

The potential of synthetic turbulence in large eddy simulations during stable conditions over ocean wind farms

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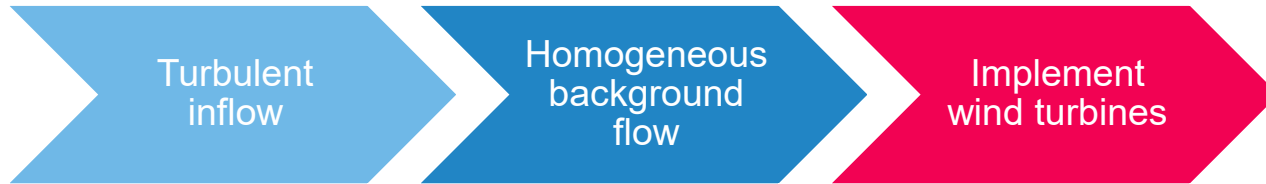
Joachim Reuder, Mostafa Bakhoday Paskyabi, Maria Krutova

Objectives

1. Investigate the influence of LLJ on a turbine wake

2. Test PALM with synthetic turbulence in stable conditions

Method

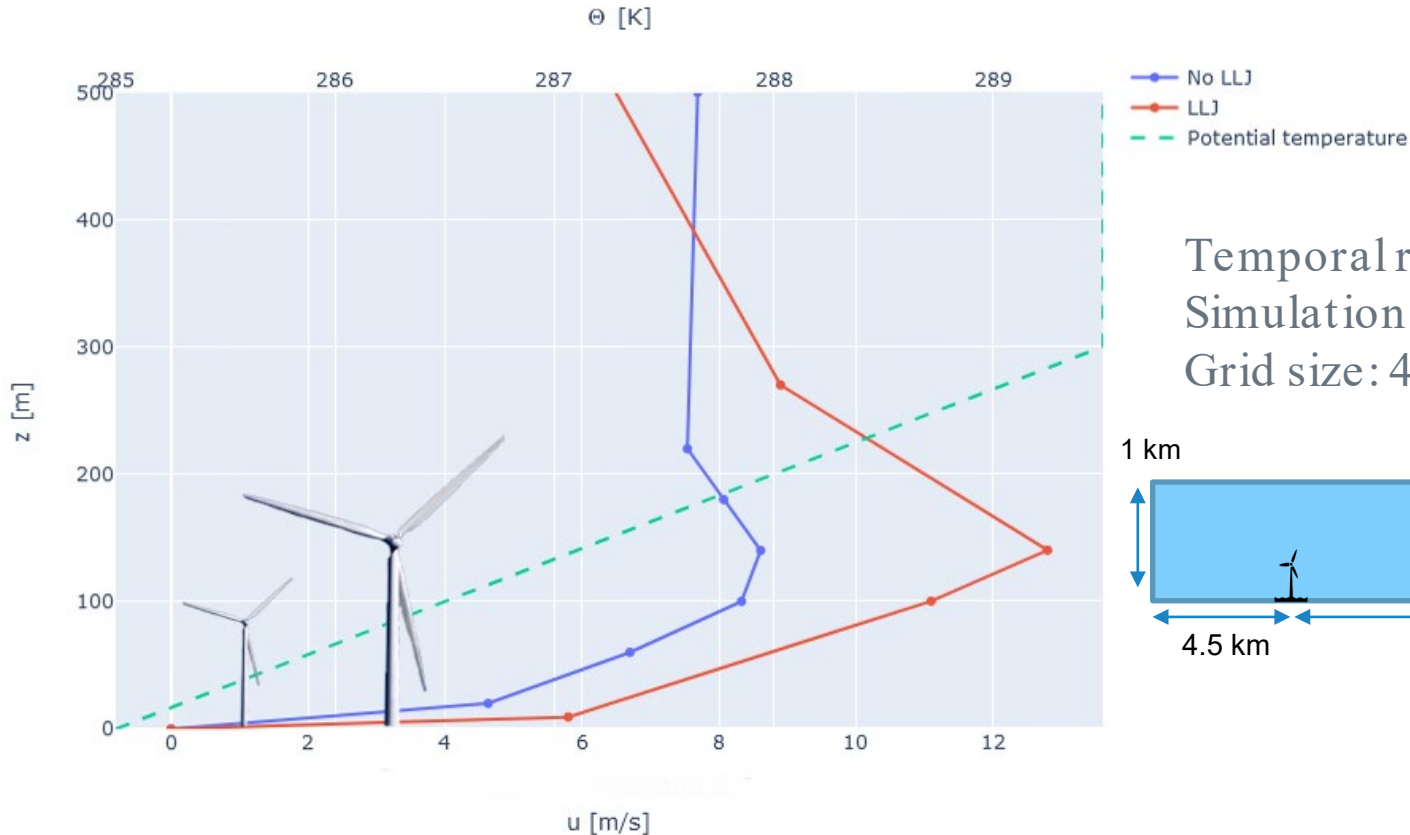


$$u_i = \bar{u}_i + a_{ij} u_{*j} \quad \left| \begin{array}{l} \text{Turbulence} \end{array} \right.$$

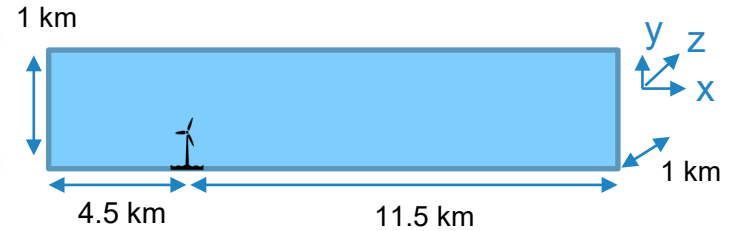
Prescribe: reynolds tensor, length and timescales

