



Validation material of Whiffle's LES 'GRASP'

Content

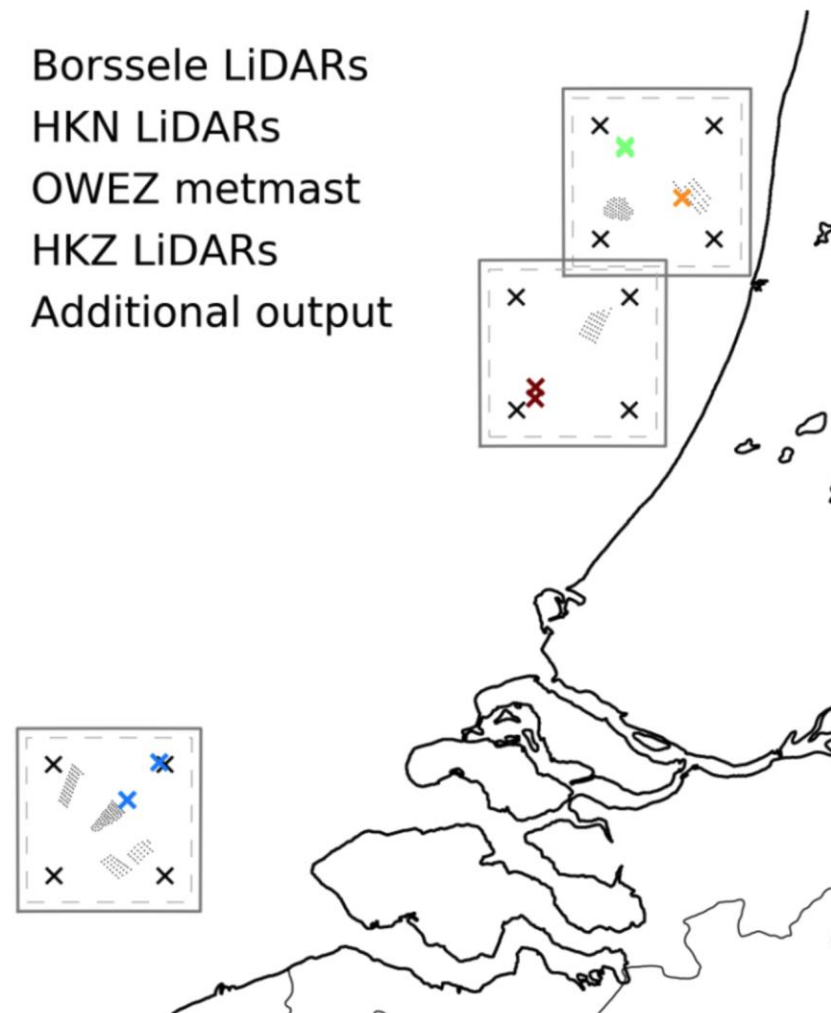
1. Validation of wind speed against LiDAR measurements at three Dutch offshore sites
2. Validation of wind speed against metmast measurements at one Dutch onshore site including the wake effects of the surrounding wind turbines
3. Validation of wind speed, wind speed standard deviation and turbulence intensity against metmast measurements at three sites (two offshore and one onshore)

1. Wind speed validation (LiDAR)

Wind speed and direction validation at three Dutch offshore sites

- Includes:
 - Scatter plots of observed against modelled wind speed and direction
 - Statistical metrics (correlations, RMSE, MAE, etc.) of simulations
 - Comparison of Weibull figures for simulations and observations
 - Vertical wind speed profiles with bias
- [Link to publication](#)

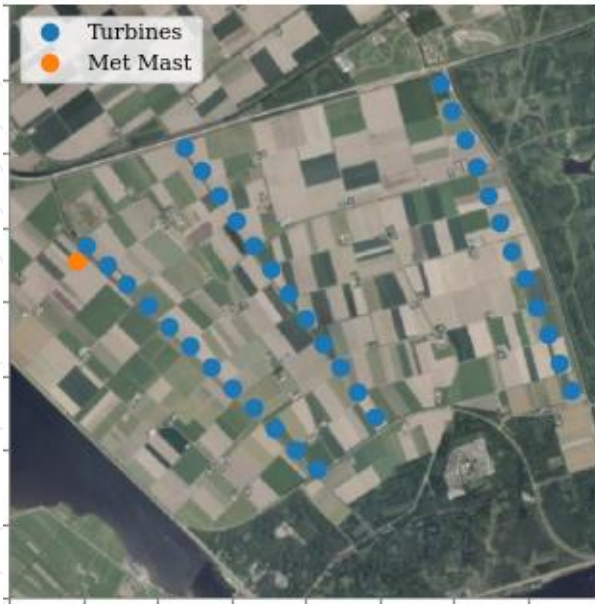
- × Borssele LiDARs
- × HKN LiDARs
- × OWEZ metmast
- × HKZ LiDARs
- × Additional output



