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Drought impact on *Quercus pubescens* Willd. isoprene emissions over the Mediterranean area: what future?

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Biogenic Volatile Organic Compounds (BVOCs) released by plants mostly originate from their secondary metabolism. Their emissions are modulated, in terms of intensity and molecule diversity, by environmental conditions. Among BVOCs, isoprene has been especially studied due to its high emission fluxes and its contribution to tropospheric photochemistry, both in the gaseous and particulate phases. However, the way isoprene emissions are impacted by some abiotic factors, especially water stress, is still under debate. In a world facing climatic changes, global climate models expect air temperature and drought intensity to strengthen in the Mediterranean area by 2100.

Our work focuses on the impact of water stress on isoprene emissions (ERiso) from *Quercus pubescens* Willd. This species covers large areas of the Mediterranean area where it appears to be the main isoprene emitter. An *in situ* experimentation was performed at the O_3HP (Oak Observatory at OHP, southern France) in a pubescent oak forest with trees adapted to long lasting stress periods. We investigated during a whole seasonal cycle (from June 2012 to June 2013) the course of ERiso under both natural water stress (control treatment: C) and intensified water stress (stress treatment: S) by artificially reducing rain by 30% using a specific rain exclusion device. Restricted rain did not modify either the net CO_2 assimilation or ERiso during the whole season. However, isoprene emission factors (Is) for trees under S were significantly higher (a factor of ≈ 2) than for trees growing under C in August (137.8 compared to 75.3 μgC.g$_{DM}^{-1}$.h^{-1} respectively) and September (75.3 compared to 40.2 μgC.g$_{DM}^{-1}$.h^{-1} respectively).

Based on our experimental emission database, an appropriate isoprene emission algorithm (GZ2014) was developed using a statistic approach (an artificial neural network). Using ambient and edaphic environmental parameters integrated over up to 3 weeks, GZ2014 was found to represent more than 80% of ERiso variations, during natural and intensified water stress. Soil water content cumulated over 2 and 3 weeks was found to be the dominant parameter among the others considered in GZ2014. In comparison, isoprene seasonal variations at O_3HP were poorly represented by the MEGAN model during both natural and intensified drought periods.

Based on GHG-Europe forcings and ORCHIDEE model outputs, GZ2014 was used to predict changes of *Q. pubescens* isoprene emission between present and 2100. In 2100, maximum isoprene emissions were found to occur earlier (June instead of August) with values 3.5 times higher in 2100 than at present.

Keywords: Biogenic volatile organic compounds (BVOCs), isoprene emissions, water stress, drought, artificial neural network, climate changes, ORCHIDEE.