Combined CFOSAT SWIM and SCAT measurements: a tropical cyclone case study

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Résumé

A fully consistent 2D parametric model of wave development under spatially and/or time-varying winds is exploited to jointly analyze CFOSAT SWIM, SCAT, and altimeter data. Derived coupled equations are written in their characteristic form to provide practical means to rapidly assess how the energy, frequency, and direction of dominant surface waves are developing and distributed under varying wind forcing conditions. Considering the case of the powerful tropical cyclone (TC) Goni, explosively intensifying over the Philippine Sea on Oct. 29th, 2020, CFOSAT measurements are jointly analyzed with Sentinel-1 and Radarsat-2 SAR acquisitions. Here, the fully consistent 2D parametric wave development model is solved in the storm frame of reference using wind field inputs from CFOSAT SCAT and SAR estimates. Wave-rays then help visualize how wave trains develop and travel through the TC varying wind field, and how they leave the storm area as swell systems. Results are compared to CFOSAT SWIM measurements, including altimeter ones. Comparisons confirm that depending on the main TC characteristics, - maximal wind speed (um), radius (Rm), and translation velocity (V)-, wave fields will likely exhibit a strong azimuthal asymmetry, resulting from group velocity resonance between traveling waves and moving TC. For TC Goni, this effect is well captured, leading to extreme waves, further outrunning as swell forerunners in the TC heading direction. Over extreme storm events, combined CFOSAT SWIM and SCAT data open new perspectives to refine the practical 2D parametric model of wave development for practical and scientific purposes.

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