THE EFFECT OF MATMO TYPHOON ON MIXED ZONE BETWEEN THE YELLOW SEA AND BOHAI SEA

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ABSTRACT

The results of remote sensing, buoy and profile based on measured data indicate that the wind speed, $H_{1/3}$ and salinity increased, sea surface temperature declined, and wind direction changed greatly during the transit of the Matmo typhoon on July 25. It was found that the typhoon transport the Yellow Sea Cold Water Mass into the the Yellow and Bohai seas mixed zone.

Index Terms: the Yellow and Bohai seas mixed zone, the Yellow Sea Cold Water Mass, wind speed, buoy data, remote sensing data.

1. INTRODUCTION[1]

The Yellow and Bohai seas mixed zone (Y-B) is an ideal breeding base for wildlife, and there are more than 210 types of abundant seafood. There are also more than 320 migratory birds each year and the total number of birds is greater than 1.2 million. Every year this habitat supports nearly 400 Pacific leopard seal. The Y-B is a national nature reserve area and the provincial level nature reserve area of seals.

The two main marine hydrological characteristics of the Yellow Sea are the Yellow Sea Warm Current (YSWC), and the Yellow Sea Cold Water Mass (YSCWM). The YSWC and Yellow Sea (western) flow constitute a cyclone type circulation; it said that it was the circulation of the Yellow Sea. To some extent, the YSWC has the nature of compensation flow: where the winter monsoon has a north-west wind field and the coastal current increase, resulting in a strong YSWC. The coastal rheological is weak due to the SE monsoon in summer, and as a result the YSWC is also weak. The YSWC is mainly limited to the upper mixed layer and the lower layer is limited by the YSCWM (low temperature and high salinity). YSWC has characteristics of strong winter summer weakness. The stronger the YSWC is in winter, the stronger the YSCWM is in summer of next year (Bao et al, 2001).

The Matmo typhoon on July 23, 2014 landed at 0:15 on the coast of Taiwan, with a maximum wind speed of 42 m/s near the central. The typhoon on July 25, 2014, occurred in the afternoon at 17:10, and changed into a tropical storm, landing at Rongcheng in Shandong province. The

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maximum wind speed near the central maximum was 20 m/s (Fig.1a). Here we analyze how the Matmo typhoon affected the Y-B and whether it brought YSCWM into the Bohai Sea.

2. MATERIALS AND METHODS

Remote Sensing observations have been widely used in studying typhoons (Friedman and Li 2000; Li et al., 2002; Li et al., 2013; Li et al., 2015) The wind field, significant wave height ($H_{1/3}$), sea surface temperature (SST), salinity (SAL) and chlorophyll concentration (CHL) of Y-B were analyzed using Radarsat-2 SAR, MODIS and Buoy1 (37.54 ˚N, 122.01 ˚E) data. Study area is rectangular region (Guo et al, 2016) located near the Y-B; A (37.5 ˚N, 120 ˚ E), B (37.5 ˚N, 124 ˚E), C (39 ˚N, 124 ˚E), D (39 ˚N, 120 ˚E) (Fig.1b).We applied a statistical analysis method in this paper.

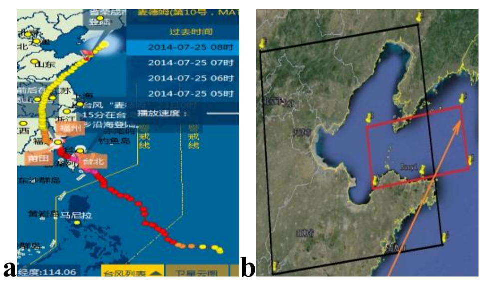
a  b

Fig.1 Typhoon path of Matmo (a); and a sketch map of study area (b)

3. DISCUSSIONS

The wind velocity retrieved by Radarsat2 data (2230) was compared with buoy1 data (Table1). The maximum differences in longitude and latitude are 0.15° and 1hour in time. We found that wind velocity retrieved from the Radarsat2 real-time data using the C-band Cross-Polarization Ocean Backscatter (C-2PO) model (Zhang et al., 2012) was in a good agreement (RMS=1.96m/s)with real-time buoy1 data (Table1).This shows that the C-2PO model inversion under the high wind speed is effective (Fig.2).

Table1. Wind field inversion by Radarsat2 data compared with wind field data measured by buoy 1 data （Root mean square-RMS）

Instrument	Time	Latitude	Longitude	Wind speed	Wind-Dir
Radarsat2_VH	2014.07.25_18:18.64	37.54°N	122.01°E	RMS=1.96m/s	349°
Buoy1	2014.07.25_18:00	37.54°N	122.01°E	17.03m/s	349°

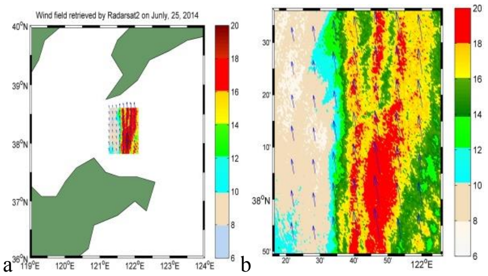
a  b

Fig.2 Wind field retrieved by Radarsat2 data at 18:18.64 on July, 25, 2014

Fig.3 shows that the highest average winds speed was 17.3m/s at 17:00 on July, 25, 2014, and the wind direction varied considerably from 14 to 15 points. $H_{1/3}$ increased gradually to 2.3m from 0:00 to 19:00, and decreased slowly from 20:00 to 23:00. The SST decreased gradually to 17.82 ˚C from 0:00 to 10:00 and maintained a relatively stable value from 11:00 to 23:00. The SAL had a relatively stable value of 30.00 psu from 0:00 to 7:00, rapidly increased to 30.454 psu from 8:00 to 10:00, and then suddenly decreased to 29.946 psu from 10:00 to 12:00 due to rain. SAL then was increased abruptly to 30.517 psu from 12:00 to 16:00, and then maintains a relatively stable value from 16:00 to 23:00. Overall, SAL had an increasing trend.

