# Change and Variation of Satellite Chlorophyll in the East China Sea and Yellow Sea over 10 Years

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## 1. Introduction

Recently red tides are frequently reported around the East China Sea coast, and large number of giant jerry fish is caught along the Japan Sea coast. Furthermore, Changjiang River, one of the largest rivers in the world, discharging to the East China Sea, has been eutrophicated, and construction of the Three Gorge Dam is now almost completed and starting the operation. It is expected that the ecosystems of the East China Sea and Yellow Sea are changing. Ocean color satellite is a new technology to monitor ocean environments, including biomass of phytoplankton which is the major primary producer of the organic matter. In this study, we use 10 years time series of Sea-viewing-Wide-Field-of-view Sensor (SeaWiFS) to understand how phytoplankton dynamics in the East China Sea is related to the Changjiang River and to examine possible changes caused by the eutrophication and the dam construction.

## 2. Method

SeaWiFS chlorophyll-a data (level-3 standard mapped data reprocessed in July 2007) from 1998 to 2007 was obtained from NASA Ocean Color Homepage. Salinity data in the East China Sea was obtained from Korean Oceanographic Data Center. Discharge amount of Changjiang River was supplied by J. Zhu (personal communication).

## 3. Result

It is known that discharge of Changjiang River is large during summer. High satellite chlorophyll-a distribution was extended from the mouth of Changjiang River to east toward the Jeju Island during summer, and the distribution in August well corresponded to the distribution of low salinity water, known as Changjiang Diluted Water (Fig. 1). This indicates that the satellite chlorophyll-a can be used as the tracer of the Changjiang Diluted Water. The distribution significantly different yeas by year, and it was expected that the amount of Changjiang River discharge influences the areal extension. When the discharge of Changjiang River was high, areal extension became larger after 1-2 month of the discharge.

Seasonal changes of satellite chlorophyll-a indicated that summer peak of satellite chlorophyll-a was observed between the mouth of Changjiang and Jeju Island and that the peak timing was June for near Chinese coast to September around Jeju Island (Fig. 2). Peaks of satellite chlorophyll-a were observed in May, and they are expected to be spring bloom. Normalizing water leaving radiance at 555 nm, nLw(555), which is the indicator of turbidity, was high around the coast and on the Changjiang Hillock, especially during winter when the water was well mixed. The higher satellite chlorophyll-a coincided with the high nLw(555) may be caused by the overestimation of satellite chlorophyll-a with the problem of satellite data processing.

