TURBULENCE MEASUREMENTS ABOVE STEEP TERRAIN DURING GAUDEX 2003

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Abstract: Three turbulence towers were deployed across a steep-sided ridge as part of GAUDEX 2003. The ridge has a triangular cross-section, an average height of 200 m, cross-ridge width 300 m and along-ridge length of about 1 km. The ridge has maximum slopes of 45 degrees near the sharply defined ridge crest. This topography facilitates turbulent lee-slope flow separation. Associated flow features were measured with an array of 27 automatic weather stations, 2 sodars, and 6 turbulence sites. Three of the turbulence sites located at the crest and 50 m down both slopes, consisted of 3-axis ultrasonic anemometers at heights of 7.5 m and 15 m providing 5 Hz data. Reynolds stress and sensible heat flux components were calculated for each height as eddy covariances over a 10 minutes averaging period. Streamline elevations of up to 60 degrees from horizontal were observed during the experiment, offering a unique test of post-processing techniques used to transform turbulence data into mean streamline coordinates. Results applying both double rotation and planar fit methods are compared. The double rotation method involves coordinate transformation each averaging interval while the planar fit method involves calculation of a constant rotation matrix for a given dataset. Correlation between turbulent heat fluxes computed using both methods is good at all sites, while momentum fluxes are poorly correlated. The application of a planar fit method at the sharp crest is found to be limited. Fluxes during case study periods when mean flow is cross-ridge at all levels are also compared and related to the mean flow measurements.