

Initial manuscript evaluation of the paper:

“Evaluation of Wind Profiles from the NERC MST Radar, Abeystwyth, UK”
by Christopher F. Lee, Geraint Vaughan and David A. Hooper

SYNOPSIS:

The paper attempts a quantitative assessment of the uncertainties of wind measurements with the 46.5 MHz Aberystwyth MST radar due to

- a non-homogeneous wind field due to gravity waves
- echo power aspect sensitivity
- hardware issues (aging)

based on comparisons with independent upper-air wind measurements by radiosondes. The various effects are carefully discussed and comprehensively analyzed.

GENERAL COMMENTS:

The topic is very relevant from an application oriented view and the manuscript is well written. It is definitely suitable for publication in AMT.

SPECIFIC COMMENTS:

Abstract

- (1) The following sentence in line 5 and 6 is unclear and a bit confusing:
“...suggesting an influence from local mountain waves; this is an important consideration when using radar winds as a measure of regional conditions.”
There are two points that must not be mixed and should be mentioned more clearly: 1.) Every wind estimate from an active monostatic remote sensing system is necessarily a retrieval with implicit assumptions regarding the wind field (e.g. homogeneity or a linear wind field). Any violation of these assumption leads to errors which are difficult to quantify since the true atmospheric flow field is unknown. 2.) There is always a discrepancy between the scales resolved by current NWP models and the local measurements of a particular sensor. The mismatch of these scales is called sampling error or error of representativity. Both points need to be mentioned and separated more clearly since they are different effects.

Introduction

- (2) The introduction appears to be a bit long, with some potential for shortening.
- (3) Line 20-22: Most boundary layer radar wind profilers in Europe and Asia operate at L-band (1.29 or 1.357 GHz), while UHF (915 MHz) is frequently use in North America. This definition of the radar bands follows the “IEEE Standard Letter Designation for Radar-Frequency Bands” according to IEEE Std 521-1984. By the same token, free troposphere and lower stratosphere are also covered by UHF systems (e.g. 404, 449, 482 MHz radars) and not only VHF.
- (4) Line 22-23: The minimum achievable temporal resolution of wind measurements with these radars depends on the state of the atmosphere. For example: It will be difficult to perform wind measurements with 10 min resolution in a convective boundary layer since the usual retrieval assumptions (e.g. homogeneity) are not fulfilled and averaging is required to “restore” these assumptions in a statistical sense for the mean wind field. The authors are invited to comment on the limitations of this assertion.
- (5) Line 46: The vertical velocity components from opposing beams cancel only under the assumption of a homogeneous wind field – this limitation needs to be explicitly stated.
- (6) Line 71: In reality, the radiosonde measurement is also no point measurement at any one time. Averaging of the GNSS derived sonde position is required to eliminate the artificial pendulum motion of the sonde underneath the balloon and to minimize the effect of GPS receiver noise. Data are therefore typically smoothed over about 40 seconds, which indirectly implies a vertical averaging of the wind measurements over about 200 m. This is clearly no point measurement.

Radar and Radiosonde Measurements

- (7) Line 175-176: The paper quotes from Nash et.al. (2011): “*The standard error in radiosonde winds is less than 0.5 ms^{-1}* ”. Does this refer to single components (u,v) or the wind speed $\sqrt{u^2+v^2}$ or is this the magnitude of the vector difference ?
- (8) Line 179: “*Radial velocities from oblique beams can be combined to give vertical velocity...*” Again, this statement is only correct under assumptions regarding the wind field, which are however not mentioned. In this sense, equation 7 provides a measure of the non-homogeneity of the wind field.
- (9) Line 194-195: “*..wind speed is over-estimated below 10 km, and under-estimated above*”. Do the authors have an explanation for this height-dependent bias ?

Results and Discussion

- (10) Line 254-255: “*At low SNR, the signal processing struggles to identify atmospheric signals...*” Suggest changing the formulation in the following way: At low SNR, the probability of detection of the atmospheric echo signal is reduced....

Conclusion

- (11) Line 313-314: “*Faced with such a range, the typical practice of quoting a single value for wind velocity uncertainty is clearly inadequate.*” The statement is obviously correct, but it is questionable that this is the typical practice. For example: The RMS observation error for the wind vector components in the ECMWF model is prescribed as a function of height (in pressure coordinates), see e.g. the current documentation of the IFS available at www.ecmwf.int .
- (12) As the typical measure for wind uncertainty in an NWP context is the RMS vector difference or the RMS of the vector components, it would be highly welcome if the authors could provide either measure as a function of height.

Figures

- (13) It would be desirable to have some Figures, for example Fig. 5 (a), in color for a better readability.

References

- (14) Line 355: Typo: Ruster → Ruster
- (15) Line 382: Typo: Vomel → Vömel
- (16) Line 387: Typo: Srinivasa → Srinivasa Rao