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Turbulence measurements in an Alpine valley: The CividatEX Experiment case

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Results regarding the analysis of turbulence data, collected during Summer 2012, 2013 and 2014 in the framework of the CividatEX Experiment, are presented. The CividatEX Experiment, kicked off in July 2012 and still ongoing, aims at quantifying the mass and energy fluxes exchanged at the soil–atmosphere interface in an Alpine valley. A micro–meteorological station, equipped with standard meteorological devices, four TDR probes, soil heat–flux plate, soil thermometers and an eddy–covariance system (sonic anemometer and gas analyser), was installed on the valley floor of Valle Camonica at Cividate Camuno ($274\,\mathrm{m\,a.s.l.}$, Oglio river basin, Central Italian Alps).

The experimental site is a gentle–sloping Technosol lawn, covered by common grass and surrounded by a steep hill (E and S) and by an anthropized landscape (W and N). Such complex terrain conditions affect the wind regime that, especially during fair weather conditions, is mainly regulated by thermally–driven winds. At least three winds were recognized, i.e. (1) the local wind *Óra del Sebino* (WSW, speed ranging from 2 to 4 $\mathrm{m\,s^{-1}}$), which rises the valley from Lake Iseo (*Sebino*) in the afternoon; (2) a katabatic flow with small speed (from 0.5 to 1.5 $\mathrm{m\,s^{-1}}$) blowing down the hillslope (directions ranging from E to SE) since the evening to the sunrise; and (3) an up–slope cross–valley wind (W, from 0.5 to 1.5 $\mathrm{m\,s^{-1}}$) flowing in the late morning.

The 15 and 30–minutes eddy–covariance fluxes of momentum (τ), latent heat (λE) and sensible heat (H_s) were estimated using the software EddyPro. The surface energy imbalance was calculated as $1-(\lambda E+H_s)/(R_n-G)$, where R_n and G are the net radiation and the ground heat flux respectively. For all the three data–sets the imbalance assumes values ranging between 0.3 and 0.4. A dependence of its magnitude from the atmospheric stability and from the blowing wind was observed. In fact the imbalance reduces during unstable conditions, when the *Óra* occurs, and it increases during the night when the wind speed is small and stable conditions are approached.

The separation of the turbulent components from the low–frequency unsteadiness of the mean–flow was investigated by means of three different approaches, that are the block average, the linear detrending and a digital recursive–filtering technique. The obtained dimensionless standard deviations of the wind velocities and of the temperature fluctuations were analyzed in the framework of the Monin–Obukhov similarity theory by checking their thickening on the similarity relationships. Due to the presence of meaningful unsteadiness during the investigated time–windows, the block average and the linear detrending were less effective than the recursive–filtering procedure at separating the turbulent fluctuations from the mean–flow.