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# Seasonal calcareous nannoplankton and other biogenic particle fluxes for 1990-2009: twenty-year long records from the central subarctic Pacific Ocean and the Bering Sea

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Time-series sediment traps were deployed for nearly 20 years (1990-2009) at two long-term locations: Station SA (49°N, 174°W, trap depth 4,800 m, water depth 5,400 m) in the central subarctic Pacific, and Station AB (53.5°N, 177°W, trap depth 3,200 m, water depth 3,800 m) in the southern Bering Sea. Among many biogenic particles, calcareous nannoplankton represented nearly half or more of the entire calcium carbonate fluxes of the regions. Dominant taxa include Coccolithus pelagicus and Emiliania huxleyi. The flux maxima of the former taxon occurred twice a year during June and October-November, whereas that of the latter taxon only occurred primarily once a year in November at both stations, indicating environmental preferences of the taxa. Among many environmental conditions, the fluxes of Emiliania huxleyi showed strong correlations with both water temperatures above 45 m depth and air temperatures (these parameters taken with one-month lag [earlier values] considering sinking time of ca. a month to the respective trap depths). Coccolithus pelagicus, on the other hand, showed lower values in the correlation with temperatures (Tsutsui et al., 2016), indicating that this taxon is somewhat more dependent on other factors such as nutrients compared to those of E. huxleyi. The timings of the seasonal flux maxima of calcareous nannoplankton are quite different from and later than those of other taxonomic groups such as diatoms and silicoflagellates. The primary seasonal flux maxima of diatoms and silicoflagellates, for example, occurred in May, a month earlier than the June maximum of C. pelagicus, and secondary seasonal flux maxima occurred in August, 2-3 months earlier than those of calcareous nannoplankton at both stations, based on 8 year flux records for diatoms (Onodera and Takahashi, 2009) and 4 year records for silicoflagellates (Onodera and Takahashi, 2012). By examining seasonal changes of nitrate and phosphate concentrations above 50 m depth from ERDDAP and NOAA, it appears likely that siliceous phytoplankton such as diatoms and silicoflagellates is more dependent on high nutrient conditions than calcareous nannoplankton requires. Calcareous nannoplankton, on the other hand, appears to require rather narrow own species range of temperatures while nutrient requirement may not be as strict as those by siliceous microplankton. Within the two calcareous nannoplankton taxa, it is clear that C. pelagicus has higher nutrient dependency than E. huxleyi. Essentially, calcareous nannoplankton can still produce in November [actual production in surface water in October] when solar intensity decreases significantly, as long as temperatures are still appropriate. By this time of the year most siliceous phytoplankton had more or less completed bulk of their annual production. Exceptions for this are rather limited characteristic species that are adapted in dim light but high nutrients such as Coscinodiscus marginatus (diatom) and Dictyocha mandarai (silicoflagellate) in the subarctic Pacific (Takahashi et al., 1989).