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Current and future green and blue water fluxes in Africa under climate and land use change

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Within the context of global change the current and future amount of available fresh water plays a central role for households, industry and agriculture. In turn, these activities put pressure on this resource. Most of the recent studies that perform quantitative assessments of freshwater availability on the regional and global scale are focused on blue water and come to the conclusion that freshwater resources are finite and that many areas already suffer from water stress (Islam et al., 2007; Smakhtin et al., 2004; Alcamo et al., 2003). The concept of green and blue water (Falkenmark, 1995; Röckström 1999) describes the partitioning of precipitation into a vertical return flow to the atmosphere by evapotranspiration processes, and a horizontal return flow, defined by surface runoff, flow to aquifers, river discharge, but also by irrigation water use. Especially in semi-arid and arid regions, evapotranspiration is an important component of the hydrological cycle. Therefore, the consideration of water stored in the atmosphere as vapour might be a source not yet tapped to its full potential. Rainfed agriculture plays a core role in Africa: Especially in sub-Saharan Africa rainfed agriculture accounts for 96.5% of total agriculture, which leads to a strong dependency on green water. There is evidence that this dependency might increase even further under the prospect of future water requirements for agricultural food production due to the projected population growth rates under most of the currently available scenarios. The study assesses the impact of climate and land use change on current green and blue water fluxes on agricultural land in Africa. It evaluates two scenarios developed in context with the UNEP Global Environmental Outlook 4 for a time horizon up to 2050, in order to give an outlook for this global hot spot region of rainfed agriculture.

The study is carried out by linking two state the art models for land use change and hydrology that operate in a spatially explicit manner with grid resolutions of 5 and 30 arc minutes. In the first step, the global land use change model LandShift (Schaldach et al., 2006) is used to simulate the impact of increasing food demand on the spatial extent and intensity of agriculture. Then the global hydrology model WaterGAP (Alcamo, 2003b) is applied to evaluate the combined effect of changing climate and the increasing extent of agricultural area on the green and blue water fluxes. The calculated current and future agricultural water demands are compared to domestic and industrial water demands in order to develop a balance of the total water demands and the total available renewable water resources.

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