落石岬で観測される APO の季節変動成分の年々変動と SST および NPP との関連

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Inter-annual variation in seasonal cycle of APO observed at Cape Ochi-ishi and its relationship with SST and NPP

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Atmospheric potential oxygen (APO), defined as a combination of atmospheric O_2 and weighted CO_2 concentrations ($APO=O_2+1.1\times CO_2$), has been considered to be a useful tracer for studying the air-sea gas exchanges of O_2 and CO_2 because APO is invariant with respect to the terrestrial biotic gas exchange. Here we analyze the seasonal cycle of APO, which is based on the atmospheric CO_2 and O_2 observation at Cape Ochi-ishi (COI; 43.2°N, 145.5°E) since December 1998 by using flask sampling system (*Tohjima et al.*, 2008). The observed APO shows clear seasonal cycles with the average minimum and maximum in March and June, respectively. Although the inter-annual variability in the seasonal cycles at COI was relatively small, the detrended monthly APO clearly shows significant inter-annual variations in the seasonal cycles; for example, the enhanced maximum and depleted minimum were observed in June 2005 and in March 2006, respectively (Fig. 1). The main driving forces for the seasonal cycle of APO are the O_2 outgassing associated with the ocean primary production during spring-summer and the O_2 ingassing associated with the ocean ventilation that brings deeper waters with depleted O_2 to the surface during fall-winter. Additionally, the temperature-induced solubility changes also slightly enhance the above seasonal O_2 fluxes. Thus, we examine the relationship of the inter-annual variation in the APO seasonal cycle with the sea surface temperature (SST) and the net primary productin (NPP) for the ocean surrounding COI. Note that the monthly SST data are taken from the NOAA Optimum Interpolation (OI) SST (Reynolds et al., 2002; www.esrl.noaa.gov/psd/data/griddeddatanoaa.oisst.v2.html/) and the monthly NPP estimated from Vertically Generalized Production Model (VGPM) are used (Behrenfeld and Falkowski, 1997; www.science.oregonstate.edu/ocean.productivity/index.php). The seasonal maximum and minimum of APO seem to show positive correlations with NPP during summer and the SST in winter for the ocean surrounding COI in the western Pacific (see Fig. 2 for SST). These results seems to suggest APO at COI is sigificantly influenced by the O_2 outgassing/ingassing associated with the net primary production/ocean ventilation for the sorrunding oceans.

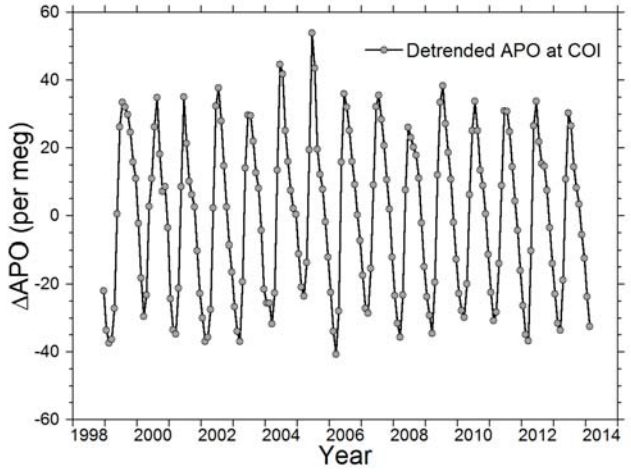

Fig. 1. The time series of the detrended monthly mean APO at COI. The seasonal cycles with maximum in June and minimum in March show small but significant inter-annual variations.

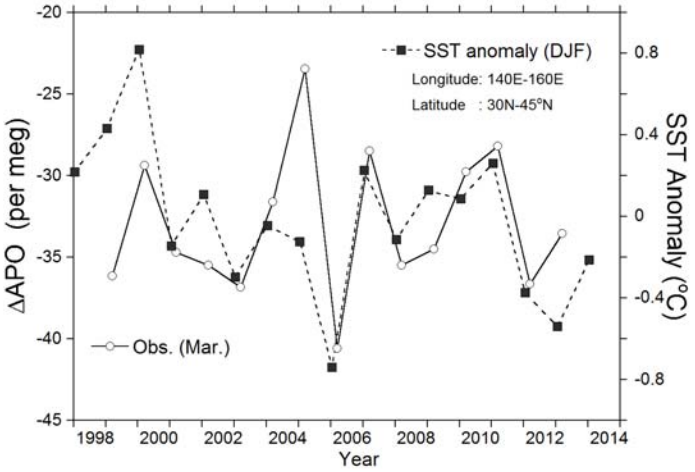

Fig. 2. Comparison of temporal changes in (left axis, open circles) the APO minimum in March and (right axis, solid squares) the SST anomaly in winter (Dec.-Feb.) for the rectangle region (140ºE-160ºE, 30ºN-45ºN).

References

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