Geophysical Research Abstracts
Vol. 18, EGU2016-5507, 2016
EGU General Assembly 2016

Interannual variation of spring phytoplankton bloom in the central Southern Yellow Sea in response to atmospheric forcing

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The interannual variations of the start timing, magnitude and duration of the spring phytoplankton bloom (SPB) in the central southern Yellow Sea (SYS) were studied using the satellite-derived surface chlorophyll-a concentrations (Chl-a) from 2000 to 2014. The correlations between the characteristics of SPB and the generation rate of turbulent kinetic energy (TKERT) supplied from the atmosphere to the ocean were examined. The start timing of SPB was delayed in years with high TKERT supplied to the ocean before SPB. The TKERT during SPB had no relationship with the magnitude of SPB, but had positive correlation with the duration. A 1-D physical-biological model was used to examine the influencing mechanisms of the TKERT on the characteristics of SPB quantitatively. The wind speeds and related TKERT before the start of SPB were stronger in 2010 than in 2008. Comparison of the model results forced by winds in the two years suggested that the enhanced physical dilution of phytoplankton caused by the stronger TKERT in 2010 induced a later start timing of SPB. When increasing the winds during SPB period, more phytoplankton was taken downward from the surface layer by the enhanced vertical mixing. Meanwhile, more nutrients were pumped upward to the surface layer and supported more net growth of phytoplankton. These two contrary processes led to the independence of the magnitude of SPB on the TKERT during the SPB period. However, larger TKERT along with stronger wind resulted in a longer duration of SPB because of more nutrients supply by stronger vertical mixing.