Abstract Submitted
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The effects of an algal biofilm on the turbulent boundary layer at high Reynolds number[1] ELIZABETH MURPHY, University of Virginia, JULIO BARROS, MICHAEL SCHULTZ, KAREN FLACK, CECILY STEPPE, United States Naval Academy, MATTHEW REIDENBACH, University of Virginia — Algal biofilms are an important fouling community on ship hulls, with severe economic consequences due to increased drag. As with other types of roughness on aquatic surfaces, biofilms increase skin friction and thus induce severe drag penalties. In fact, slime layers appear to induce greater drag than would be predicted by the roughness height alone. Our work indicates that this is likely due to two characteristics of algal biofilms: i) flexible streamers that protrude into the flow, and ii) the compliant nature of a biofilm layer. High resolution PIV was used to measure the turbulent boundary layer flow over diatomaceous biofilm grown under dynamic conditions. Local mean streamwise velocity profiles were used to estimate the local wall shear stresses and to determine the similarity between the inner and outer layers of the boundary layer and those of a smooth wall. Spatially explicit turbulent kinetic energy (TKE), Reynolds shear stress (RSS), swirling strength and quadrant analyses over the biofilm were compared to those over a smooth wall and a rigid mesh roughness. We found that the combination of canopy flow due to streamers coupled with compliant wall-flow interactions result in large wall shear stresses and higher turbulence.

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