

# Addressing and Resolving Discrepancies in Wind Resource and Metocean Studies for Offshore Wind Farms

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C2Wind

## A simple recipe for extrapolating your 10m model wind speeds to hub height:

- ✓ Keeps consistency between modelled wind & waves
- ✓ Increases the accuracy of hub height time series

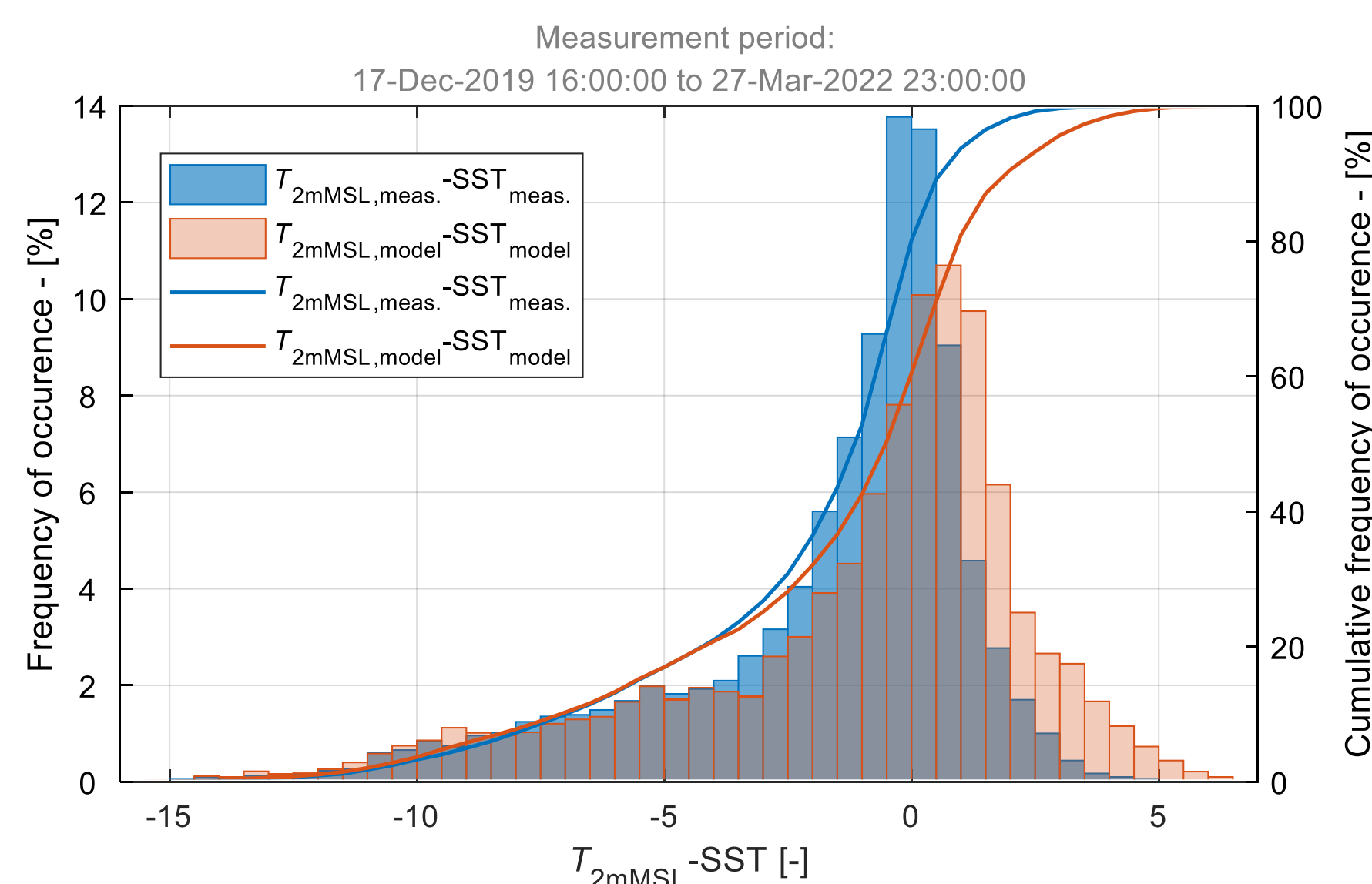
Reanalysis data, which form the basis for metocean studies, are often provided at 10 mMSL and not at hub height.

