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Small scale currents and ocean wave heights: from today's models to future satellite observations with CFOSAT and SKIM

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Tidal currents and large oceanic currents, such as the Agulhas, Gulf Stream and Kuroshio, are known to modify ocean wave properties, causing extreme sea states that are a hazard to navigation. Recent advances in the understanding and modeling capability of ocean currents at scales of 10 km or less have revealed the ubiquitous presence of fronts and filaments. Based on realistic numerical models, we show that these structures can be the main source of variability in significant wave heights at scales less than 200 km, including important variations at 10 km. This current-induced variability creates gradients in wave heights that were previously overlooked and are relevant for extreme wave heights and remote sensing. The spectrum of significant wave heights is found to be of the order of $70\left\langle H_s\right\rangle^2/(g^2\left\langle T_{m0,-1}\right\rangle^2)$ times the current spectrum, where $\left\langle H_s\right\rangle$ is the spatially-averaged significant wave height, $\left\langle T_{m0,-1}\right\rangle$ is the average energy period, and g is the gravity acceleration.

This small scale variability is consistent with Jason-3 and SARAL along-track variability. We will discuss how future satellite mission with wave spectrometers can help observe these wave-current interactions. CFOSAT is due for launch in 2018, and SKIM is a proposal for ESA Earth Explorer 9.