A methodology review of uncertainty estimation in wind resource and power performance assessments when using LIDARs.

Mike Courtney*, Julia Gottschall**, Brian Gribben†, Jonathan Hughes‡
**The Technical University of Denmark, Roskilde, Denmark, mike@dtu.dk*
*** Fraunhofer IWES, Bremen, Germany, julia.gottschall@iwes.fraunhofer.de*
†Frazer-Nash Consultancy, Bristol, United Kingdom, b.gribben@fnc.co.uk
‡Jonathan Hughes, Offshore Renewable Energy Catapult, Blyth, United Kingdom, jonathan.hughes@ore.catapult.org.uk

Summary
A review has been undertaken of the wind speed uncertainty methodology embodied in the recently updated standard for wind turbine power performance measurement IEC 61400-12-1, specifically the new Annex L "The application of remote sensing technology". The focus is on methodology using vertically profiling LIDAR data. The results of this review are discussed, with specific interpretations and alternative methods described, and significant uncertainty reductions demonstrated.

1. Introduction

It is well established in the offshore wind industry that the effective application of remote sensing wind measurement technology, particularly using LIDARs (LIght Detection And Ranging), could be improved by improving how the industry calculates uncertainty. The recent update to IEC 61400-12-1 formalised a process for this for the first time, but since then, it has become clear that this could be further improved.

This led to the Carbon Trust's Offshore Wind Accelerator (OWA) launching a project to review the uncertainty methodology embodied in the standard for wind turbine power performance measurement IEC 61400-12-1, specifically the new Annex L "The application of remote sensing technology".

2. Results

An expert review of the standard has highlighted a number of methodology areas which can be improved upon as follows:

- LIDAR calibration uncertainty
- LIDAR classification uncertainty
- Distance from mast/terrain/variation in flow across site uncertainty
- Mounting uncertainty
- Flow variation within the control volume
- Shear uncertainty
- Simultaneous use of LIDAR and mast.

Alternative recommendations and/or methods have been developed and justified. To demonstrate and quantify the impact of the work, example calculations have been performed. Two data sets are used, one from an onshore power performance test using a mast and a fixed LIDAR, and a second from an offshore scenario where mast and floating LIDAR data are available.

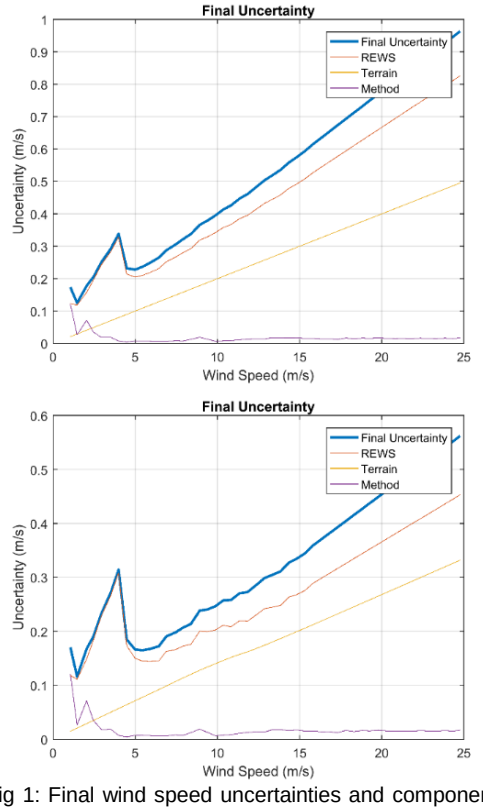

Fig 1: Final wind speed uncertainties and components for onshore case using LIDAR data only: applying the standard's methodology (top), and applying a revised methodology (bottom).

4. Conclusions

A number of improved methods for performing uncertainty calculations have been developed and demonstrated, which have a significant effect on the final uncertainty value, in some cases reducing this by several percent.