Scaling Analysis of the China France Oceanography Satellite Along Track Wave and Wind Data

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Turbulence or turbulence-like phenomena are ubiquitous in nature, often showing a power-law behavior of the Fourier power spectrum in either spatial or temporal domains. This power-law behavior is due to interactions among different scales of motion, and to the absence of characteristic scale among several scale ranges. It can be further interpreted in the framework of turbulent cascade with movements on continuous range of scales. The power-law feature and the associate cascade picture are vitally important to our understanding of the ocean and atmosphere dynamics. In this work, we consider the China France Oceanography SATellite (CFOSAT) data in the general framework of ocean and atmosphere multi-scale dynamics. We apply both Fourier power spectrum analysis and second-order structure-function analysis, used in the fields of turbulence, to extract multiscale information from the wind speed (WS) and significant wave-height (Hs) data provided by CFOSAT project. The data analyzed here are along track data spatially collected from 29\textsuperscript{th} July to 31\textsuperscript{st} December 2019. The measured Fourier power spectrums for both WS and Hs illustrate a dual power-law behavior respectively from 5 to 25 km, and 30 to 500 km with measured scaling exponents $\beta$ close to 2 and 5/3. The measured second-order structure-functions confirm the existence of the dual power-law behavior. The corresponding measured scaling exponents $\zeta(2)$ close to 1 and 2/3 for the spatial scales mentioned above. Our preliminary results confirm the relevance of using multiscale statistical tools and turbulent theory to characterize the large-scale movements of both ocean and atmosphere.