Simulation of stream discharge from an agroforestry catchment in NW Spain using the SWAT model

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Predict the impact of man-made changes and management practices

Predict the impact of potential climate change

Water discharge, sediment, nutrients

**Important topics in catchment**

The first step for the evaluation of water resources in light of future climate change and/or land use is to know the adequacy of the model to reflect adequately current conditions.
Test the performance and feasibility of the SWAT model (ArcSWAT 2009) in the prediction of the stream discharge in a rural catchment located in NW Spain.

Establish the adequacy of the model to local conditions, considering the possibility of its use in future studies in a wider area.

**In a further step**

Predict the effects of climate change and land management practices on the water discharge, sediment and nutrients in the study area.
MATERIAL AND METHODS
A Coruña
(250,000 inhabitants)

Cecebre reservoir
CORBEIRA CATCHMENT

- Catchment area: 16 km²
- Length of the main stream: 10 km
- Mean annual discharge: 0.20 m³ s⁻¹

- Climate: humid temperate
- Mean annual rainfall: 1024 mm
- Mean temperature: 13°C

1985-2005

Stream gauge
Digital Elevation Model (DEM)

Elevation Range: 65-474 m
Mean: 267 m

SOILS CHARACTERISTICS:
- Silt-silty loam texture
- High organic matter content
- Acid pH

Soil Map

Fluvisols
Cambisols
Umbrisols
MODEL INPUT DATA

Land Use Map

- **Land uses**
  - Forest (65%)
  - Grassland (26%)
  - Cultivated land (3.8%)
  - Impervious area (5.2%)

Meteorological Information: Mabegondo station

- Closest station to the study area
OBSERVED DATA

Stream water level

Data from Oct 2004 (10 min)
METHODOLOGY

**SENSITIVITY ANALYSIS**
- Latin hypercube (LH)-one-factor-at-a-time (OAT)

**MANUAL CALIBRATION**
- Trial-and-error basis
- Selecting as final values
  - maximize model efficiency
  - minimize stream deviation

**AUTOCALIBRATION: Parasol Uncertainty analysis**
- Initial values: final parameter values of the manual calibration
- Parameters selected by range of sensitivity analysis

**CALIBRATION AND VALIDATION**
- Observed data at the catchment outlet
- At daily step
- 5 hydrological years (2005/06-2009/10) of data divided into two time series:
  - 2005/06-2007/08: CALIBRATION
  - 2008/09-2009/10: VALIDATION
- Evaluation of the results using R2, PBIAS, NSE
INITIAL RUN (default flow-related parameter values)

Significant differences between observed and simulated discharge. NSE<<0.36

SENSITIVITY ANALYSIS (both with and without the use of observed discharge data)

The most sensitive parameters: related to groundwater

Qwqmn: Threshold water depth in the shallow aquifer for flow
Rchrg_Dp : Deep aquifer percolation fraction
PRELIMINARY RESULTS: discharge predictions

- Calibration period comprises more extreme conditions:

  - 2006/07: VERY WET
  - 2007/08: DRY
MANUAL CALIBRATION

- The SWAT model tends to overestimates peak discharge. This is more evident at the beginning of the rainy season.

- The largest discrepancies occur in summer, when SWAT underestimates discharge and predicts a somewhat quicker recession curves than those observed.

- The discharge peaks simulated by SWAT anticipate the catchment response to

  Heaviest rainfall in the last hours of the day

- Some discharge peaks were not captured by SWAT. On the other hand, some predicted discharge peaks were not observed at the catchment outlet

  Local rainfall
## SENSITIVITY ANALYSIS with observed data

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Descripcion</th>
<th>Sensitivity rank</th>
<th>Range used in autocalibration</th>
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<tbody>
<tr>
<td>Blai</td>
<td>Maximum potential leaf area index</td>
<td>10</td>
<td>0-1</td>
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<tr>
<td>Canmx</td>
<td>Maximum canopy storage</td>
<td>8</td>
<td>0.1-10</td>
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<td>Ch_K2</td>
<td>Channel hydraulic conductivity</td>
<td>13</td>
<td>0-150 (mm hr(^{-1}))</td>
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<td>CN2</td>
<td>Initial SCS CN II value</td>
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<td>EPCO</td>
<td>Plant uptake compensation factor</td>
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<td>0-1</td>
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<td>ESCO</td>
<td>Soil evaporation compensation factor</td>
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<td>0-1</td>
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<tr>
<td>Gw_Delay</td>
<td>Groundwater delay</td>
<td>12</td>
<td>0-50 days</td>
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<tr>
<td>Gw_Revap</td>
<td>Groundwater revap coefficient</td>
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<td>0.02-0.2</td>
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<td>Qwqmn</td>
<td>Threshold water depth in the shallow aquifer for flow</td>
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<td>0-1</td>
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<tr>
<td>Rchrg_Dp</td>
<td>Deep aquifer percolation fraction</td>
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<td>0-1</td>
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<td>Slope</td>
<td>Mean slope steepness</td>
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<tr>
<td>Sol_Alb</td>
<td>Moisture soil albedo</td>
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<td>-25% to 25%</td>
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<tr>
<td>Sol_AWC</td>
<td>Available water capacity</td>
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<td>-50% to 50%</td>
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<td>Sol_K</td>
<td>Saturated hydraulic conductivity</td>
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<tr>
<td>Sol_Z</td>
<td>Soil depth</td>
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<td>-25% to 25%</td>
</tr>
</tbody>
</table>

## PRELIMINARY RESULTS: discharge predictions
PRELIMINARY RESULTS: discharge predictions

- Acceptable performance of SWAT
- High deviation: dry season of the validation period
Autocalibration only provided better results during the calibration period

Useful tool that can be used to facilitate the manual process
CONCLUSIONS AND FURTHER WORKS

• Both manual and autocalibration produce a satisfactory performance of SWAT to predict daily discharges of the Corbeira catchment. Autocalibration approach only improves model performance during the calibration period.

• The SWAT parameterization obtained in this study will be used as a starting point in the Mero Basin, but it will be combined with the existing knowledge of the basin to guarantee reliable results. This information will be also used to analyse the impact of possible climate change on water resources.

• For more adequate modelling of stream discharge, a large effort will be needed to improve the quality of available information concerning groundwater, soils and rainfall in the catchment.
Thank you for your attention!