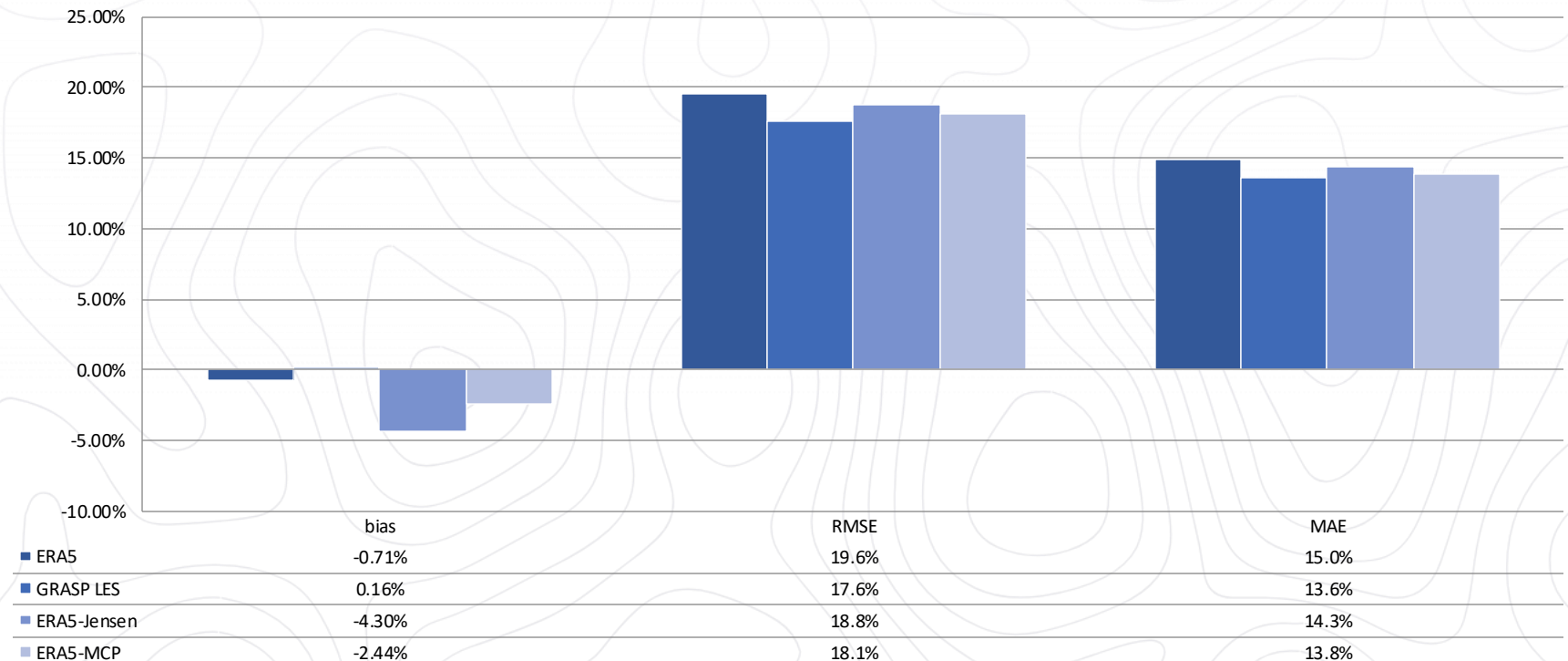
2. Wind speed validation incl. wakes

Wind speed (incl. wakes) validations were done at a metmast located near the onshore wind farm 'Prinses Alexia' in The Netherlands

- One year validation with an hourly time resolution
- Including a comparison with other downscaling approaches (next to Whiffle's LES model 'GRASP')



