

IF Project UniTTE

Load Validations on the SWT 2.3 MW at Nørrekaer Enge

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WP5. Loads measurement

Task 5.1 Evaluation of standard loads measurements procedure

- This task will establish a reference estimate of the differences associated with load simulations between measured wind and use of a standard hub height based wind field

Task 5.2 Loads measurements procedure with a profiling nacelle lidar

- In this task, We determine the parameters requiring a more accurate description of the wind field in terms of loads simulations, e.g. shear, veer and turbulence parameters.

Task 5.3 Loads measurement based on near flow wind speed

- In this task, the use of near field wind measurements from a lidar to characterise the loads is described and validated.

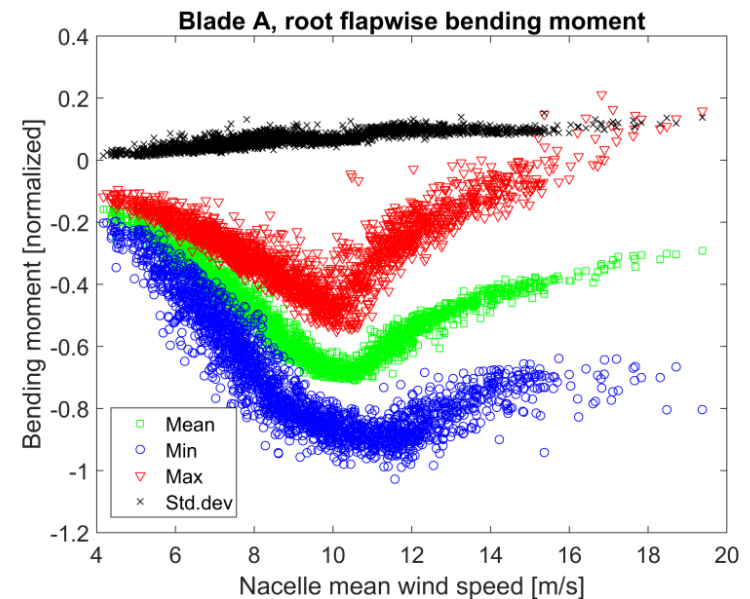
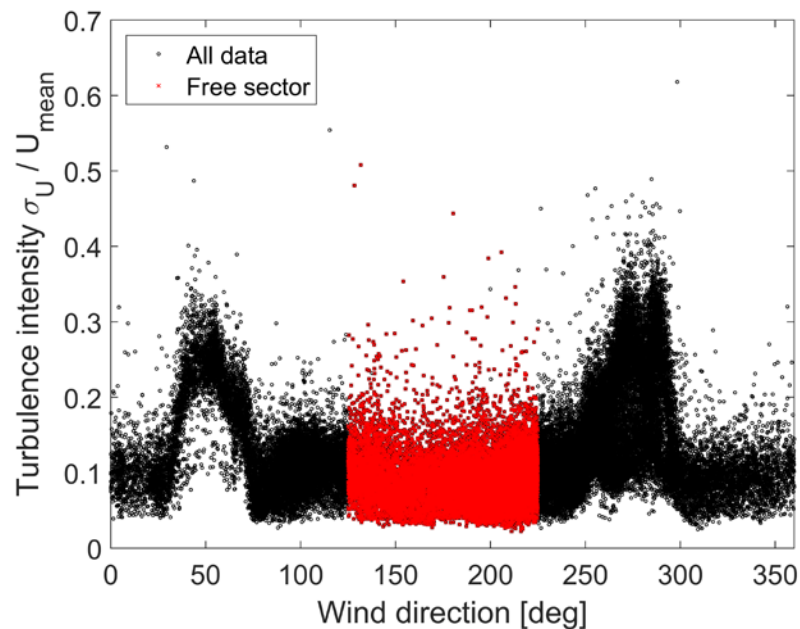
Task 5.4 Derivation of wind parameters from the nacelle lidar measurements

- This task will investigate specific wind field parameters conducive to design loads prediction that can be measured with a nacelle-based profiling lidar.

