D-3.2.1 Study on monitoring of anthropogenic input and its effect on marine ecosystem by satellite and ship observations

Contact person Kuniaki Miyaji
Oceanography and Southern Ocean Resources Division
National Research Institute of Far Seas Fisheries
7-1, 5-chome, Orido, Shimizu, 424 Japan
Tel: 0543-36-6061 Fax: 0543-35-9642
E-mail: miyji@enyo.affrc.go.jp

Total Budget for FY1996-FY1998 17,647,000 Yen (FY1998: 5,915,000 Yen)

Abstract We analysed the data obatined in Suruga Bay and the East China Sea. Atomic ratio of nitrite + nitrate/silicate seems to be a good indicator for the influence of anthropogenic input via river. We made the imageries of colored dissolved organic materilas, chlorophyll and suspended solid in the East China Sea in May 1997 based on OCTS data. High chlorophyll concentrations were found around the areas where high concentrations of colored dissolved organic materials were observed. Ocean color remote sensing has a potentiality to monitors the chlorophyll increased by the input of anthropogenic nutrient via river.

Key Words Anthropogenic input, Marine ecosystem, Chlorophyll a, Phytoplankton, Nutrient, N/Si atomic ratio, Ocean color remote sensing, Colored dissolved organic materilas

1. Introduction

Terrigeous input of nutrients via river promotes phytoplankton productivity and hence increases phytoplankton biomass in the sea, especially near coast. Terrigeous nutrient includes anthropogenic nutrient, and thus it is necessary to clarify the influence of anthropogenic nutrient on phytoplankton increase. The input of anthropogenic nutrient via river extends three-dimensionally and rapidly. Ocean color remote sensing is an useful tool to monitor the extend of anthropogenic nutrient. In this study, we tried to extract the chlorophyll increased by input of anthropogenic nutrient, by using ocean color remote sensing.

2. Research methods

Shipboard observations were carried out in Suruga Bay in May 1996 and the East China Sea in May 1998 (Fig. 1). Chlorophyll a concentration was measured after filtration with a Whatman GF/F according to Parsons *et al.* (1984). Nitrite + nitrate and silicate concentrations were measured with a Bran and Luebbe Traacs 800. Phytoplankton species and cell density were detemined by light microscope. Temperature and salinity were measured with a CTD. According to Tassan (1994), monthly imageries of colored dissolved organic materials (CDOM), chlorophyll and suspended solid in the East China Sea in May 1997 were made based on the data of ocean color remote sensing (OCTS).

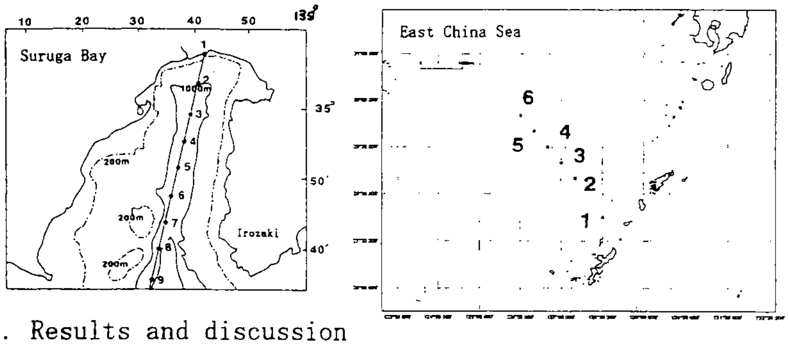


Figure 1 Location of sampling stations in Suruga Bay in May 1996 and in the East China Sea in May 1998.

3. Results and discussion

In Suruga Bay in May and June 1996, atomic ratio of nitrite + nitrate (NO2 + NO3)/silicate (SiO2) (N/Si ratio) was more than 0.2 at Sta. 1, 2 and 3 where salinity was less than 34 (Fig. 2), indicating that the ratio is higher in the coastal area. Diatoms and dinoflagellates were abundant at the stations (Fig. 3). In the East China Sea in May and June 1998, nitrogenous nutrient and silicate concentrations were higher at 1% light depth at Sta. 6 than at others (Table 1). Criptophyceae which is predominant in coastal area was abundant at 1% light depth at Sta. 6 (Table 2). The atomic ratio of N/Si at 1% light depth at Sta. 6 was higher those at others, indicating that the ratio is higher in the waters influenced by coastal waters. The ratio seems to be a good indicator for the strong influence of anthropogenic input. Moreover, dissolved organic nitrogen concentration was higher at 1% light depth at Sta. 6 than at others (Table 1), implying that CDOM concentration is higher in waters influenced by the water of the Changjiang River.

