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Large-eddy simulations of mean and turbulence dynamics in unsteady Ekman boundary layers[1] MOSTAFA MOMEN, ELIE BOU-ZEID, Princeton University — Unsteady geostrophic forcing in the atmosphere or ocean not only influences the mean wind, but also affects the turbulent statistics. In order to see when turbulence is in quasi-equilibrium with the mean, one needs to understand how the turbulence decays or develops, and how do the turbulent production, transport and dissipation respond to changes in the imposed forcing. This helps us understand the underlying dynamics of the unsteady boundary layers and develop better turbulence closures for weather/climate models and engineering applications. The present study focuses on the unsteady Ekman boundary layer where pressure gradient, Coriolis, and friction forces interact but are not necessarily in equilibrium. Several cases are simulated using LES to examine how the turbulence and resolved TKE budget terms are modulated by the variability of the mean pressure gradient. We also examine the influence of the forcing variability time-scale on the turbulence equilibrium and TKE budget. It is shown that when the forcing time-scale is in the order of the turbulence characteristic time-scale, the turbulence is no longer in quasi-equilibrium due to highly nonlinear mean-turbulence interactions and hence the conventional log-law and turbulence closures are no longer valid.

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