

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

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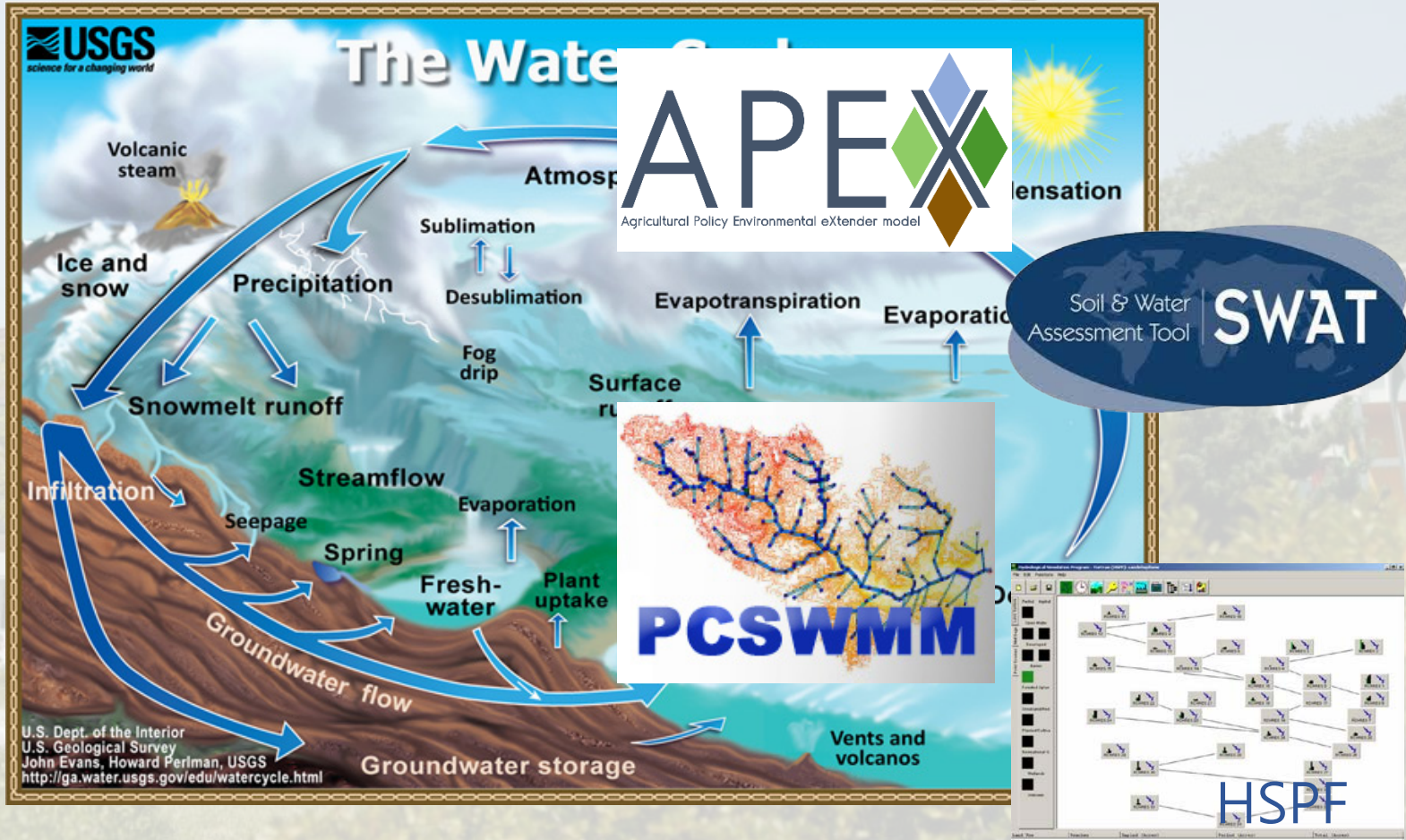
- 01 Introductions
- 02 Design and Functions
- 03 Test case
- 04 Conclusions
& Prospects

PART

1

Introduction

❖ Hydrology Cycle & Model



- ✓ Most hydrological models can not deal with land use dynamics



Does hydrological models simulate correctly without considering land use change?



