

Estimation of potential area for red tide occurrence in the Korean coasts by Marine GIS

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Abstract: It was studied on the choice of potential area for red tide occurrence from oceanographic factors. Oceanographic factors of favorable marine environmental conditions for the red tide formation included warm water temperature, low salinity, high suspended solid, low phosphorus, low nitrogen. It was founded the potential areas for red tide occurrence in August 2000 by GIS conception: Yeosu~Dolsan coast, Gamak bay, Namhae coast, Marado coast, Goheung coast, Deukryang bay, respectively.

Key words: Red tide, Oceanographic factors, Marine GIS

1. Introduction

Red tide is a natural phenomenon in the coastal area that blue sea water becomes by the fertile breeding and growth/accumulation of phytoplankton [1]. Then, phytoplankton groups as standing corps related to red tide are generally divided into diatoms and flagellates [2]. Anytime diatom can be bred in large quantities under the favorable conditions. Flagellate was occurred at the same area and similar period every year, and under favorable environments its dormant spore rises from the sea bottom and become phytoplankton.

It should be considered as a serious matter that red tide appears frequently to the southern coastal area and extends gradually to the all coastal areas in the Korean peninsula. Thus, it is necessary to know beforehand the characteristics of the oceanographic conditions, and the prediction for the prevention of disasters related to red tide in this study area [3]. Many studies for red tide have carried out at the limited fields as taxonomy, physiology, ecology and molecular biology [4], but they have not given a full and satisfying answers. Recently a few papers have studied for the mechanism related to red tide in the fields of physics, dynamics, remote sensing, and GIS [5].

Generally the important oceanographic factors for red tide formation were known to be water temperature, salinity, nutrients, chemical substances [6]. The main object of this study is to understand the mechanism and favorable conditions for red tide occurrence on their related oceanographic factors, and find the potential area for red tide occurrence in the middle coastal area of the South Sea of Korea.

2. Field observation data

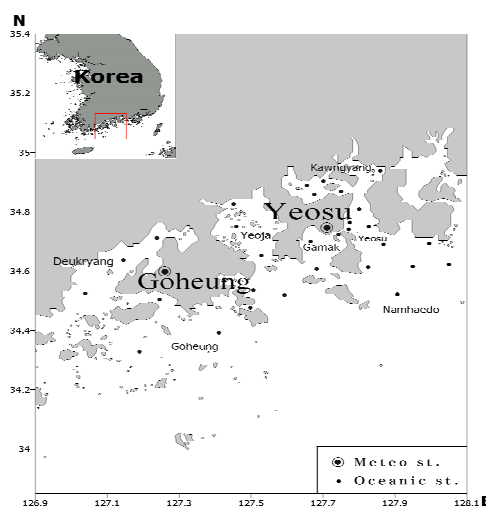


Fig. 1. Middle coastal area in the South Sea of Korea.

The study area is the middle coastal area in the South Sea of Korea (Yeosu and Goheung, Fig. 1). The reported monitoring data used are as follows: the the oceanographic factors are water temperature, salinity, chlorophyll_a, suspended solids, phosphorus, nitrogen for the periods of 1996 to 2001 and the observed times of February, May, August, and November. The chlorophyll_a concentrations on August 22, 2000 was calculated from the ocean chlorophyll 2 algorithm [7]. The red tide occurrence data is in-situ data for the periods of 1984 to 2001.

3. Results and Consideration

Red tide in August 22, 2000 was obtained from SeaWiFS image by using the ocean chlorophyll 2 algorithm (OC2) (Fig. 2). Here, in the case of the Dolsan coast, the satellite values presented 2.509 ~ 41.879 mg/m (average: 7.699 mg/m) and the in-situ values presented 80 ~ 910 cells/l (average: 495 cells/l), respectively.

In the distributions of oceanographic factors(here, the figures were not shown in this paper), the favorable oceanic conditions for the red tide formation in August, 2000 are considered as follows; the calm weather (25.93 °C & 199.7hours) increases sea water temperature (23 ~ 28 °C), the heavy precipitation(305.7mm) brings some riverine water, nutrients and other chemical substances to ocean: low salinity (22 ~ 32‰), high

suspended solid (10~35mg/l), low phosphorus (0.025~0.070mg/l) and high nitrogen (0.04~0.18mg/l), respectively.

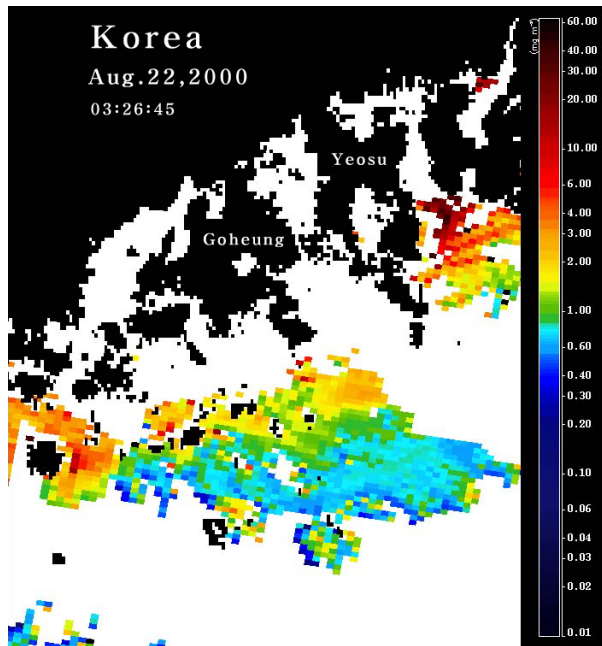


Fig. 2. Areal distributions of Chlorophyll_a from SeaWiFS image on August 22, 2000.

