



Measurements with Nacelle LIDAR at large distance

Presentation to Unitte workshop

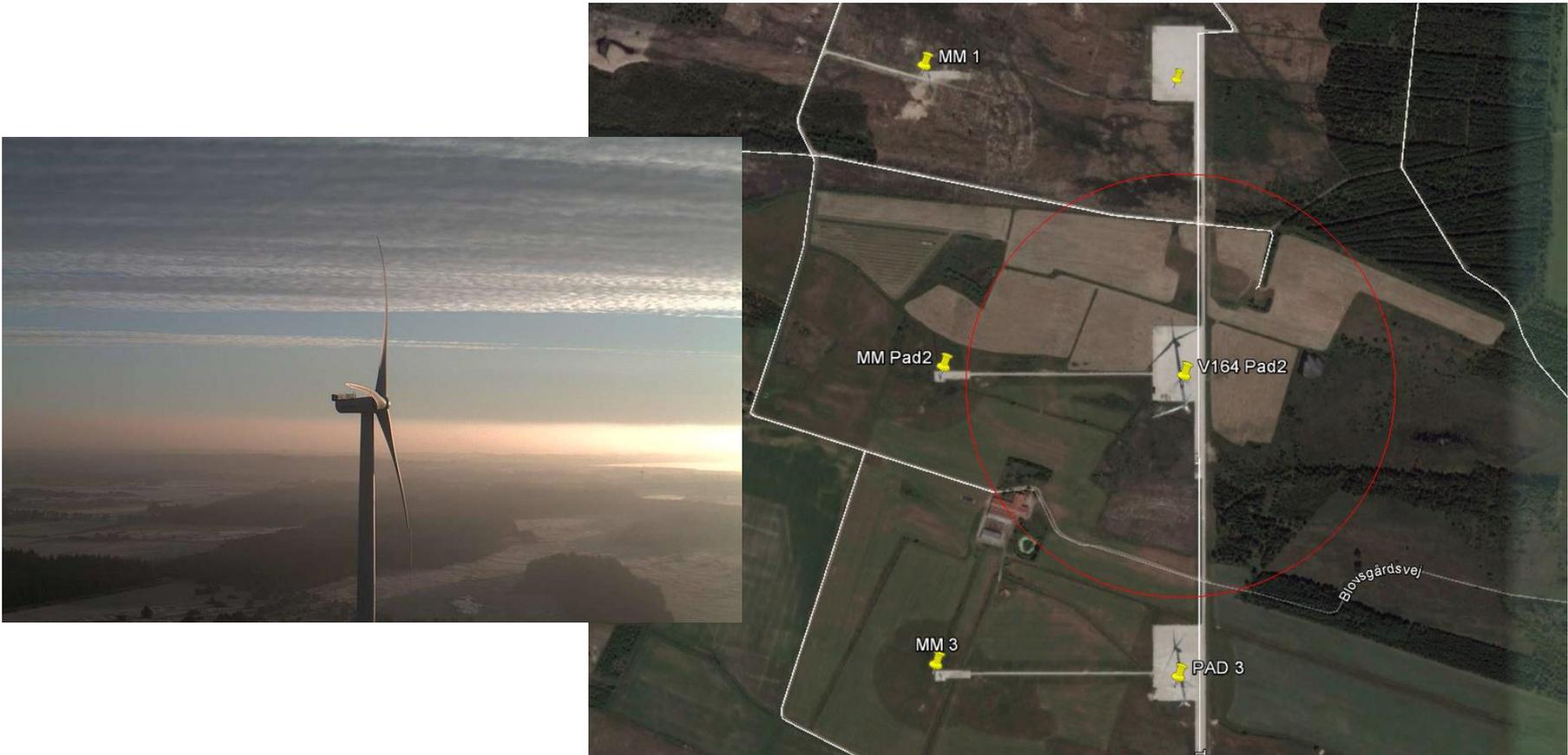
Introduction

Agenda:

