Large-scale oceanic features detected by airbone and spaceborne SAR in the Mediterranean Sea

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Airborne SAR DATA

During the MAC-Europe Campaign in June/July 1991, the NASA JPL synthetic aperture radar (SAR) carrying a polarimetric 3-frequency SAR operating at 440 MHz (P-Band), 1.25 GHz (L-Band) and 5.30 GHz (C-Band) flew several missions over the Gulf of Genoa and the Strait of Messina.

On 22 June 1991, SAR images were taken over the Gulf of Genoa showing an anti-cyclonic eddy south of Genoa with a diameter of approximately 15 km. Model calculations carried out by V. CASULLI (University of Trento) and G. MANSELLA (ENEA, La Spezia) show that this eddy is generated by the modification of the steady cyclonic circulation caused by wind forcing and the interaction with the coastline and the bathymetry. This model result is also substantiated by AVHRR images.

On 28 June 1991, SAR images were taken over the Strait of Messina showing a strong non-linear internal wave train south of the Strait of Messina. This wave train was imaged several times. By correlating successive SAR images, the propagation speed of the internal waves was determined.

During the passes over the Strait of Messina the JPL SAR was operated in an interferometric SAR-mode by using two antennas. Surface current velocities as well as correlation times are derived from these interferometric data (R. CARANDE, JPL)

Spaceborne (ERS-1) SAR Data

ERS-1 SAR images were obtained on several occasions in the period from 7 January to 22 March 1992, over the Strait of Gibraltar during spring tides. These images show non-linear internal wave patterns propagating eastward as well as long wavelength patterns in the western part of the strait which are very likely caused by atmospheric effects.

On May 17, 1992, an ERS-1 SAR image was obtained over the Strait of Messina during a spring tide. This image shows internal waves north of the Strait of Messina.

The ERS-1 SAR images obtained over these two Straits are interpreted oceanographically.

Advances in the detection of oil pollution by remote sensing

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Mineral oil spills appear on the ocean surface radar images as dark patches. However, dark patches can also be caused by natural surface films floating on the sea surface. These natural surface films are produced by plankton or fish and are often encountered in coastal regions where the biological productivity is high.

Monomolecular surface films reduce the radar backscattering cross section by a similar amount as do mineral oil films. This implies that the exclusive application of a single-frequency radar for monitoring oil pollution would often lead to false alarms.

However, there seems to exist a possibility to discriminate between mineral oil films and monomolecular sea slicks by using multi-frequency radars. This technique exploits the fact that the damping of ocean surface waves exhibits a resonance-type behaviour in the short gravity wave region which can be described by Marangoni wave damping theory (see e.g., CINI and LOMBARDINI, 1978).

Results of multifrequency radar backscattering measurements carried out over several artificial monomolecular sea slicks of different physico-chemical properties and over mineral oil spills in the North Sea are presented. They show that the functional dependence of the reduction in backscattered power on radar wavelength and incidence angle is quite different for monomolecular sea slicks and mineral oil films.

It is proposed to exploit this difference in developing a multifrequency radar technique by which it is possible to discriminate between mineral oil films and natural surface films.

REFERENCES

CINI R. and LOMBARDINI P.P., 1978. - Damping effect of monolayers on surface wave motion in a liquid, *J. Colloid Interface Sci.*, 65, 387-389.