Deriving an accurate hub height wind speed time series requires accounting for atmospheric stability and surface layer relationship between shear and stability (Monin-Obukhov Similarity Theory, MOST).

From (Gryning, 2007) and (Peña, 2008), we demonstrate that a more accurate time series can be obtained when accounting for shear/stability relationship above the surface layer and across the entire boundary layer.

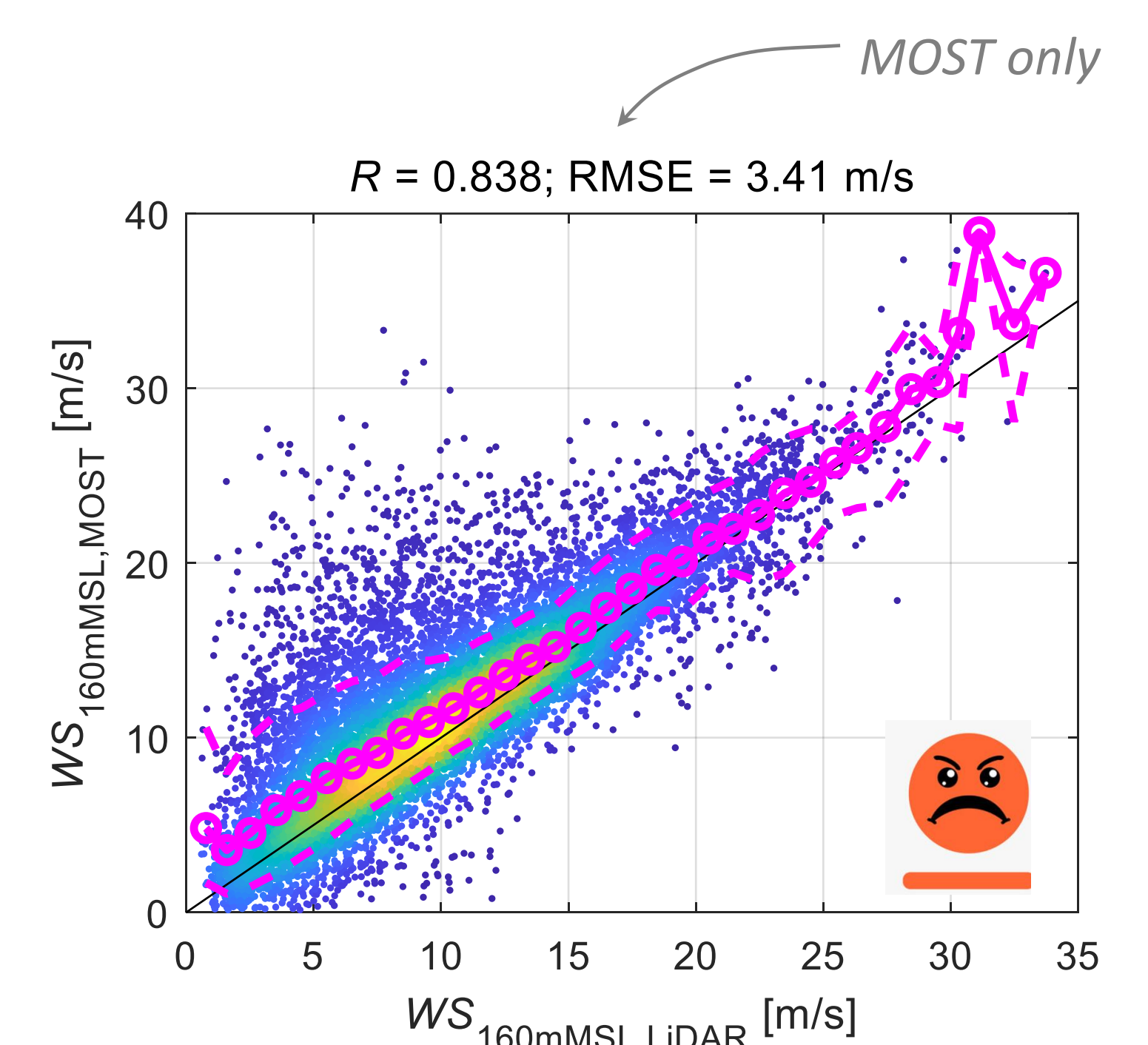
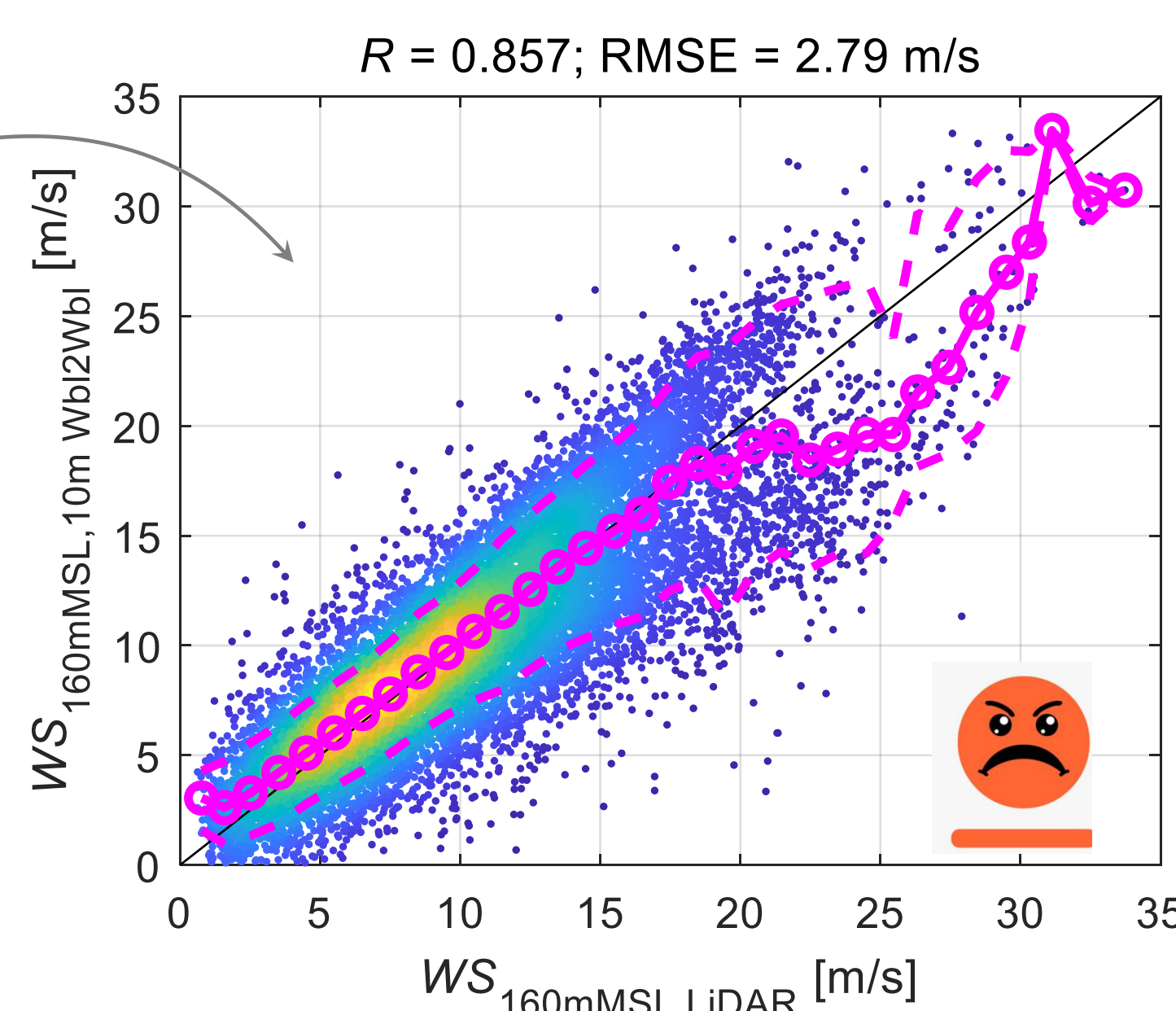
### Method:

- $L$  is derived from the Bulk Richardson number and empirical function from TOGA COARE experiment, see (Peña, 2008) using model
  - 10 m wind speed,
  - $T_{2m}$  and Sea Surface Temperature.
- $u_{*,0}$  and  $z_0$  are derived from model data, using Charnock's formulation or directly from the dataset, see (Peña, 2008)
- $z_i$  (boundary layer height) and  $L_{MBL}$  (a length scale at the middle of the boundary layer) are derived from (Gryning, 2007)