From July 17, to August 2, 2014 (Fig.4), the wind speed, $H_{1/3}$ and SAL increased, SST declined, and wind direction changed greatly during the transit of the Matmo typhoon on July 25. From Fig.5 we can see that the average SST (CHL) in July 2014 was less (more) than that in July from 2004 to 2013 in the study area. The area was significantly affected by the Matmo typhoon, compared with buoy1 and remote sensing data.

As the YSWC flowed into Bohai Sea during the winter of 2013 (Guo et al, 2016), the YSCWM would increase in northern Yellow (Jiang et al, 2007), as shown in Fig.6.

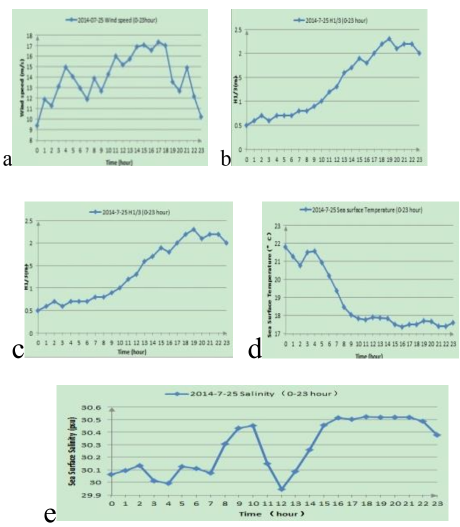
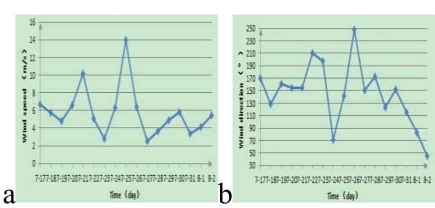


Fig.3 Wind speed (a), wind direction (b); $H_{1/3}$(c); SST (d); SAL (e) variation between 0 to 23hours on July, 25, 2014 based on buoy1 data



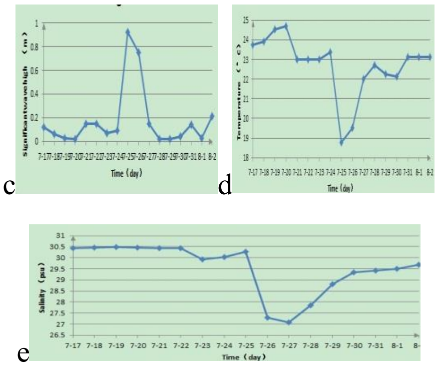


Fig.4 Wind speed (a); wind direction (b); $H_{1/3}$(c); SST (d); SAL (e) variation from July 17 to August 2, 2014based on buoy1 data

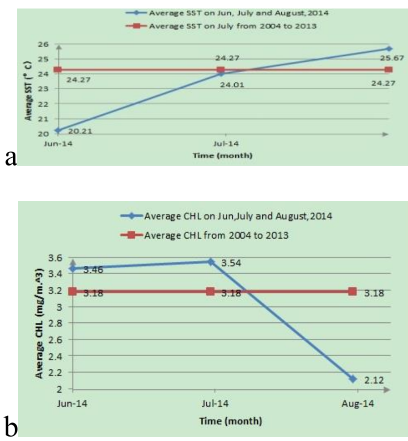


Fig.5 Average SST (CHL) in June, July, and August, 2014 compared with the average SST (CHL) in July from 2004 to 2013(a,b);

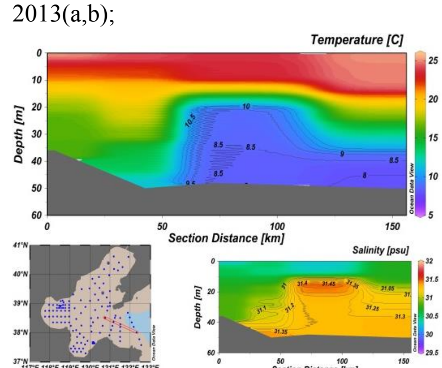


Fig.6 SST and SAL profile based on measured data in Y-B from 12, August to 6, September, 2014

4. CONCLUSIONS

Because the maximum wind speed during the Matmo typhoon near center was grade eight (20 m/s) in Y-B, it could transport YSCWM into Y-B (Su et al, 2001). This was one of the most important factors that caused SST cooling (Fig.4d and 5a) on July 25, 2014 and a higher than average CHL in July from 2004 to 2013 (Fig.5b). It also caused an increase in SAL on July, 25, 2014. The inversion layer of SAL in Fig.6, it came from SST and SAL profile measured data in Y-B from August 12 to September 6, 2014, showing the typhoon transporting YSCWM into the Y–B

5. ACKNOWLEDGMENTS

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