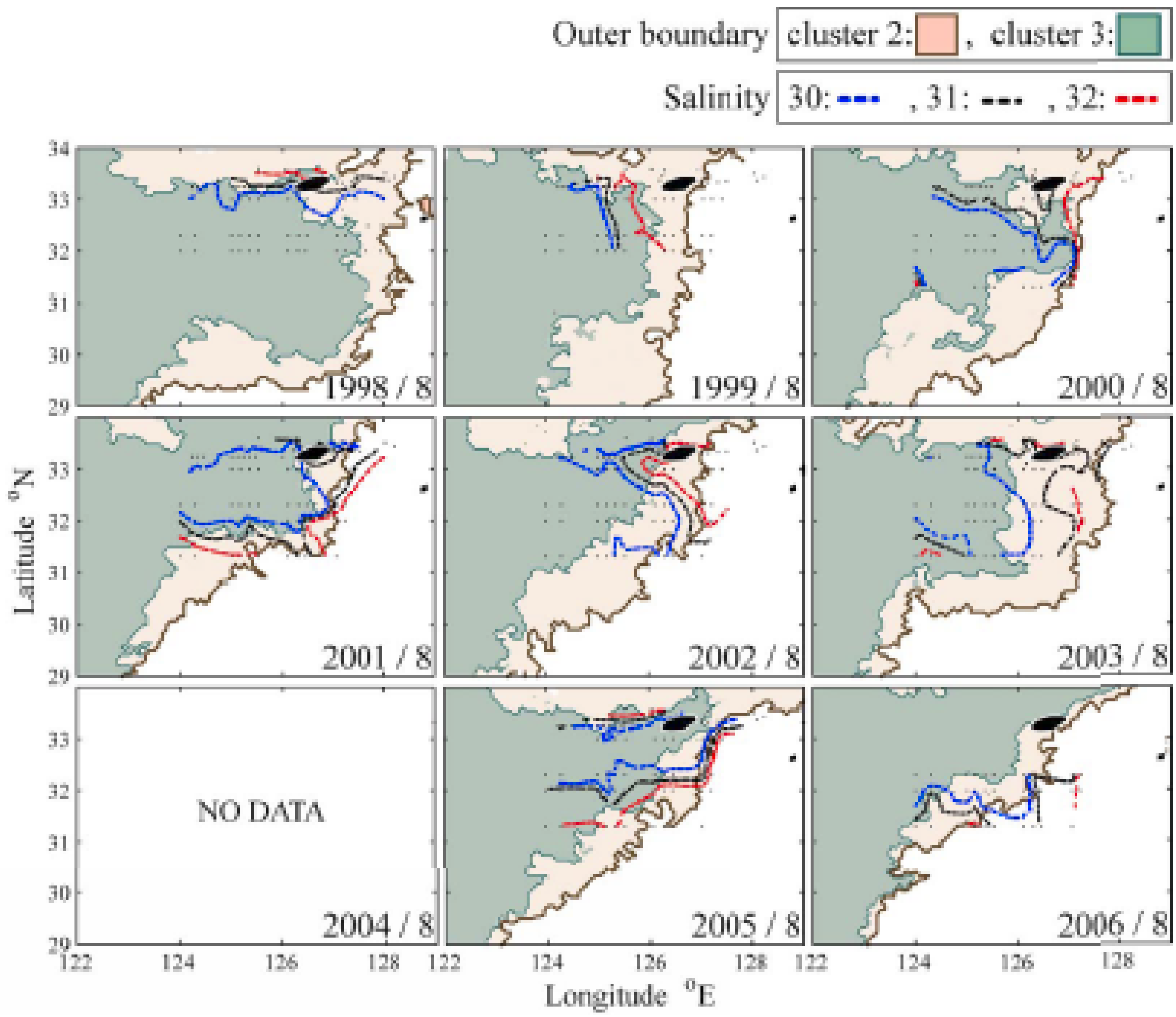


Figure 1. Distributions of salinity and satellite chlorophyll-a during August from 1998 to 2006. Satellite chlorophyll-a concentration was >0.42 and >0.92 mg m$^{-3}$ for cluster 2 and 3, respectively.

Interannual variability of satellite chlorophyll-a during summer was well corresponded with the interannual variability of Changjiang river discharge in the area where summer peak was observed. This further indicated that the satellite chlorophyll-a was influenced by the Changjiang river discharge. On the other hand, in the middle of Yellow Sea where the summer peak was not observed, satellite chlorophyll-a concentration increased gradually from 1997 to 2006. This might be indicated the eutrophication of the Yellow Sea.

