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Statistics of Turbulence in the Stable Boundary Layer Affected by Gravity Waves

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In order to investigate effects of interactions between turbulence and gravity waves in the stable boundary layer on similarity relationships, we re-examined a data set, collected during three April nights in 1978 and in 1980 on the 300 m tower of the Boulder Atmospheric Observatory (BAO). The BAO site, located in Colorado (USA), 30 km east of the foothills of the Rocky Mountains, has been known for frequent detection of wave activities. The considered profiles of turbulent fluxes and variances were normalized by three local, gradient-based scaling systems, and subsequently compared with similarity functions of the Richardson number, obtained based on data with no influence of gravity currents and topographical factors. The first scaling system was based on local values of the vertical velocity variance σw and the Brunt-Väisäla frequency N, while the second one on the temperature variance $\sigma\theta$ and N. The third system used the length scale Lz independent of stability, but dependent on height z and the depth of the neutral boundary layer ho. Analysis showed that wave activities can produce significant departures from similarity functions, obtained for data with virtually no influence of mesoscale motions, nonetheless the overall dependency of dimensionless moments on the Richardson number is maintained.