NKE load measurements

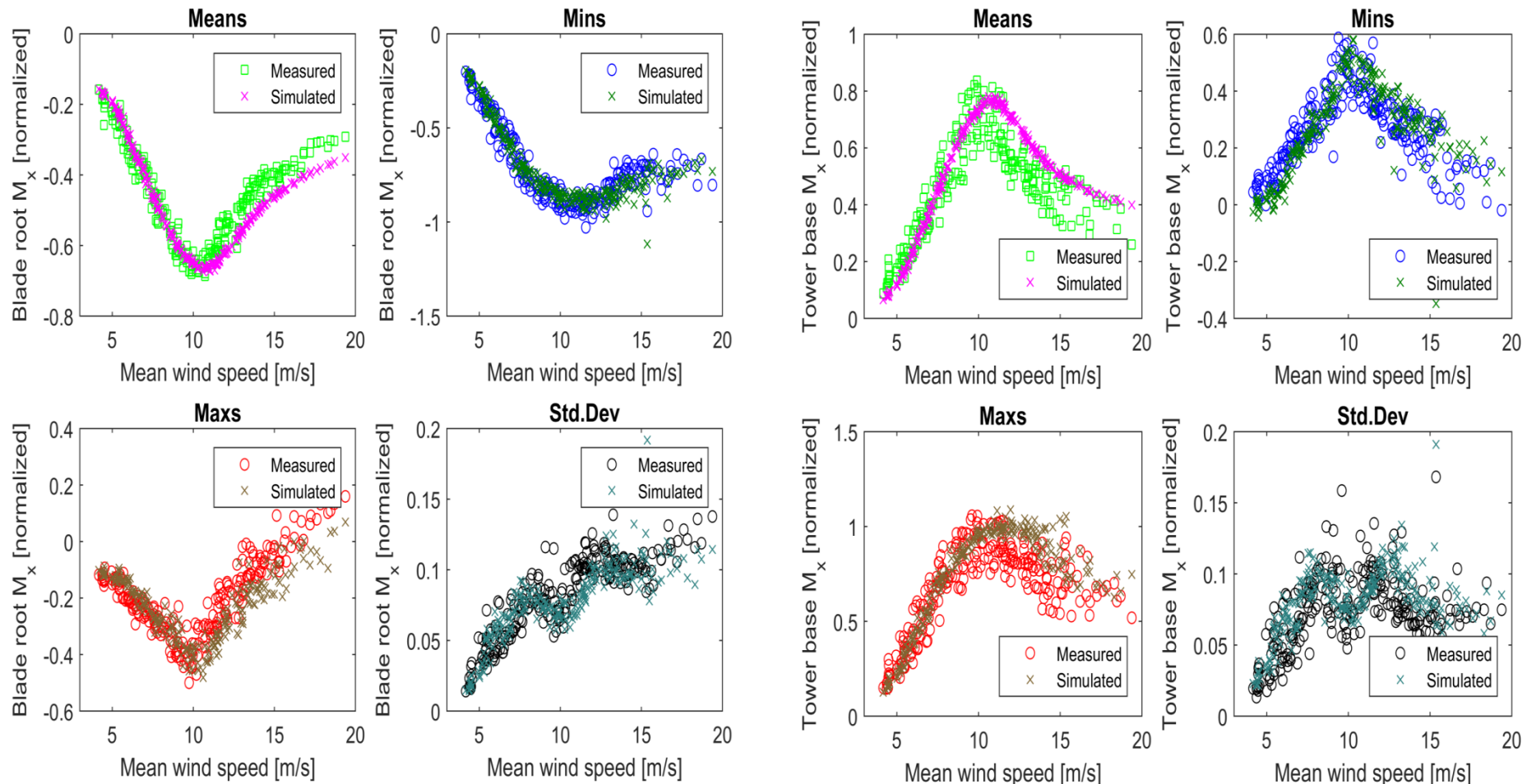
Measurement data for Siemens 2.3 MW turbine at different operating conditions and different wind conditions

Simulations in the corresponding HAWC2 model compared to measurements.



