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Application of high resolution SAR of the TerraSAR-X to coastal zones

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The presentation will give a summary on the Dragon 2 project “Coastal Zones” (ID5338). It particularly focuses on the application of the high resolution SAR TerraSAR-X (TS-X) to coastal zones including retrieval of high resolution sea surface wave field, wind field, mapping of underwater topography, monitoring of oil spill.

The sea surface wave and wind are the two most important parameters in the air-sea interface. SpaceborneSAR has its unique capability to derive high resolution sea surface wave and wind field, particularly in coastal zones where they often exhibit significant spatial variations. With respect to the TS-X, we focus on developing methods to derive the sea surface wave and wind information from it. The XWAVE and XMOD are the Geophysical Model Functions (GMF) developed to retrieve significant wave height and sea surface wind field from the TS-X. We will present several case studies to demonstrate the application of TS-X on investigating of coastal sea surface wave and wind field, such as over offshore wind farming parks, in the China Sea and European Seas.

Mapping of high resolution underwater topography is another important application of TS-X to coastal zones. The long swells propagate toward to shore are often clearly and linearly imaged by SAR. In shallow water area, swell can “feel” the change of underwater topography which in turn changes the wavelength of swell. By extracting the change of wavelength, we can derive the high resolution bathymetry using the wave dispersion relation from the TS-X data.

The TS-X also can provide the data acquired in dual-polarisation with combination of VV/HH, VH/VV, and HV/HH. By using the dual-polarisation data, we develop a novel method for oil monitoring. Choosing the combination VV/HH it gives the possibility to estimate the co-polarization correlation. Here the co-polarisation correlation is estimate trough the Co-polarization Phase Difference Standard deviation (CPDStd), i.e. the standard deviation of the phase retrieved by the two complex channels. The CPDStd gives the opportunity to discriminate between heavy oil and weak damping oceanic features, i.e. coastal biogenic slicks. Applications are demonstrated for oil spill accidents in the North Sea in Europe and Bohai Sea in China.

Dragon project id
08 COASTAL ZONES (ID. 5338)

高分辨率合成孔径雷达TerraSAR-X在海岸带地区的应用

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摘要

本文总结了龙计划二期中ID5338项目取得的主要成果。突出展示了高分辨率合成孔径雷达TerraSAR-X在海岸带观测中的应用，包括海浪信息和海面风场的反演，水下地形测量和海面溢油的监测。

海浪和海面风场是海气界面上最重要的两个海洋参数。在海岸带地区，海浪和海面风场具有非常明显的空间变化特性，因此，能够提供高空间分辨率的海浪和风场信息的合成孔径雷达在海岸带观测中具有得天独厚的优势。对于TerraSAR-X，研究重点集中在设计反演海浪和海面风场信息。XWAVE和XMOD是我们开发的两个用于反演海浪和海面风场信息的模式函数。通过个例研究展示利用TerraSAR-X在海岸带研究海浪和海面风场的空间变化，例如在中国海和欧洲北海的海洋风力发电场。

绘制高分辨率的浅海海底地形是TerraSAR-X在海岸带观测中另外一个非常重要的内容。合成孔径雷达可以非常清楚而且接近线性地对波长较长的涌浪在近岸浅水区成像。当涌浪传播到浅水区域时，它可以"感知"地形的变化，因此涌浪的波长就会发生改变。通过分析涌浪波长的变化规律，我们可以通过海浪的频散关系来提取高分辨率的浅海海底地形。

TerraSAR-X也可以获取VV/HH，VH/VV，HV/HH组合方式的双极化数据。通过估计双极化VV/HH数据中两个通道的相关性，我们开发了一种新的用于溢油监测的方法。而相关性的估计是建立在计算双极化复数据的相位差的标准偏差之上，这种方法简称为CPDStd算法。该算法可以比较好的区分海面溢油和其他类似于溢油的信息，比如在海岸带经常存在大量的生物油膜。通过分析在中国海和欧洲北海的溢油事故，展示这种算法的应用价值。