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In situ observations of ocean productivity using the SeaCycler mooring in the central Labrador Sea

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The Central Labrador Sea is a major deep-convection region in the NW Atlantic which is the most intense sink for anthropogenic carbon in the global ocean (de Vries et al, 2013). CO_2 enters the ocean by air-sea exchange and is transported into the ocean's interior mainly though the biological pump (Longhurst et al., 1989). Despite its important role for CO_2 uptake and high natural variability, the Labrador Sea is undersampled due to rough conditions and an overall lack of volunteer observing ship (VOS) transits. The SeaCycler moored profiler is currently providing year-round data from the central Labrador Sea and resolves daily changes of inorganic carbon and related properties from the upper 150m of the water column. SeaCycler's sensor float is equipped with 13 physical, chemical and biooptical sensors which measure temperature, salinity, dissolved gases, nutrients and optical properties of seawater.
A combination of Pro-CV (Pro-Oceanus Inc, Canada) and CO_2 optode (Aanderaa, Norway) sensors in profiling mode provides a detailed description of Dissolved Inorganic Carbon (DIC) dynamics in the upper 150m over the productive season. This allows, for the first time, high-resolution carbon-based estimates of ocean productivity from throughout the euphotic zone over an annual cycle which can be compared to estimates derived from simultaneous oxygen and nitrate (Deep SUNA, Satlantic LP, Canada) profiles. These in situ carbon, nitrogen and oxygen-based estimates of using in-situ data are further compared with remotely-sensed estimates from MODIS satellite data. The SeaCycler data allow estimation of the annual cycle of the air-sea CO_2 flux and carbon export. Concurrently recorded in-situ bio-optical data allow direct comparison of optical measurements of biomass change and reveal key patterns in the seasonal succession of phytoplankton groups responsible for carbon drawdown.