Using high-resolution remote sensing CubeSat to observe the distribution of sea ice

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Abstract:

Affected by global warming, the formation and melting of sea ice have some new characteristics. Research points out that there is some relationship between sea ice change and climate disasters in some areas of China. Satellite remote sensing technology is useful for sea ice monitoring and disaster prediction. This paper introduces several research methods based on satellite remote sensing image, and a high-resolution submeter 12U CubeSat designed by Dalian University of technology is introduced. This CubeSat could be used for sea ice detection in the future and the related image will free of charge for the researchers.

1.Introduction

With the development of the national economy and human development, greenhouse gases emitted by human activities dramatically increased in recent years, causing global warming, sea-level rise, and other climate changes. These impacts of climate change are spreading all over the world, and the natural disasters caused by it have an inestimable effect on the economies of all countries and people's daily life.

2. The relation between Sea ice and China climate change

Sea ice is very sensitive to the change in sea temperature. In recent years, with global warming, the degree of sea ice melting in the Arctic is increasing, and the sea ice coverage area is gradually reduced. Recent research found that the reduction of Arctic sea ice has a good correlation with the occurrence of blizzard in northern China [1]. In

autumn, the decrease of Arctic sea ice results in the weakening of the westerly tailwind and the negative phase of North Atlantic Oscillation (NAO) in the general circulation, which makes it easier for the cold air to invade southward. The combination of polar cold air and Pacific warm and humid air will cause frequent snowstorms in Northeast China. At the same time, the melting of sea ice will also lead to the winter cold wave in the mid-latitude continent. Affected by the cold wave, ice will appear in the Yellow Sea and the Bohai Sea in the winter half-year. The Yellow Sea and blue sea ice have caused severe harm to aquaculture, marine navigation, offshore oil production, and other maritime activities[2]. Therefore, how to monitor the change of sea ice distribution has become a research topic of many scholars.

To detect the movement of sea ice, it is necessary to be able to distinguish different sea ice blocks. At present, there are many sea ice detection methods, among which satellite remote sensing technology is very useful. Some innovative research has been done by the images of satellites. The size distribution characteristics of Arctic ice floes could be found by comparing satellite images with different spatial resolutions. Besides, using the method of limited growth, they can automatically identify the ice floes and obtain that the ice size distribution meets the power-law distribution [3]. The Chinese research team has synthesized sea ice products with MASIE multi-source data, and combined with the reanalysis data of the European medium-term weather forecast center. The result found the short-term spatiotemporal variation law of the sea ice in the Yellow Sea and the Bohai Sea, which is convenient for forecasting the sea ice changes in the Yellow Sea and the Bohai sea[4]. High-resolution satellites will have an advantage in identifying small-scale sea ice. By analyzing the image, we can quickly observe the change of sea ice edge and make accurate predictions. Because the image range of a single satellite is limited, countries should open up the relevant satellite data within their capabilities, comprehensively refer to different satellite images, and draw more accurate conclusions.

3. High-resolution remote sensing 12U CubeSat for sea ice observation

However, most countries do not disclose their own real-time climate observation data, and there is still a shortage of China's satellite observations alone.
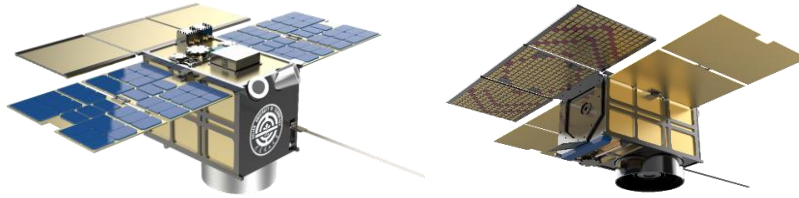

Fig 1. Small Bright Eye CubeSat mission

To obtain more sufficient data on sea ice in the Arctic, Yellow Sea and Bohai Sea, the satellite research team of the Dalian University of Technology where I work is considering using 12U CubeSat for the observation of sea ice. The mission is called Small Bright Eye (SBE). SBE is a 20kg sub-meter high-resolution sensing 12U CubeSat. One of its primary payloads is PAN/Multispectral high-resolution camera.

According to the design, the resolution of the satellite is better than 1 m in the orbit of 500km Sun-synchronous orbit. The width of the field of view can reach 11.5 km, and its pointing accuracy is less than 0.05 degrees. The satellite will be launched by the end of 2021. It can provide real-time high-resolution satellite images for sea ice analysis with a downlink speed of 400Mbps. Through the satellite image, we can get the real-time distribution data of sea ice more clearly, observe the development of sea ice generation, and analyze the reasons for the abnormal reduction of the area.

4.Conclusion

There is still a significant gap in the field of sea ice research based on satellite data. Due to economic and technical reasons, there are not many kinds of on-orbit working satellites with sea ice observation function, and the observation information provided is not enough. All countries should pay attention to climate change and its impact, and take advantage of the new opportunities generated by climate change to develop

themselves while avoiding losses caused by climate change. Next year, the SBE Satellite will be launched, and the team will provide free images for climate research experts from all over the world. Coping with climate change is for the better survival of human beings.

5.References

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