

Comparison of microclimate in various land-use systems in Sumatra, Indonesia

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Deforestation and land-use changes are ongoing problems for rain forests in Indonesia. The conversion of forests to monocultures of rubber and oil palm plantations reduces not only biodiversity and carbon pools but also affects canopy structure, which is an important determinant of microclimate. There is, however, a lack of quantitative information characterizing the effect of land transformation on microclimate with a systematic experimental design.

Here, we report observations microclimatic conditions (air temperature, relative humidity, soil moisture and soil temperature) on a daily, weekly and seasonal basis across four land-use systems (rain forest, jungle rubber, rubber plantation, oil palm plantation) in two near-by landscapes. The data set covers a period of approximately three years from April 2013 to March 2016 and includes one of the strongest El Nino-Southern Oscillation (ENSO) of the last decades.

Mean air temperature, soil temperature, relative humidity, and vapour pressure deficit differed significantly between the four land-use systems whereas the mean soil moisture differed significantly between two landscapes. Air temperature, vapour pressure deficit and soil temperature were highest in oil palm and rubber plantations whereas lowest in forest and jungle rubber. Canopy openness was the most dominant control of microclimatic differences across the land-use systems. During the ENSO 2015, a significant increase in mean air temperature, soil temperature and vapour pressure deficit but a decrease in relative air humidity and soil moisture in all four land-use systems was found. The relative effect of ENSO was highest in forest and jungle rubber compared to rubber and oil palm plantations. In conclusion, conversion of forest to rubber and oil palm plantations has led to substantially warmer and drier microclimatic conditions than before.