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WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "From standard wind measurements to spectral characterization: turbulence length scale and distribution" *by* Mark Kelly

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Author's reply to comment (SC1) by A. Peña

> "Thanks for a very interesting paper. It is indeed extremely convenient to have a parametrization for the Mann length scale that is based on commonly measured parameters. Here three short comments on your manuscript:"

Thanks; I'm hoping to provide something which is theoretically and empirically sound, and convenient to use in wind applications.

> "1. My previous work both in the citations and in the references should be Peña, A and not Peña Diaz, A. I think you have two references (and the corresponding citations) with that issue."

Ok, I'll update my BibTeX entries that include your name.

> "2. In Peña *et al*. (2010) we did not explicitly suggest a parametrization for the Mann length scale but we relate it to the length scale of the wind profile as you point out. Your work suggests $L_{\rm MM} \approx \sigma_u/(dU/dz)$ which roughly means that $L_{\rm MM} \approx z$ in the surface layer (if the approximation $\sigma_u \approx u_*/\kappa$ is used), whereas our relation $L_{\rm MM} \approx 1.7\ell$ roughly means $L_{\rm MM} \approx 0.68z$. The latter is also in accordance with the work of Chougule *et al*. (2014) from measurements at Høvsøre and at Ryningsnäs."

First, this is only approached in the *neutral* surface layer (ASL).
Secondly, for $\sigma_u/u_* \approx 2.3$ (as shown in sections 2–3, and also found for the data sets in the neutral ASL), then $L_{MM}|_{\rm nASL} \approx 2.3z/\kappa \simeq 0.92z$ as given at the beginning of section 2.3.

Chougule *et al.* (2014, e.g. Fig. 5) actually shows agreement with $L_{MM} \sim z$ in the ASL ($z = 20$m) at Høvsøre (though their analysis is only for U between 7–8 m/s). At Ryningsnäs, when accounting for the displacement height ($d \simeq 13$m) then their results are again consistent with the above, with $L_{MM} \approx z - d$ or actually slightly larger (though affected by roughness-sublayer effects above the forest there).

> "3. So what is the reason for the differences between Peña *et al*. (2010)/Chougule *et al*. (2014) and your results? Could it be the way the velocity spectra was analyzed (you seem to extract the Mann parameters from each individual 10-min record whereas Peña *et al*. (2010)/Chougule

et al. (2014) ensemble average spectra for different turbulence conditions)? What is the uncertainty of the fit when performed on each 10-min case?"

As noted in my response to point 2 above, in the *neutral surface layer* there are not significant differences.

Overall, the increase of L_{MM} in unstable conditions is significantly larger than the decrease in stable conditions, as also implied e.g. in Sathe *et al.* (2012). The vertical range and extent to which $\langle L_{MM} \rangle \sim z$ in all conditions depends on the (relative) widths of the stable- and unstable sides of the stability distribution $P(1/L)$ as well as the distribution of ASL depth.
As for the uncertainty on spectrally-fit L_{MM}, this is beyond the scope of the current article—though I do note that the fit was improved markedly by rejecting $\Gamma > 4.95$ (which corresponds to the fit using the highest Γ of the lookup-table of Mann-model outputs), and such rejection roughly appeared to eliminate potential bias in L_{MM}; the latter is included as a footnote in section 3.2. Continuing work includes checking such fitting uncertainty/variability, as well as analysis per wind speed bin.

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