Seasonal and Interannual Variability of Chlorophyll a and Primary Productivity in the subarctic North Pacific during 1997-2000 using Multi-Sensor Remote Sensing

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The objectives of this study were to describe and understand the processes controlling the temporal and spatial variability of chlorophyll-a (chl-a) and primary productivity in the subarctic North Pacific Ocean during 1997-2000. Remotely sensed data from multi sensors, including ocean color (OCTS and SeaWiFS), sea surface temperature (SST, AVHRR), wind (SSM/I) and photosynthetically available radiation (PAR, SeaWiFS) datasets were utilized for the purpose of this study. Calculation was made for primary productivity using VGPM Model (Behrenfeld and Falkowski, 1997), and sea surface nitrate using SST and chl-a data (Goes et al,. 1999, 2000).

Ocean color imagery clearly showed seasonal and interannual variability in the spatial abundance and distribution of chl-a and primary productivity in the study area. Magnitude of chl-a seasonal variability at WSG (Western subarctic Gyre, near the 50N, 165E) is greater than that at AG (Alaska Gyre, near the 50N, 145W). Ranges of chl-a concentrations at WSG were about 0.2-1.1 mg m^{-3} throughout the year, and a few peaks (about 1.0 mg m^{-3}) were seen in spring and fall bloom periods. Chl-a concentrations at AG were generally low (0.2-0.7 mg m^{-3}), and no bloom was observed. Contrary to this, ranges of primary productivity were similar in the west (100-850 mgC m^{-2} d^{-1} at WSG) and the east (150-800 mgC m^{-2} d^{-1} at AG), and the seasonal variability of primary productivity was similar in both regions, where one single peak was seen in summer (July or August).

A large interannual variability of chl-a and primary productivity coincided with the 1997/1998 El Niño and 1998/1999 La Niña events. In 1998 fall, Chl-a and primary productivity at WSG were remarkably high (about 0.9 mg m^{-3} and 850 mgC m^{-2} d^{-1}) compared with those in the same season of the other years. Coincidentally, chl-a and primary productivity at AG in summer to fall 1998 (about 0.3 mg m^{-3} and 400-650 mgC m^{-2} d^{-1}) were lower than those in other years. It appeared that high chl-a at WSG corresponded to the warmer SST and low chl-a at AG corresponded to cooler SST. We suggest, based on the multi-sensor satellite data, that the high chl-a around the WSG from summer to fall in 1998 was resulted from combination of; 1) larger nutrients inputs in winter, 2) stronger wind in spring to summer causing light limitation of phytoplankton growth, 3) higher PAR in summer, and 4) warmer surface waters in fall compared with the normal years.

Further discussion will be made on the east-west differences in distribution patterns of chl-a and primary productivity, and their controlling factor in the subarctic North Pacific in relation to ENSO events.