Error statistics of 4 models against mast measurements

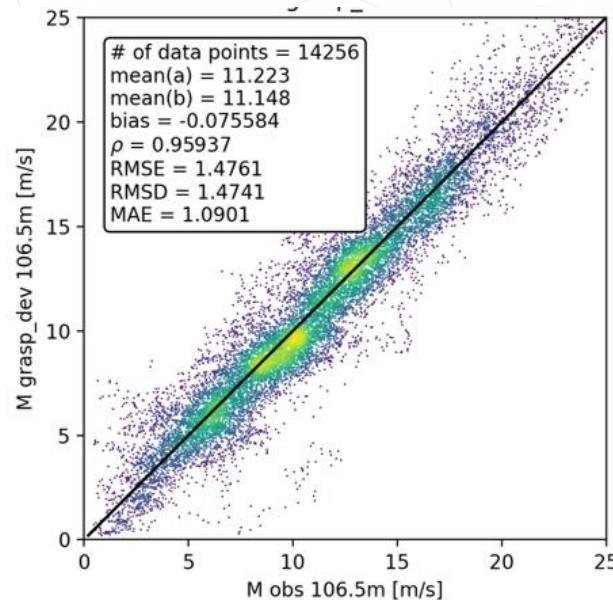


3. Wind speed validation (metmast)

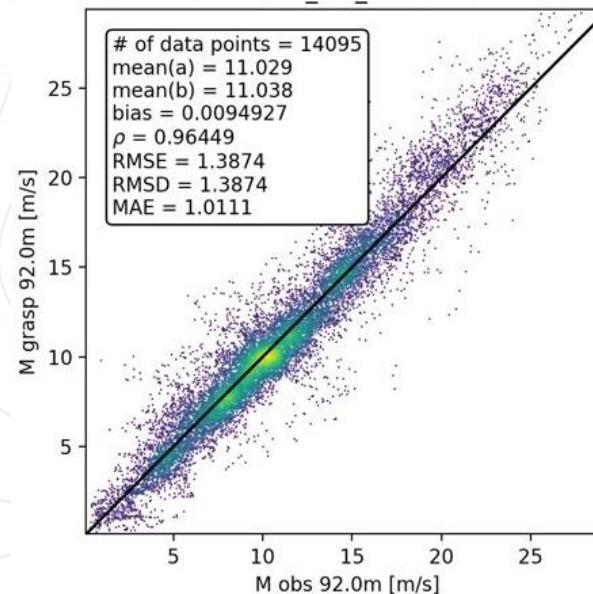
Wind speed validations were done at one onshore- and two offshore sites

- M_obs: Wind speed observations
- M_grasp: Wind speed of Whiffle's LES model 'GRASP'

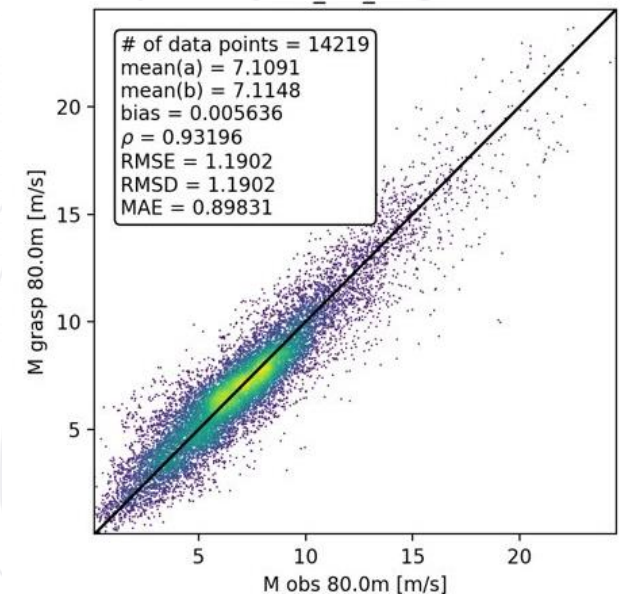
Metmast FINO3 (offshore)



Metmast IJmuiden (offshore)



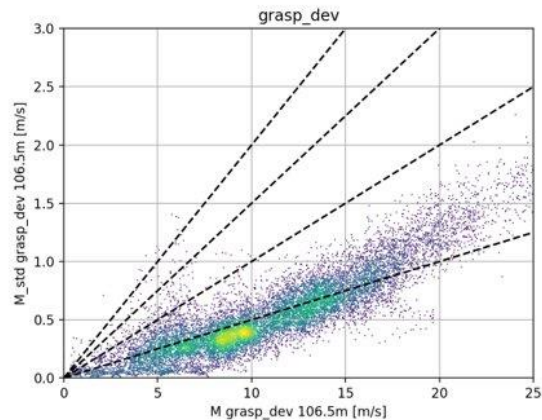
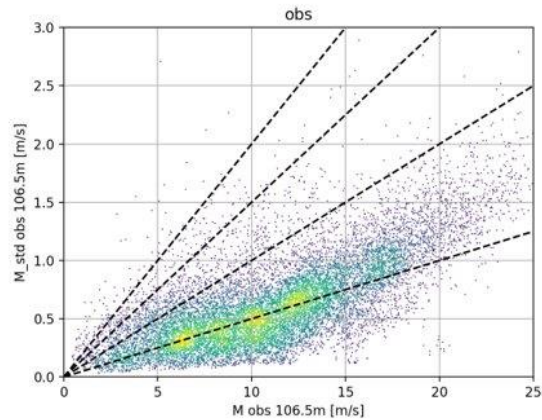
Metmast Cabauw (onshore)



