Development of Web-based SWAT LUC with SWAT BFlow Alpha Factor Module

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PART 1

Introduction
Hydrology Cycle & Model
Most hydrological models cannot deal with land use dynamics.

Does hydrological models simulate correctly without considering landuse change?
## SWAT Input Data

<table>
<thead>
<tr>
<th>Input Type</th>
<th>Static</th>
<th>Dynamic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Terrain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Scale

- Geological
- Centuries
- Decades
- Years
- Days
- Hours

(Friedrich J. Koch, 2012)

- SWAT Model cannot consider dynamic land use change
SWAT2009_LUC, SWAT LUSPA, SWAT Tool have been developed to overcome this problem in Soil and Water Assessment Tool (SWAT).
The SWAT2009_LUC and SWAT Tool cover only existing HRUs in SWAT scenarios.

The SWAT LUPSA module can account unique HRUs and update HRU slopes.

The SWAT LUPSA module is not publicly accessible at this time.

(Friedrich J. Koch, 2012)
In the study, the Web-based interface were developed to provide user-friendly interface for dynamic SWAT modeling considering spatial and temporal characteristics at a watershed.

Web-based SWAT LUC was developed base on LUPSA module.

Development of SWAT BFlow function to apply alpha factors.

Additional functionality can help SWAT users to simulate more correctly.
PART 2

Design & Functions
**Web based SWAT LUC**

- Program Language: Python, HTML
- Input Data: TxtInOut.zip file
### Web based LUC Module process

(Friedrich J. Koch, 2012)

<table>
<thead>
<tr>
<th>Result</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>New HRU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HRU</td>
<td>Fraction</td>
<td>Slope</td>
</tr>
<tr>
<td>Match</td>
<td>000010001</td>
<td>Frc1</td>
<td>Slp1</td>
</tr>
<tr>
<td></td>
<td>000010002</td>
<td>Frc1</td>
<td>Slp1</td>
</tr>
<tr>
<td>Unique in 1</td>
<td>000010003</td>
<td>Frc1</td>
<td>Slp1</td>
</tr>
<tr>
<td>Match</td>
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<td>Frc1</td>
<td>Slp1</td>
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<tr>
<td>Unique in 2</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Unique in 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Extract identification, area, and slope of HRUs, rename, rewrite new HRUs
3. Check total sub-catchment HRU fractions
Design & Functions

Web based SWAT LUC

Step1. Input Files
- First Scenario File:
  - User Upload
  - Start Date: [Date]
- Second Scenario File:
  - User Upload
  - Start Date: [Date]

SWAT LUC Run
Design & Functions

[Option 1] Enter your flow data here!

[Option 2] Upload dat file!

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**BFlow Alpha Factor Module**

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**SWAT BFlow was run successfully [1940 ~ 1940]**

<table>
<thead>
<tr>
<th>Baseflow/Retros</th>
<th>First Pass</th>
<th>Second Pass</th>
<th>Third Pass</th>
</tr>
</thead>
<tbody>
<tr>
<td>baseflow/drawflow</td>
<td>0.50</td>
<td>0.41</td>
<td>0.31</td>
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</tbody>
</table>

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**Alpha Factor**

0.2428 <<< Use this in SWAT .gw file

::: Alpha value editor program :::

http://www.envsys.co.kr/~swatbfow/USGS_GOGL

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PART 3
Test case
Little Eagle Creek Ave, IN

- Area: ~258.20 km²
- Elevation: 257.02 ~ 289.91 m
- Slope: 0.88 ~ 4.40 %

- Using Landsue data:
  - Landuse data of 2001
  - Landuse data of 2011
Little Eagle Creek Ave, IN

Urbanization

Test Case
Web based LUC Process of Test case

Scenario 1
- SWATTxtInOut file
  - Using Land use 2001 file
- 351 HRUs in 23 Subbasins

Scenario 2
- SWATTxtInOut file
  - Using Land use 2011 file
- 356 HRUs in 23 Subbasins

Common HRU: 36
Unique HRU1: 315
Unique HRU2: 320

Output Data
- SWATTxtInOut file based on renamed HRUs
- 671 HRUs in 23 Subbasins
- Update Lup.dat, file1.dat, file2.dat and file.cio based on New HRUs
## Compare Flow Simulation

<table>
<thead>
<tr>
<th>Subbasin</th>
<th>Mean</th>
<th>Max</th>
<th>Min</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>2001</td>
<td>2011</td>
<td>LUC</td>
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<tr>
<td>10</td>
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<td></td>
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<td>Final outlet</td>
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<td>0.000</td>
</tr>
</tbody>
</table>

(m³/s)
Prospects

- Development and application of BMPs Module
- Development and application of the Sloped CN module
- Correct error in the Web-based LUC site
- Open the web-site at the end of the year

Conclusions

- The system, developed in this study, can consider dynamics of watershed spatially and temporarily with better accuracies than ever before.
- This system will be helpful in deciding policy related to land use change.
Thank you for your attention!