SWAT2009_LUC: A TOOL TO ACTIVATE LAND USE CHANGE MODULE IN SWAT 2009

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NIVERSITY OF ARKANSAS

VISION OF AGRICULTURE

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BACKGROUND

VISION OF AGRICULTURE

- Simulate impact of soil, land use, and management activities on water quantity and quality¹
- Past studies mostly relied on "snapshot" approach for characterizing **land use in watersheds** for the entire study period
- Temporal land use changes have direct impact on hydrology, sedimentation, and nutrient losses²

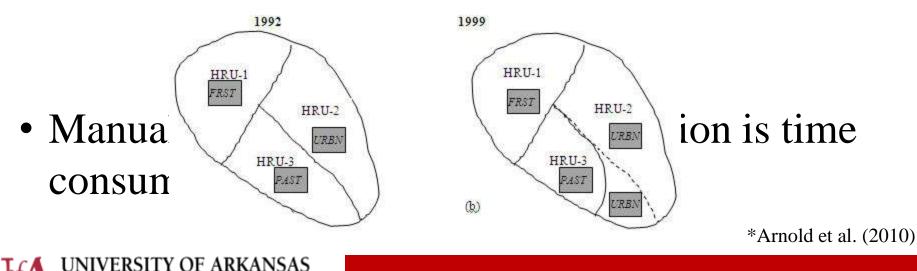


• A single land use dataset is therefore not a reasonable representation¹Frankenberger (2011) ²Miller et al. (2002), Ahearn et al. (2005), Ouyang et al. (2010)

BACKGROUND.....

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- SWAT 2009: released January 2010
- New module: land use change (LUC)*{LUU}
- Distribution of existing land use could be varied AT ANY TIME DURING the model run



OBJECTIVES



Develop a Graphical User Interface (GUI) for a desktop based, stand-alone tool to activate LUC (LUU) module in SWAT 2009

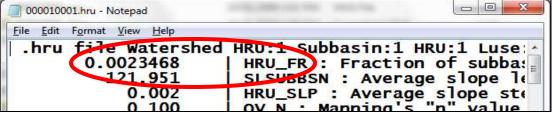


Assess the performance by comparing LUC tool's output with input land use data



LUC MODULE CONCEPT

- Assumption: SWAT model for the project area has been created
- **HRU**: unique combination of land use, soil, and slope within a subbasin
- Fractional area of an existing HRU is represented by HRU_FR variable in *.hru files 000010001.hru Notepad



- LUC module operates by updating HRU_FR variable as many times as the number of temporal land use data layers are input in the model
- Constraints: 1) HRUs can't be added or deleted
 2) Sum of HRU_FR for each subbasin = 1



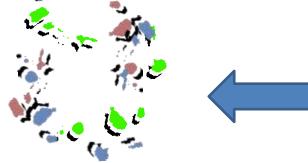
LUC MODULE: CHALLENGE

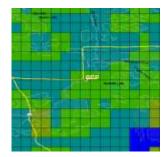
- Depending on watershed size, threshold decision, and heterogeneity
- Numerous HRUs: few 100's to 1000's
 LS (4) * ST (10) * SC (4) = 160 computational time
- 2. Fragmented HRUs: Single HRU could consist of multiple islands#

Mapping challenge

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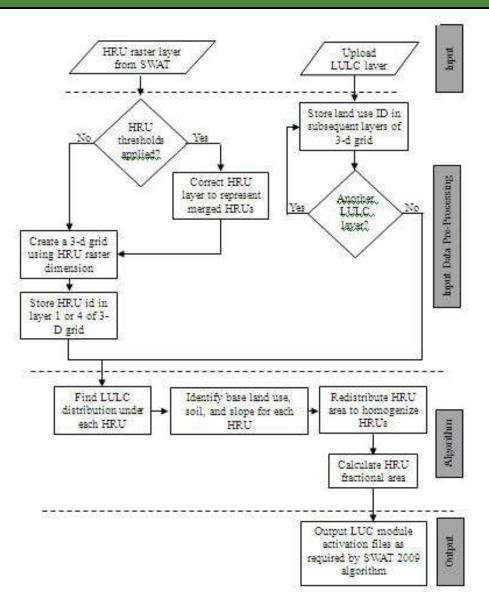
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Fragmented HRU Regular LULC raster grid 3. Area under all HRUs require- labor and time (hrus1.rrd) ^{#Pai et al. (2011; in review)}

LUC MODULE: FLOW CHART





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Input Processing

- For *non-threshold SWAT models*: use 0-0-0 HRU raster that includes all unique combinations of land use, soil, and slope (hrus1.rrd)
- For SWAT models created using threshold: post process non-dominant (ND) HRUs with nearest dominant (D) HRUs in 0-0-0 raster using Euclidean distance allocation method*

