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The effect of thin liquid films on boundary-layer separation RADU CIMPEANU, DEMETRIOS PAPAGEORGIOU, MARINA KRAVTSOVA, ANATOLY RUBAN, Imperial College London — In this study we develop the theory for understanding the process of boundary-layer separation in the presence of a thin liquid film. The investigation is physically motivated by the accumulation of water on aircraft surfaces as a result of flying during adverse weather conditions, with implications in aircraft safety, certification and performance. We present an extension of the asymptotic framework of viscous-inviscid interaction and formulate a modified triple-deck model accounting for the strong density and viscosity contrast between the fluids in the system. The primary goal of the study is to address the question of whether the thin liquid layer acts to suppress or promote boundary-layer separation. We find that an increase in liquid film height (within its asymptotic scaling) contributes to a delay in the onset of separation. Furthermore, the main flow features, represented by local extrema in the perturbed flow quantities, are shifted further downstream within the interaction region. The consequences of the presence of the liquid film are illustrated through two typical examples encountered in flows past aircraft wings, namely surface roughness elements and corners/flap junctions.

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