

Winter Monsoon over the Northwestern Pacific Ocean: Study of Cloud Structure with AQUA AMSR-E

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This study investigates the spatial structure and the temporal dependencies of the fields of the total cloud liquid water content Q over the Northwestern Pacific Ocean during winter monsoon. The distributions of Q have been estimated from the brightness temperatures of the ocean - atmosphere system $TB(f)$, where f is frequency, measured by AQUA AMSR-E in December 2002 – March 2003. Marine strati (St) and stratocumuli (Sc) are typical for winter monsoon season. They were analyzed using mainly high-frequency channels at $f = 23.8, 36.5$ and 89.0 GHz. Data on near surface wind speed, air temperature and humidity downloaded from Internet were used to decrease the retrieval error. Besides, near surface wind speed was estimated from TB at 6.9 and 10.7 GHz. A method of the spatial spectrum modeling has been suggested to analyze spatial structure of extended cloud layers. The method is based on the analysis of two one-dimensional model spectra which are computed for downwind and crosswind sections of Q fields. The spatial scales were restricted by the AMSR-E antenna field of view at 89.0 GHz (about 5 km) and the cloud field sizes (500 - 1000 km). Two main types of spectra were revealed: scale-invariant spectrum and spectrum which may be regarded as a superposition of a scale-invariant component and another one corresponding to the periodical structure of the cloud field. Several case studies are discussed in the paper. Experimental data were obtained over the Japan and Okhotsk Seas and over the northwestern Pacific Ocean when extended cloudiness of strati forms was observed. Cloud streets were clearly identified in satellite visible and infrared images as well as in TB fields at $f = 36.5$ and 89.0 GHz. Q -field over the Japan Sea (measurements for 31 January 2003) was characterized by the spectral slope of about -1.9 both in downwind and crosswind directions. One-dimensional downwind spectrum was strictly scale-invariant as opposite to crosswind spectrum where several peaks (put on strait line in log-scale) were detected. Very likely they corresponded to the periods in Q field structure.