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The impact of land use change on the energy and water fluxes between atmosphere and tropical vegetation in Central Sulawesi, Indonesia

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The conversion of tropical rain forest to agriculturally used land is a spreading process throughout Indonesia. Besides the effects on the biological diversity and the hydrological functions of a forest, this also has an impact on the turbulent exchange processes between vegetation and atmosphere, the radiative properties of the surface and therefore on atmospheric boundary layer and local climate. Within the framework of the project STORMA "Stability of rain forest margins" (SFB 552, University Goettingen, financed by the German Research Foundation), the energy and water fluxes above a Cacao agroforestry system (AFS), a common and profitable land-use in Central Sulawesi, Indonesia, were investigated using the Eddy-Covariance (EC) technique. Simultaneous measurements of meteorological variables and the components of the radiation budget were conducted to investigate the dependencies of the turbulent exchange processes on canopy and atmospheric boundary layer conditions. A SVAT model was used to compute the heat exchange between canopy and atmosphere, to conduct a plausibility test to the measured fluxes, and to investigate the component fluxes. Measurements were conducted for one year.

Energy balance closure showed to be significantly different for the morning and the afternoon boundary layer. Eddy-Covariance measurements included canopy surface infrared temperature and photosynthetic active radiation (PPFD) to investigate the response of the energy fluxes to changes in radiation and canopy surface temperature. The results show a significantly different response in the diurnal cycle, that we analysed with respect to the energy balance closure. Analysis of Potential evaporation and evaporation rate give indication of internal boundary layer growth and local advection

for the morning hours.

The sensible heat flux showed an unexpected large contribution to the total turbulent heat transport compared to other tropical land surfaces, and was about equal to the latent heat flux. This resulted in an averaged day-time Bowen ratio of nearly 1. The seasonal course of Bowen ratio coincided with that of precipitation. The comparison to measurements above undisturbed rain forest indicates a significantly different atmospheric boundary layer above the Cacao-AFS. We assessed the hypothesis that partitioning of energy fluxes between surface layer of the atmosphere and vegetation differs fundamentally from that of primary rain forests. We conclude that forest conversion to land-use types as Cacao-AFS leads to enhanced heating of the convective atmospheric boundary layer. This research was funded by the DFG.