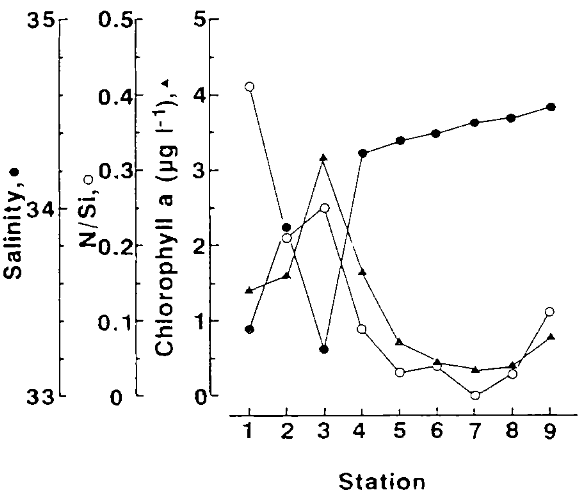


Figure 2 Changes in salinity, chlorophyll and the ratio of N/Si at the surface in Suruga Bay in May 1996

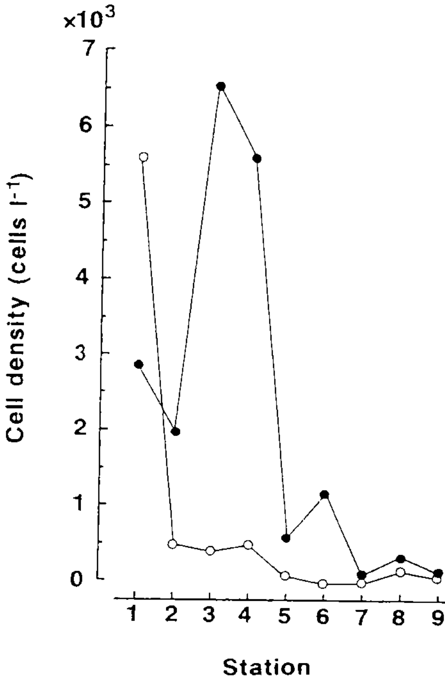


Figure 3 Changes in cell densities of diatoms and dinoflagellates at the surface in Suruga Bay in May 1996

The imageries of CDOM, chlorophyll and suspended solid obtained by OCTS in the East China Sea in May 1997 were shown in Fig. 4. High CDOM concentration was found around the coastal area of China. High CDOM was also found offshore of China in the Yellow Sea. The high CDOM concentration was observed in the middle of the East China Sea. In general higher chlorophyll concentrations were observed around the areas of high CDOM. This implies that chlorophyll concentration is influenced by the input of anthropogenic nutrient via the Changjiang River. We thus suggest that ocean color remote sensing has a potentiallity to monitor the chlorophll increased by the input of anthropogenic nutrient.

References

Parsons, T.R., Y. Maita and C.M. Lalli (1984): A Manual of Chemical and Biological Methods for Seawater Analysis. Pergamon Press, Oxford, 173pp.

Tassan, S. (1994): Local algorithm using SeaWiFS data for the retrieval of phytoplankton, pigments, suspended sediment, and yellow substance in coastal waters. Applied Optics, 33, 2369-2378.

Table 1 Summary of physical and chemical environmental factors in the East China Sea in May 1998

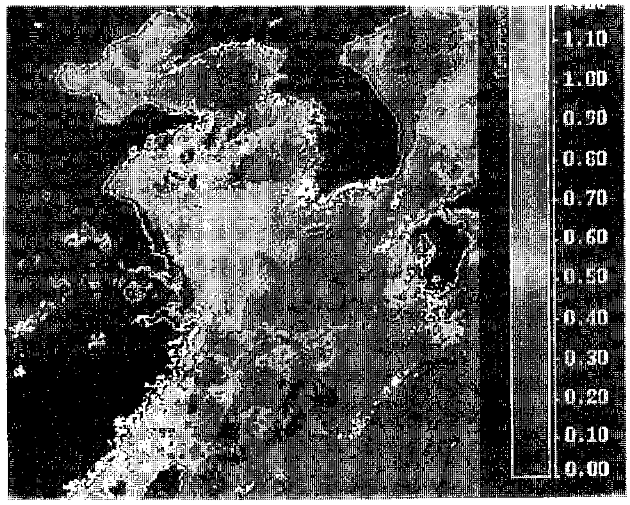
Station	Depth (m)	NO_2+NO_3 (N; μM)	SiO_2 (Si; μM)	N/Si	DON (μM)	Salinity
1	0(100%)	0.3	1.4	0.21	ND	34.5
2	0(100%)	0.4	1.7	0.21	5.0	34.487
	7(30%)	0.3	1.4	0.18	5.0	34.486
	30(10%)	0.3	2.2	0.15	6.7	34.614
	70(1%)	0.5	1.7	0.27	4.3	34.702
3	0(100%)	0.2	2	0.09	4.3	34.374
4	0(100%)	0.2	2.9	0.06	5.0	33.501
5	0(100%)	0.2	4	0.04	ND	33.179
6	0(100%)	0.1	5.5	0.02	5.7	31.988
	6(30%)	0.1	5.2	0.02	6.0	32.022
	17(10%)	0.3	5.2	0.06	6.7	32.292
	40(1%)	8.1	11.2	0.72	11.4	33.465

