Enhanced-resolution reconstruction for the China-France Oceanography Satellite scatterometer

The China-France Oceanography Satellite SCATterometer (CSCAT) can observe radar backscatter values on the same sea surface at multiple incidence angles, and is often used to estimate the ocean near-surface wind. However, CSCAT utilizes a novel scanning mechanism and the wind vector cell has a spatial resolution is 25km or 12.5km, which limit the study of high-resolution land and sea ice monitoring. To address this issue, this paper constructs a geometric model of the main lobe-to-ground projection relationship and generates the enhanced-resolution radar images which improve the spatial resolution from traditional 25km to 5km.

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Introduction

- Lin et al. used CFOSAT to study coastal wind retrieval, but there have been few studies that have applied CSCAT data in image reconstruction.
- we use the CSCAT antenna pattern to construct a geometric model of the main lobe-to-ground projection relationship to estimate a simplified spatial response function to produce enhanced-resolution images.

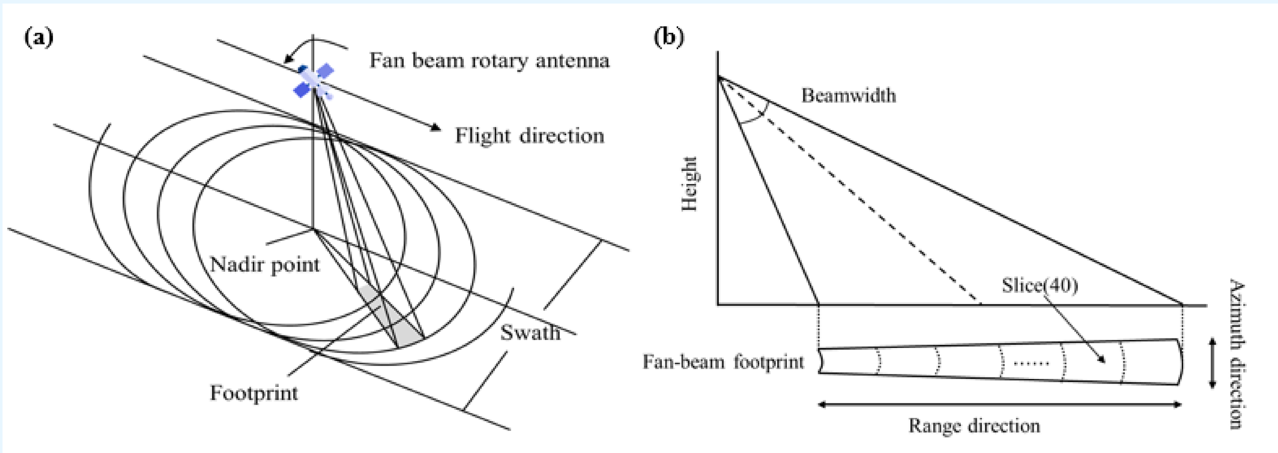

Figure 1. (a) Observation schematic of the CSCAT, (b) Schematic of fan-beam footprint.

Methods

The antenna configurations of microwave scatterometers with different scanning mechanisms are different, resulting in different observation geometries that directly affect the ground footprint morphology and effective beamwidth of observations and thus affect image reconstruction, it is necessary to construct a geometric model of the main lobe-to-ground projection relationship for CSCAT, a new scanning mechanism.

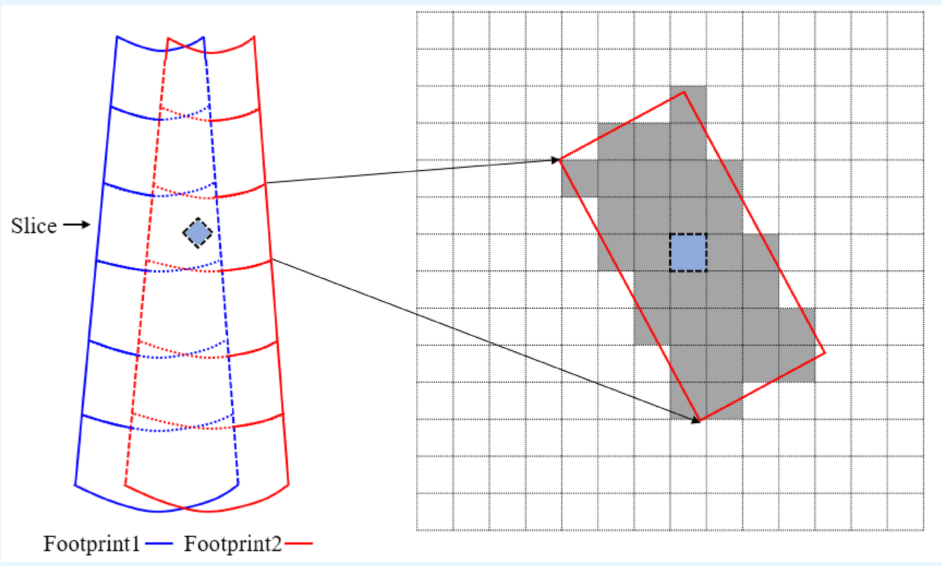

Figure 2. Pixelation of slice on the imaging grid.

The unification of the reconstructed coordinate system and the coordinate system established in the flight direction is performed based on the center position of each slice, and the distances in the elevation and azimuth directions are calculated from the known center position of the slice and the beamwidths to obtain the size and position of the antenna main lobe-to-ground footprint.

