Abnormal oceanic conditions around the Korean peninsula caused by typhoons

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Abstract: Abnormal oceanic conditions associated with the passage of typhoons are examined using hydrographic and satellite data 1990-2002. During the passage period of typhoons in the Korean waters, an abrupt decrease of sea surface temperature(SST) in range of 5 to 8 ℃ was observed. The areas of SST decrease were an order of 100-200km, and the low SST lasted about 15-25 days after passage of typhoon. After passage of typhoon, the water temperatures in the surface mixed layer of 30m show negative anomalies for quite a long period. In addition, stratification parameters were substantially decreased and chlorophyll a density was rapidly increased.

Keywords: Typhoon, Sea surface cooling, The Korean waters, Satellite remote sensing, Abnormal oceanic conditions.

1. Introduction

Recently, Bates and Smith(1985) showed that sea surface cooling by a hurricane is observable in geostationary satellite data. Stramma et al.(1986) studied polar satellite observations of sea surface cooling by hurricanes in the western North Atlantic (north of Cuba and east of Florida) between September 1981 and December 1984. Sea surface cooling caused by typhoons in the Japanese waters was studied by satellites remote sensing and moring buoy system (Sakaid et al., 1998, Senjyu and Watanabe, 1999).

Suh et al.(2002) studied sea surface cooling caused by typhoons in the Korean coastal waters for 10 years (1990-1999). The temporal and spatial variation of SSTs at coastal waters in summer were depended on the various types of the typhoons' paths which were passing through the Korean peninsula. When a typhoon passed by the western parts including the Yellow Sea of the Korean peninsula, upwelling cold water occurred along the eastern coastal waters of the peninsula. The reason was estimated with the typhoon that was as very strong wind which blew from south toward north direction along the eastern shore of the peninsula, led to the Ekman transport from near the eastern coastal area toward the offshore.

Here we extended the study area in relation to the sea surface cooling by typhoons using infrared data from NOAA satellites, and ocean color data from SeaWiFS and MODIS. Abnormal oceanic conditions associated with the passage of typhoons are examined for 13 years (1990-2002).

2. Data and Method

Information of the track, the minimum pressure and the maximum wind velocity of the typhoons that approached the Korea peninsula was from websites related to the Korea Meteorology Agency (http://www.Magokr/index.html) and the Typhoon Research Center(http://www.typhoon.or.kr ~jecu7/ rame 2.html).
The field data were from the serial oceanographic observing station for the cruises of National Fisheries Research and Development Institute in Korea.
The focused areas of the cold water appearance in the estimated SST imageries derived from NOAA satellites were examined.

3. Result

The imageries of NOAA satellites were used to quantify the sea surface cooling by the typhoons, DOUG and ELLIE in 1994, ANN in 1999 (Fig.1), PRAPIROON in 2000 and RUSA in 2002.

The imageries of SeaWiFS satellite before and after the passage of the typhoon, RUSA in August 2002 were used to quantify the variation of chlorophyll a in relation to the phytoplankton bloom (Fig. 2).

The distribution of suspended sediments around the waters off the Yangtze river in China were extended when the typhoon, NFRI was approaching to the Yangtze river in September, 2001. (Fig. 3)

4. Conclusions

A sudden decrease of sea surface temperature ranged from 5 to 8℃ was found during the passage period of typhoons in the Korean waters. The remarkable sea surface cooling caused by typhoons were formed in a diameter of 100-200km and lasted for 15-25 days.

Horizontal distribution of the chlorophyll a density related to the amount of phytoplankton was rapidly increased after passage of typhoon.

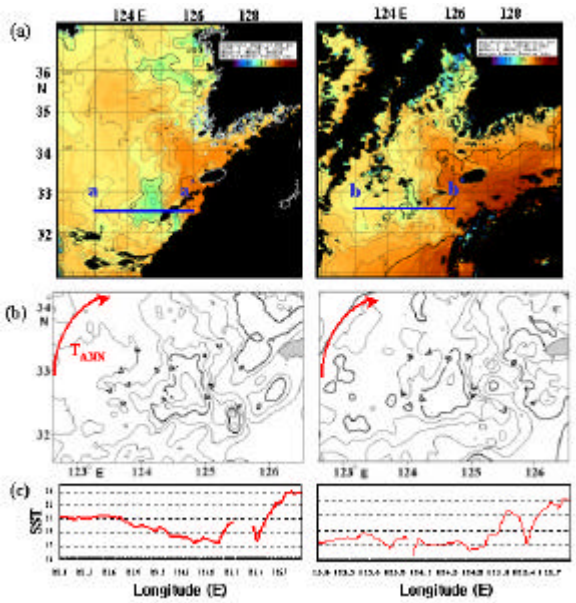

Fig. 1. (a) SST distributions derived from NOAA-14 IR imageries related to the after typhoon ANN on 26th and 27th September, 1999 in the Yellow Sea.
(b) Horizontal distribution of SST anomalies in the period after the passage of the typhoon in the southeastern part of the Yellow Sea.
(c) MCSST profile on the a-a' and b-b'(a).

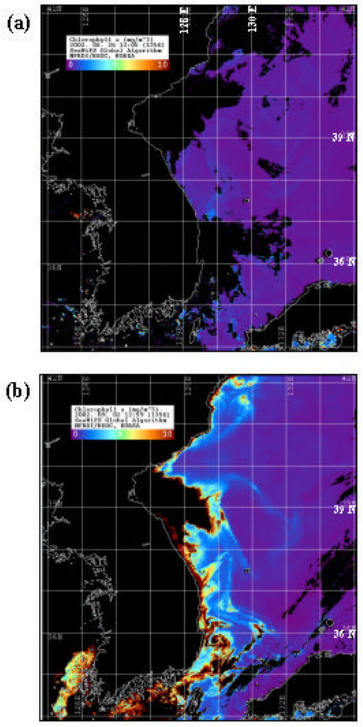

Fig. 2. Distribution of chlorophyll *a* imageries of SeaWiFS satellite in the East Sea (Japan Sea).
(a) The imagery before the passage of the typhoon, RUSA on 26th August, 2002.
(b) The imagery after the passage of the typhoon on 2nd September, 2002.

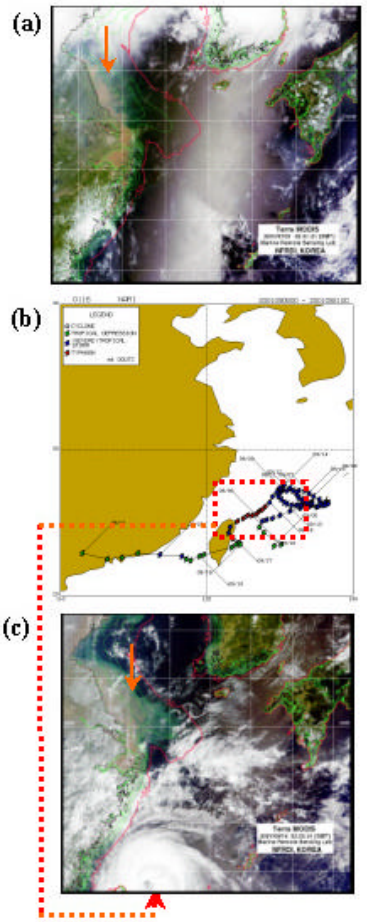

Fig. 3. (a) Normal distribution of the suspended sediments around the waters of the Yangtze river in July, 2001.
(b) Path of the typhoon, NARI in September, 2001.
(c) Extended distribution of the suspended sediments related to the approaching typhoon, NARI around the waters of the Yangtze river in September, 2001.

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