STUDY OF ATMOSPHERIC FRONTAL LINES OVER SEA AREAS BORDERED BY COASTAL MOUNTAIN RANGES USING MULTI-SENSOR SATELLITE DATA AND NUMERICAL MODELS

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Surface signatures of meso-scale atmospheric frontal lines are often observed on synthetic aperture radar (SAR) images acquired over sea areas which are bordered by coastal mountains. These frontal lines have been observed previously on SAR images of the European Remote sensing satellites ERS-1 and ERS-2 acquired along the east coast of Taiwan, but now also on SAR images of the Advanced SAR (ASAR) of the Envisat satellite acquired over other coastal areas, like the east coasts of Vietnam, Korea, South Africa and Mexico.
In the first part of the paper ERS SAR and Envisat ASAR images acquired over the east coast of Taiwan are analyzed. In order to verify that these frontal features are indeed sea surface manifestations of quasi-stationary fronts they are compared with images of the cloud distribution obtained from the Japanese Geostationary Meteorological Satellite GMS-4 and the Terra satellites, and with radar reflectivity maps (converted to rain rate maps) obtained by ground-based weather radars. In addition, weather maps, radiosonde data
from Taiwanese weather stations, and sea surface wind data from the scatterometer onboard the Quikscat satellite are used for interpreting the SAR images.
Furthermore, simulation results are presented which have been carried out with the meso-scale atmospheric model MM5 which show that the atmospheric fronts are generated when a weak to moderate easterly synoptic-scale wind blows against the high mountain range at the east coast of Taiwan which blocks the onshore airflow. The interface between the airflows associated with the easterly synoptic-scale wind and the wind reflected /deflected by the mountain range becomes visible on SAR images as a frontal line separating areas differing image brightness which results from differing sea surface roughness or sea surface wind velocity at both sides of the front. In the frontal area the air is forced to move upward, which often gives rise to the formation of coast-parallel cloud bands and rain bands. These atmospheric fronts stretch along the east coast of Taiwan and have offshore distances typically between 40 and 70 km. In one case this front persisted over two days as revealed by weather radar images.
In the second part of the paper we present ASAR images showing sea surface signatures of meso-scale fronts off the east coast of Vietnam and the east coast of Mexico. In the case of Vietnam, atmospheric frontal lines are observed when a weak to moderate wind blows against the coastal mountain range. But here the frontal lines are less uniform since the height of the coastal mountain range and their distance from the coastline varies much more than in the case of the east coast of Taiwan. .In particular, gaps in the mountain range find their correspondence in dents in the frontal lines.

In the case of the east coast of Mexico, most of the coastal frontal lines visible on Envisat ASAR images of the sea surface can be attributed to barrier jet and land breeze fronts as evidenced by simulations carried out with the meso-scale atmospheric model WRF.