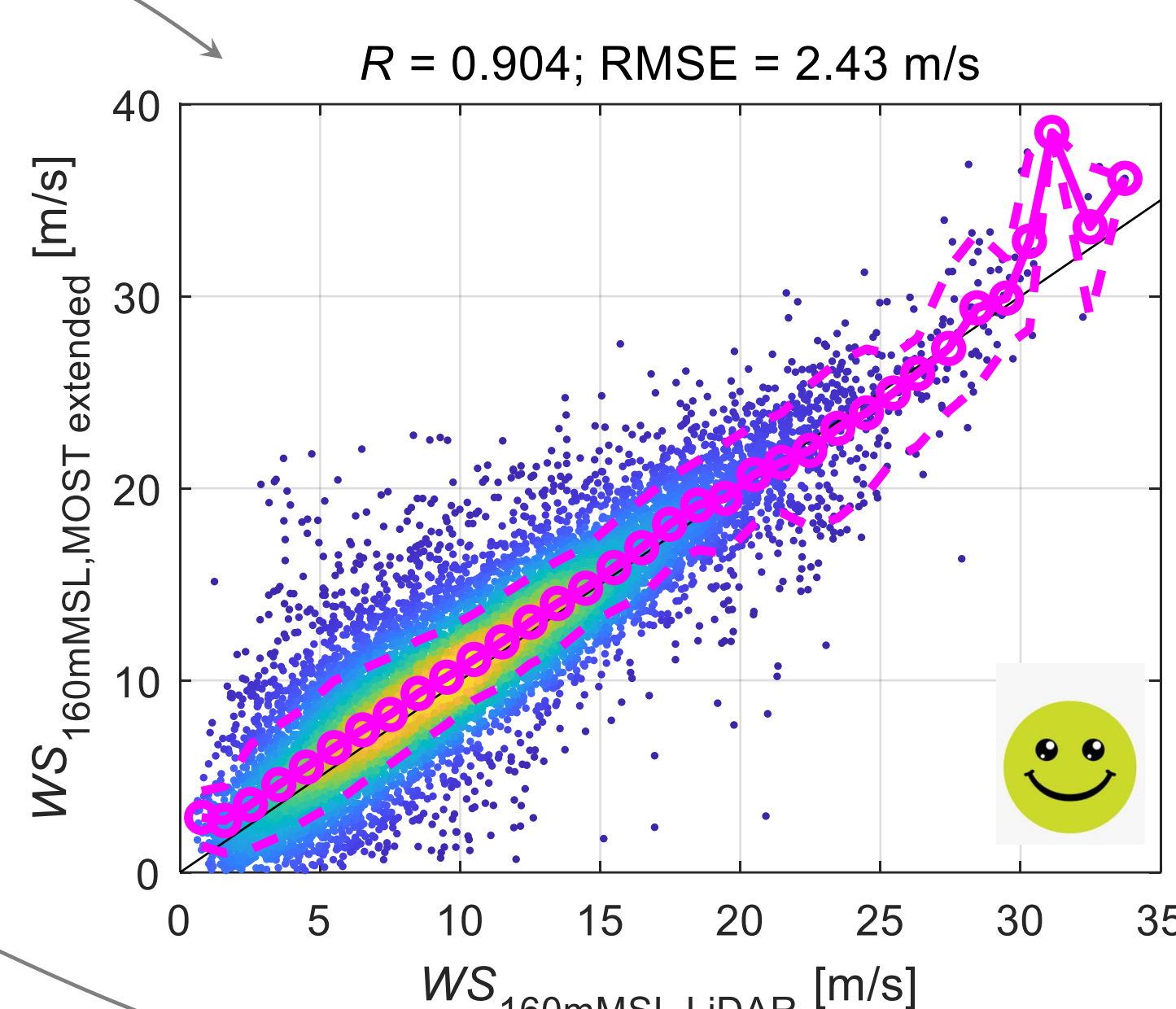


### Results:

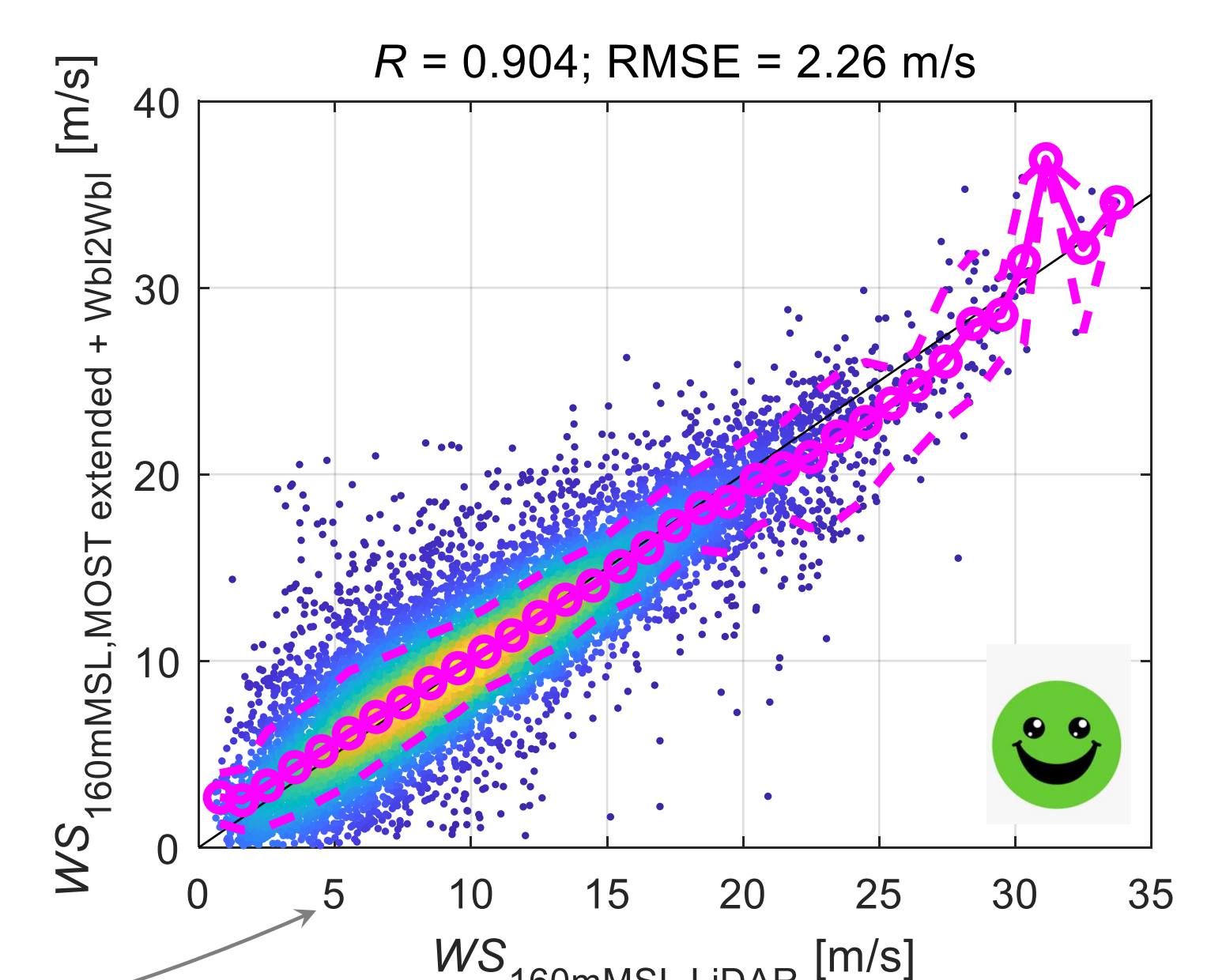
Simple scaling using a target Weibull distribution (state of the art, this equates to scaling the 10m to match the desired distribution)



Extrapolating using only (Gryning, 2007)



Adding additional scaling with desired Weibull



Gryning S-E., Batcharova E., Brümmner B., Jørgensen H., Larsen S. On the extension of the wind profile over homogeneous terrain beyond the surface boundary layer. Boundary-Layer Meteorology (2007).  
Peña A., Gryning S-E. and Hasager C. Measurements and Modelling of the Wind Speed Profile in the Marine Atmospheric Boundary Layer. Boundary-Layer Meteorology (2008)

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