Predictive Factors for "Aoshio" Occurrences in Tokyo Bay

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Many large cities such as Tokyo, Yokohama, and Chiba and large industrial areas have been developed along Tokyo Bay with frequent reclamation from its coastal area. The bay is a typical coastal sea in Japan, and has not yet improved its water quality in spite of governmental regulations against the concentrations of nutrients and organic matter in drainage. Eutrophication in the bay has been increased to a critical level and results in "red tide" (phytoplankton bloom) in every seasons. Anoxic water, whose dissolved oxygen (DO) is less than 1 mg/L, develops into a wide area over a bottom in the offshore area of the bay under the highly eutrophicated conditions during the stratified season from early summer to early autumn.

We have suffered from "Aoshio" or "blue tide" phenomena, which resulted from an upwelling of anoxic water mass from the bottom to sea surface, along the northeastern coast of Tokyo bay during the season since 1960's. It is believed that the milky–blue color of Aoshio water comes of the sun–light reflection with colloidal sulfur particles which appear at the surface water by oxidation of H_2S in the anoxic water. The occurrence of Aoshio has been observed over 30 times and for more than 50 cumulative days in the last five years. This often causes unpleasant smell mainly due to H_2S and death of a lot of fishes and shellfishes; therefore, the damage to fisheries becomes an object of public concern.

In order to resolve an Aoshio mechanism and to predict its occurrence, a periodic observation has been conducted in the northeast area of Tokyo Bay since 1989; on water quality, such as temperature, salinity, DO, nutrient and organic–matter concentrations and some biological parameters. Obtained data set was tabulated with meteorological data, and analyzed to extract a simple concept for predicting an Aoshio occurrence.

As a result of the analysis, three necessary conditions for the Aoshio prediction were obtained as follows:
1) A lot of anoxic water masses develop at near the bottom.
2) Wind directions change from south to north; and daily mean value of the air temperature falls by more than 4 °C from that for previous days.
3) A northern or northeastern wind continues for at least 2 days.

The prediction on the basis of the above three conditions can explain 22 cases of 24 Aoshio occurrences reported in the last 4 years. The high fitting suggests the conditions relate an Aoshio occurrence mechanism.