

Application of models to estimate erosion, sediment production and future scenarios in two Brazilian tropical watersheds

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Abstract The main objective of this study was to evaluate the application of two different tools; the USLE (Universal Soil Loss Equation) to estimate soil erosion and the SWAT (Soil Water Assessment Tool) to estimate sediment production in two tropical ungauged basins, subjected to different land uses, located within the state of São Paulo, Brazil. The Guabirobas watershed (51 km²) is used for agricultural production and the Jataí watershed (80 km²) includes the Ecological Station of Jataí (36%), which is a preservation area. The models were effective in identifying areas most susceptible to erosion and sediment production and in simulating different environmental scenarios. The results of USLE epitomized the values expected for the regions whereas the SWAT model was found to overestimate stream flow when compared with monitoring data observed in one of the basins.

Key words erosion; hydrologic processes; hydrographical basin; USLE; SWAT; scenarios

INTRODUCTION

The expansion of agricultural activities in Brazil, mainly the cultivation of sugar cane for the production of biofuels, in addition to the prospect of climate change and intensification of the hydrological processes in the tropics, underlines the need for improvement in rural planning practices, and also requires that future scenarios can be forecasted and assessed. However, data for these ungauged basins are rare, but are essential to support sustainable rural planning in these areas.

Assessing different land uses and their impacts on soil and water resources of a watershed is an extremely important task, which contributes to the understanding of the implications of each management option. In this sense, it becomes increasingly important to conduct intensive studies in watersheds to identify critical areas and their specific management needs.

Mathematical simulation models can assist the investigation of future scenarios, in quantitative terms, as they allow the incorporation of various factors influence the decision-making process. Their use represents a valid method for the optimization of integration of varied information.

The Universal Soil Loss Equation, USLE (Wischmeier & Smith, 1965, 1978) is one of the most widely used models in the world (Kinnell, 2010), even serving as an indicator of soil quality (Podmanicky *et al.*, 2011). In Brazil, for example, it is widely applied in agricultural planning. The USLE model was widely tested using over 25 years of experimental data in different soils and regions, specifically in the State of Sao Paulo.

The Soil and Water Assessment Tool, SWAT (Arnold *et al.*, 1998) is a simulator developed by the Agricultural Research Service (ARS) of the United States. It consists of various mathematical models which incorporate knowledge of the physical characteristics of agricultural catchments. It was developed to predict the impact of soil management practices on surface and groundwater environments in complex watersheds with varying types of soils, land use and management practices over long periods of time.

Similar to USLE, the SWAT model has been applied worldwide in recent years to estimate and simulate hydrological parameters, loads and non-point sources of pollutants, including sediment, nutrients and pesticides (Hiepe, 2008; Lam *et al.*, 2010; Wang *et al.*, 2010).