Results

Three enhancement algorithms(AART, MART and SIR) can reconstruct the features from CSCAT data, although there is considerable noise in the images reconstructed with the AART and MART algorithms. Additionally, the amount of high-frequency noise in the images reconstructed with the SIR algorithm is significantly reduced, which indicates that the SIR algorithm has better noise suppression ability and can effectively improve the spatial resolution of images.

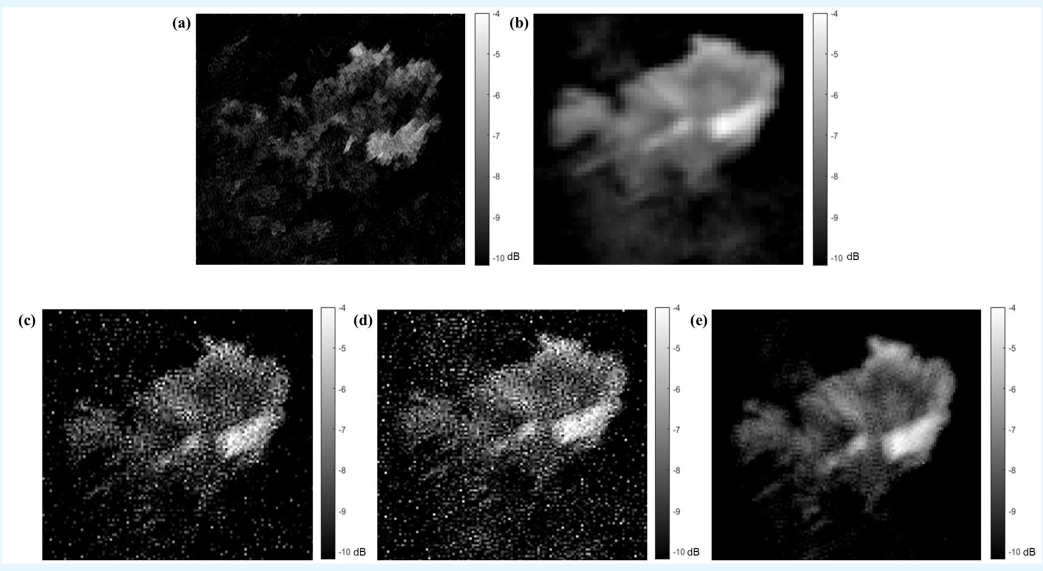

Figure 3. Image reconstruction of Iceland by different algorithms. (a) Original backscatter coefficient distribution, (b) fDIB GRD image at 10 km, (c) AART-reconstructed image at 5 km, (d) MART-reconstructed image at 5 km, and (e) SIR-reconstructed image at 5 km.

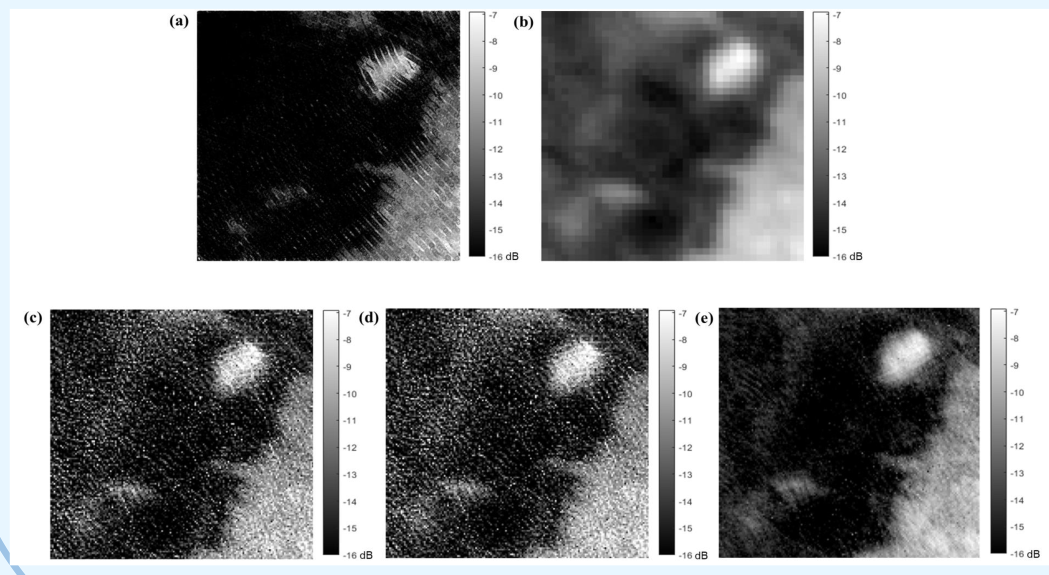

Figure 4. Image reconstruction of Hudson Bay. (a) Original backscatter coefficient, (b) fDIB GRD image at 10 km, (c) AART-reconstructed image at 5 km, (d) MART-reconstructed image at 5km, and (e) SIR-reconstructed image at 5 km.

Conclusion

We construct a geometric model of the main lobe-to-ground projection relationship based on the detection mechanism of CSCAT and characteristics of CSCAT data and apply it for high-resolution backscatter coefficient-based image reconstruction which improve the spatial resolution from traditional 25km to 5km. The reconstruction accuracy of the SIR algorithm is higher than that of the AART and MART algorithms. By using image reconstruction techniques combined with CSCAT with high-resolution sensors, studies of land, vegetation and sea ice monitoring can be extended to larger areas.

References

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