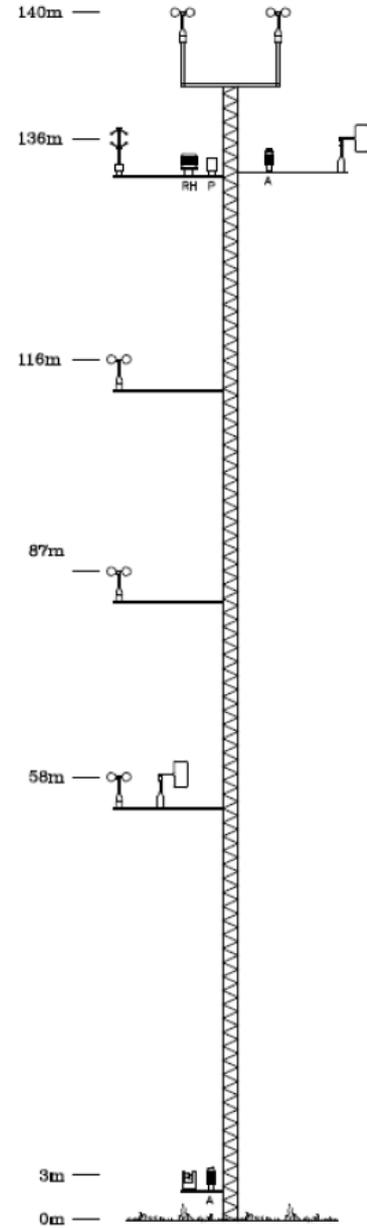
- Nacelle LiDAR measurements on the V164 turbine
- Nacelle LiDAR on multi rotor turbine

Please ask questions whenever they arise!

