

## **Techniques for Sea Ice Characteristics Extraction and Sea Ice Monitoring Using Multi-Sensor Satellite Data in the Bohai Sea**

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The Bohai Sea and its coastal regions are significant economic development areas in China. When winter comes, sea-water-frozen ice and its drift pose a great threat to coastal construction and manufacturing industry, such as marine transportation, off-shore oil and gas exploration and fishery industry, leading to severe economic loss to China. Therefore, it is necessary to develop techniques for sea ice monitoring.

In this project, we will extend the techniques implemented as part of the Dragon-2 programme (ID: 5290) to extract sea ice parameters and to improve sea ice monitoring capabilities using multi-sensor satellite data in the Bohai Sea.

At first, we will implement field work in winter of each year and use airborne SAR, space borne SAR and EM-31 & laser ice thickness measurement instrument to obtain sea ice in-situ data, synchronized with space borne remote sensing. Then we will fill gaps of knowledge concerning the characteristics of multi-frequency and multi-polarization data of different sea ice types in the Bohai Sea in order to find the optimization configuration of SAR data for sea ice monitoring. Using optical and SAR data combined with the fieldwork results, we will analyse spectral characteristics and backscattering characteristics of different ice types; and try to establish multi-sensor sea ice classification methods. Thirdly, combined with the EM ice thickness data, we will analyse the relation between ice surface temperature and sea ice thickness with thermal satellite data, analyse the relation between ice surface roughness and sea ice thickness with SAR data, and try to present sea ice thickness retrieval methods using thermal satellite data and SAR data. Fourthly, according to sea ice types and thickness information extracted by sea ice classification methods and sea ice thickness retrieval methods, we will produce sea ice production thematic map, and analyse the relationship between sea ice regime grades and environmental factors (e.g. temperature, wind,  $\rho$ ). At last, we will investigate and analyse the backscattering statistics of ice in the Bohai Sea and those in the Baltic Sea using different SAR sensors. The comparison serve as a guideline if the methods developed for the Bohai Sea are applicable under the Baltic Sea conditions and, vice versa, if the results achieved in the Baltic Sea remain useful in the ice conditions typical for the Bohai Sea. The developed methods can provide technical support in the operational sea ice monitoring in the Bohai Sea.

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## 基于多源遥感数据的渤海海冰特征提取和遥感监测技术研究

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渤海及其沿海地区是中国重要的经济开发区。每年冬季，海冰冻结及漂移会严重威胁渤海的航运，油气勘探及海上作业生产等活动，给中国造成了无法估量的经济损失。因此，有必要发展海冰监视监测技术。

本项目将在“龙计划”二期项目（ID：5290）的基础上，进一步发展基于多源遥感数据的渤海海冰参数提取技术，提高渤海海冰的遥感监测能力。

首先，我们将在每年冬季，利用机载SAR、星载SAR和EM-31&激光海冰厚度测量设备，开展海冰现场同步探测实验，获取海冰实测数据。然后开展渤海海冰类型的多波段多极化SAR响应特性分析研究，找到适合于海冰监测的最佳SAR观测参数。利用光学数据、SAR数据和现场实验数据，分析海冰的光谱特征和后向散射特征，建立多源遥感海冰分类方法。第三，结合EM海冰厚度数据、热红外卫星数据和SAR数据，分析海冰表面温度、海冰表面粗糙度与海冰厚度的相关性，建立基于热红外数据和SAR数据的海冰厚度反演方法。第四，根据由海冰分类方法和海冰厚度反演方法提取出的海冰类型和海冰厚度信息，生成海冰产品专题图，分析海冰冰情等级与环境要素（如温度、风场等）的相关性。最后，利用不同SAR传感器，分析比较渤海海冰和波罗的海海冰的后向散射特征，两个海域的比较结果可为渤海海冰探测方法是否可应用于同类型的北极海冰探测，或北极海冰的探测方法是否可应用于同类型的渤海海冰探测中提供指导。本项目发展的方法将为渤海海冰的业务化监测提供技术支持。

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