

Review of “Predicting and reducing wind energy field experiment uncertainties with low-fidelity simulations” by Houck et al.

Overall assessment

This is a useful contribution to the often-overlooked discipline of designing experiments, here with particular relation to field testing in wind energy. The paper outlines a methodology for determining the testing duration necessary in order to obtain significant and converged results in a testing situation where a simultaneous control can be performed. This control is often possible but maybe just as often, impossible. My initial reaction was that the authors had rather neglected this latter case, giving the impression that bias uncertainties can easily be disregarded in most wind energy field experiments.

This is of course not the case. A large field experiment to examine and quantify wind farm global blockage has just been completed and here both the random and bias uncertainties are significant and both play a crucial role in determining whether a meaningful outcome of the experiment is possible.

On re-reading, maybe my initial reaction was rather harsh. In any case, I have several suggestions in the detailed comments below, to create in my view a more balanced view regarding random and bias uncertainties.

My other main comment is that the case study section is especially lengthy with a lot of detail. I am not convinced that all the detail is justified and would ask the authors to reflect on whether some simplification and shortening could be possible, for example, reducing the number of rotor size cases and possibly taking fewer QoIs. This would maybe help to highlight the several important points that the case study illuminates.

Detailed comments

Title

I don't think the title quite matches the paper core topic – determining the testing duration required when random uncertainties dominate. Maybe reconsider this?

Abstract

L3 replace “commonly” by “sometimes” or re-word to something like “some field experiments can be conducted with a control and treatment”

Introduction

L24 drop the “are still of great value” ?

L33 maybe add “especially where control and treatment are carried out essentially simultaneously” before “it is often safe” (or something like this..). My concern here is that if bias

errors depend critically on the conditions, in a non-simultaneous control and treatment, the bias uncertainty may still be very relevant.

L45 Probably just me but the sentence “Represented as error bars,... within the uncertainty interval.” took me a long time to understand. Maybe re-word to something like “To demonstrate a significant difference, the error bars derived from the best estimate and the uncertainty at the selected confidence level, should not contain zero.”

L60 “Like significance, convergence is also ensured by increasing the number of samples..” – Is significance always ensured – what if there really is no difference?

2.1 Simulation Method

L96 The simulation must have “acceptable accuracy” – what is this accuracy? How does this relate to the “low-fidelity” of the paper title? I think this requires a little more attention.

2.3 Analysis and uncertainty quantification

L166 “any bias errors should be calculated for each Qol..” – I understand this as bias *uncertainties* (if you know the errors you can just correct for them). Please be careful in your use of “error” and “uncertainty”. Could your methodology be extended to include this step – i.e. calculating an estimate of bias uncertainties based on the input (and output ?) of the simulations?

3.1 Tip Extensions

L210 “region 2” – people not familiar with wt control may not know what this means.

3.2 Inflow creation for the base study

L251 “The shear exponent was then averaged for each 10-minute bin.” – why not just use the 10 minute means to calculate one alpha?

L252 “It is not necessary to apply quality control to the time series” – Don’t understand this. Do you mean that the necessary QC can be performed using the 10 minute statistics?

3.5 Discussion of the Case Study

L453 sentence ending “, perhaps the addition of a few additional samples.” seem incomplete.

L466 “suss out” is rather colloquial! Maybe use boring old “determine” instead 😊.