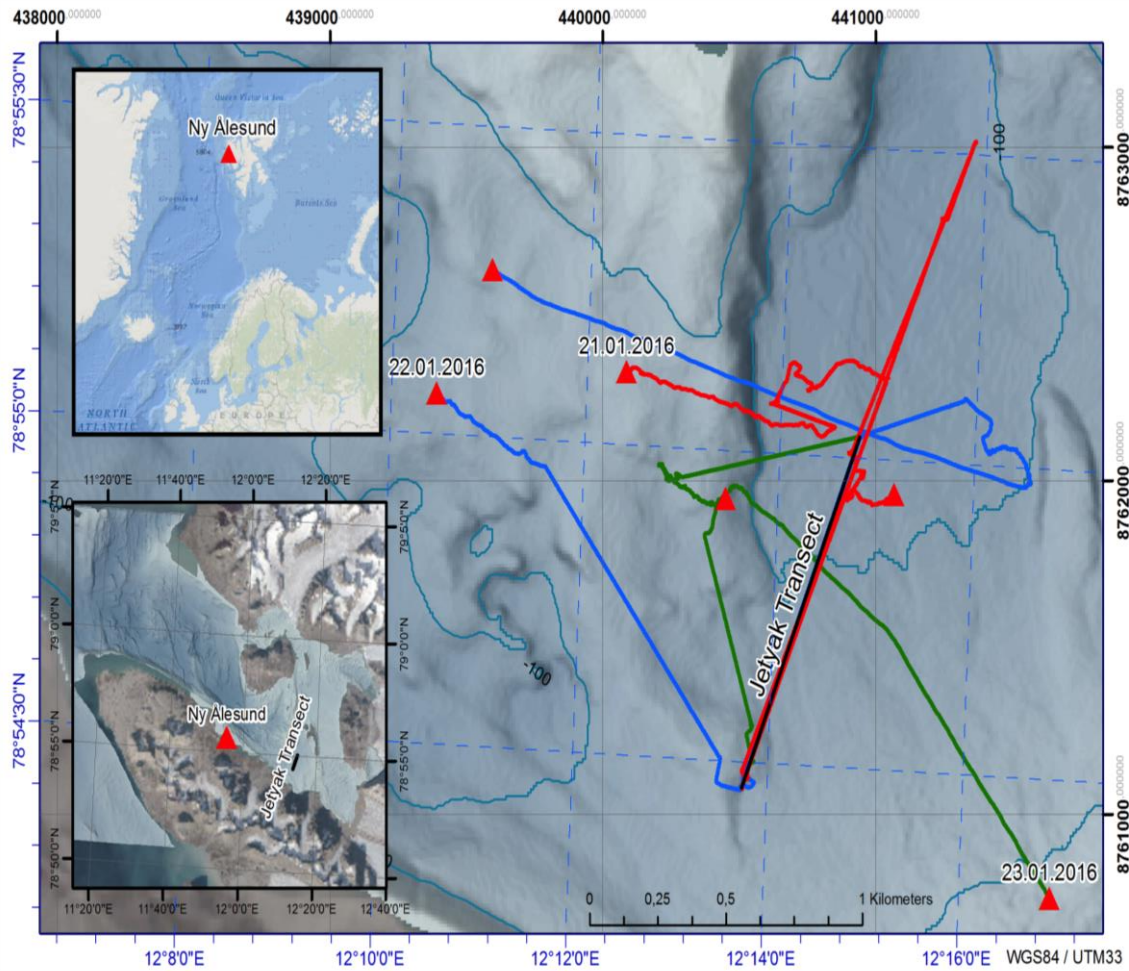


fig. S1. Map of the study area in Kongsfjorden. The green line indicates the track of the ASV on January 21, the mission of January 22 is marked with the red line, and the trajectory on January 23 is marked with blue. The ASV patrolled back and forth with bearings from 20° to 200° .

