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Large-eddy simulation of the early evening boundary layer transition

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The early evening transition from daytime mixed boundary layer flow to nocturnal shallow boundary layer flow is a complex mechanism that is not well understood. In the past, field observations were primarily used to assess the role of this transition period in the initiation of inertial oscillations, nocturnal accelerations and the formation of low-level jets. In this study, we utilize a new-generation tuning-free large-eddy simulation subgrid-scale model, named as the "locally-averaged scale-dependent dynamic" model, to further investigate some of these critical issues. In parallel, we also explore a few unresolved questions, such as the scaling behavior of the turbulent kinetic energy decay and the validity of Nieuwstadt's Local Scaling hypothesis in these highly nonstationary boundary layers. Results from this study are expected to improve our ability to parameterize the land-atmosphere exchange processes in non-equilibrium transitional boundary layers and consequently increase the accuracy of large-scale weather and climate models.