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Eddy covariance measurements of ozone fluxes at 4 levels above and within a forest canopy in the Po valley (Italy)

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In June and July 2012, during the intensive field campaign of the ECLAIRE project, ozone fluxes as well as sensible heat and momentum fluxes were measured at four different levels at the Bosco Fontana site, a 26 m tall mixed oak-hornbeam forest in the Po valley (I). Each measuring level (41 m, 32 m, 24 m and 16 m) was equipped with a sonic anemometer and a fast ozone analyser, absolute ozone concentrations were measured by means of a UV photometer. Additional meteorological parameters were measured on the top and at each level and ozone concentrantions were measured at ground level (0.15 m) by another UV photometer.
In order to compare measurements collected with different instruments, data were preliminary processed and the following methodology were applied: despiking, instantaneous rotations, WPL corrections, frequency loss corrections and calculation of the random error.
The main aims of this field campaign were the description of the deposition processes within and above canopy and the test of the constant flux hypothesis. About this latter interesting features emerged: the conservation of the flux was valid for the momentum only outside the canopy and no conservation was observed for the sensible heat. On the contrary ozone fluxes showed a much more irregular behaviour: for the three upper levels, ozone fluxes were nearly constant in the first hours of the day while an enhancement of the fluxes was observed at 24 m. This latter fact was strictly linked with the in-canopy dynamics: a greater heating of the canopy was observed in the afternoon, leading to the formation of an inversion at this level. This inversion divided the in-canopy air volume into two layers: the lower one with a stable stratification and the upper one with a turbulent regime; as a consequence of this inversion a remarkable reduction of the ozone concentration was observed for the two lowest levels in the afternoon, when in the lowest layers ozone is consumed by NO emissions from soil.
The ozone canopy uptake was estimated in two different ways: with the big-leaf approach and as a difference of the above and below canopy fluxes. A comparison of the results of these two approaches will be showed.