Geophysical Research Abstracts
Vol. 13, EGU2011-9181, 2011
EGU General Assembly 2011

Fluxes of BVOC and tropospheric ozone from a Citrus orchard in the California Central Valley

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Citrus plants, especially oranges, are widely cultivated in many countries experiencing Mediterranean climates. In many of these areas, orchards are often exposed to high levels of tropospheric ozone (O3) due to their location in polluted airsheds. Citrus take up O3 through their stomata and emit biogenic volatile organic compounds (BVOC), which can contribute to non-stomatal O3 removal through fast gas-phase reactions with O3. The study was performed in a valencia orange orchard in Exeter, California. From fall 2009 to winter 2010, CO2 & water fluxes, together with O3 uptake and BVOC emissions were measured continuously in situ with specific sensors (e.g. fast ozone analyzer and Proton Transfer Reaction Mass Spectrometer) using the eddy covariance techniques. Vertical concentration gradients of these compounds were also measured at 4 heights from the orchard floor to above the canopy. We observed high levels (up to 60 ppb) of volatile organic compounds including methanol, isoprene, monoterpenes, sesquiterpenes, and some additional oxygenated BVOC. Methanol dominated BVOC emissions (up to 7 nmol m-2 s-1) followed by acetone. Monoterpenes fluxes were also recorded during the all vegetative period, with the highest emissions taking place during flowering periods, and in general highly temperature dependent. The orchard represented a sink for ozone, with uptake rates on the order of 10 nmol m-2 s-1 during the central hours of the day. We found that BVOC played a major role in removing ozone through chemical reactions in the gas-phase, while only up to 40 % of ozone was removed via stomatal uptake. The current research aimed at investigating the fate of BVOC emitted from orange trees will help understanding the role of Citrus orchards in the complex oxidation mechanisms taking place in the polluted atmosphere of the San Joaquin Valley (California).