Geophysical Research Abstracts
Vol. 12, EGU2010-3085-1, 2010
EGU General Assembly 2010

Assessment of hydrology, suspended sediment and particulate organic carbon transport in a large agricultural catchment using SWAT model

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Suspended sediment transport from agricultural catchments to stream networks is responsible for aquatic habitat degradation, reservoir sedimentation and the transport of sediment-bound pollutants (pesticides, particulate nutrients, heavy metals and other toxic substances). Quantifying and understanding the dynamics of suspended sediment transfer from agricultural land to watercourses is essential in controlling soil erosion and in implementing appropriate mitigation practices to reduce stream suspended sediment and associated pollutant loads, and hence improve surface water quality downstream. Gascogne area, southwest France, has been dominated by anthropogenic activities particularly intensive agriculture causing severe erosion in recent decades. This leads to a major threat to surface water quality due to soil erosion. Therefore, the catchment water quality has been continuously monitored since January 2007 and the historical data of hydrology and suspended sediment has existed since 1998. In this study, the Soil and Water Assessment Tool (SWAT 2005) was applied to assess hydrology, suspended sediment and particulate organic carbon in this catchment Agricultural management practices (crop rotation, planting date, fertilizer quantity and irrigations) were taken into the model for simulation period of 11 years (July, 1998 to March, 2009). The investigation was conducted using a 11-year streamflow and two years of suspended sediment record from January 2007 to March 2009. Modelling strategy with dominant landuse and soil type was chosen in this study. The SWAT generally performs satisfactorily and could simulate both daily and monthly runoff and sediment yield. The simulated daily and monthly runoff matched the observed values satisfactorily (ENash>0.5). For suspended sediment simulation, the simulated values were compared with the observed continuous suspended sediment derived from turbidity data. Based on the relationship between SSC and POC (R2 = 0.93), POC was modelled by simulated SSC from SWAT. The model predicted that the average annual catchment rainfall of the 11-year evaluation period (726 mm) with evapotranspiration (78.3%), percolation/groundwater recharge (14.1%), transmission loss (0.5%), and yielding surface runoff (7.1%). The simulated average total water yield of 11 years accounted for 138 mm (observed=133mm) and annual sediment yield varying from 4766 t to 123000 t (Mean= 48 t km-2). The annual yield of particulate organic carbon ranged from 120 t to 3100 t (Mean=1.2 t km-2).