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Wind farms and scalar fluxes over a farmland, a Large Eddy Simulation study MARC CALAF, École Polytechnique Fédérale de Lausanne (EPFL), CHAD HIGGINS, Oregon State University, MARC PARLANGE, École Polytechnique Fédérale de Lausanne (EPFL) — Recent numerical studies have shown that when the horizontal dimension of the wind farms exceeds the height of the atmospheric boundary layer by a factor of ten or more, a fully developed Wind Farm Array Boundary Layer (WFABL) develops, and scalar fluxes beneath the wind turbines are increased by about 10%. Additionally, in situ measurements have shown a variation in scalar concentrations close to the surface below large wind farms. Therefore, it seems clear that large wind farms do actively interact with and change the local boundary layer, and the consequence (on scalar flux and concentrations) of this interaction might be non-negligible. Are increases in irrigation required to offset an increase in evapo-transpiration? A geo-spatial analysis of the placement of wind farms relative to irrigated lands revealed that 26% of all wind farms in the US are located above some irrigated agriculture, but this overlap only represents 1% of the total wind farm footprint, thus irrigated lands below wind turbines are highly fragmented and variable. Therefore, a new set of Large Eddy Simulations (LES) with variable surface boundary conditions designed to replicate the simplified agricultural landscape below a typical large wind farm were performed. Wind turbines were modeled using the standard actuator disk approach. Results showing the breakup of the internal farmland boundary layer due to the presence of a large wind turbine array will be presented. The role that spatial variability plays in the scalar transport below and above the wind turbines is explored.

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