Similarity scaling in a complex mountain valley boundary layer

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Monin-Obukhov Similarity Theory (MOST) is evaluated in case of truly complex mountainous terrain. Two years of data, originating from 6 different sites, in terms of slope, surface roughness and orientation in the Inn Valley of Austria, are used for this purpose. Surface-layer 'ideal' similarity relations for non-dimensional standard deviations of temperature, humidity and wind components are employed as reference and compared with the best-fit curves to the data, for every site individually. It is observed that the non-dimensional temperature variance increases when approaching neutrality, as a consequence of temperature variance not going to zero when sensible heat flux does. This is not reflected in the ideal-terrain MOST relations, producing large deviations from the reference curve within the near-neutral limit. These deviations are, however, not considered to be failure due to complex terrain, but rather due to inadequate near-neutral behavior of the reference curves. In this study, therefore, the high near-neutral variance is being taken into account in both the reference and the fitted relations. Self-correlation of each studied variable, as well as the variation of the turbulent fluxes with height is examined, as background information. The results show that these mountainous sites do not follow MOST, but they seem to be in good agreement with a local scaling assumption. Significant differences are found in the non-dimensional variances between the sites. The dependence of those local similarity relations on slope will be discussed in detail.