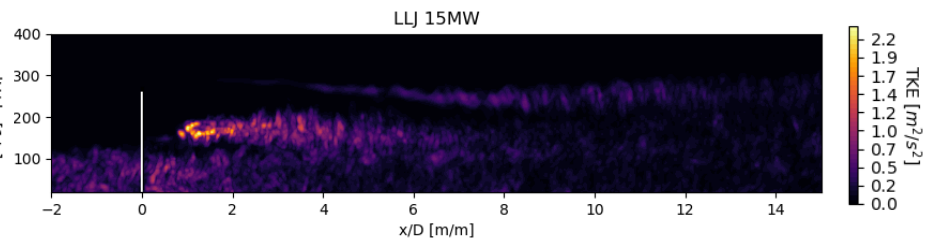
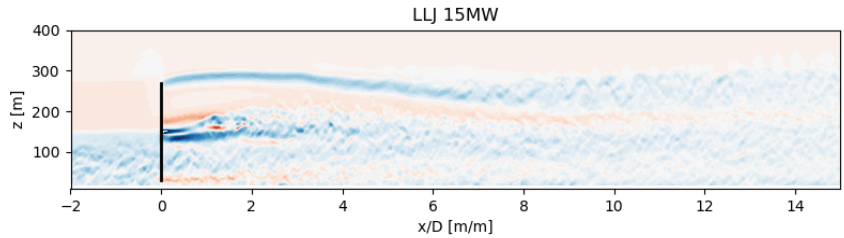
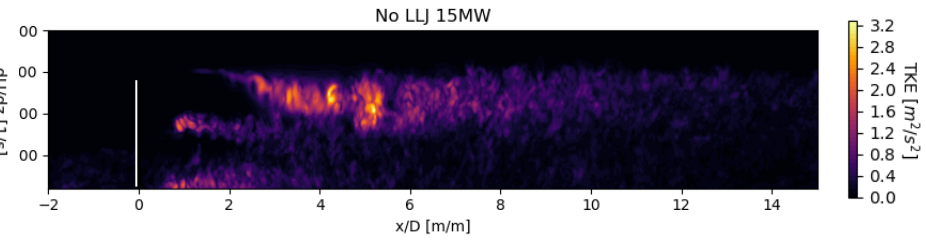
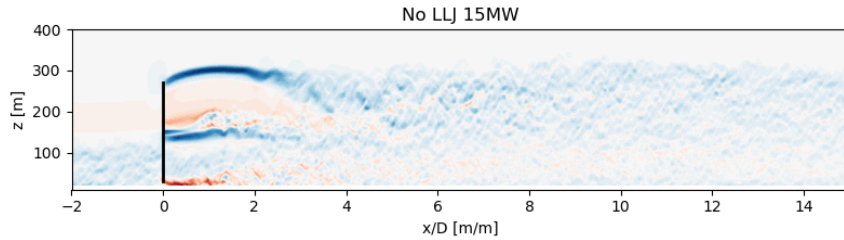
Balance surface friction,
temperature profile, wind profile
and pressure force

Compare no LLJ to a LLJ at the top of the turbine



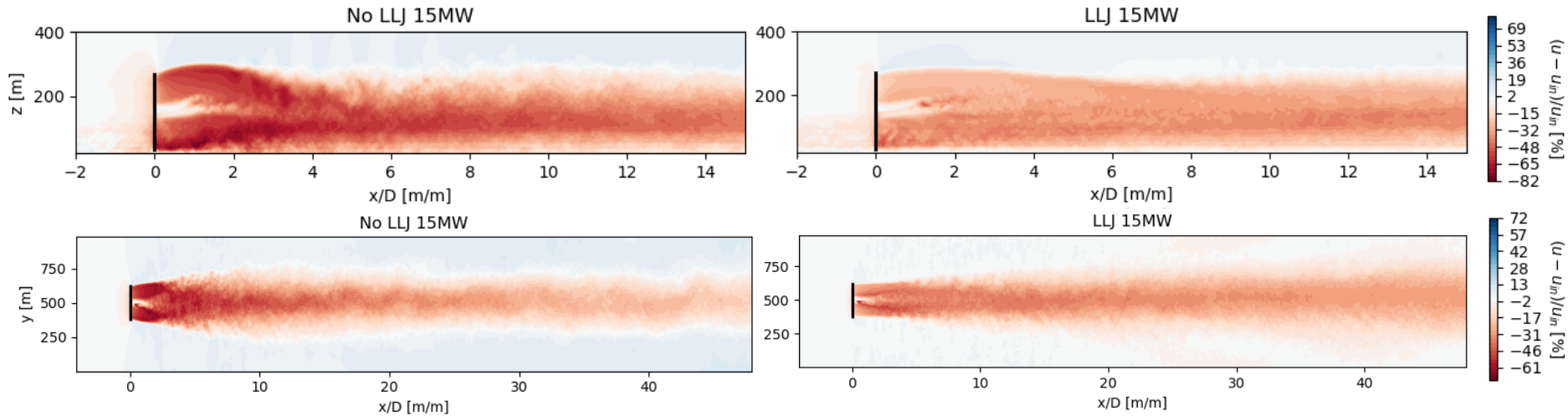
Temporal resolution: 0.25 s
Simulation time: 3-4 hours
Grid size: 4 x 4 x 4 m





For a large turbine, a LLJ at hub height results in:

- ▷ less vertical shear at the top of the turbine (due to negative background shear)
- ▷ thus, less mechanical turbulence



A LLJ at hub height results in:

- ▷ a smaller velocity deficit in the near-wake
- ▷ less mixing in the far-wake, so slow wake recovery

A LLJ above hub height results in the opposite.

LLJ can cause fast wake recovery, but this depends on height relative to the turbine