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Stability theory for the synchronized waving of marine grass RAVI SINGH, Brown University, AMALA MAHADEVAN, Woods Hole Oceanographic Institution, SHREYAS MANDRE, Brown University, L.M. MAHADEVAN, Harvard — Synchronized waving of grass blades in the presence of fluid flow has been observed in cases such as wheat field in wind, marine grass in tidal currents. The synchronous motion can have important environmental and ecological impact via mixing of fluid due to waving. When the hydrodynamic and elastic time scales are well separated, this waving is thought to be due to Kelvin-Helmholtz instability resulting from an inflection point in the flow profile. We find that the inflection point is located near the tip of grass canopy. We extend the Orr-Sommerfeld equation for the stability of a shear flow to include a continuum mean-field approximation for the vegetation, thus capturing the essential ingredients for flow instability leading to coherent waving. Our linear stability analysis shows that the flow in presence of grass become unstable not only through a mechanism of Kelvin-Helmholtz instability but also through shear instability of flow above grass. We also find that flow with low submergence ratio of grass becomes unstable due to Kelvin-Helmholtz instability whereas flow high submergence ratio becomes unstable due to shear instability of flow above the grass. Numerical results demonstrating these instability mechanism will also be presented.

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