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Integrating water and carbon fluxes at the ecosystem scale across African ecosystems

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In this study we report on water and carbon dioxide fluxes, measured using the eddy covariance (EC) technology, from different ecosystems in Sub-Saharan Africa. These sites differed in ecosystem type (C3 plant dominated woodlands to C4 plant dominated grass savannas) and covered the very dry regions of the Sahel (250 mm rainfall, Sudan), the tropical areas in Central Africa (1650 mm in Uganda) further south to the subtropical areas in Botswana, Zambia and South Africa (400-900 mm in precipitation).

The link between water and carbon dioxide fluxes were evaluated for time periods (see also the corresponding abstract by Bruemmer et al.) without water limitation during the peak growing season. Our results show that plant stomata control ecosystem scale water and carbon dioxide fluxes and mediate between plant growth and plant survival. On continental scale, this switch between maximizing carbon uptake and minimizing water losses, from here on called the “Carbon-Water-Tipping Point” was positively correlated to the mean annual growing season temperature at each site.

Even though similar responses of plants were shown at the individual leaf-level scale this has to our knowledge not yet been shown at the ecosystem scale further suggesting a long-term adaptation of the complete ecosystems to certain climatic regions. It remains unclear how this adaption will influence the ecosystem response to ongoing climate change and according temperature increases and changes in precipitation.