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YEAR-LONG, DAILY-SCALE ECOSYSTEM OBSERVATIONS UNDER PERENNIAL ICE COVER IN THE ARCTIC OCEAN

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Between 2011 and 2013 eight Ice-Tethered Profilers (ITPs) were outfitted with bio-optical/biogeochemical sensor suites and deployed in perennially ice-covered regions of the Arctic Ocean. These deployments represent an important new approach for obtaining biological and bio-physical observations of the changing Arctic in ocean ecosystems that are extremely difficult to sample over seasonal and annual scales. These ITPs were deployed in the central Arctic and Beaufort Gyre and carried sensors for chlorophyll fluorescence, optical scattering, CDOM fluorescence, and incident solar radiation (Fig. 1). They have generated unique, long-term and high-resolution time series of under-ice irradiance, algal biomass, particulate scattering, and organic matter concentrations in the top 800m of the Arctic Ocean, with profiles conducted daily or better. Two of these systems operated for twelve months or longer, capturing the entire annual trend in these bio-optical properties in the central Arctic Ocean and Beaufort Sea respectively. These observations were used to estimate the timing and duration of the under-ice algal growing season, the subsequent export of particulate organic matter later in the season, and the occurrence of intermittent physical perturbations that affect biological and bio-optical distributions. The ITP's high-resolution profiling enables a more accurate temporal assessment of the timing and magnitude of intermittent events down to the time scale of less than a single day, in principle. These initial eight profilers provide some of the highest-resolution observations of the basic seasonality in fundamental biological and bio-physical dynamics in perennially ice-covered regions of the Arctic Ocean, and demonstrate the utility of autonomous long-term observing in the deep central Arctic.

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Fig. 1. Left: An ITP end cap fitted with a WHOI-engineered 'bio-suite': a cluster including a commercial triplet fluorometer, an irradiance sensor, and a modified copper shutter for biofouling protection. Middle: A bio-optically equipped ITP being deployed through an ice hole in the Arctic. Right: Sampling tracks of five bio-ITPs operating in the central Arctic and in the Beaufort Gyre between 2010 and 2014.

Laney, S. R., R. A. Krishfield, J. M. Toole, T. R. Hammar, C. J. Ashjian, and M.-L. Timmermans. 2014. Assessing algal biomass and bio-optical distributions in perennially ice-covered polar ocean ecosystems. *Polar Science* **8**, 73-85.