NKE measured vs. simulated loads – 1st aeroelastic model

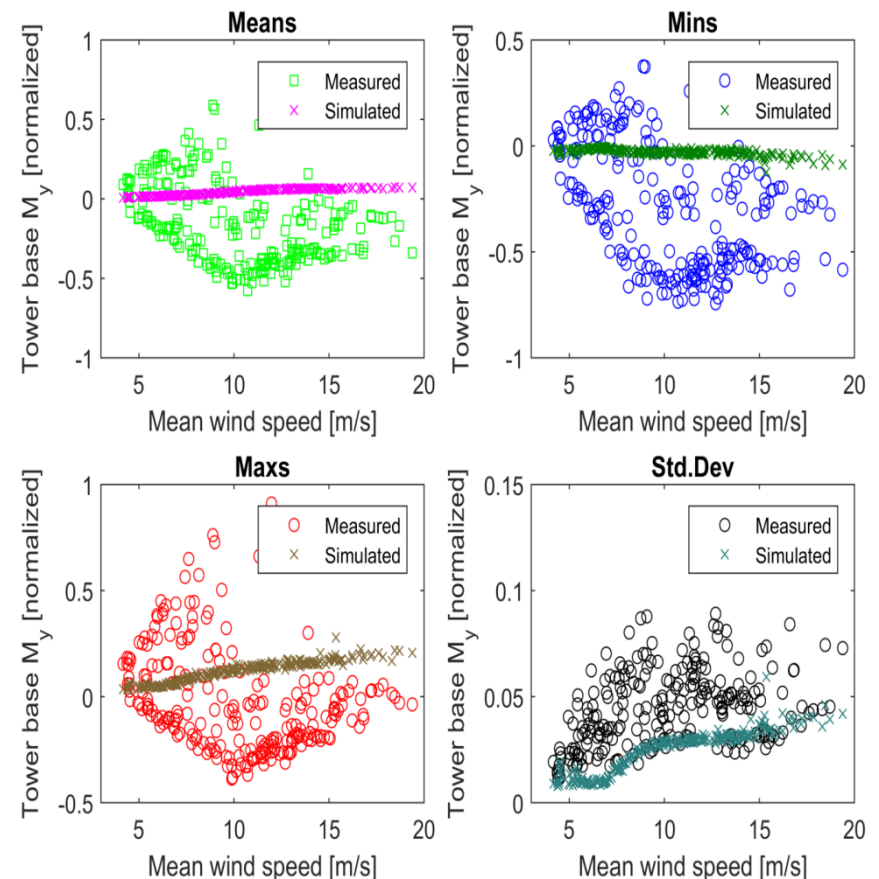
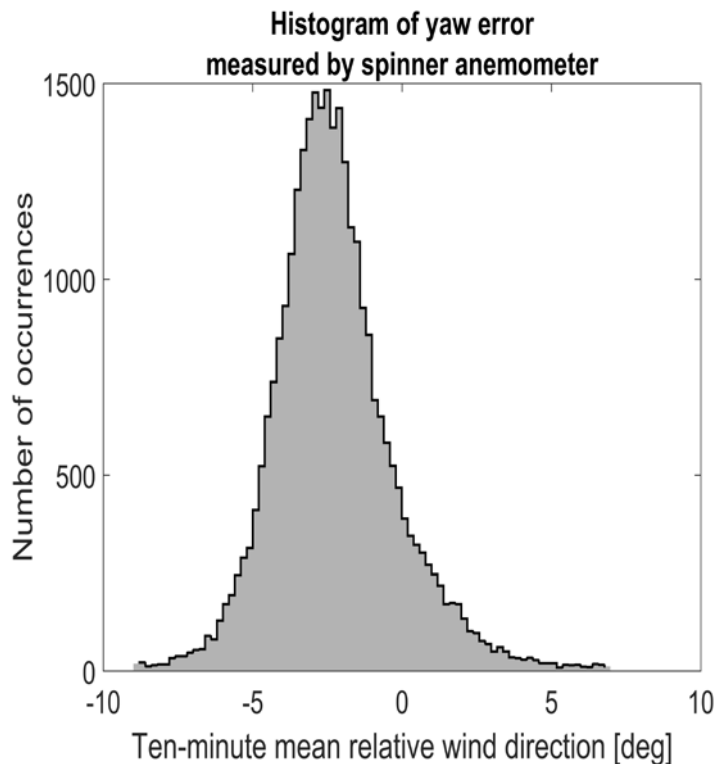
- Blade root flapwise, tower base fore-aft loads showed good agreement but some improvements in the tower base are still feasible.



