



On the role of surface friction in tropical cyclone intensification

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Recent studies have debated on whether surface friction is positive or negative to tropical cyclone intensification in the view on angular momentum budget. That means whether the frictionally induced inward angular momentum transport can overcome the loss of angular momentum to the surface due to surface friction itself. Although this issue is still under debate, this study investigates another implicit dynamical effect, which modifies the radial location and strength of eyewall convection. We found that moderate surface friction is necessary for rapid intensity of tropical cyclones. This is demonstrated first by a simple coupled dynamical system that couples a multi-level boundary layer model and a shallow water equation model above with mass source parameterized by mass flux from the boundary layer model below, and then by a full physics model. The results show that surface friction leads to the inward penetration of inflow under the eyewall, shift the boundary layer mass convergence slightly inside the radius of maximum wind, and enhance the upward mass flux, and thus diabatic heating in the eyewall and intensification rate of a TC. This intensification process is different from the direct angular momentum budget previously used to explain the role of surface friction in tropical cyclone intensification.