Site map – Østerild test center Pad2

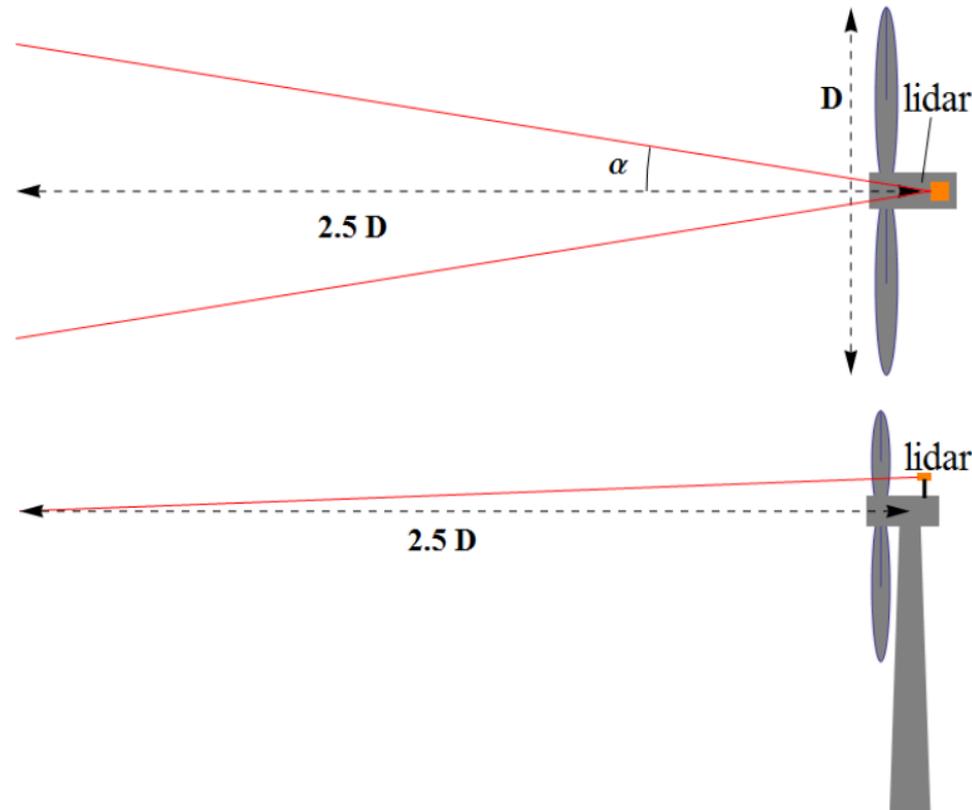


Test setup



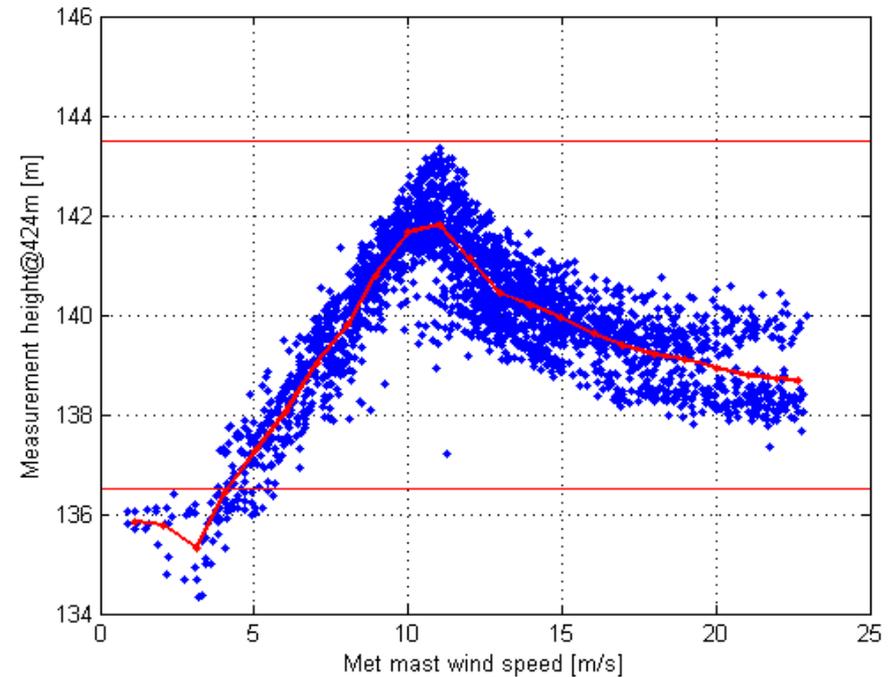
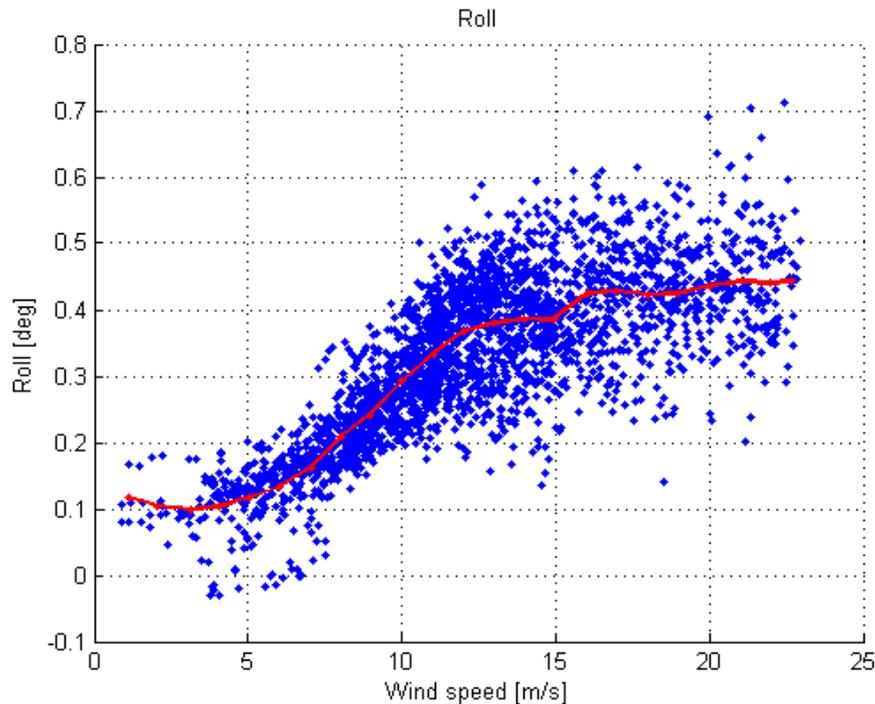
Try to follow DTU procedure for power performance measurement with a two-beam nacelle LiDAR

- Wind speed is measured at hub height in a distance of $2.5D$
- The LiDAR needs to be pre-tilted to measure at hub height at $2.5D$



