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Are BVOC exchanges in agricultural ecosystems overestimated? Insights from fluxes measured in a maize field over a whole growing season

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Maize is the most important C4 crop worldwide. It is also the second most important crop worldwide (C3 and C4 mixed), and is a dominant crop in some world regions. Therefore, it can potentially influence local climate and air quality through its exchanges of gases with the atmosphere. Among others, biogenic volatile organic compounds (BVOC) are known to influence the atmospheric composition and thereby modify greenhouse gases lifetime and pollutant formation in the atmosphere.

However, so far, only two studies have dealt with BVOC exchanges from maize. Moreover, these studies were conducted on a limited range of meteorological and phenological conditions, so that the knowledge of BVOC exchanges by this crop remains poor.

Here, we present the first BVOC measurement campaign performed at ecosystem-scale on a maize field during a whole growing season. It was carried out in the Lonzée Terrestrial Observatory (LTO), an ICOS site. BVOC fluxes were measured by the disjunct by mass-scanning eddy covariance technique with a proton transfer reaction mass spectrometer for BVOC mixing ratios measurements. Outstanding results are (i) BVOC exchanges from soil were as important as BVOC exchanges from maize itself; (ii) BVOC exchanges observed on our site were much lower than exchanges observed by other maize studies, even under normalized temperature and light conditions, (iii) they were also lower than those observed on other crops grown in Europe. Lastly (iv), BVOC exchanges observed on our site under standard environmental conditions, i.e. standard emission factors SEF, were much lower than those currently considered by BVOC exchange up-scaling models.

From those observations, we deduced that (i) soil BVOC exchanges should be better understood and should be incorporated in terrestrial BVOC exchanges models, and that (ii) SEF for the C4 crop plant functional type cannot be evaluated at global scale but should be determined for each important agronomic and pedo-climatic region. Moreover, as in our region (i.e. temperate climate, silty-loam soils), SEF observed on maize were much lower than SEF currently considered by models, our results tend to lower the impact of agricultural ecosystems on BVOC exchanges.