Abstract Submitted
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Large Eddy Simulation study of scalar transport in fully developed wind-turbine array boundary layers[1] MARC CALAF, MARC B. PARLANGE, School of Architecture, Civil and Environmental Engineering, EPFL, Switzerland, CHARLES MENEVEAU, Mechanical Engineering & CEAFM, Johns Hopkins University — Large wind farms are attaining scales at which two-way interactions with the atmospheric boundary layer must be taken into account. A recent study by Baidya et al. (PNAS 2010) has shown that wind farms increase scalar fluxes at the surface. Numerical simulations from Calaf et al. (Pof 2010) together with laboratory experiments from Cal et al. (JSRE 2010) showed that the friction velocity underneath the wind turbines is decreased. Conversely, above the turbine, friction velocity is increased. To shed light onto the relevant phenomena, a suite of Large Eddy Simulations of an infinite (fully developed) wind turbine array boundary layer, including passive scalar transport, is performed. Results clearly show an overall increase of scalar fluxes in the presence of wind turbines, of about 10-15%. And this increase is not highly dependent on wind turbine loading or spacing. This resultant increase in the scalar fluxes can be explained through a balance between two competing effects. Further, following the approach of Calaf et al. (PoF 2010), a single-column model has been developed which confirms the observed trends.

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