01 Introduction



SWAT Input Data

| | | | | | | | |
|------------|------------|--|-----------|---------|-----------------|------|-------|
| Input Type | Static | | | Dynamic | | | |
| SWAT Input | Soil | | | Climate | | | |
| Scale | Geological | | Centuries | Decades | Years | Days | Hours |
| | Terrain | | | | Land Use | | |

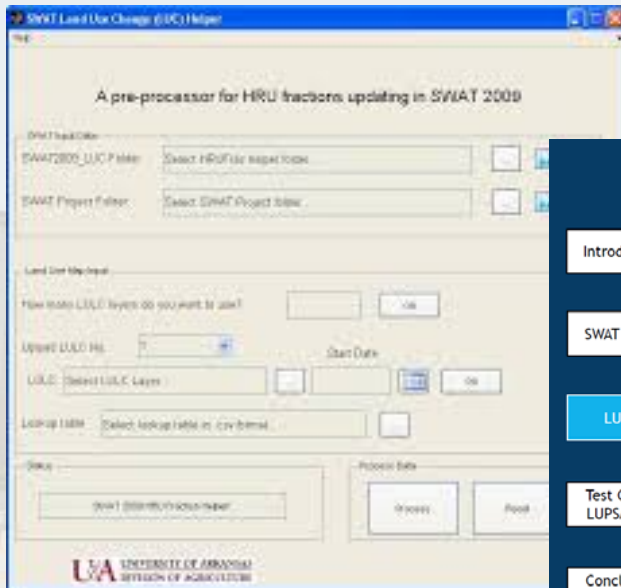
(Friedrich J. Koch, 2012)

- ✓ SWAT Model cannot consider dynamic land use change

01 Introduction

- ✓ SWAT2009_LUC, SWAT LUSPA, SWAT Tool have been developed to overcome this problem in Soil and Water Assessment Tool(SWAT).

SWAT 2009_LUC



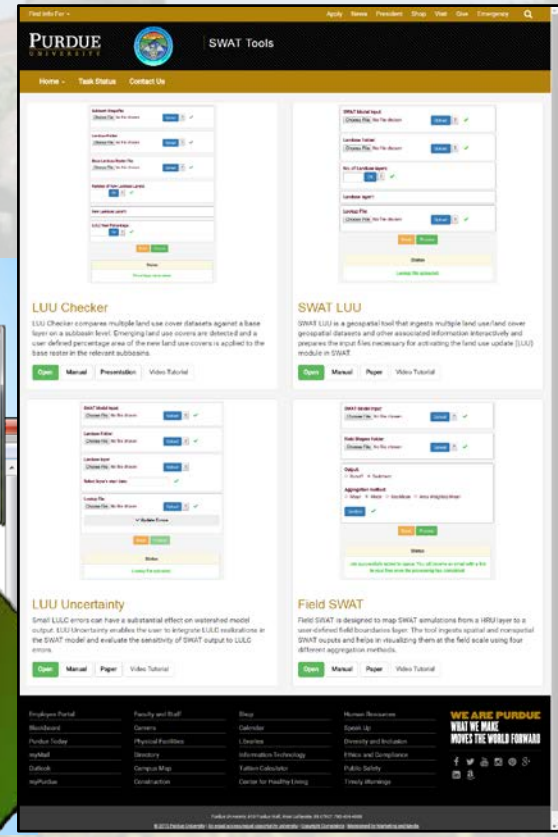
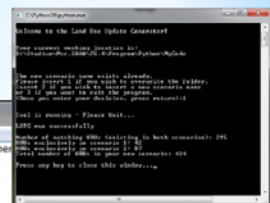
- Introduction
- SWAT & LUC
- LUSPA
- Test Case & LUSPA app.
- Conclusions & Prospects

