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Interaction of vegetation dynamics with water and nutrient cycling: Ecohydrological analysis of heavily modified agricultural fields in the Cerrado of Mato Grosso, Brazil

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Between 1992 and today extensive forest clearance has been ascertained for mechanised agriculture in the state of Mato Grosso (Brazil). Soy production has increased from 3 to nearly 20 Million tons per year in the state and further expansion as well as double cropping is projected. This development will mainly replace the natural vegetation and Biodiversity Hotspot of the Cerrado Savannah. The deforestation process of the Cerrado is - unlike in the Amazon - legally possible, because there are only 2% of the total area under protection. At present, 50% of the Cerrado is agriculturally used and thus it is one of the world's top regions for intensive cash crop production. To produce high biomass yields it is required to apply large amounts of fertilizer, lime and pesticides.
However, the interactions between current crop production under intensive management and the biogeochemical and hydrological cycling on the meso-scale have until now not received much attention. It is believed that the combined effects of land-use change alter soil resources and lead to high concentrations of sediment-attached nutrients with strong impact on water quality in the Cerrado streams and the Pantanal floodplain.
To quantify these effects we want to apply the meso-scale ecohydrological modelling tool SWAT (Soil Water Assessment Tool) to simulate current and future feedback mechanisms of water and nutrient cycling of the Cerrado. The approach allows us to evaluate different management practices on biomass production, water quantity and quality and soil physical properties. To enable modelling we investigated the effects of intensive land-use change on i.) soil resources and ii.) water quality of the Cerrado in the upper Pantanal. To get an insight into the spatial variability of soil properties an extensive field study was conducted to determine key model parameters within different land use types (forest, pasture, cash crops) and management practices in a characteristic meso-scale catchment (900 km^2) under intensive agricultural use. We measured frequent model parameters which include vegetation cover, soil type, ponded infiltration rate and hydraulic conductivity, particle size distribution, soil aggregate stability, soil moisture and nutrient content. To study the spatial variability of physical water parameters and nutrient concentrations, a catchment wide snapshot sampling was conducted. To get an insight of maximum peaks of nutrient and sediment concentrations we focused on event based sampling, too. Statistical analysis is applied to categorise data for the compilation of an ecohydrological data base for Cerrado catchments. Thus, the poster summarises key primary data sets and ranges of soil and water quality parameter within the Cerrado Biome. The overall modelling framework is presented as well as the uncertainties and limitations in parameterisation of the complex ecohydrological model SWAT.
The outcome will enable current and future impact on the water balance and nutrient cycling in intensive agricultural fields of Mato Grosso.