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Relationship between seasonal cycle of APO at Cape Ochi-ishi and net primary production in the western North Pacific

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We examine the seasonal variation of the atmospheric potential oxygen ($APO=O_2+1.1xCO_2$) observed at Cape Ochi-ishi (COI; 43.2oN, 145.5E) during the period from 1999 to 2011. Because APO is invariable with respect to the terrestrial biotic exchanges, its seasonal variations mainly reflect air-sea exchanges of O_2. Generally, the ocean takes up O_2 in fall and winter, and releases O_2 in spring and summer. This seasonal variation in the O_2} fluxes, partially explained by the temperature-induced solubility changes in surface waters, is strongly driven by ocean biological and dynamical processes in the mid and high latitude region. In fall and winter, surface cooling causes the oceanic ventilation, which brings deeper waters with depleted O_2 in contact with the atmosphere. In spring and summer, O_2 production occurs during the phytoplankton blooms. Actually, APO observed at COI shows minimum in February-March and maximum in June-July, and the seasonal peak-to-peak amplitude is about 70 per meg. However, the seasonal amplitude increased during 2004-2006; especially in 2005 the amplitude reached about 90 per meg. As was previously reported, in-situ observation of APO at COI showed large short-term variations with significantly elevated values from late May to early July in 2005. The backward trajectory analysis suggested that the elevated APO were associated with occurrences of strong net primary production (NPP), which is satellite-derived estimation from the Vertically Generalized Production Model (VGPM), in the Okhotsk Sea and the western North Pacific. Comparing the seasonal amplitude of APO with the NPP from the VGPM for the rectangular region (35-55N, 140-160E) in the western North Pacific, we find there is positive correlation between the APO seasonal amplitude and the NPP in June. This result suggests that the seasonal amplitude of APO at COI may reflect the strength of the NPP in the Okhotsk Sea and the western North Pacific.

Keywords: atmospheric O2, APO, ocean primary production, VGPM