Program Language: Python
License: Open Source
OS: Windows (95+) and Linux
Running on: Command Line
GUI: .txt setup file

```
setup.dat - Notepad
File Edit Format View Help
***LUSPA-Setup-File***This line is for Comment
Name of Scenario 1      : 1972
Name of Scenario 2      : 1994
Date of Land Use 1 (yyyymm) : 197201
Date of Land Use 2 (yyyymm) : 199401
New Scenario Name       : TEST
Simulation Start (yyyymmdd) : 19760101
Simulation End (yyyymmdd)  : 19920101
Sequence (1=annual, 2=monthly) : 1
Number of slope classes  : 3
End of first slope class (%) : 11
End of second slope class (%) : 18
End of third slope class (%) : 0
End of fourth slope class (%) : 0

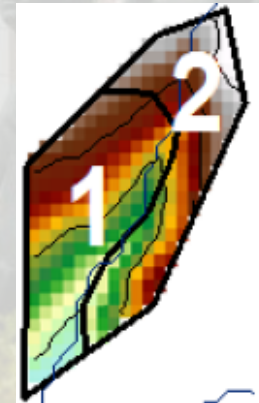
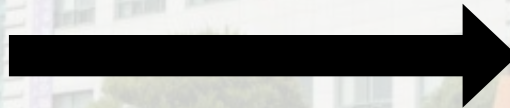
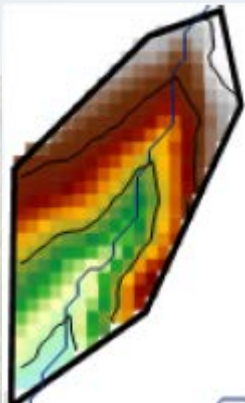
Please specify your input file for this setup file and the input "txtinput" - folders must be created. You must define your source...
```

Related modified SWAT Version
SWAT2009lu-slope.exe
SWAT2009lu-noslope.exe
SWAT2009lu-slope-length.upd



- ✓ 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.

HRU:
Fraction: 0.13
Slope: 22%



HRU_1:
Fraction: 0.06
Slope: 18%
HRU_2:
Fraction: 0.07
Slope: 25%

(Friedrich J. Koch, 2012)

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

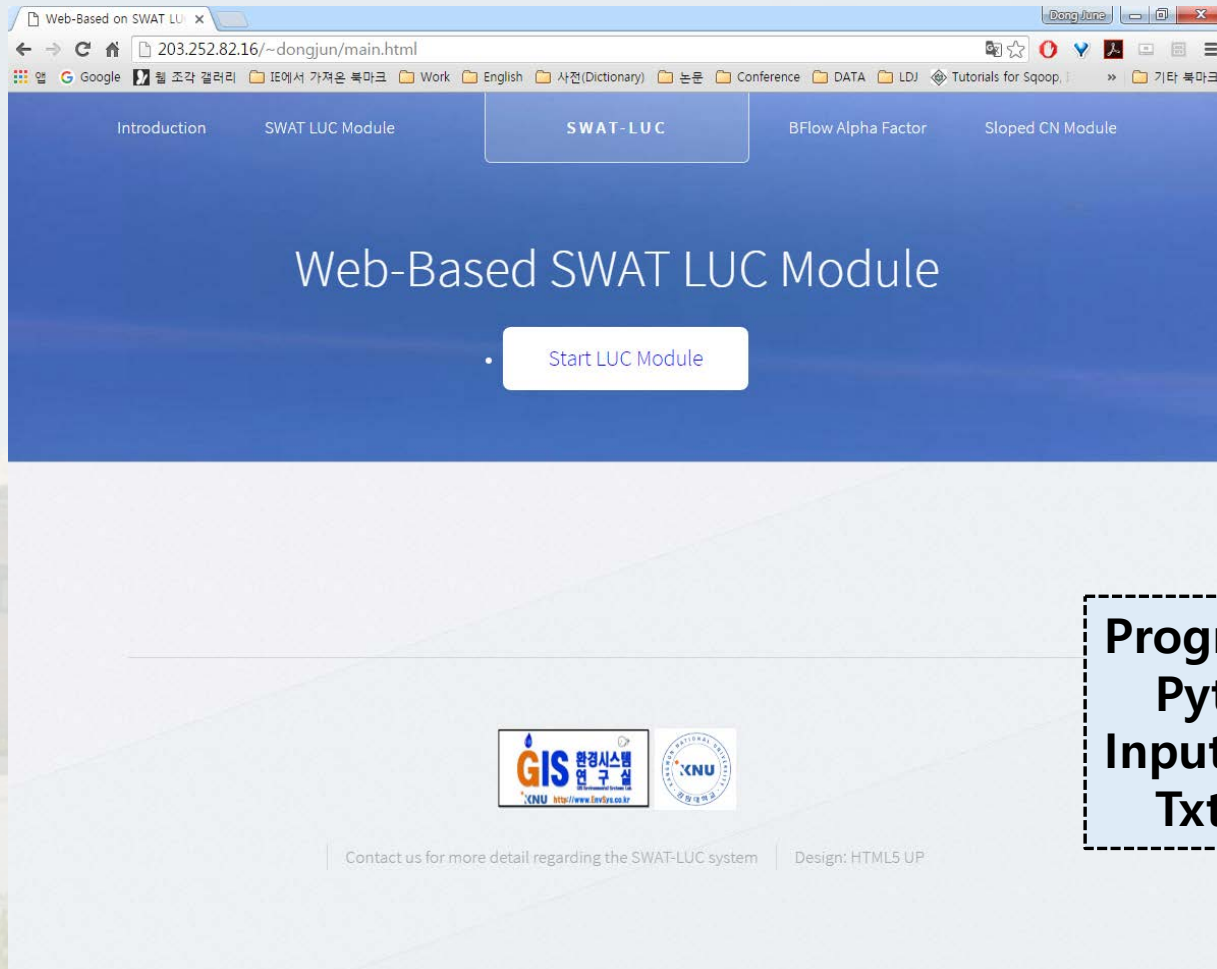
- ✓ In the study, the Web-based interface were developed to provide user-friendly interface for dynamic SWAT modeling considering spatial and temporal characteristics at a watershed.
- ✓ Web-based SWAT LUC was developed base on LUPSA module.
- ✓ Development of SWAT BFlow function to apply alpha factors.
- ✓ Additional functionality can help SWAT users to simulate more correctly.