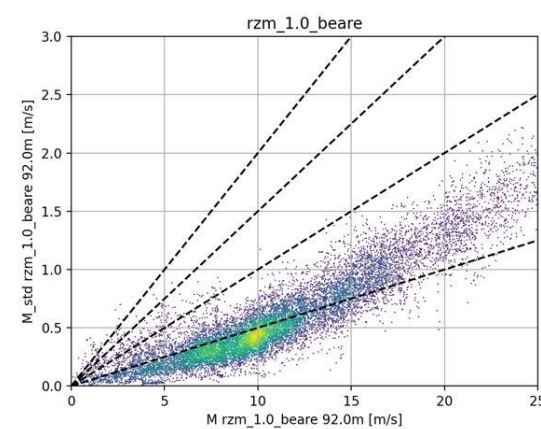
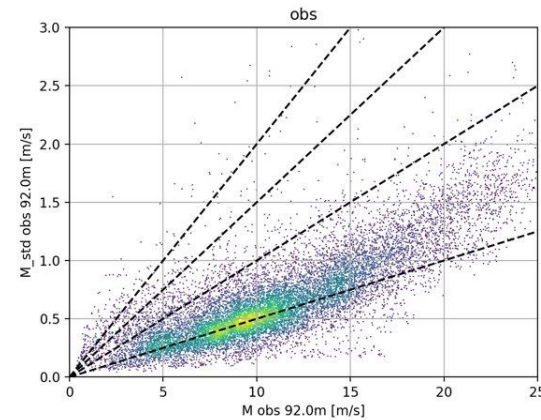
3. Wind standard deviation validation

Wind speed standard deviation (M_std) validations were done at three sites

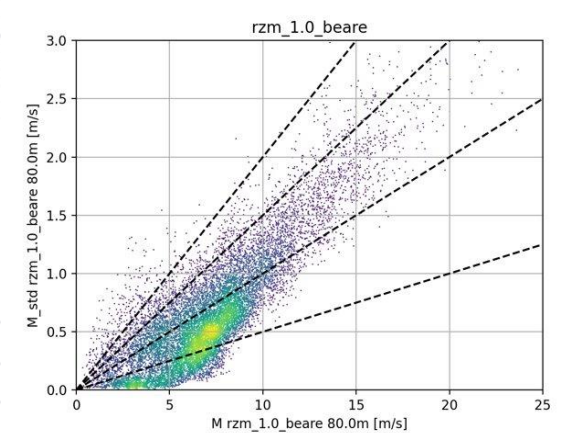
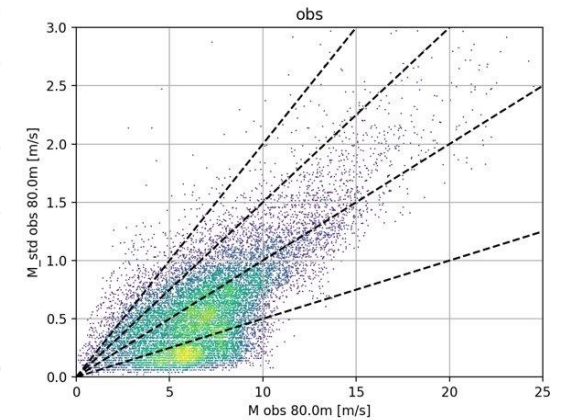
Metmast FINO3 (offshore)



Metmast IJmuiden (offshore)



Metmast Cabauw (onshore)



