Application of SWAT to a data scarce catchment in the Three Gorges Region, China

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Introduction

Construction of the Three Gorges Dam

Land use change

Erosion and landslides

Risk of Eutrophication

Foto: S. Schönbrodt 2010

Foto: D. Ehret 2010

Foto: X. Jiang 2007
Project collaboration

YANGTZE-Project: land use change, erosion, mass movement, diffuse inputs

Coordination: Research Centre Jülich

Remote Sensing
Potsdam
Assessment of mass movements using remote sensing techniques

Land use change
Giessen
Classification of land use and assessment of vulnerability

Erosion
Tübingen
Assessment and analysis of soil erosion

Landslides
Erlangen
Assessment and analysis of landslides

Diffuse sediment and P inputs
Kiel
Analysis of sediment and phosphorus inputs to rivers using SWAT

Aim:
Analysis of land use change and vulnerability, risk assessment of mass movements, soil erosion and diffuse inputs to rivers
Study area: Xiangxi Catchment

- Catchment area: 3200 km²
- Length of Xiangxi River: 94 km
- Mean annual temperature: 16.9°C
- Mean annual precipitation: 1000 mm
- Discharge at Gauge Xingshan: 36.4 m³/s
Seasonality of discharge

- Low flow period in winter
- Higher flows and frequent flood events in summer due to monsoon climate
Xiangxi River from source to mouth
Model setup: input data

1987

Legend
- Woodland
- Water/Reservoir
- Grassland
- Garden land
- Built-up land
- Bare rock/river bed
- Arable land

Legend
- Xiangxi Catchment
- River
- Climate Station

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Availability of time series for calibration

1970 - 2010

Climate: 1970-2007
Q: 70-74
Sed: 70-74

Calibration 1976-1986
Validation 1988-1998

Phosphorus: 2001-2010

1999:
New land use map
+ 1 reservoir implemented at Gufu River
Calibration of daily discharge

NSE: 0.63
R²: 0.63
PBIAS: 38.8
Average error: -3.4 m³/s
Water balance

Division of precipitation into ET and water yield:

- Water yield: 594 mm
- ET: 627 mm

Proportions of different flow components:

- Surface Q: 387 mm
- Lateral Q: 175 mm
- Groundwater Q: 66 mm
Auto- and cross correlations

Simulated runoff characterized by a faster response to precipitation events than observed runoff
Sediment transport

- Simulated sediment output too high
- Recession of sediment transport too slow
Spatially distributed sediment sampling

Xiangxi River: 22 and 25 July 2010 → Contrasting flow conditions
Sediment concentrations July 2010

Fast recession of sediment transport confirmed by own observations
Sediment yield of different land use classes

Legend
Annual sediment yield [t/ha]
- 0 - 44
- 45 - 227
- 228 - 333
- 334 - 439
- 440 - 5741
Reasons for overestimation of sediment yield

- Vegetation cover on agricultural areas (crop growth or USLE C Factor)
- Erodibility of soils (USLE K Factor)
- Peak rate adjustment factor for sediment routing
- Terraces not yet implemented in the model

Picture: C. Seeber 2009
Conclusions and outlook

- Average error for discharge very low
- Statistical criteria satisfactory
- Proportions of different flow components have to be revised
- Reduction of sediment yield from agricultural areas
- Reduction of recession time of sediment transport peaks
- Simulation of phosphorus transport
- Development of land use scenarios
Thanks for your attention!

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