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Leaf water enrichment of stable water isotopes (δ18O and δD) in a mature oil palm plantation in Jambi province, Indonesia.

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During the last few decades, Indonesia experienced rapid and large scale land-use change towards intensively managed crops, one of them is oil palm. This transition results in warmer and dryer conditions in microclimate. The impacts on the hydrological cycle and on water-use by plants are, however, not yet completely clear.

Water stable isotopes are useful tracers of the hydrological processes and can provide means to partition evapotranspiration into evaporation and transpiration. A key parameter, however, is the enrichment of water stable isotope in plant tissue such as leaves that can provide estimates on the isotopic composition of transpiration.
Here we present the results of a field campaign conducted in a mature oil palm plantation in Jambi province, Indonesia. We combined continuous measurements of water vapor isotopic composition and mixing ratio with isotopic analysis of water stored in different pools like oil palm leaves, epiphytes, trunk organic matter and soil collected over a three days period.

Leaf enrichment varied from -2 ‰ to 10 ‰ relative to source (ground) water. The temporal variability followed Craig and Gordon model predictions for leaf water enrichment. An improved agreement was reached after considering the Péclet effect with an appropriate value of the characteristic length (L).

Measured stomatal conductance (gs) on two different sets of leaves (top and bottom canopy) was mainly controlled by radiation (photosynthetically active radiation) and vapor pressure deficit. We assume that this control could be explained in conditions where soil water content is not representing a limiting factor. Understanding leaf water enrichment provides one step towards partitioning ET.