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Can single-point measurements near a mountain ridge top give evidence of an airflow direction over the ridge?

Pavel Sedlak (1), David Hanslian (1), Jiri Hosek (1), Dalibor Janous (2), and Katerina Potuznikova (1)

(1) Institute of Atmospheric Physics AS CR, Prague 4, Czech Republic (SEDLAK@UFA.CAS.CZ, 00420-272763745), (2) Institute of Systems Biology and Ecology AS CR, Brno, Czech Republic

The Fluxnet site Bily Kriz in the Czech Republic is located near the top of a forested mountain ridge. Flow directions across the ridge (i.e. upslope or downslope) strongly prevail at the site. Our experience gained so far suggests that an analysis of the Bily Kriz data (both the flux data and the results of special field experiments) should be done separately for the cases when the site is on the upwind, resp. downwind side of the ridge. However, the flow is retarded on the downwind site or it can be even reversed. Therefore the mean wind velocity direction recorded at the point of the standard eddy covariance measurements is not always suitable for separating the data sets into the upwind and downwind classes. The aim of the present study is to find out if the single point wind data still carries some information about the larger-scale flow direction over the ridge.

The NCEP/NCAR reanalysis provided the data on the larger-scale (or "outer") flow, which was related to quantities derived from the half-hour averages of the post-processed signals of the ultrasonic anemometer being part of the eddy covariance system at Bily Kriz. When the site is on the downwind side of the ridge, the wind speed above the canopy is relatively low. At the same time, the wind speed at higher levels (in the upper part of the wake) is typically large. This implies an existence of a strong wind shear zone, and explains the relatively high values of the friction velocity that are detected at the measurement point. Thus the ratio of the friction velocity to the mean wind speed (i.e. so called "cup wind speed") is relatively high in the downwind cases. It follows from the Bily Kriz data analysis that there is quite a well-defined threshold value of the above mentioned ratio that can be used to separate the downwind cases from the upwind cases with respect to the larger-scale flow.