PART
2

Design & Functions

❖ Web based SWAT LUC



The screenshot shows a web browser window displaying the 'Web-Based SWAT LUC Module' website. The browser's address bar shows the URL '203.252.82.16/~dongjun/main.html'. The website has a blue header with navigation links: 'Introduction', 'SWAT LUC Module', 'SWAT-LUC' (highlighted), 'BFlow Alpha Factor', and 'Sloped CN Module'. The main content area features the title 'Web-Based SWAT LUC Module' and a prominent white button labeled 'Start LUC Module'. At the bottom, there are logos for 'GIS 환경시스템 연구실' and 'KNU', along with contact information and a design credit to 'HTML5 UP'.

Program Language:
Python, HTML
Input Data:
TxtInOut.zip file

❖ Web based LUC Module process

For one subbasin (Friedrich J. Koch, 2012)

| Result | Scenario 1 | | | Scenario 2 | | | New HRU |
|-------------|------------|----------|-------|------------|----------|-------|-----------|
| | HRU | Fraction | Slope | HRU | Fraction | Slope | |
| Match | 000010001 | Frc1 | Slp1 | 000010001 | Frc2 | Slp2 | 000010001 |
| Unique in 1 | 000010002 | Frc1 | Slp1 | - | - | - | 000010002 |
| Match | 000010003 | Frc1 | Slp1 | 000010002 | Frc2 | Slp2 | 000010003 |
| ... | ... | ... | ... | ... | ... | ... | ... |
| Unique in 2 | - | - | - | 000010015 | Frc2 | Slp2 | 000010019 |
| Unique in 2 | - | - | - | 000010016 | Frc2 | Slp2 | 000010020 |

1. Extract identification, area, and slope of HRUs, rename, rewrite new HRUs
2. Update 'Lup.dat', 'file1.dat'... 'file(n).dat', 'file.cio' files.
3. Check total sub-catchment HRU fractions

❖ Web based SWAT LUC

The screenshot shows a web browser window displaying the SWAT LUC interface. The browser's address bar shows the URL `203.252.82.16/~dongjun/left-sidebar.html`. The page has a navigation menu with items: Introduction, SWAT LUC Module, SWAT-LUC (highlighted), BFlow Alpha Factor, and Sloped CN Module.

