THE PROPAGATING SPEED OF INTERNAL SOLITARY WAVES INVESTIGATED BY X-BAND RADAR NEAR DONGSHA ISLAND

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1. INTRODUCTION

Oceanic internal waves, which are important ocean mesoscale phenomena, are frequently observed on the continental shelf when the ocean is stratified. Satellite images have long been used to study oceanic nonlinear internal waves (NIWs) by oceanographers and remote sensing researchers. Various Satellite images for the past many years have been collected to research the spatial distributed characters of NIWs in SCS [1]. NIWs appear more at continent shelf than those at deep sea basin. Moreover, the big amplitude internal solitary waves (ISWs) can damage sub-sea oil and gas drilling operation platforms.

For the velocity of the solitary internal waves around Dongsha island, Bole [2] found its maximum ranges is from 0.5m/s to 1.5m/s, however, it is also reported that it may exceed 3m/s at some place around Dongsha. GAN et al [3] found it is between 1.5 and 2m/s using multiple remote sense images. Due to the destructiveness of the big amplitude ISWs, it is necessary to acknowledge the character of the ISWs around Dongsha island.

2. DATA AND METHODOLOGY

30-day-long shipboard X-Band radar images were obtained during the field investigation cruise of Key program and normal program of Knowledge Innovation project of Chinese Academy of Sciences in SCS. One day's continuous observation from 15:40 on 24 June to 16:40 on 25 June 2009 was made, 'Kexue No. 1' research vessel was anchored at K106 (117°37.6198′E, 21°02.2990′N) in the vicinity of the continental slope northeast of

Dongsha Island, where the water depth was 697 m. The onboard nautical radar was operated at 9.4GHz (X-band) with horizontal (HH) polarization. GPS system was else installed on the vessel. SBE 911plus CTD was used to obtain profiles of temperature and conductivity during the entire observation. Thermistor chains were used for internal wave measurement during this in situ observation. ADCP was applied to measure the current velocity.

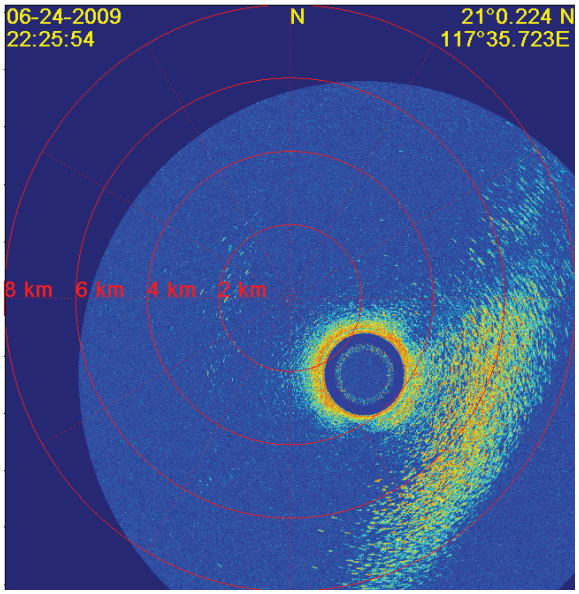

Fig. 1 Backscatter power image recorded on board 'Kexue NO.1' at 22:25:54 on 24 June 2009.

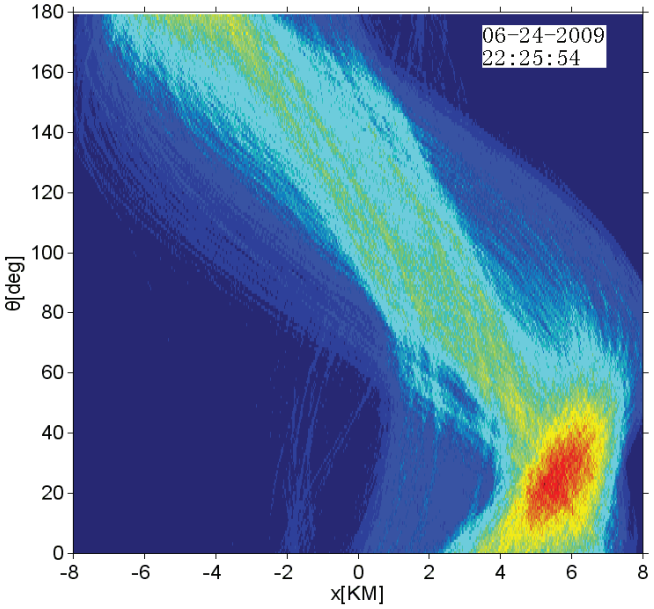

Fig.2 Backscatter power image (homogeneous) recorded at 22:25:54 on 24 June 2009 in normalized Radon space

When the internal waves propagate with the effect of the background current, the phase speed and wave structure are modulated by background currents, the current shear has little effect on wave structure, whilst the current curvature could have a strong impact on the wave structure [4]. To obtain a better resolution, we will use the current averaged over the 30 min before the arrival of the wave as the background current $C0 = 0.04$ m/s.

The horizontally polarized (HH) X-Band radar images (Fig. 1) can be used to measure the backscatter power which is associated with sea surface roughness. The homogenization process to radar images are reconstructed by two-dimensional inverse wavelet analysis, and then made an edge analysis. Finally, Radon Transform technique is used to detect internal wave features from backscatter images [5]. Fig. 2 shows the image after Radon Transform. Some other figures are not presented here because of limited pages. We can calculate its velocity, $C1$, which

is3.08 m/s. So the propagating speed of the ISW is $C = C1 - C0 = 3.04$ m/s.

3. REASON OF THE DIFFERENCE

The speed value is bigger than other studies' results, especially that calculated only by using the distance between two NIWs in satellite remote sensing images and the period, 12.4h. In fact, however, the interval of two ISWs in northeast of SCS is less than 12.4h from Thermistor chains measurement, so the speed calculated from satellite .remote sensing images should be less than that in situ. That is also why we get the speed from X-band radar images is bigger than these obtained from satellite remote sensing images.

4. CONCLUSION

Shipboard X-Band radar images acquired on June 24th , 2009 are used to study solitary internal waves (ISWs) characteristics at northeast of the South China Sea (SCS). The ISW amplitude is more than 100 meters and it propagates westward at a speed of 3.04 m/s. It is necessary to consider the period of the studied internal waves from a time series of isotherm obtaining their character from SAR or other satellite remote sensing images.

5. REFERENCE

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