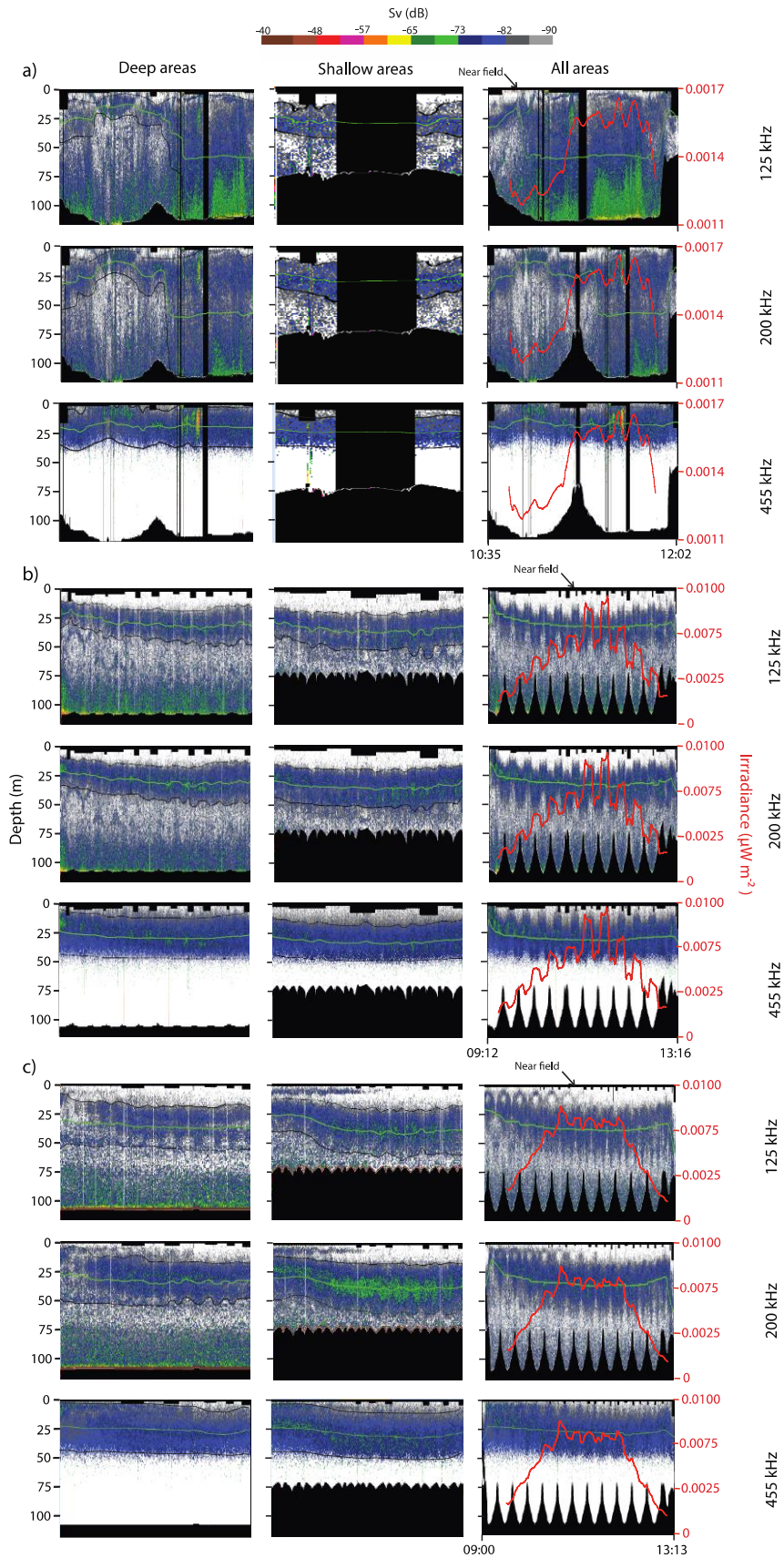


fig. S2. AZFP echograms from ASV. a) AZFP echograms at 125 (dominated by euphausiids), 200 (dominated by chaetognaths), and 455 kHz (dominated by copepods) on January 21 (a), 22 (b) and 23 (c) for the deep areas only (left column); the shallow areas only

