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The influence of mesoscale modes on horizontal dispersion and turbulence diffusion for stable conditions

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The bulk formulation for surface fluxes based on surface-layer similarity theory is found to be a poor approximation for weak-wind stratified conditions. These conditions are often nonstationary with very weak turbulence and have been generally excluded from analysis. As a consequence of such exclusion and the failure to account for self-correlation in the bulk aerodynamic formulation for the surface stress, the validity of the similarity theory has been overestimated for weak-wind stable conditions.

Special attention is devoted to the difficulty of estimating turbulence in weak-wind nonstationary conditions. Four months of turbulence data from FLOSSII are analysed to generalise the bulk formula to include the influence of the nonstationary (mesoscale meandering) part of the flow on generation of turbulence. This generalization leads to more systematically variation of the drag coefficient for weak-wind stable conditions. Excluding cases of significant nonstationarity of the wind field also leads to more systematic behavior of the drag coefficient, although such exclusion removes the majority of the most stable cases creating climatic bias. A modified bulk formula is developed. Additional data needs for establishing confidence for application to numerical models are briefly noted.

Additional datasets are incorporated to study the statistical behaviour of the mesoscale meandering and variation of such motions between sites. The meandering modes often take the form of shifts in wind direction rather than oscillation. The impacts on dispersion are demonstated