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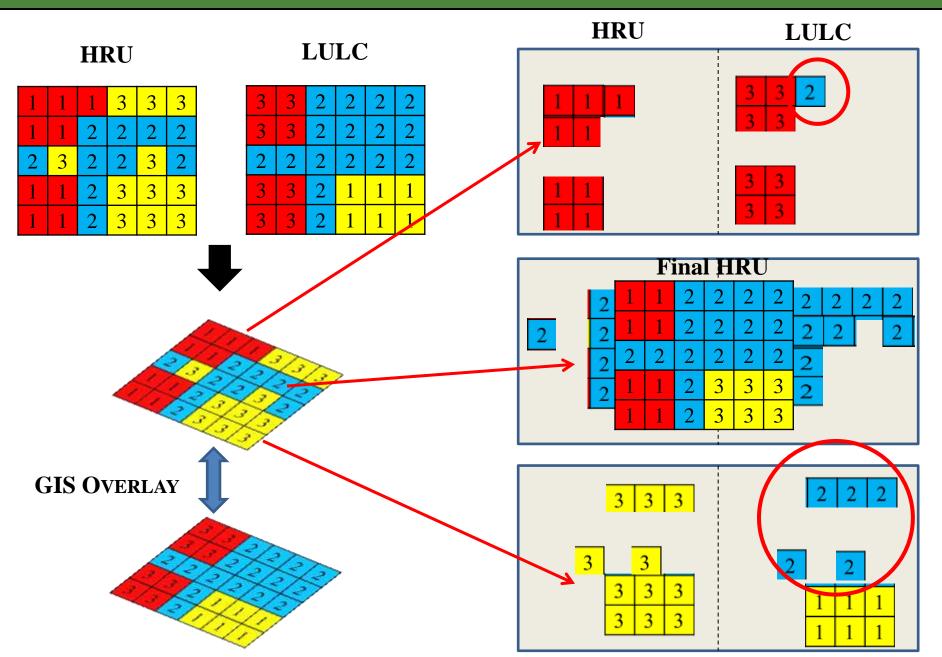
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HRU – LULC MAPPING



- GUI for activating LUC module developed
- Ingests multiple land use layers interactively
- Interacts with SWAT project folder
- Output: lup.dat, file1.dat, file2.dat,....

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• Projection is **important**

- Step 1: Identify SWAT2009_LUC folder
- Note: buttons sequentially enabled
- Create sub-folders:
 - Shape
 - Raster
 - Output
- Store:
 - hru1.shp
 - hrus1.rrd
 - lup.dat, fileX.dat



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- **Step 2**: Identify SWAT project folder
- Copy hrus1.rrd (from Watershed/Grid folder) in Raster folder
- Copy hru1.shp (from Watershed/Shapes folder) in Shape folder (to identify HRUs that passed the threshold)
- Post-process hrus1.rrd (for thresholded projects only using Euclidean Allocation method)



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- **Step 3**: Upload LULC data and starting dates
- Use starting dates to create **lup.dat** and store in Output folder
- Upload lookup table to connect land use map with SWAT four-alphabet code

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- Step 4: Hit Process button
- Identify base LULC for each HRU using *.hru files
- Re-classify HRU ids based on LULCs that are not part of base HRU definition
- Re-calculate HRU_FR and output in fileX.dat in Output folder
- Copy lup.dat, file1.dat, file2.dat, ... to TxtInOut to activate LUC module

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Land Use Map Input	
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Upload LULC No : 1	
	Start Date
LULC: Select LULC Laye	er
Lookup table Select loo	kup table in .csv format
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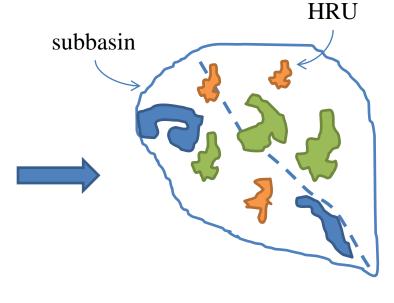