Overlaid on the browser window is a Windows file explorer dialog box titled "열기" (Open). The dialog shows a file list with the following items:

- 라이브러리 (Library)
- 문서 (Documents)
- 비디오 (Videos)
- 사진 (Pictures)
- 음악 (Music)
- 컴퓨터 (Computer)
- 로컬 디스크 (C:) (Local Disk (C:))
- DATA (E:) (Data (E:))
- 네트워크 (Network)
- 16.03.09_광청사(유량).xlsx
- 16.06.29_1_DJ_표토보전기술 개요

Below the file explorer, a calendar for July 2016 is displayed. The date 16 is selected. The calendar table is as follows:

| 일 | 월 | 화 | 수 | 목 | 금 | 토 |
|----|----|----|----|----|----|----|
| 26 | 27 | 28 | 29 | 30 | 1 | 2 |
| 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 |
| 17 | 18 | 19 | 20 | 21 | 22 | 23 |
| 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 1 | 2 | 3 | 4 | 5 | 6 |

Annotations on the screenshot include:

- A dashed box around the "파일 선택" (File selection) button in the "First Scenario File:" section.
- A dashed box around the "연도-월-일" (Year-Month-Day) date input field.
- A dashed box around the calendar.
- A dashed box around the "SWAT LUC Run" button at the bottom.

[Option 1] Enter your flow data here !


[Option 2] Upload dat file!

www.envsys.co.kr/~swatbflow/USGS_GOOGLE/run_SWAT_BFLOW_using_usgs_flowdata.cgi

1: GoogleMap Interface (48 states in US Only) 2: Enter / Upload my date/flow data 3: Related Doc

SWAT BFlow was run successfully [1940 ~ 1940]

| Baseflow Ratio | First Pass | Second Pass | Third Pass | Alpha Factor |
|---------------------|------------|-------------|------------|--|
| baseflow/streamflow | 0.58 | 0.41 | 0.31 | 0.2428 <<== Use this in SWAT .gw file ::: Alpha value editor program ::: http://www.envsys.co.kr/~swatbflow/USGS_GOOGLE |

Download SWAT BFlow Output ---  or Open Output in HTML Table

Web-based SWAT BFlow - <http://www.EnvSys.co.kr/~swatbflow>



Alpha Factor

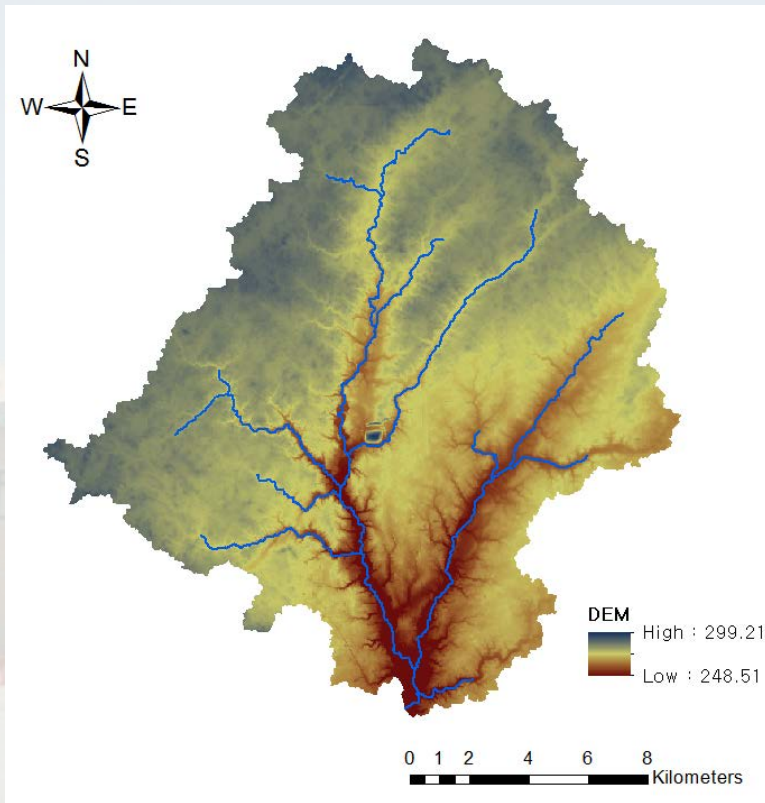
0.2428 <<== Use this in SWAT .gw file
::: Alpha value editor program :::
http://www.envsys.co.kr/~swatbflow/USGS_GOOGLE



