Remote Sensing of Costal Oceans by SAR: A Perspective Review

Kun-Shan Chen and Chih-Tien Wang
Center for Space and Remote Sensing Research
National Central University
Chung-Li, TAIWAN

Synthetic Aperture Radar (SAR) operating at microwave frequency has provided very rich information about the oceanic process and its interactions with bottom topography atmosphere, among others. Many interesting and yet important features have been explored and captured through the use of SAR by forms of frequency and polarization diversities, that are impossible to make with traditional optics system. Exhaustive review on full ocean phenomena wouldn't be possible. Instead, in this presentation, we focus on the costal ocean current and wind fields mapping by SAR, particularly where the fine spatial resolution is required. We first give a quick review on principles of SAR imaging of ocean, followed by characteristics of ocean surface scattering via mechanisms of wind-wave interactions. Among all, wave is the most discernible feature. By calculating the SAR image spectra and incorporating with ocean wave-SAR transformation, the wavelength and its direction can be determined. As for the current field, the velocity can be measured by means of along-track SAR interferometry. Fig. 1 is an example of two images, after and front, acquired near Liouciou in 2000 with airborne system. By interferometric process into an interferogram (phase-difference), the current velocity relative to the flight path can be inferred. Fig. 2 displays a current field map derived from the SAR interferometry. Comparison with the model prediction by TSNOW-NCOR, good agreement is obtained.

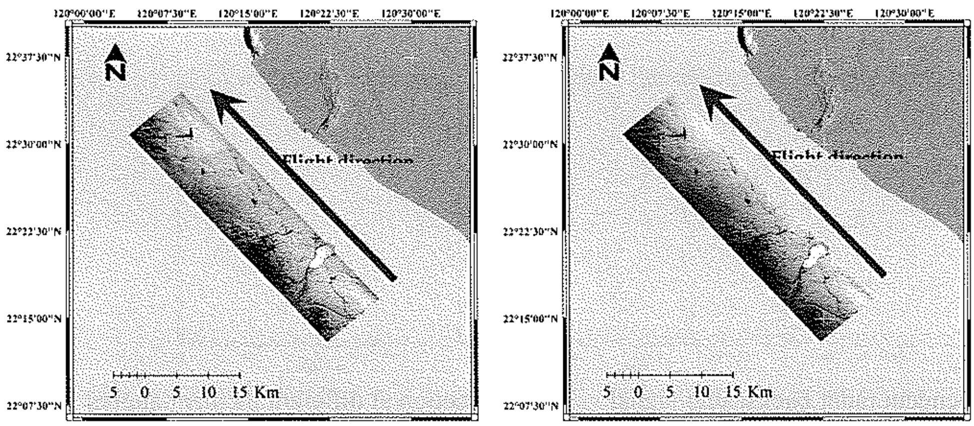

Fig. 1 SAR images of a current field near Liouciou: front (right) and aft (left)

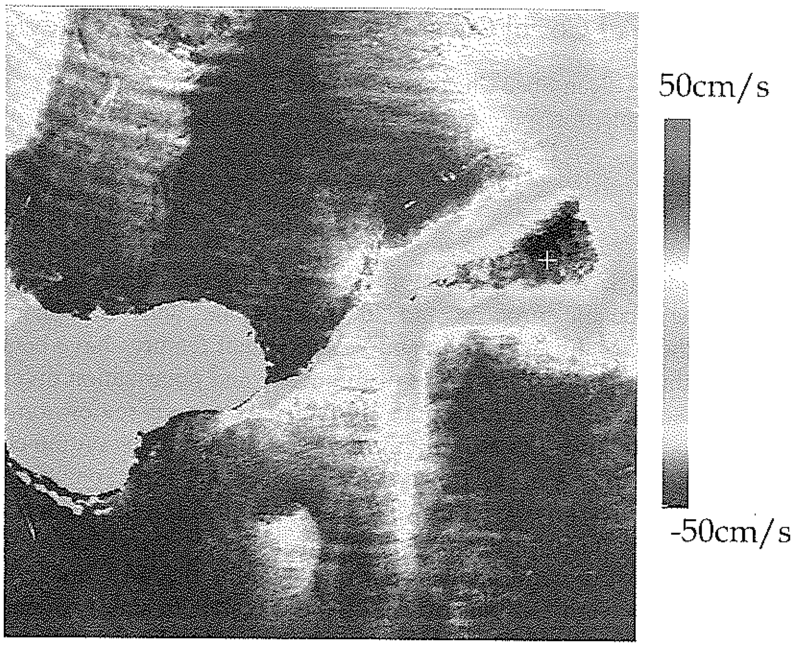

Fig. 2 Current velocity map by SAR interferometry

The minimum detectable velocity or velocity resolution is dependent on the radar wavelength, platform velocity, the baseline of two antenna and surface brightness.