Figures in the parentheses indicate light depth.
ND: No data
DON: Dissolved organic nitrogen

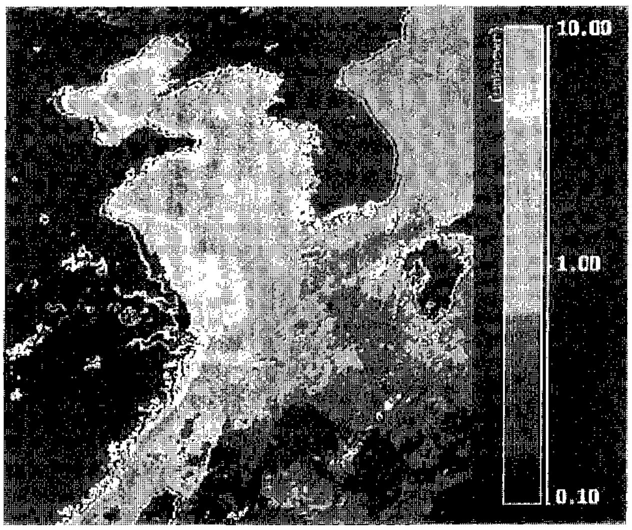
Table 2 Phytoplankton species and cell density (cells/l) in the East China Sea in May 1998

		Station					
	Depth (%)	1	2	3	4	5	6
Blue-green algae	100 (0m)	10	165	1095	45	45	NO
	30						NO (6m)
	10		608 (30m)				NO (17m)
	1		NO (70m)				NO (40m)
Crypto-phyceae	100 (0m)	NO	NO	NO	NO	30	NO
	30						15 (6m)
	10		NO (30m)				300 (17m)
	1		NO (70m)				1365 (40m)
Dino-flagellates	100 (0m)	75	265	390	195	115	110
	30						240 (6m)
	10		205 (30m)				380 (17m)
	1		75 (70m)				505 (40m)
Diatoms	100 (0m)	NO	130	335	415	130	140
	30						235 (6m)
	10		135 (30m)				245 (17m)
	1		180 (70m)				105 (40m)
Hapto-phyceae	1008 0m)	60	450	15	60	15	90
	30						375 (6m)
	10		105 (30m)				165 (17m)
	1		300 (70m)				60 (40m)

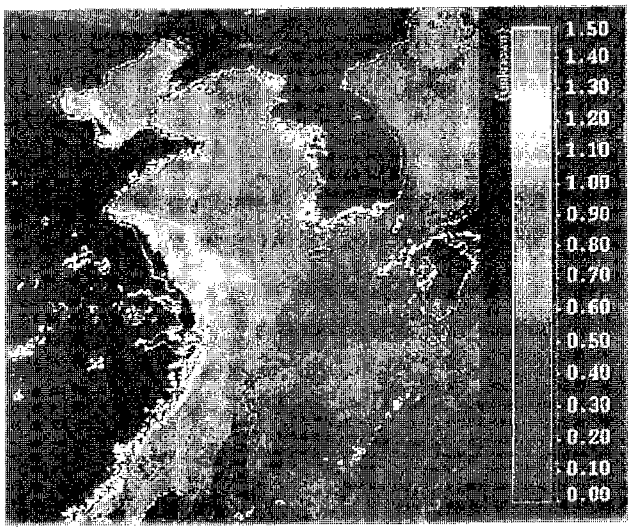
NO: No occurrence



(a) monthly composite imagery of yellow substance (m^{-1})



(b) monthly composite imagery of chlorophyll ($\mu g/l$)



(c) monthly composite imagery of suspended solid (g/m^3)

Figure 4 Monthly composite imageries of yellow substance absorption (colored dissolved organic materials; a), chlorophyll (b) and suspended solid (c) in the East China Sea in May 1998 obatined by OCTS