

Interactive comment on “FLOWSTAR-Energy: a high resolution wind farm wake model” by Amy Stidworthy and David Carruthers

Anonymous Referee #1

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The manuscript attempts to describe how the flow model FLOWSTAR can be extended to account for wind farm wake. A wake deficit model is introduced which builds on concepts from the study of dispersion of plumes. A model for shear-induced (also referred to as wake-added) turbulence is also introduced. The manuscript includes comparison with measured data from three sites, two of them offshore.

General comments:

1. There appears to be very little connection between FLOWSTAR and the superimposed wake deficit model. The downstream propagation of the wakes appears for example to be independent of the stream lines of the flow. I therefore recommend that the connection to FLOWSTAR is down-played until the validation in complex terrain is in place.

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2. The manuscript does not include validation of the calculated shear-induced (wake-added) turbulence. The connection between the model for shear-induced turbulence and wake deficit model appears to be one-way, such that the shear-induced turbulence model is not necessary for the description of the wake deficit. I therefore recommend that the description of the shear-induced turbulence model is removed until the output of this model is validated. Influencing this recommendation is the observation that many of equations in section 2.3 have generated specific or technical comments below.

Specific comments:

1. Page 5, line 13: In eq. (8) it is unclear if σ_{shear} is the turbulence contribution from one WTG or the accumulation of the wake-added turbulence from all upstream WTG:s. The formula seems to suggest the former.
2. Page 5, line 22: What is $\sigma[i + 1]$ and how is it calculated?
3. Page 6, line 4: Eq. (12) leads to a higher value of TI than the standard definition. Is the introduction of a non-standard definition intentional?

Technical comments:

1. Page 3, line 24: Reference is missing.
2. Page 4, line 25: A “crosswind vertical slice” is not an intuitive concept. Consider adding a sketch to illustrate the concept.
3. Page 5 line 1: Eq. (7) appears to be missing a y_s (corresponding to z_s).
4. Page 5, line 19: In eq. (9) σ_{tot} should be $\sigma_{tot}[i]$ or $\sigma_{tot}[i + 1]$?

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