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Hydraulic conductivity of tropical peat soil in natural and planted forest in East Sumatra, Indonesia: implications for runoff generation

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The form of peatlands and how they function depends strongly on their hydrological status, which in turn depend largely on their peat soil hydraulic conductivity (K). It has been suggested that clearing and drainage of tropical peat swamp forests can alter their hydrological functioning primarily due to peat decomposition and subsidence. However, despite this, little detail is actually known about the effect of land use change on the magnitude or variability of K in tropical peatlands. In an attempt to fill this knowledge gap we measured K of an ombrotrophic tropical peatland under contrasting land use types in Riau, East Sumatra. Saturated horizontal hydraulic conductivity (Khsat) was measured at eight depths starting from 0.5 m until 2.50 m soil depth at an interval of 0.25 m, in two major land use types in the area viz. undisturbed natural forest and Acacia plantations (ca. 3-years-old and. ca. 5-years-old). Near-surface (0.5–1.0 m) median Khsat values were highest for the natural forest (34–43 m day-1) and were lowest for the 5-years-old Acacia plantation (3–5 m day-1). A similar pattern with depth was observed for the three sites in that the Khsat decreased exponentially down to a depth of 1.25 m and thereafter remained consistently low. This decrease with depth was uncorrelated with dry bulk density. Moreover, below 1.25 m depth difference in Khsat between the respective land use types were mostly non-existent, indicating the lack of influence exerted by the land use change on the deeper soil layers. The higher median near-surface Khsat for 3-years-old Acacia plantation as compared to that for the 5-year-old Acacia plantation indicates that that K declines as the peat decomposes and because of that the effect of drainage on peat decomposition may be self-limiting to some extent. Our results further suggest the need to take into account land use change effect on Khsat and its vertical distribution when evaluating the changes in hydrological response due to land use change in tropical peatlands.