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The improved analytical wake model named as 2D_k Jensen model (which was proposed to overcome some shortcomings in the classical Jensen wake model) is applied and validated in this work for wind turbine multi-wake predictions. Different from the original Jensen model, this newly developed 2D_k Jensen model uses a cosine shape instead of the top-hat shape for the velocity deficit in the wake, and the wake decay rate as a variable that is related to the ambient turbulence as well as the rotor generated turbulence. Coupled with four different multi-wake combination models, the 2D_k Jensen model is assessed through (1) simulating two wakes interaction under full wake and partial wake conditions and (2) predicting the power production in the Horns Rev wind farm for different wake sectors around two different wind directions. Through comparisons with field measurements, results from Large Eddy Simulations (LES) as well as results from other commercial codes, it is found that the predictions obtained with the 2D_k Jensen model exhibit good to excellent agreements with experimental and LES data.

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