Modulation of wave forces on kelp canopies by alongshore currents

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ABSTRACT: The predominant view of the canopy-forming kelp's mechanical response to water motion is that they sway passively under waves such that they are only rarely stretched out in flow, which reduces relative fluid velocities and decreases the applied force. Such a view is an appropriate first-order approximation but becomes conceptually problematic in the face of the net surface velocities (Stokes drift) that arise under waves of all but infinitesimal height, since such flows can tug organisms into fully extended positions, allowing forces to act unabated. Focusing on *Nereocystis luetkeana*, the bull kelp, this study examines quantitatively the capacity of alongshore currents to mitigate the consequences of Stokes drift by maintaining canopy-forming macroalgae in "neutral" positions with regard to the onshore-offshore orbits of the waves. Results indicate that alongshore currents can indeed substantially reduce the forces imposed on canopy-forming kelps, as well as decrease the levels of wave damping that result from the interaction of these organisms with the passing fluid.