NKE measured vs. simulated loads

– 1st aeroelastic model

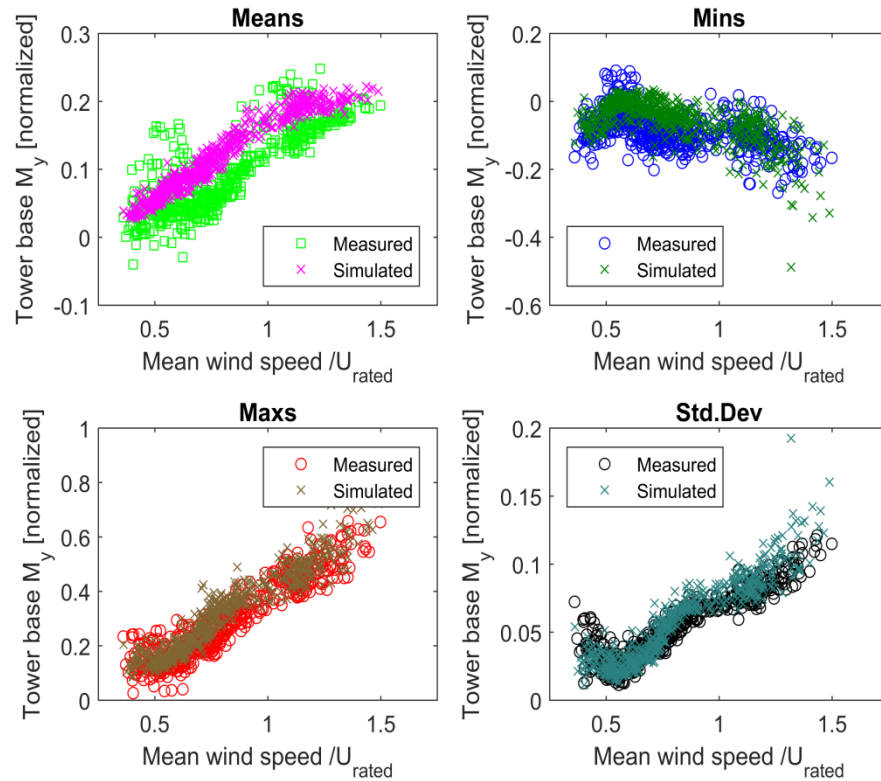
- BUT.....Simulated side-to-side loads (tower base side-side, blade root side-side) were totally different in comparison to measured ones:



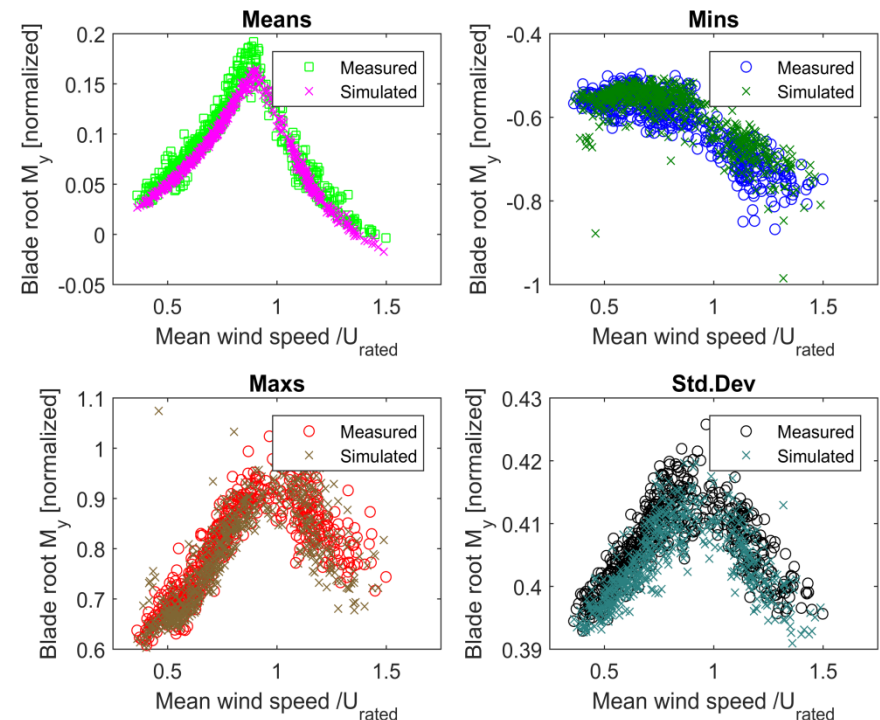
Required Corrections to the Model

- Obtained corrected blade aerodynamics parameters from Siemens wind power: due to blade add-ons on that turbine.
- Corrected time stamps (synchronization) between different measurements.
- Corrected the blade weight distribution as per new data from Siemens.
- Based on these details, an improved aeroelastic model was developed in HAWC2 and compared to the measured loads.

