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Relative contributions from meandering and turbulence to dispersion

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Meandering of the wind vector can be attributed to a variety of mesoscale motions but its origin and dynamics are still unknown. It has been shown to affect horizontal dispersion under weak-wind conditions. However, the effects of meandering on the dispersion are not easily separated from the turbulence. Namely, using the fixed averaging length that separates turbulence from the mesoscale can incorporate part of the mesoscale spectrum into turbulence and artificially enhance the turbulence contribution to the dispersion.

Here we show the separate contributions of the turbulence and meandering on the dispersion. The distinction between the turbulence and mesoscale motions is based on the multiresolution flux decomposition. The dispersion is studied using a Lagrangian stochastic particle model, where the wind field for the model is taken from the observations. The results show that the contribution of meandering to the time-averaged horizontal dispersion is dominant under all atmospheric conditions: weak and strong winds, and unstable and stable stratification. The meandering motions are also shown to be responsible for streaks and multimodal distributions of the time-averaged horizontal concentration patterns.