(middle column); and whole echograms where the red line indicates the diffuse skylight irradiance ($\mu\text{W m}^{-2}$) when away from the ship (right column). The black lines indicate the top and bottom edges of the sound scattering layer (i.e. -82 dB contours), the green line indicates the median depth of the sound scattering layer at each frequency, the white line indicates the seafloor, and black areas mask the near field, noise and areas below the seafloor. Note that a time-varied-threshold of -122 dB was applied at 455 kHz. Additionally, on January 22, the reflectance plate was accidentally bumped to $\sim 30^\circ$ off horizontal during Jetyak deployment from the research vessel. This led to distinct oscillations in the irradiance time series on that day; peaks occurred while the Jetyak was heading away from the waxing moon, resulting in moonlight directly illuminating the reflectance plate.

table S1. Ascent and descent rates of the SSL at 455 kHz in January 2016.

	Descent (cm s^{-1})	Ascent (cm s^{-1})
21.01.16	0.72	-1.33
22.01.16	0.11	-0.07
23.01.16	0.06	-0.13

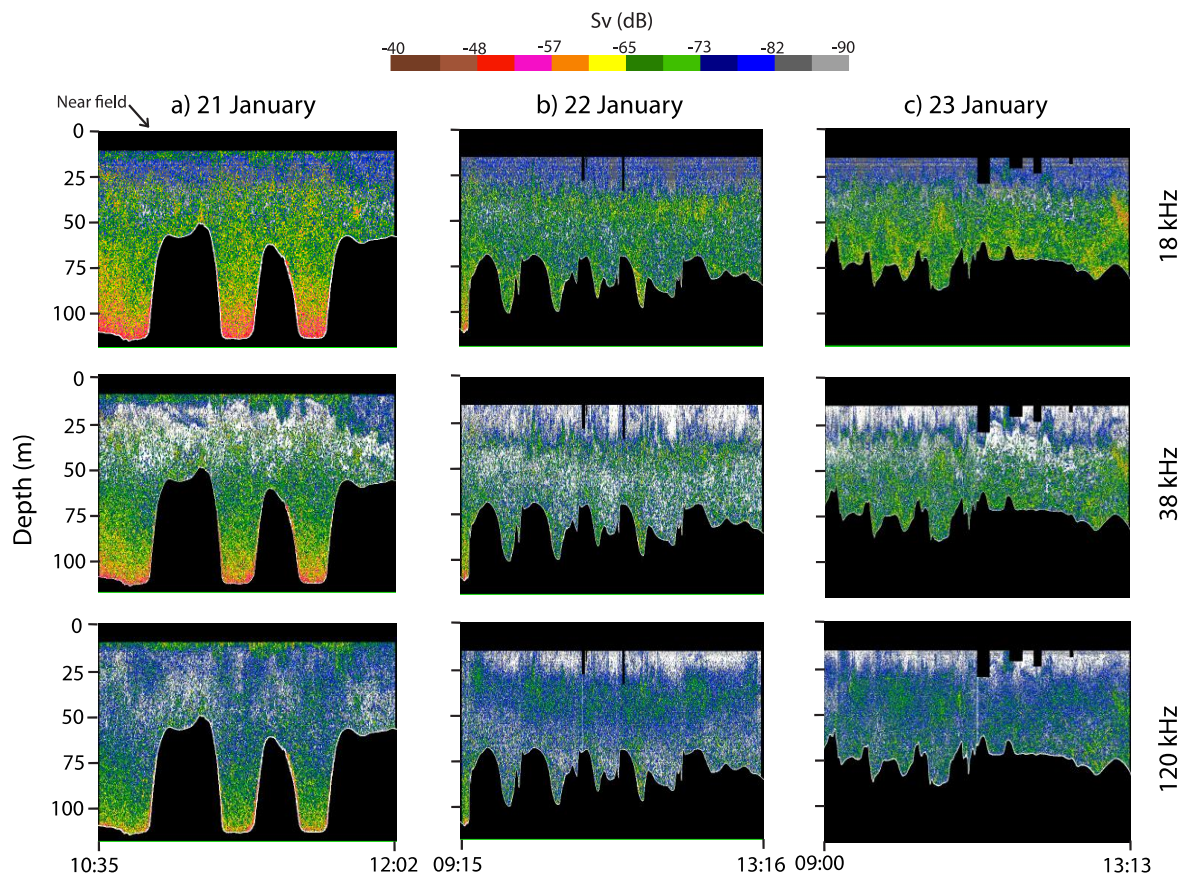


fig. S3. EK60 echograms from RV *Helmer Hanssen*. EK60 echograms at 18, 38 and 120 kHz collected onboard the RV *Helmer Hanssen* during the Jetyak deployments on a) January 21, b) January 22, and c) January 23.

