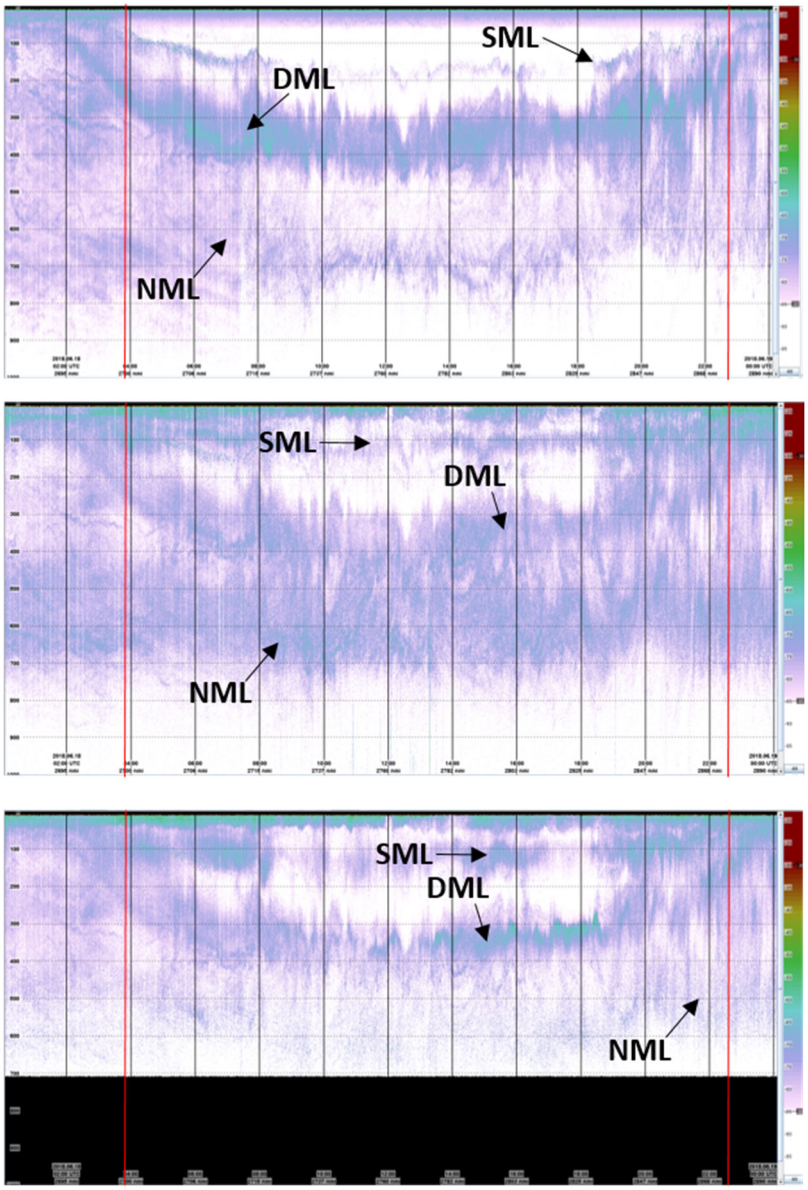
Light control on spatial distribution of the mesopelagic layers

The mesopelagic (also known as twilight zone) is the region of the ocean between 200 and 1000 m depth (Sutton 2013). Recently, Kaartvedt et al. (2019) suggested an alternative definition considering light conditions, being the region that covers absolute light intensities ranging from 10^{-9} to 10^{-1} µmol quanta m^{-2} s^{-1}. Mesopelagic organisms aggregate in the acoustic deep scattering layer, a strong and ubiquitous sound-reflecting layer in the open ocean (Davison et al. 2013). These organisms play an important role in the vertical carbon flux, because most of them feed in surface layers at night and staying between 200-1000 m depth during daylight (Robinson et al. 2010). This diel vertical migration (DVM) is suggested to be the biggest animal migration in the planet (Hays 2003). Variation in light environment appear to affect the depth of the sound sacattering layers (e.g., Aksnes et al. (2017) and Røstad et al. (2016)). Knowledge in the DVM behaviour is necessary to understand the role of the diel vertical migration in the carbon flux.



Echogram at 3 frequencies (18, 38 and 70 kHz) from 18 June 2018 at 00:00 to 19 June 2018 at 00:00 showing the 3 scattering layers. NML: non-migrating deep layer, MDL: migrating deep layer and SML: migrating shallow layer.

Method

In this Master project, we will investigate the small-scale variation in the migration patterns mesopelagic densities and vertical distribution at two different areas and seasons. Comparing the scattering layers from two areas in the North Atlantic Ocean, we will test the hypothesis that the murky waters (Svinøy cruise) forces DVM during periods when prey densities are low (i.e., when *Calanus* sp. have migrated down) and at the clear waters (oceanic cruise) light conditions allow higher efficiencies or feeding at depth. This project will use light and acoustic data.

Research environment: The master project is hosted by the he Institute of Marine Research, Bergen with main supervisors there. The student will also be affiliated with the Theoretical Ecology Group http://bio.uib.no/te/ at Department of Biological Sciences, University of Bergen.

Supervisors: Eva García Seoane (IMR), Tom Langbehn (UiB), Thor Klevjer (IMR) and Christian Jørgensen (UiB).

References

Aksnes, D. L., A. Røstad, S. Kaartvedt, U. Martinez, C. M. Duarte & X. Irigoien, 2017. Light penetration structures the deep acoustic scattering layers in the global ocean. Science Advances 3(5):e1602468 doi:10.1126/sciadv.1602468.

Davison, P. C., D. M. Checkley Jr., J. A. Koslow & J. Barlow, 2013. Carbon export mediated by mesopelagic fishes in the northeast Pacific Ocean. Progress in Oceanography 116:14-30 doi:http://doi.org/10.1016/j.pocean.2013.05.013.

Hays, G. C., 2003. A review of the adaptive significance and ecosystem consequences of zooplankton diel vertical migrations. Hydrobiologia 503(1):163-170 doi:10.1023/B:HYDR.0000008476.23617.b0.

Kaartvedt, S., D. L. Aksnes & T. J. Langbehn, 2019. Enlightening the ocean's twilight zone. ICES Journal of Marine Science doi:10.1093/icesjms/fsz010.

Robinson, C., D. K. Steinberg, T. R. Anderson, J. Arístegui, C. A. Carlson, J. R. Frost, J.-F. Ghiglione, S. Hernández-León, G. A. Jackson, R. Koppelmann, B. Quéguiner, O. Ragueneau, F. Rassoulzadegan, B. H. Robison, C. Tamburini, T. Tanaka, K. F. Wishner & J. Zhang, 2010. Mesopelagic zone ecology and biogeochemistry – a synthesis. Deep Sea Research Part II: Topical Studies in Oceanography 57(16):1504-1518 doi:10.1016/j.dsr2.2010.02.018.

Røstad, A., S. Kaartvedt & D. L. Aksnes, 2016. Light comfort zones of mesopelagic acoustic scattering layers in two contrasting optical environments. Deep Sea Research Part I: Oceanographic Research Papers 113:1-6 doi:http://doi.org/10.1016/j.dsr.2016.02.020.

Sutton, T. T., 2013. Vertical ecology of the pelagic ocean: classical patterns and new perspectives. Journal of Fish Biology 83(6):1508-1527 doi:doi:10.1111/jfb.12263.