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Boundary layer characteristics and turbulent exchange mechanisms in highly complex terrain

Mathias W. ROTACH[1], Marco ANDRETTA[2], Pierluigi CALANCA[3], Andreas P. WEIGEL[1], and Alexandra WEISS[4]

[1]Federal Office for Meteorology and Climatology, MeteoSwiss, Zurich, Switzerland
e-mail: mathias.rotach@meteoswiss.ch

[2]Department for the Environment, Canton Ticino, Bellinzona, Switzerland

[3]ART Reckenholz, Zürich, Switzerland

[4]British Antarctic Survey, Cambridge, UK

A b s t r a c t

The Mesoscale Alpine Programme's Riviera project investigated the turbulence structure and related exchange processes in an Alpine valley by combining a detailed experimental campaign with high-resolution numerical modelling. The present contribution reviews published material on the Riviera Valley's boundary layer structure and discusses new material on the near-surface turbulence structure. The general conclusion of the project is that despite the large spatial variability of turbulence characteristics and the crucial influence of topography at all scales, the physical processes can accurately be understood and modelled. Nevertheless, many of the "text book characteristics" like the interaction between the valley and slope wind systems or the erosion of the nocturnal valley inversion need reconsideration, at least for small non-ideal valleys like the Riviera Valley. The project has identified new areas of research such as post-processing methods for turbulence variables in complex terrain and new approaches for the surface energy balance when advection is non-negligible. The exchange of moisture and heat between the valley atmosphere and the free troposphere is dominated by local "secondary" circulations due to the curvature of the valley axis. Because many curved valleys exist, and operational models still have rather poor resolution, parameterization of these processes may be required.

Key words: MAP, complex terrain, boundary layer, valley wind, slope wind, turbulent exchange, high-resolution numerical modeling, turbulence parameterisation.