The wind field estimated from the SAR image has also been studied considerably. With precisely radiometric calibrated SAR data sets, high spatial variations wind in the costal region has been made possible. At microwave frequencies at which SAR operates, the wind is mainly responsible for radar backscatter, as illustrated in Fig. 3. Fusion with scatterometer, wind direction can be better determined.

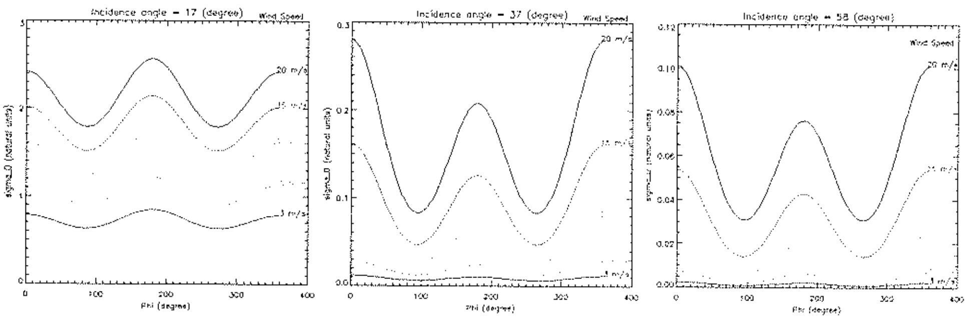

Fig. 3 Wind dependent radar backscatter signal vs. wind direction at different incident angles. Phi=0, 90, 180 degrees corresponding to upwind, cross-wind, and downwind directions, respectively.

Fig. 4 displays high spatial variations of costal wind near southern Taiwan. A gap-flow type of radar signature with tongue-shaped is clearly visible The oil-spill smoothed the surface causing low radar return is also visible in strip.

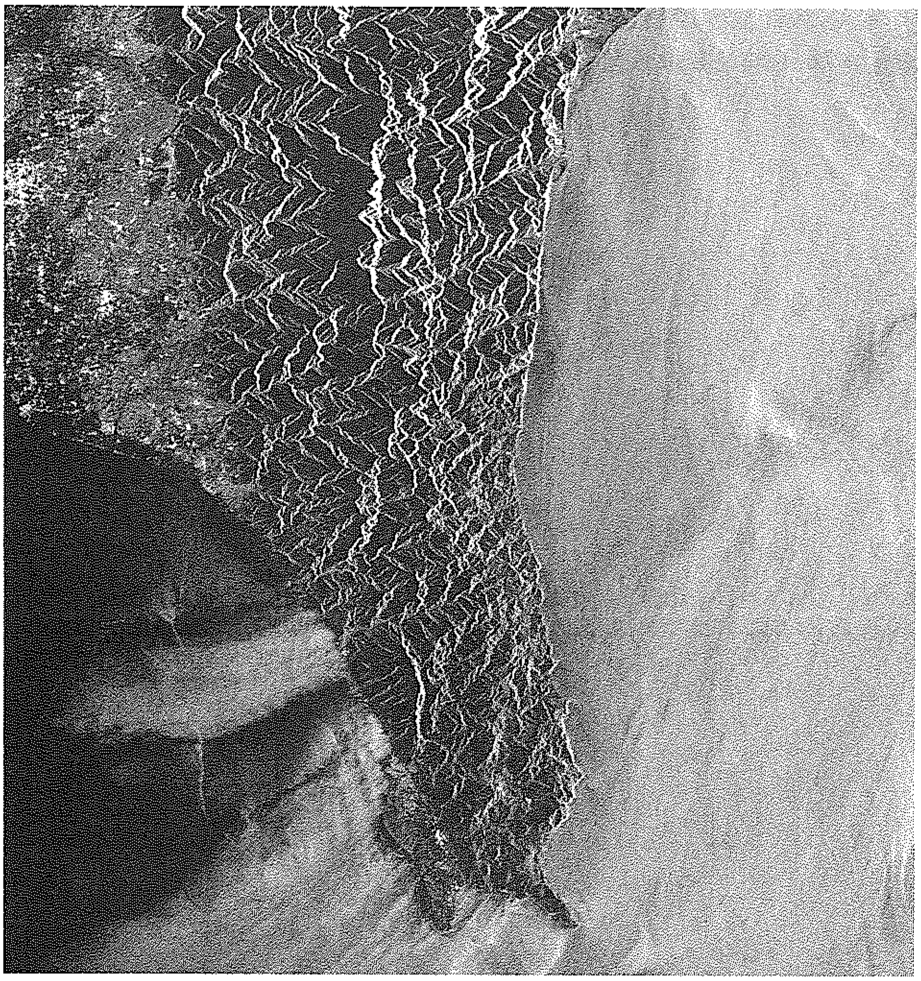

Fig. 4 SAR image acquired by ERS-1 (C-band VV-polarization) over southern Taiwan shows strong variations of wind. A gap-flow type of radar signature with tongue-shaped is clearly visible. Scattered oil-spill smoothed the surface causing low radar return is also standing out.

References:

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