Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Modeling velocity space-time correlations in wind farms[1] LAURA J. LUKASSEN, Max Planck Institute for Dynamics and Self-Organization, RICHARD J.A.M. STEVENS, University of Twente, CHARLES MENEVEAU, Johns Hopkins University, MICHAEL WILCZEK, Max Planck Institute for Dynamics and Self-Organization — Turbulent fluctuations of wind velocities cause power-output fluctuations in wind farms. The statistics of velocity fluctuations can be described by velocity space-time correlations in the atmospheric boundary layer. In this context, it is important to derive simple physics-based models. The so-called Tennekes-Kraichnan random sweeping hypothesis states that small-scale velocity fluctuations are passively advected by large-scale velocity perturbations in a random fashion. In the present work, this hypothesis is used with an additional mean wind velocity to derive a model for the spatial and temporal decorrelation of velocities in wind farms. It turns out that in the framework of this model, space-time correlations are a convolution of the spatial correlation function with a temporal decorrelation kernel. In this presentation, first results on the comparison to large eddy simulations will be presented and the potential of the approach to characterize power output fluctuations of wind farms will be discussed.

[1]Acknowledgements: 'Fellowships for Young Energy Scientists' (YES!) of FOM, the US National Science Foundation grant IIA 1243482, and support by the Max Planck Society.

Laura J. Lukassen
Max Planck Institute for Dynamics and Self-Organization

Date submitted: 22 Jul 2016 Electronic form version 1.4