

Impact of dynamic wind conditions on wind farms

Description

Wind energy has its inherent variability due to the wind fluctuations across a wide range of scales (Figure 1). Our recent studies show that the dynamic changes of wind direction [2] and wind speed [3] have a significant impact on the power output of wind farms. In reality, the wind speed and direction change concurrently, and their combined effects on wind farm power output need further investigation. The overarching goal of this project is to employ high-fidelity Large Eddy Simulations (LES) to investigate the impact of realistic dynamic wind conditions on wind farms.

Our group focuses on investigating various phenomena of atmospheric turbulence and their impact on wind farms. We primarily employ numerical method (i. e. in-house LES code) to study wind farm flow in well-controlled conditions. Simulations are performed on distributed supercomputers throughout Europe.

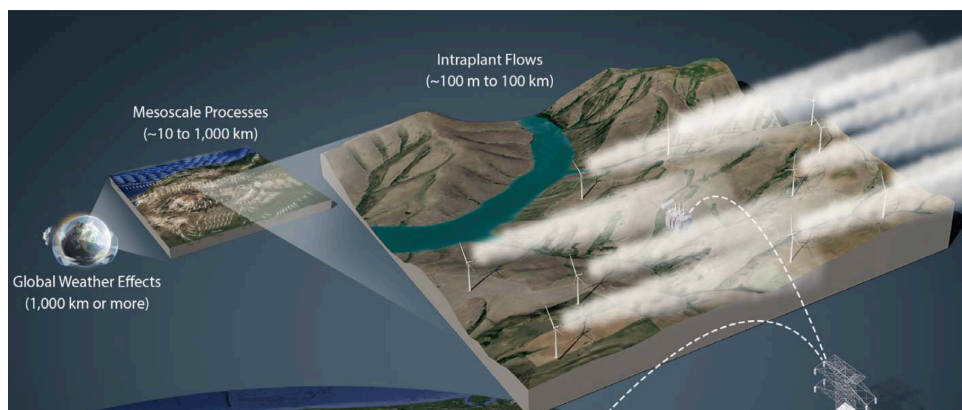


Figure 1: Atmospheric phenomena across different scales connected to wind farms. [1]

Assignment

This project is considered in conducting the following steps:

- Implementation of existing methods of dynamic wind speed and direction changes in the LES code;
- Validation of methods through idealized test cases;
- Investigation of dynamic effect on wind farm power output using realistic wind signals.

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References

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- [2] Stieren, A., Gadde, S. N. & Stevens, R. J. A. M., 2021. Modeling dynamic wind direction changes in large eddy simulations of wind farms. *Renewable Energy* **170**, 13421352.
- [3] Liu, Y., Stieren, A. & Stevens, R. J. A. M. Modeling large-scale wind speed variations in large eddy simulations of wind farms. *In preparation*.