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Determination of the isotopic composition of evapotranspiration in a mature oil palm plantation in Jambi province, Indonesia.

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Evapotranspiration (ET) is defined as the sum of the water vapor fluxes from evaporation (E) and transpiration (T). The relative proportion between these two quantities depends on the species, on their age and on the structure of the stand and canopy. Evaporation represents the fraction of water that doesn't contribute to plants growth hence it often considered as "unused" water by the plants root system. For this reason, in a fast changing environment like Indonesia where, since almost 30 years, tropical rainforests are gradually converted into extensive oil palm plantation, it is important to quantify the amount of evaporated water to improve agricultural practices and water quality. As powerful tracers of the hydrological cycle, water stable isotopes represent an important tool to estimate the isotopic composition of the evapotranspiration flux and they can be used as a starting point for the determination of the T/ET ratio, which can be considered as a plant water uptake efficiency indicator.

The isotopic composition (δD$_v$and δ^{18}O$_v$) and the mixing ratio (q$_v$) of water vapor measured in a stand is the result of the isotopic mixing between two members; ecosystem evapotranspiration (δ_{ET}) and background air (δ_a). With the implementation of laser-based isotopic analysers we are now able to improve the measurement frequency of δD$_v$and δ^{18}O$_v$ that leads us to an improved estimation of δ_{ET}.

Here we present the results of a measurement campaign, performed with a Picarro L-2120i and conducted in a mature oil palm plantation in the province of Jambi, Indonesia. We measured the atmospheric water vapor mixing ratio and isotopic composition at 5 sampling heights (21 m, 16 m, 9 m, 3.5 and 0.3 m) along a flux tower throughout the oil palm canopy (average height 10 m). The range of the water vapor isotopic composition was between -19 and -11 and -134 and -82 ‰ for δ^{18}O$_v$ and δD$_v$respectively. A fairly open canopy structure resulted in small mixing ratio gradients along the vertical profile. We collected and analysed all rain event and estimated the variability of the water vapor isotopic composition. Micrometeorological measurements, provided by the tower's sensors, were used to calculate ET using the Bowen ratio energy balance. To determine the isotopic composition of the evapotranspiration flux we used and compared two different methods: Keeling plot and flux gradient approach.