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



❖ Web based LUC Process of Test case

Web based LUC System

Scenario 1

SWAT TxtInOut file
Using Land use 2001 file

351 HRUs in 23 Subbasins

Scenario 2

SWAT TxtInOut file
Using Land use 2011 file

356 HRUs in 23 Subbasins

Common HRU : 36

Unique HRU1 : 315

Unique HRU2 : 320

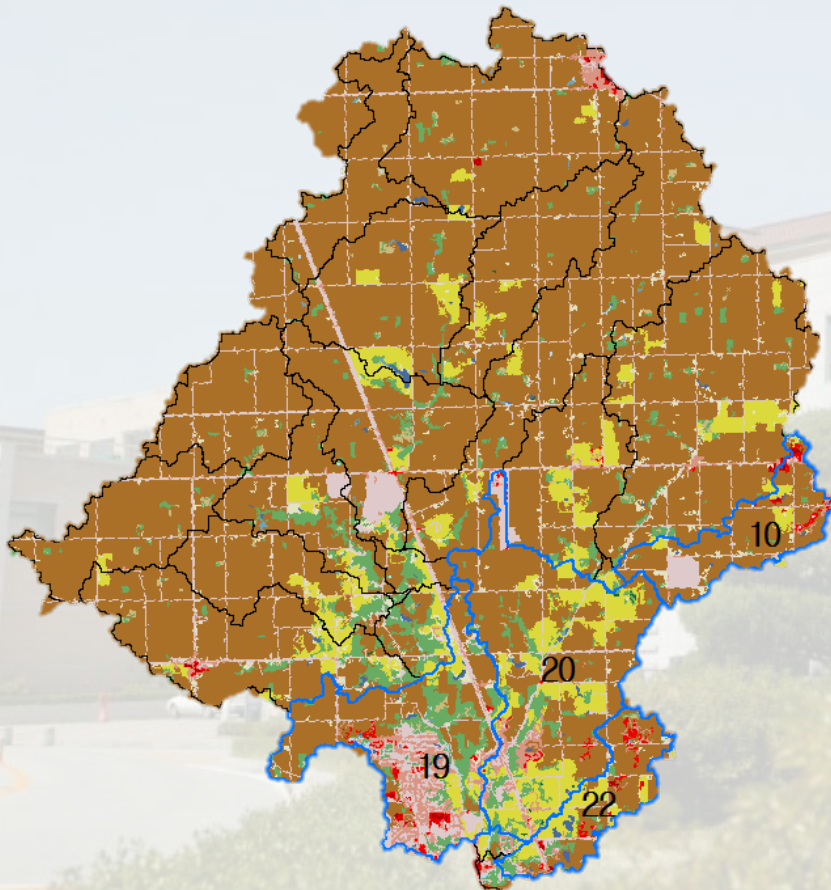
Output Data

SWAT TextInOut file based on renamed HRUs

671 HRUs in 23 Subbains

Update Lup.dat, file1.dat, file2.dat and file.cio based on New HRUs

❖ Compare Flow Simulation



| | | (m ³ /s) | | |
|---------------------|------|---------------------|--------------|--------------|
| Subbasin | | Mean | Max | Min |
| 10 | 2001 | 0.151 | 3.736 | 0.000 |
| | 2011 | 0.151 | 3.850 | 0.000 |
| | LUC | 0.157 | 3.572 | 0.001 |
| 19 | 2001 | 3.087 | 71.44 | 0.000 |
| | 2011 | 3.087 | 71.51 | 0.000 |
| | LUC | 3.224 | 64.98 | 0.000 |
| 20 | 2001 | 1.318 | 31.74 | 0.000 |
| | 2011 | 1.318 | 32.09 | 0.000 |
| | LUC | 1.369 | 28.97 | 0.002 |
| 22 | 2001 | 0.125 | 3.115 | 0.000 |
| | 2011 | 0.124 | 3.167 | 0.001 |
| | LUC | 0.132 | 3.150 | 0.001 |
| Final outlet | 2001 | 4.546 | 106.70 | 0.000 |
| | 2011 | 4.545 | 107.10 | 0.000 |
| | LUC | 4.745 | 97.59 | 0.000 |



PART
4

Conclusions
& Prospects

❖ 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!**