The random sweeping decorrelation hypothesis in stratified turbulent flows

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Longitudinal velocity measurements above a uniform dry lakebed were carried out to investigate the applicability of the random sweeping decorrelation hypothesis to thermally stratified turbulent flow. The higher order velocity structure functions of order $m$ were measured and modeled using the sweeping decorrelation hypothesis. In order to reduce the influence of Taylor’s frozen hypothesis on the assessment of the sweeping decorrelation hypothesis, two dimensionless quantities, developed by Praskovsky et al. (1993), were used. Based on these dimensionless quantities, the sweeping decorrelation hypothesis predictions agreed well with the higher order structure function measurements. Assumptions inherent in the sweeping decorrelation hypothesis were also considered. It was found that strong interaction existed between the energy containing scales and the inertial subrange scales, indicating that the sweeping action alone does not fully describe the higher order structure function. Also, local temperature-velocity interactions were measured and found to be significant thus weakening the validity of the sweeping decorrelation hypothesis. However, these two interaction mechanisms appeared to be opposite in sign and counteracted each other.