Roll and Tilt measurements

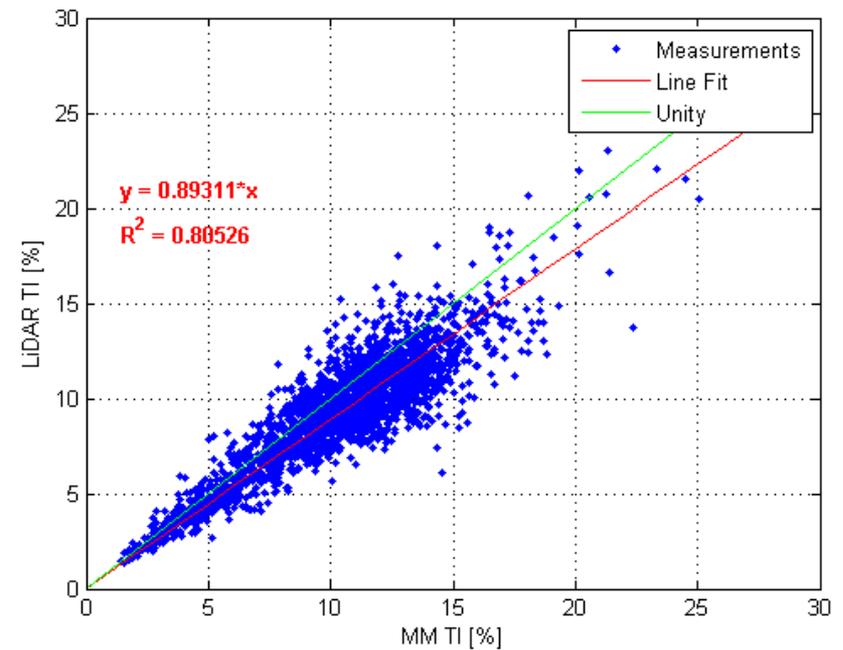
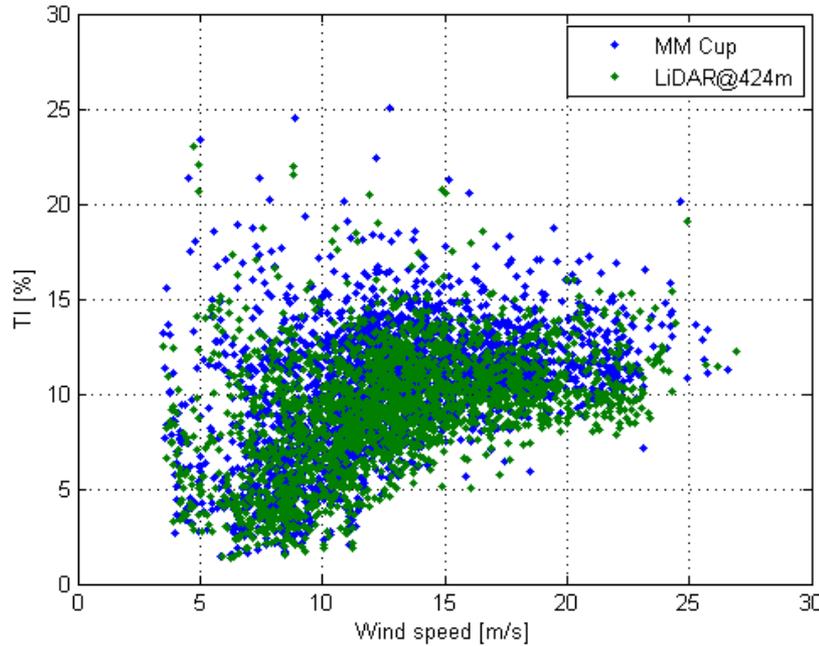
- The measurements points are moved in space because of turbine movements
- LiDAR was pre-tilted to measure at hub height in average
- The LiDAR possibly also should have been pre-rolled



Results from V164 test

TI measured with the LiDAR

- The LiDAR underestimates the turbulence intensity (TI)



$$TI_0 = \frac{dRWS0}{RWS0m} \quad TI_1 = \frac{dRWS1}{RWS1m}$$

$$TI_{LiDAR} = \frac{TI_0 + TI_1}{2}$$

Where:

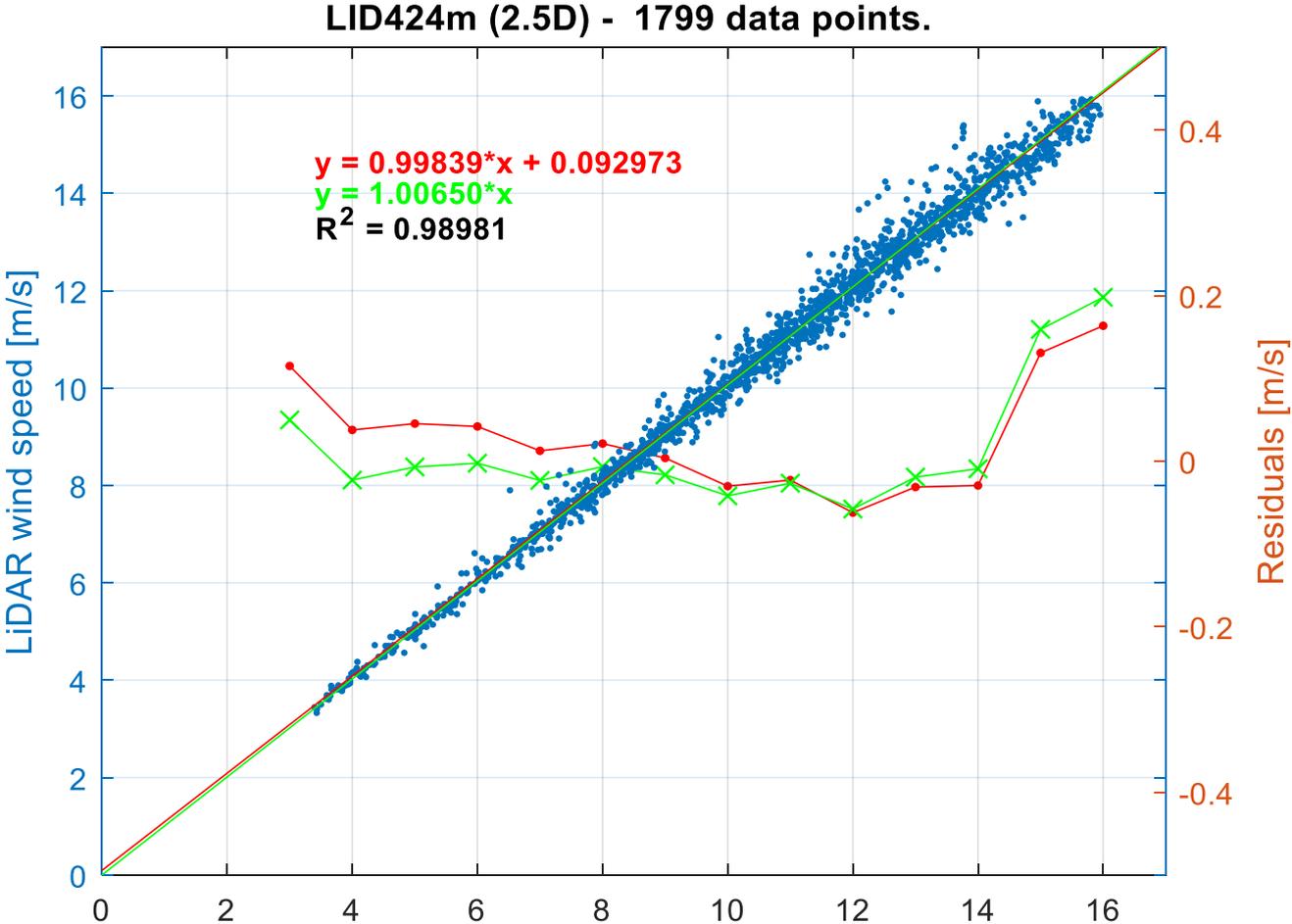
$dRWS0$ is the LOS0 radial wind speed deviation [m/s]

$dRWS1$ is the LOS1 radial wind speed deviation [m/s]

