

Fluxes across boundaries: plants shaping their own environment

Plants can survive in very variable and diverse environments, facing strong physical forcings like heavy radiation loads, extreme temperature and discontinuous water availability. Exploiting their position at the soil–atmosphere interface and leveraging basic thermodynamical processes, they can successfully handle their metabolism, growth and development in a broad spectrum of conditions. Exposed to rhythmic gradients (of temperature, moisture, carbon dioxide, etc.), they respond by establishing strong fluxes of heat and matter with the surrounding atmosphere, themselves altering local microclimate. While the physiological control of water vapor and carbon dioxide have been classical research themes of plant ecophysicists for a long time, they have seldom focused on the relevance of external factors affecting – and possibly “regulating” – these fluxes.

External factors are mostly related to the variable conductance of the air around leaves, linked to the kinematics of the boundary–layers which can be irregularly dominated by laminar or turbulent regimes as wind gusts penetrate and interact with the canopies. The dynamic partitioning of kinematic regime has huge consequences on air mixing and therefore on boundary–layer conductance and transport processes. While any analysis of flux–gradient relationships– at any scale (leaf, plant, plot) – is usually performed at the steady–state, transient conditions can lead to an enhanced variability in the local microenvironment, including plant organs.

Starting from a thorough analysis of physical principles determining leaf and canopy energy–budget partitioning, the presentation will deal with fundamental properties of canopy microclimate as measured in a properly instrumented vineyard belonging to the Integrated Carbon Observation System network, operated for 10 years by the University of Padua.