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Kinematic Shear Stress Budget and Relaxation Time-Scales in a Spatially Heterogeneous Canopy Turbulence: an Application to Finite Sized Wind Farms TIRTHA BANERJEE, University of California, Irvine, TANMOY CHATTERJEE, Argonne National Laboratory — In this talk, we investigate the kinematic shear stress budget of a highly heterogeneous finite-sized (3 X 3) wind farm, driven by neutrally-stratified atmospheric boundary layer. The study is performed with a spectral element LES code with a near-wall modeling framework and an actuator line model to represent the effect of rotating wind turbine blades. We observe, that the main imbalance of the horizontally averaged kinematic shear stress budget occurs at and around the wind turbine wake-regions, which imposes strong heterogeneity to the flow system. The goal of the present study is to develop a model of this imbalance term. This is primarily theorized and investigated by modeling the relaxation time-scales of Rotta-model for the pressure velocity correlations in the kinematic shear stress budget. This study will not only help us towards better physics-based insight for the failure of K-Theory in heterogeneous atmospheric flows in wind farms, the generalization of Rotta-models in Reynolds-stress modeling based turbulence closures of heterogeneous flows in numerical algorithms but also serve as a stepping stone toward the overarching goal- to comprehend the role of heterogeneity and wake influence in the parametrization of effects in wind farms.

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