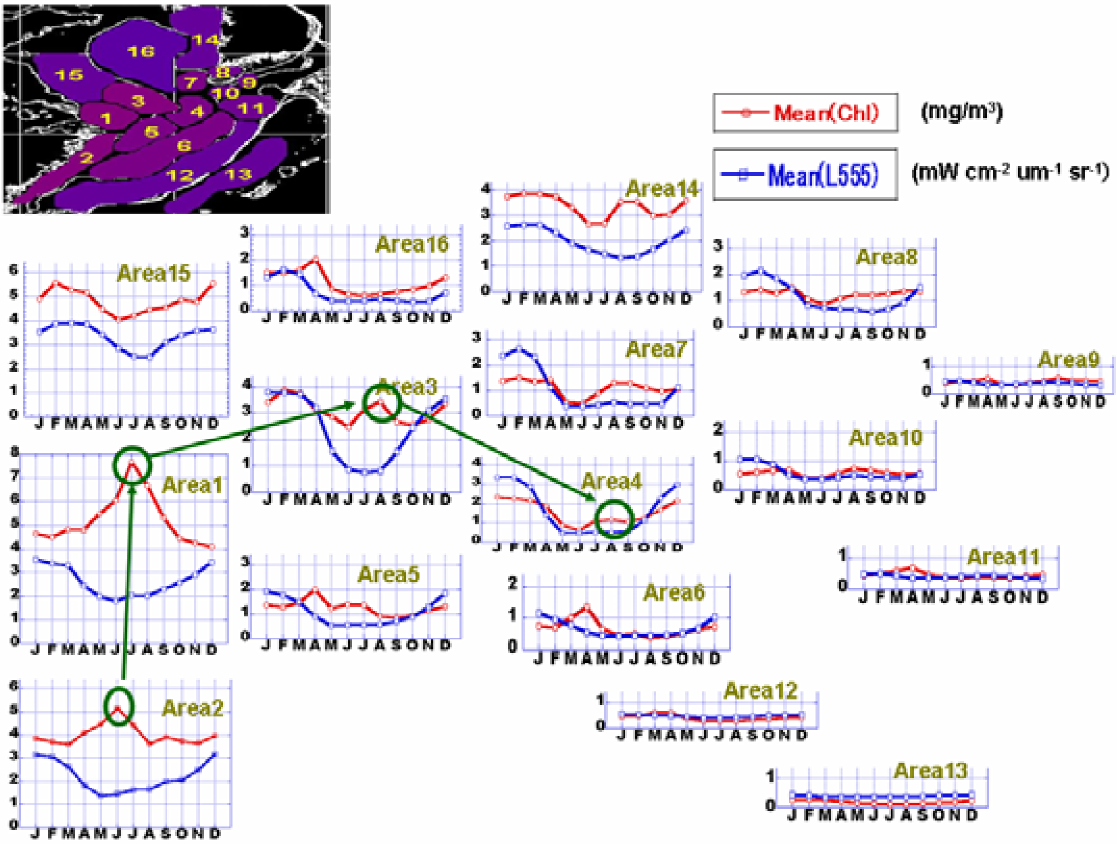


Figure 2. Seasonal change of satellite chlorophyll-a (Chl) and nLw(555) (L555) in 16 different area of the East China Sea and Yellow Sea. Arrows indicates the possible transport of Changjiang Diluted Water.

## 4. Discussion

Satellite chlorophyll-a data during 10 years indicated that 1) the areal extension of high satellite chlorophyll-a corresponded to the distribution of Changjiang Diluted Water, 2) the Changjiang Dilluted water reached around Jeju Island with 1-2 months after the discharge, 3) interannual variability of the areal coverage of the high satellite chlorophyll-a and the concentration well correlated with amount of summer Changjiang river discharge, and 4) satellite chlorophyll-a concentration has been increasing last 10 years in the Yellow Sea and it might be related with the eutrophication. Those indicate that the satellite data was very useful for environmental monitoring in the coastal area; although care has to be taken to the accuracy of the data. International collaboration is necessary for the further development of better algorithms of satellite, and the attempt is already started.

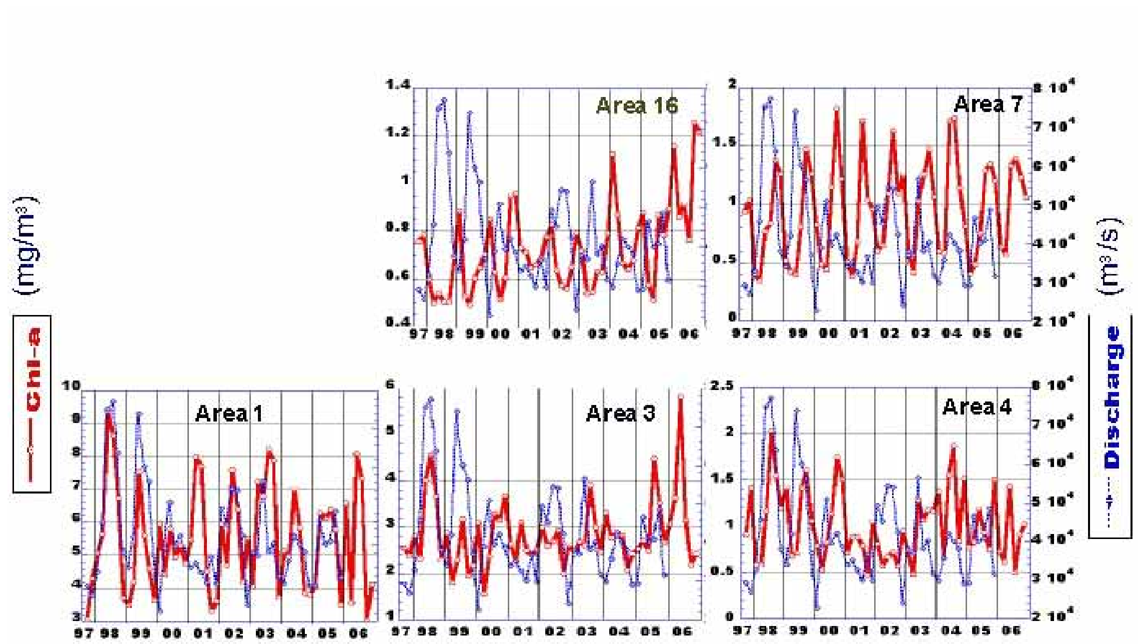


Figure 3. Interannual changes of Changjiang river discharge and satellite chlorophyll-a in 5 different areas of the East China Sea and Yellow Sea shown in Figure 2.