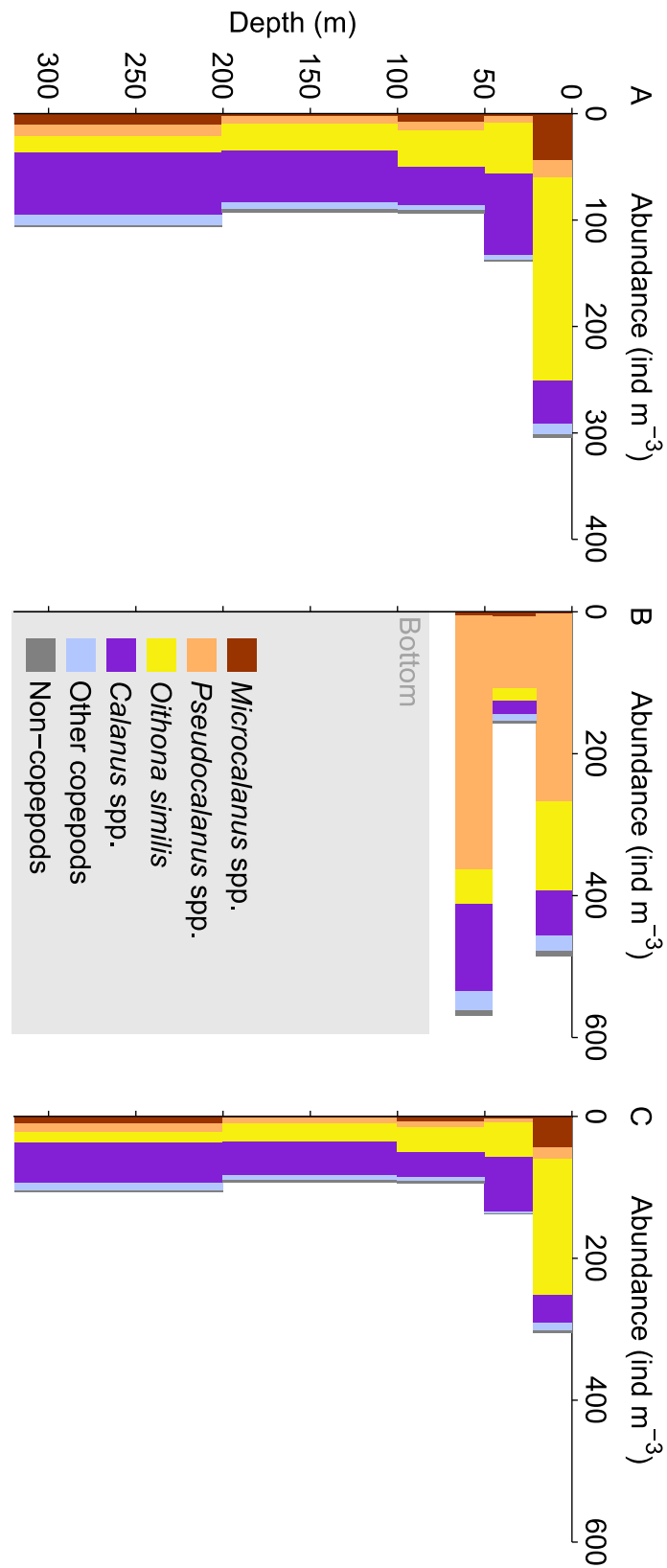


fig. S4. Vertical distribution of zooplankton. Vertical distribution of zooplankton collected with a Hydrobios Multinet (mesh size 180 μm , mouth opening 0.25 m^2) in January 2016 in Kongsfjorden A) mid-fjord (340 m bottom depth) B) inner fjord (80 m bottom depth) and C) in January 2017 mid-fjord (340 m bottom depth).