Validation of the dynamic wake meander model with focus on tower loads
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Validation of the Dynamic Wake Meander model with focus on tower loads

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DTU Wind Energy
Department of Wind Energy
In the original EU Topfarm project (2002-06) a significant part of the DWM development occurred.

- The meandering motion is essential for the loading process. It takes some time downstream for the meandering build up magnitude of motion.

- Therefore, one could expect especially tower loads to be less loaded for very small spacing distance.

- For very large spacing distance the deficit depth is very small and tower load must also be low again.

- One could therefore imagine that tower loads in wind farms are highest for a certain distance.
A good match in both power and load level is seen
Perfect match on blade loads
Yaw and tower loads are also good, though more difficult
Previous results
Lillgrund - 2015

Wake effects above rated wind speed. An overlooked contributor to high loads in wind farms.
T.J. Larsen, G. Larsen, H.A. Madsen and S.M. Petersen

- Generally a very good to excellent agreement is seen
- Blade loads seem to be easier to match than tower loads
- A slight underprediction of tower loads is seen near rated WSP
- High wind speed situations are highly important
The Nysted II Wind farm

In 200? A new wind farm was being installed.

When the tower sections were at land, it was possible to install strain gauges in the towers. Tower top and bottom bending moments were measured.

Furthermore access was granted to the SCADA data base of all turbines.

Wind conditions were estimated based on power and pitch angle of the outerly placed turbines.
Results: Tower bending

- Fine match at 8m/s (except for a small average offset)
- At 12m/s:
  - Good agreement in the multiwake sectors
  - Not so good agreement in the single wake sectors
Results: Tower yaw

- Fine match at 8-10 m/s (except for a small average offset)
- At 12 m/s:
  - Good agreement in the multiwake sectors
  - Slight underprediction in the single wake sectors
Loads as function of distance - simulations

- In the center wake a local tower bending load maximum is seen at 7-8D spacing
- However, in general loads do decrease for increased spacing
Loads function of distance - measurements

- A flat load plateau is seen from 6-9D spacing (6-7D spacing for the yaw)
- For increased distances the loads do decrease
Conclusion

- A new set of fullscale measurements are presented and compared to DWM
- The load match supports previous findings from the Lillgrund study at low and high WSP
- However, there seem to something missing near rated WSP
  - Tower loads are predicted slightly too low near rated WSP
  - Could this be due to the highly nonlinear controller behaviour on the upstream turbine?
- Tower load levels (below rated) are at the same load level between 6 and 9D spacing
- Yaw load levels has similar trend but start to decrease above 7D spacing.

Thank you!