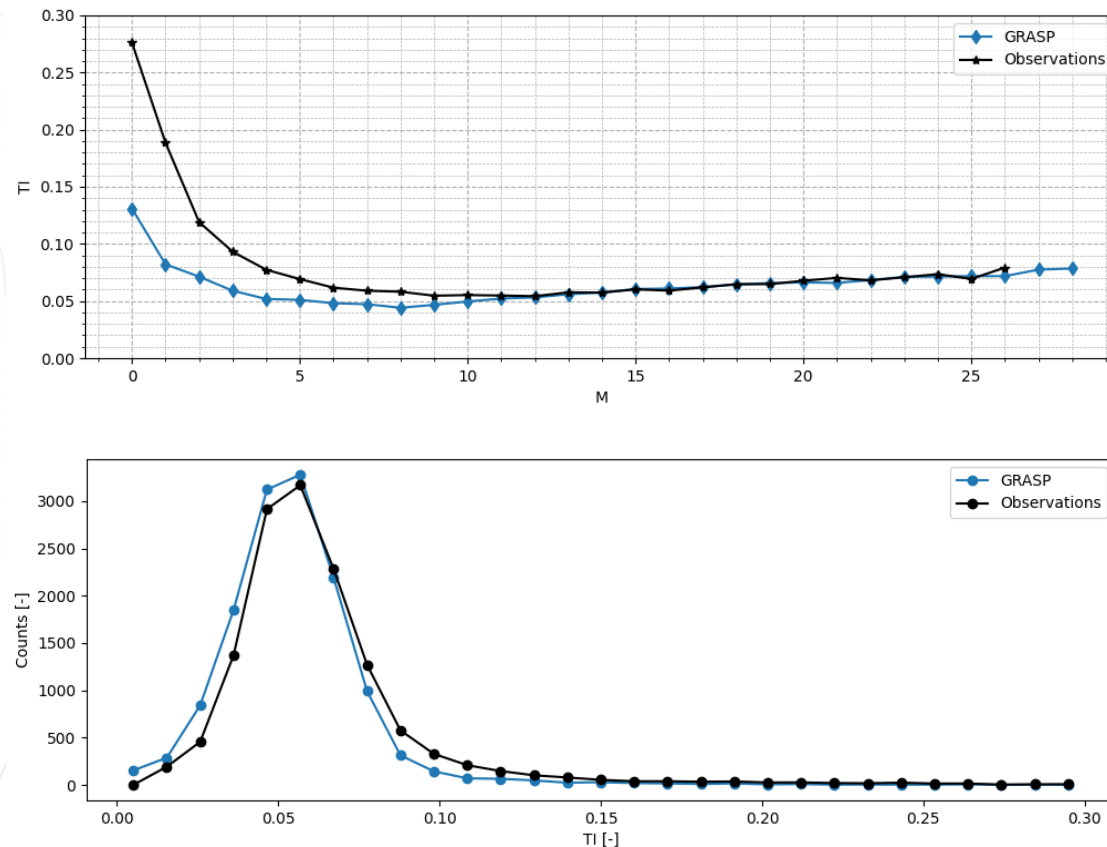
Observations

Whiffle

Turbulence intensity validation

Turbulence intensity validations were done at the IJmuiden metmast

- Turbulence intensity curves a height of 92 meters

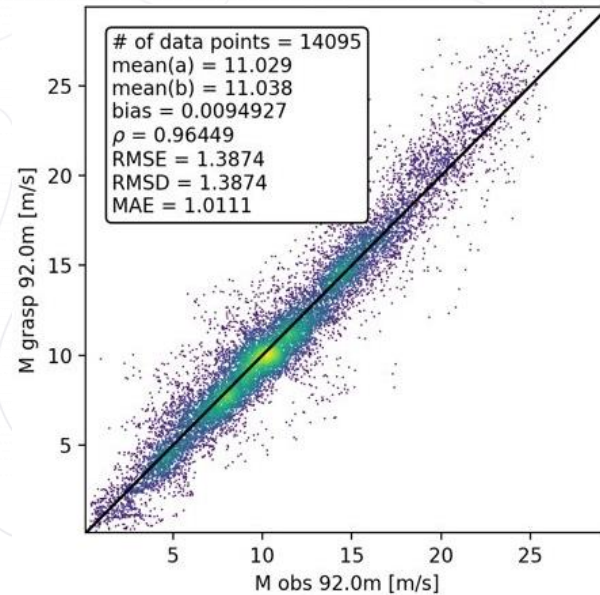


Validation of GRASP in the Netherlands

Wind speed validation (metmast)

Wind speed validation at the IJmuiden metmast:

- M_obs: Wind speed observations
- M_grasp: Wind speed of Whiffle's LES model 'GRASP'



Turbulence intensity validation

Turbulence intensity validations at the IJmuiden metmast

- Turbulence intensity curves a height of 92 meters