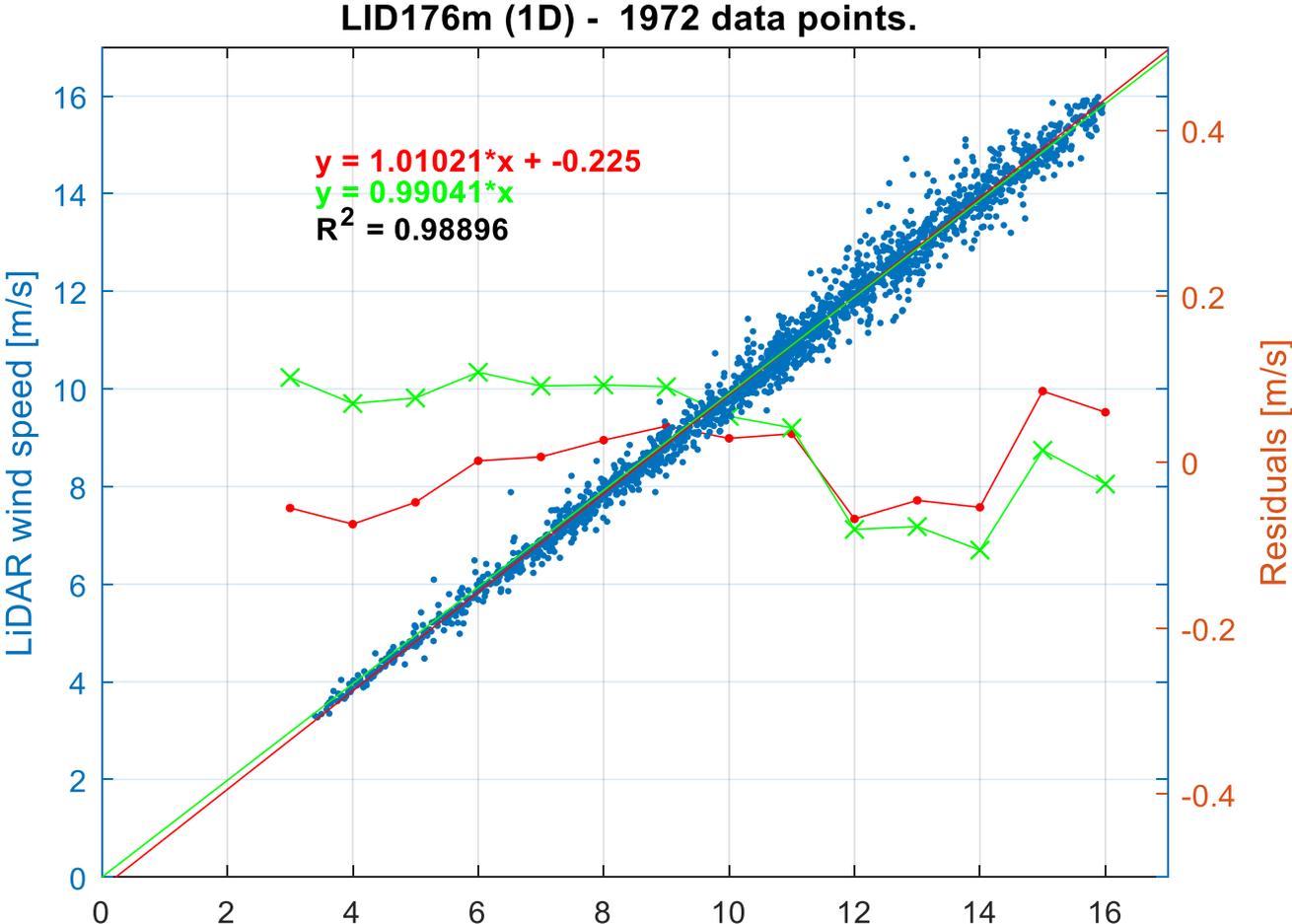
$RWS0m$ is the Average LOS0 radial wind speed [m/s]

$RWS1m$ is the Average LOS1 radial wind speed [m/s]

Results 2.5D



Results 1D



Results all distances

Distance [m]	Distance (D)	R ²	Slope
80	0.4	0.9844	0.9398
176	1	0.9890	0.9904
341	2	0.9902	1.0050
364	2.2	0.9901	1.0056
394	2.3	0.9900	1.0060
424	2.5	0.9898	1.0065
454	2.7	0.9895	1.0065
474	2.8	NA	NA

Results all distances

- ZephIR DM mounted on top level
- Integrated into controller
- Used for power curve and loads model validation



The Vestas logo is positioned in the top left corner of the slide. It features the word "Vestas" in a white, italicized, sans-serif font, followed by a registered trademark symbol (®). The background of the top half of the slide is a vibrant blue sky with wispy white clouds, suggesting a clear, sunny day.

Wind. It means the world to us.™

Thank you for your attention

Copyright Notice

The documents are created by Vestas Wind Systems A/S and contain copyrighted material, trademarks, and other proprietary information. All rights reserved. No part of the documents may be reproduced or copied in any form or by any means - such as graphic, electronic, or mechanical, including photocopying, taping, or information storage and retrieval systems without the prior written permission of Vestas Wind Systems A/S. The use of these documents by you, or anyone else authorized by you, is prohibited unless specifically permitted by Vestas Wind Systems A/S. You may not alter or remove any trademark, copyright or other notice from the documents. The documents are provided "as is" and Vestas Wind Systems A/S shall not have any responsibility or liability whatsoever for the results of use of the documents by you.