Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., author comment AC2
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Reply on CC1

Ryan Volz et al.

Author comment on "Four-dimensional mesospheric and lower thermospheric wind fields using Gaussian process regression on multistatic specular meteor radar observations" by Ryan Volz et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-40-AC2, 2021

We appreciate your concern. We believe there is a misunderstanding, since our Doppler-derived line-of-sight velocity measurements are no different than what have been used for decades to estimate winds from specular meteor scatter, including the Hocking et al. (2001) and Holdsworth et al. (2004) papers cited in the first paragraph of section 2. At least for an ideal meteor trail, we agree with the motion and measurement depicted in your figure. The trail moves from (A) to (B) with a given velocity, and we measure the projection of this velocity onto the line of sight which moves the reflection point from (A) to (C). Where we disagree is that this "creat[es] an apparent vertical motion" in the first case or "horizontal motion" in the second case. Yes, the projection has a vertical (horizontal) component, but that does not mean that we conclude from those measurements that the wind velocity has a vertical (horizontal) component. From a single measurement, we can't know what the full velocity vector is. But by combining nearby measurements with assumptions about the smoothness of the wind field and quantification of the measurement uncertainty, we can estimate the complete wind velocity vector. The measurement geometries provided by the multistatic configuration allow for such "overlapping" measurements of different meteors with a diversity of projection directions, so this works well in many cases. More importantly, we also know when we don't have sufficient information to resolve the full wind vector, and the estimate uncertainties reflect that. Indeed, the uncertainties for the vertical wind component are generally higher than the horizontal components relative to the mean because we observe relatively few meteor trails with a large vertical line of sight projection (trails close to horizontal). We hope this addresses your concern and clarifies the technique.