We decided to the potential areas in the coastal zones vulnerable to the red tide occurrence based on the limited factors controlling the growth of phytoplankton. Then, the representative criteria are nutrients (phosphorus and nitrogen) and suspended solids (chemical substances; Fe, Mn, Vitamins, etc.) in the ocean. By using GIS through the overlap for three subject figures (Figure 3), potential area for red tide occurrence on August 2000 was obtained (Fig. 4). It was founded that the potential areas are the Yeosu~Dolsan coast, the Gamak bay, the Namhae coast, the Narodo coast, the Goheung and Deukryang bay. This result was very well coincided to the results of the satellite and in-situ data.

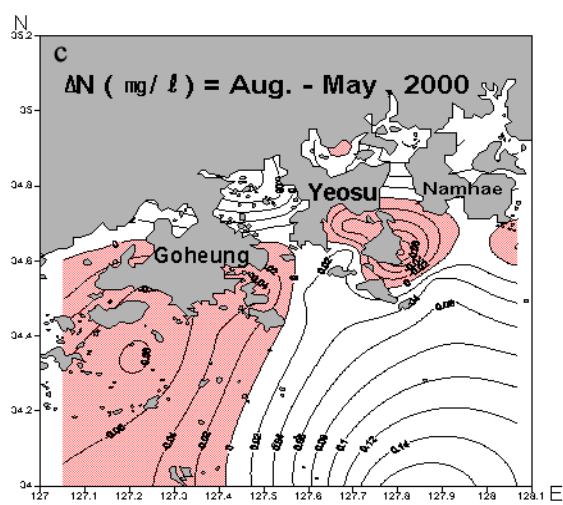
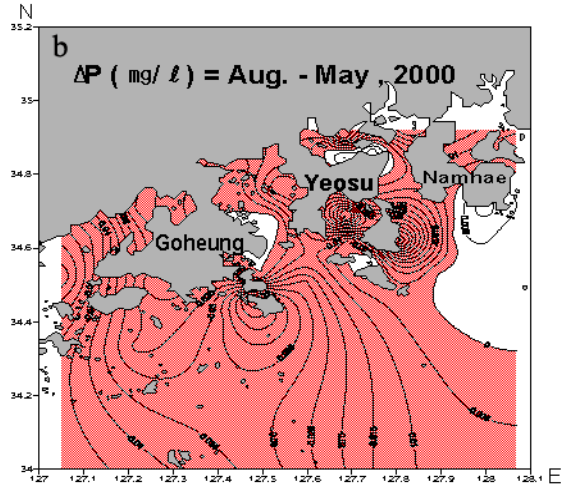
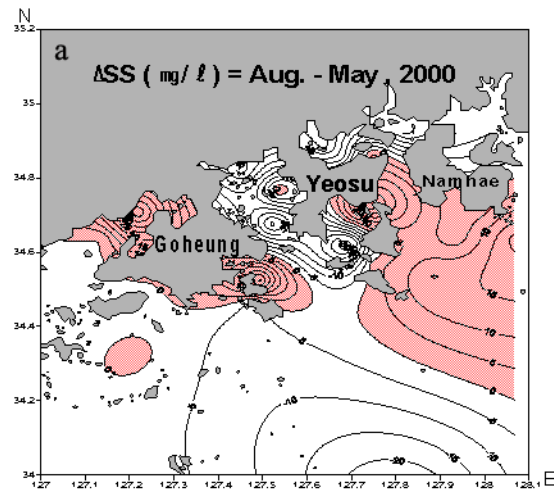


Fig. 3. Areal distributions of deviation (Δ =August - May) of (a) suspended solids (b) phosphorus and (C) nitrogen.

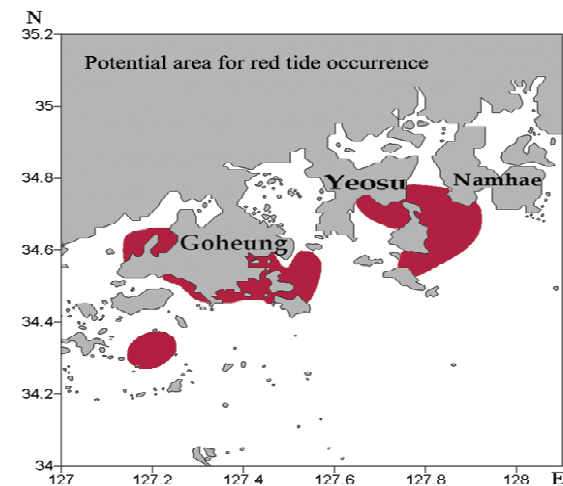


Fig. 4 Areal distributions of potential area for red tide occurrence on August 2000.

Conclusions

In the middle coastal area of the South Sea, the

analysis of oceanographic factors showed favorable marine environmental conditions for the red tide formation as follows; warm water temperature (23~28~), low salinity (22~32‰), high suspended solid (10~35mg/l), low phosphorus (0.025~0.070mg/l), and low nitrogen (0.04~0.18 mg/l). It was possible to choose for the potential area related the red tide occurrence by the overlap of three subject figures(phosphorus, nitrogen and suspended solids) as the limited factors.

Acknowledgements

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