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Importance of land use update during the calibration period and simulation of water balance response to land use change in the upper Rio das Mortes Catchment (Cerrado Biome, Central-Western Brazil)

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Changes in the hydrological balance and following degradation of the water ecosystem services due to large scale land use changes are reported from agricultural frontiers all over the world. Traditionally, hydrological models including vegetation and land use as a part of the hydrological cycle use a fixed distribution of land use for the calibration period. We believe that a meaningful calibration - especially when investigating the effects of land use change on hydrology - demands the inclusion of land use change during the calibration period into the calibration procedure.
The SWAT (Soil and Water Assessment Tool) model is a process-based, semi-distributed model calculating the different components of the water balance. The model bases on the definition of hydrological response units (HRUs) which are based on soil, vegetation and slope distribution. It specifically emphasises the role of land use and land management on the water balance. The Central-Western region of Brazil is one of the leading agricultural frontiers, which experienced rapid and radical deforestation and agricultural intensification in the last 40 years (from natural Cerrado savannah to cattle grazing to intensive corn and soya cropland). The land use history of the upper Rio das Mortes catchment (with 17500 km^2) is reasonably well documented since the 1970th. At the same time there are almost continuous climate and runoff data available for the period between 1988 and 2011.
Therefore, the work presented here shows the model calibration and validation of the SWAT model with the land use update function for three different periods (1988 to 1998, 1998 to 2007 and 2007 to 2011) in comparison with the same calibration periods using a steady state land use distribution.
The use of the land use update function allows a clearer identification which changes in the discharge are due to climatic variability and which are due to changes in the vegetation cover. With land use update included into the calibration procedure, the impact of land use change on overall modelled runoff was more pronounced. For example, the accordance of modelled peak discharge improved for the period from 1988 to 1998 (with a decrease of primary Cerrado from 60 to 30 %) with the use of the land use update function compared to the steady state calibration. The effect for the following two periods 1998 to 2007 and 2007 to 2011 (with a decrease of primary Cerrado from 30 to 24 % and 24 to 19 % respectively) show only a small improvement of the model fit.