Geophysical Research Abstracts
Vol. 18, EGU2016-11280, 2016
EGU General Assembly 2016

Influence of seasonal canopy development on turbulent flow characteristics in a hedgerow vineyard

Nadia Vendrame (1), Luca Tezza (1), Kyaw Tha Paw U (2), and Andrea Pitacco (1)

(1) Department of Agronomy, Food, Natural Resources, Animals and Environment, University of Padova, Legnaro (PD), Italy, (2) Department of Land, Air and Water Resources, University of California, Davis, USA

Turbulence is the main driver of vegetation-atmosphere exchanges. Flow characteristics determine the transport of energy and matter between different layers of the canopy and the atmosphere, defining local microclimatic conditions and influencing physiological processes of the vegetation. Therefore, studying turbulent flow dynamics inside and above the canopy is crucial to correctly predict overall fluxes of matter and energy and to understand their nature. Numerous studies have already investigated the characteristics of canopy turbulence over a wide range of vegetation types, leading to a thorough description of canopy turbulence. However, only a few studies have investigated the influence of gradual canopy structural changes such as foliage density (on multi-day time scales) on turbulence field properties. We hypothesize that seasonal variations of foliage density play a crucial role modifying foliage drag and canopy roughness, determining the degree of coupling between vegetation and the atmosphere, and changing the profiles of turbulent moments.

The aim of this study was to follow the continuous evolution of turbulent flow characteristics from leaf budbreak to fully developed foliage in a hedgerow vineyard in the North East of Italy. Synchronous measurements from a vertical profile of five sonic anemometers on a 5 m tower have been collected at 20 Hz from beginning of April to end of July 2015.Detailed measurements of Leaf Area Density (LAD) profile and canopy architecture were performed at regular intervals (ca. weekly) around the tower.

The canopy bulk drag coefficient increased during the growing season, suggesting that the coupling between the vegetation and the atmosphere increased with LAD. Vertical profiles of turbulent statistics showed to be highly correlated to local values of LAD. The penetration of momentum flux in the canopy decreased with the gradual increase of foliage. Most of the drag was exerted by the part of the canopy with denser foliage, this level moving upward during the growing season. Skewness of horizontal (Sk_u) and vertical (Sk_w) wind suggested that momentum transport in the canopy is dominated by intermittent downward gusts (sweeps). Without leaves the peaks of $Sk_u$and Sk_wwere both located in the lower part of the canopy, while during the growing season the magnitude of both values became larger, showing how sweep penetration decreased as LAD increased.The evolution of geometrical structure of the canopy imposed a strong directional behavior on mean wind, gradually increasing wind channeling effect in the lower part of the canopy.