SP 01: Analysis and regionalization of soil degradation and catchment hydrology

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Introduction

Analyzing pedophysical top soil properties is necessary for spatial evaluation of potential degradation and its mitigation. Considering the increasing stress on water resources in humid tropical countries due to rapid deforestation rates and climate change, there is an urgent global research need in humid tropical hydrology and its associated mesoscale catchment processes.
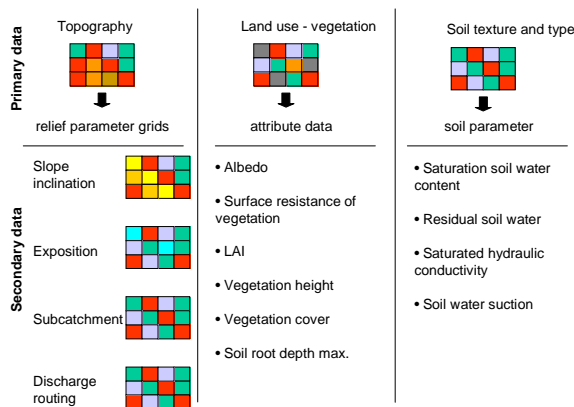
Water balance modeling with WASIM-ETH - Spatial input layer and main parameter

Methods - Hydrology

For the tasks of SP 01, 02 and 03 a well proved spatial nested research design will be build up in the Central Chaco research area. Within the catchment (first level) three sub-catchments (second level) will be selected with: reference (cerrado vegetation), predominant crop cultivation (soybean/corn), pasture. Common transect-plot studies will be placed within these sub-catchments. Within the sub-catchments (third level) micro-catchments (0.5 – 2 ha, three replications) will be selected for the main land use types (cerrado, gallery forest, pasture, soya/corn, multiple cropping), to get specific hydro-chemical data on the influence of crop management. After the first year a similar catchment size (mesoscalic) with research equipment (only for first level catchment with one weir: water level recorder, MPS with CO_2-sensor, AWS) will be selected and set up in the regions of Northern Mato Grosso and South Para .

In order to study the impact of forest conversion, land use change and climate change effects on the water balance of the three main catchments (Central Mato Grosso, Northern Mato Grosso, South Para) we apply the Water Flow and Balance Simulation Model WASIM-ETH. The main processes of water flux, storage and the phase transition of water are simulated. The water balance model is modularly built and can be adapted to the physical characteristic of the catchments area. Climate and land use scenarios will come from the subprojects SP 10, 8+14,12 .

Objectives

To quantify and regionalise human induced soil degradation in relation to land use types and age of forest conversion, and to analyse and simulate consequences of "climate change" and land management on the water balance in catchments.

Methods – Soil degradation

With geo data mining (existing brazilian soil informations) and soil profile analyses from our common plots harmonization and homogenization for soil parameter regionalisation will be done. Based on homogenized top soil attributes (texture, humus content, bulk density) terrain analysis with SAGA GIS can be used for the generation of primary and secondary regional terrain attributes as predictor variables. By multiple regression analysis spatial soil prediction functions can be defined for automated soil mapping applications. Based on false time series of soil data (age of land use impact, different management techniques like minimum tillage, reference site forest or cerrado) similar methodology can be used to assess soil degradation risk and its regional differentiation.

Expected Results

1. a parameterized and tested GIS-module for regionalization of main soil parameter as input for soil degradation assessment, erosion modeling and SOM-decision tool

2. medium-term prediction on hydrological consequences of land use change and climate change in mesoscale catchments (with WASIM-ETH)

3. based on scenario results a catalogue of recommendations to farmers and decision-makers for climate change adaption and land management adaption as well as for "desirable state" of water quality
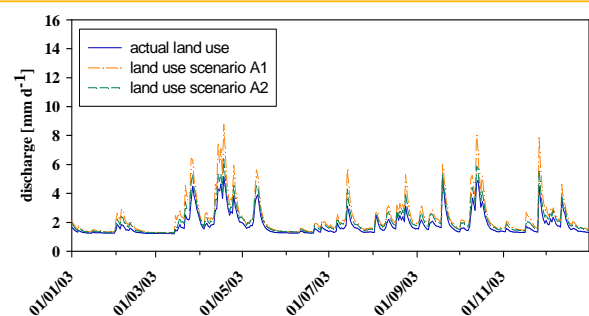
WASIM-ETH simulation of land-use change effects (rainforest conversion: scenario A1 with annual crops, scenario A2 with cacao agroforestry) on the discharge (Gumbasa watershed/Sulawesi)