Inversion and correction of wind speed at high sea state based on nadir data of SWIM on CFOSAT

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Résumé

SWIM (Surface Waves Investigation and Monitoring) is a new Centre National d'Etudes Spatiales(CNES) ku-band (13.575 GHz) real aperture radar instrument, based on the technology of a spaceborne radar altimeter carried by CFOSAT (China France Oceanography Satellite), which was launched on October 29th, 2018. it can be used to invert SWH,, windspeed and other related parameters. SWIM is the first ever space radar concept that is mainly dedicated to the measurement of ocean waves directional spectra and surface wind velocities through multi-azimuth and multi-incidence observations. Orbiting on a 519 km sun-synchronous orbit, its multiple beams include six incidence angles:0○, 2○, 4○, 6○, 8○ and 10○ with an antenna aperture of approximately 2○. Scanning the whole azimuth angles (0-360○), it provides with a 180 km wide swath and a global coverage of the planet between the latitudes of ±80○. Extreme atmospheric and sea conditions (or high sea conditions), such as typhoons, hurricanes, and rain, cause sea waves to break, thereby forming a large amount of whitecaps and foams (collectively, white foam) on the sea surface. Under normal sea conditions, the radar altimeter will receive more regular sea surface echo waveforms. According to the ocean model (Brown model), it can accurately reverse the sea surface parameters, which can meet the needs of engineering practice. However, under high sea conditions, due to the attenuation and scattering of microwave signals by foam and rain, the microwave signals received by the altimeter are very weak or even out of lock, which greatly affects the inversion and accuracy of altimeter sea surface parameters. The paper mainly studies the influence of foam and rainfall on SWIM ocean parameter inversion under high sea conditions. First of all, this paper studies the effect of foam on the parameter inversion 1: (1) Create a three-layer medium model based on atmosphere-foam-seawater, and use the electromagnetic wave incident reflection theory to analyze the incident reflection characteristics of the model to obtain the coverage of foam The sea surface reflectance changes, and then through quantitative analysis to get the effect of foam on the sea surface backscattering coefficient and error correction value. (2) According to the empirical formula of foam coverage and sea surface wind speed, the relationship between wind speed and backscatter coefficient, and effective wave height, this paper discusses the influence of foam on sea surface wind speed inversion. (3) A new iterative algorithm is proposed to correct the backscatter coefficient and wind speed measured in the presence of foam. Through loop iteration, the effect of foam on the backscatter coefficient of the nadir point of the spectrometer is eliminated. The comparative analysis forms the system fixed mode and method, which improves the accuracy of measuring wind speed.

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