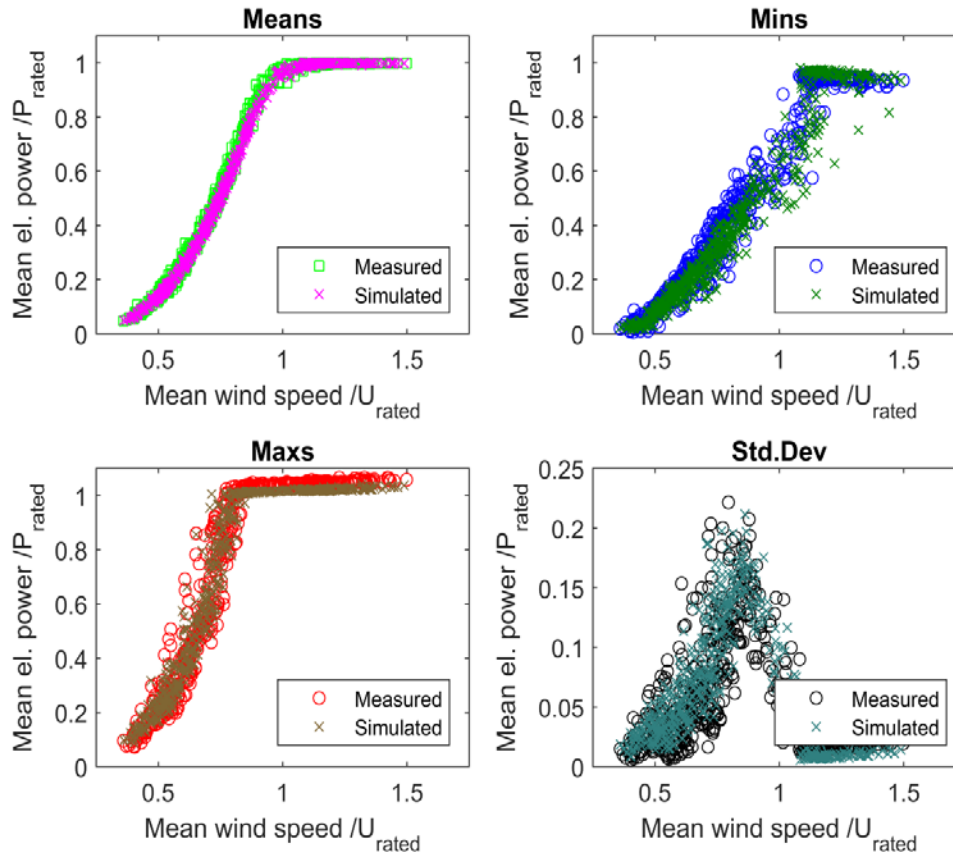
Corrected Comparisons – Ultimate Loads



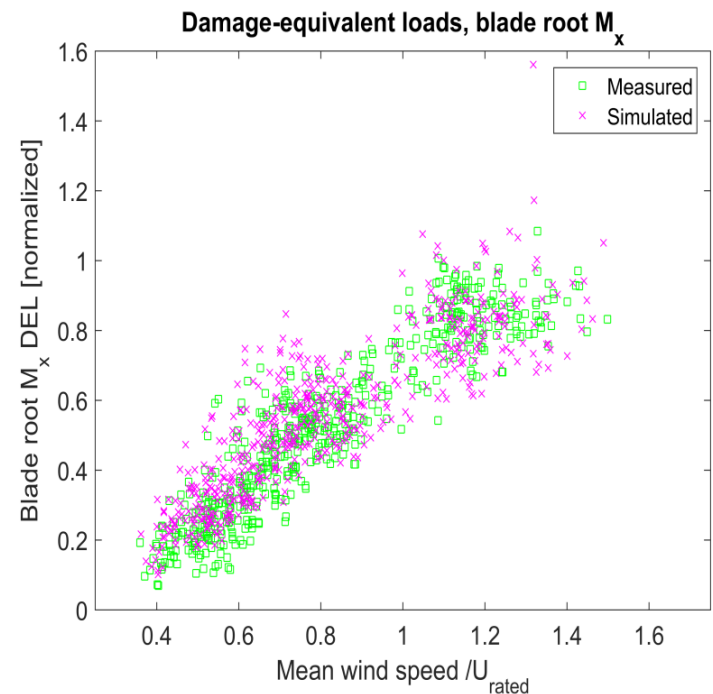
Simulated tower base side-side and blade root edge loads match measurements much better.



Corrected Comparisons



Good reproduction of power production and its variability as well as fatigue damage equivalent loads



Next Steps

- Use Lidar measured wind speed and turbulence for validations instead of met-mast.
- Determine the effects/benefits of constrained wind turbulence simulations with embedded lidar measurements/met-mast measurements for loads validations.
- Recommend standardized steps for using Lidar in loads validations.