LUC MODULE WORKING

SWAT2009 Model run 1998 - 2008

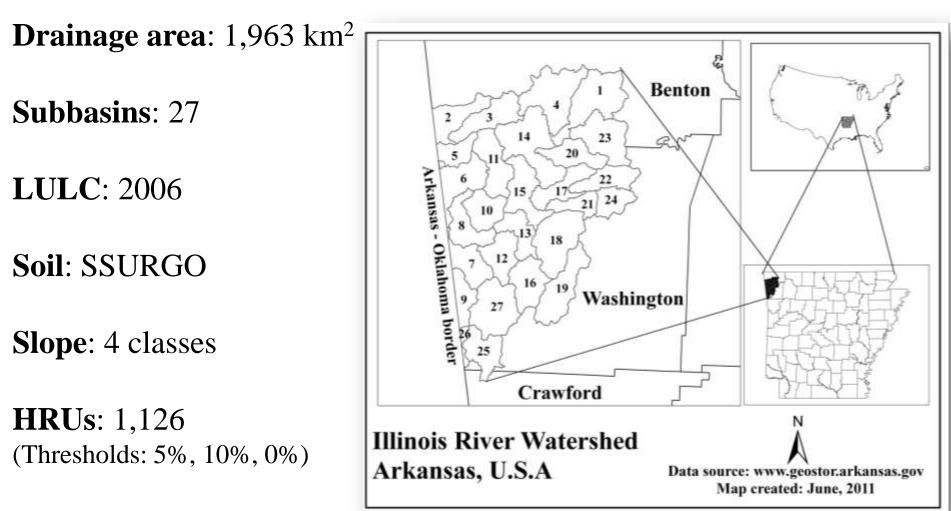


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CASE STUDY: ILLINOIS RIVER WATERSHED

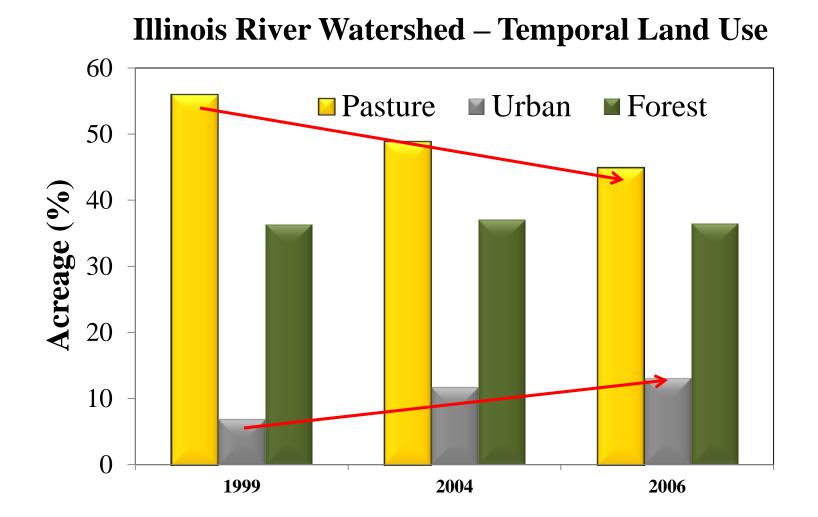


Study period: 1999 - 2006

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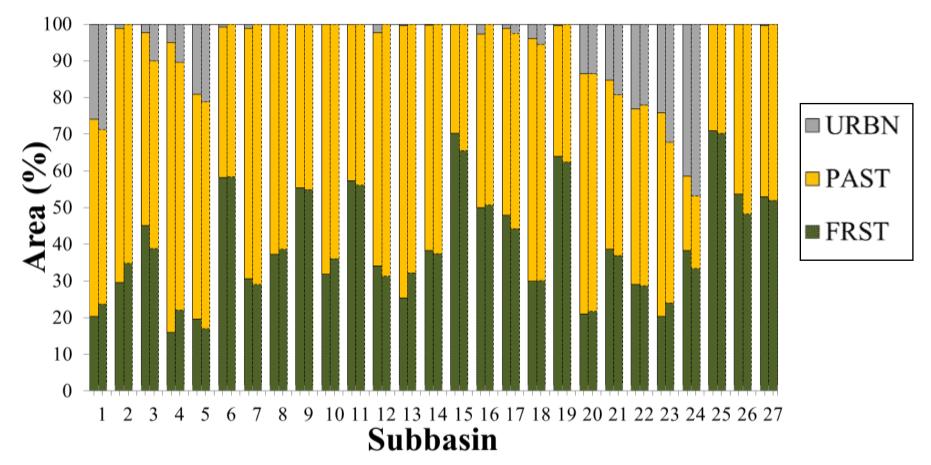
LAND USE CHANGE



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RESULTS – TOOL PERFORMANCE

✓ Land use calculated by SWAT2009_LUC closely matched LULC layer for all years





CONCLUSIONS

- ✓ Objective 1: SWAT2009_LUC, a GUI driven, desktopbased tool was developed to activate the LUC module in SWAT 2009
- ✓ Objective 2: LUC module output was comparable to actual LULC data
- ✓ Tool useful for modelers wanting to evaluate impact of land use change (LUU)



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