Application of SWAT model for streamflow simulation in the Una River Basin, Northeast of Brazil

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Introduction

• SWAT as a tool to identify opportunities of payments for environmental services (PES).
  – Quintero (2009)

Source: Groot et al 2002; Kremen, 2005
Review

• Pernambuco – **ICMS Sócio Ambiental**
  – [Lei Estadual nº 11.899/00](#)
    • ICMS – Tax on the Circulation of Goods and Supply of Services Interstate and Intermunicipal Transportation and Communication (*Imposto sobre Operações relativas à Circulação de Mercadorias e sobre Prestações de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação*)
      – 1% for the maintenance and creation of Conservation Units

• **Lei Federal nº 9.985/00 - National System of Conservation Units** (*Sistema Nacional de Unidades de Conservação da Natureza*)
  • Conservation Units: territorial space and its environmental resources, including jurisdictional waters, with significant natural features, legally established by the Government, with conservation objectives and limits set under special administration regime, which guarantees the application of adequate protection.
• Productor Of Water – Nacional Agency of Water (ANA) – incentives for financial compensation to agents that demonstrably contribute to the protection and restoration of watersheds.

• The County of Extrema, MG – Water Conservative – Lei Municipal nº 2.100/05 – Recovery and preservation of Permanent Preservation Areas (Leis 6.938/81 e 12.651/12) by the provision of technical assistance and financial support.

• Payment is justified by the contribution of farmers to reduce soil erosion and sedimentation, for increase water infiltration, conservation of natural habitat.

Permanent Preservation Areas

Some distance from the riverside (depends of the river width)
Wellspring – source of water
Slope bigger than 45º

......
Objective

- First analysis of input data and capabilities of the SWAT model simulating the River Una Basin.
Study Area

• River Una Basin
  – 6,3 thousand km²
  – 42 county fully or partially inside the basin
    • 19 of them has the city inside the basin
  – 553,3 thousand of people

• Land Use
  • Sugar Kane industry

• Historical events of floods
Average Annual Rainfall between 2000 to 2008
StreamFlow - Capivara
StreamFlow - Catende
StreamFlow - Palmares

Data

Palmares

Vazãp (m³/s)

01/01/1995 01/01/1996 01/01/1997 01/01/1998 01/01/1999 01/01/2000 01/01/2001 01/01/2002 01/01/2003 01/01/2004 01/01/2005 01/01/2006 01/01/2007 01/01/2008
StreamFlow - Barreiros

Barreiros

Data

Vazão (m³/s)

Input Data
Soil
Soil Map

Sartori, 2005.
Land Use Map
Digital Elevation Model
Slope
Methodology

- Only streamflow analysis
  - Monthly simulation

- Calibration (year)
  - 2000 to 2004
  - 97 to 99 as warm up period

- Validation (year)
  - 2005 to 2008

- Land Use
  - Sugar cane
  - Open Forest – Range Brush
  - Dense Forest – Forest Deciduos
  - Onion as Bare Soil
  - Water

- Soil
  - Sartori (2005)
  - Levantamento Exploratório e Reconhecimento de Solos de Pernambuco (1973)
    - Exploratory Survey and Recognition of Pernambuco’s Soil

- SWAT-CUP
  - Parameters
    - r__CN2.mgt
    - v__ALPHA_BF.gw
    - v__GW_DELAY.gw
    - v__GWQMN.gw
    - r__SOL_AWC().sol
    - r__SOL_K().sol
  - 120 turns
Results - Capivara

### Capivara - Calibration

- **Vazão (m³/s)**
  - Calibration
  - Validation

### Capivara - Validation

- Obs
- Sim

<table>
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<th>Calibration</th>
<th>Validation</th>
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<tr>
<td>R²</td>
<td>0.689</td>
<td>0.787</td>
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<tr>
<td>Nash</td>
<td>0.607</td>
<td>0.613</td>
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Results - Catende

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<td>$R^2$</td>
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<td>Nash</td>
<td>0.231</td>
<td>0.695</td>
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Results - Palmares

### Palmares - Calibration

### Palmares - Validation

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<td>0.582</td>
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<tr>
<td>Nash</td>
<td>0.569</td>
<td>0.730</td>
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Results - Barreiros

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<td>R²</td>
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<td>Nash</td>
<td>0.699</td>
<td>0.460</td>
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Barreiros - Calibration

Barreiros - Validation
Conclusion

• Good results of streamflow.

• Working in progress
  – More accurate land use map
  – Work with another class of slope
  – Study/Analysis precipitation data
    • Better results?
Slope
Obrigado
Thanks
Gracias

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