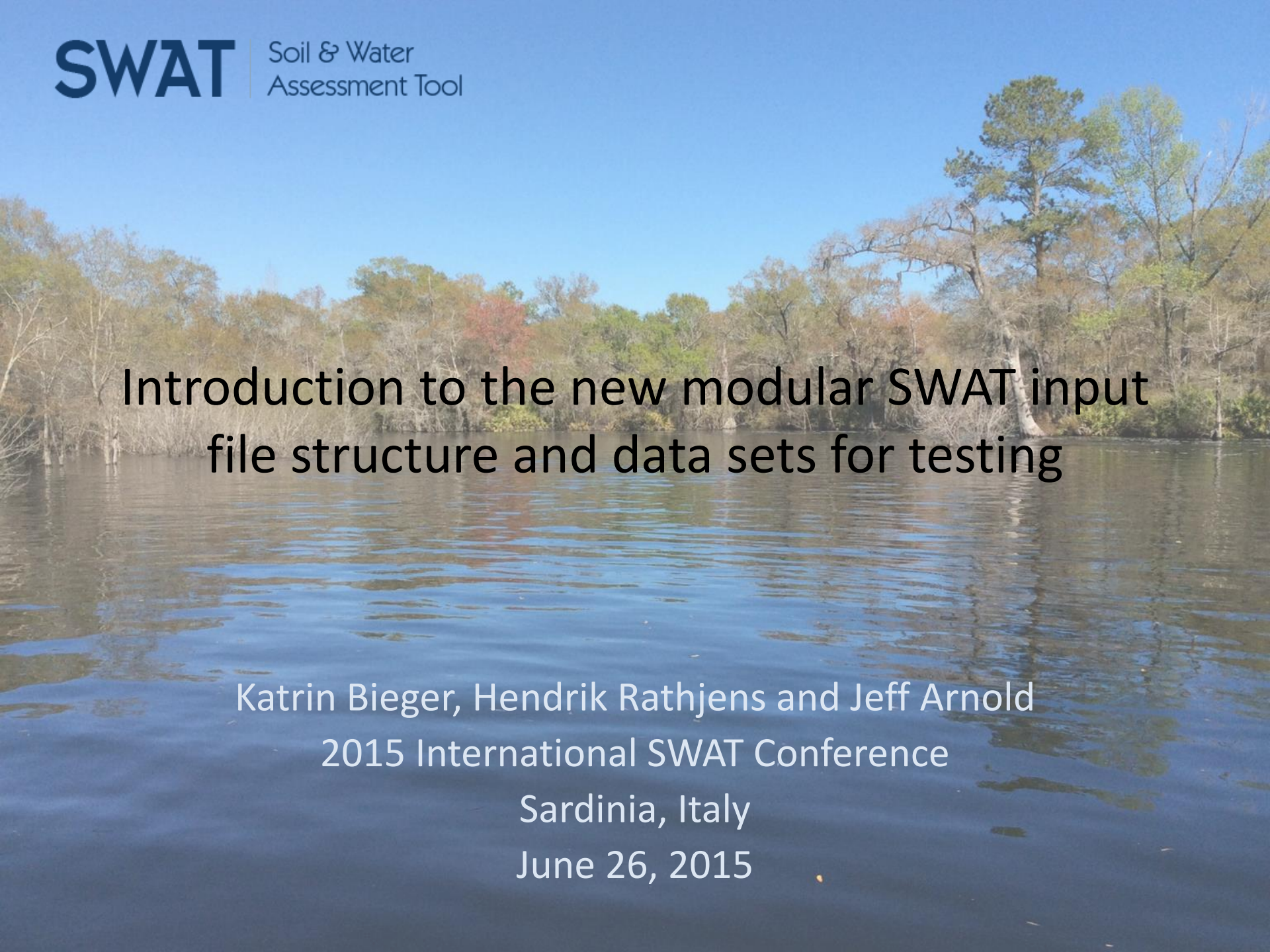

Introduction to the new modular SWAT input file structure and data sets for testing

Katrin Bieger, Hendrik Rathjens and Jeff Arnold

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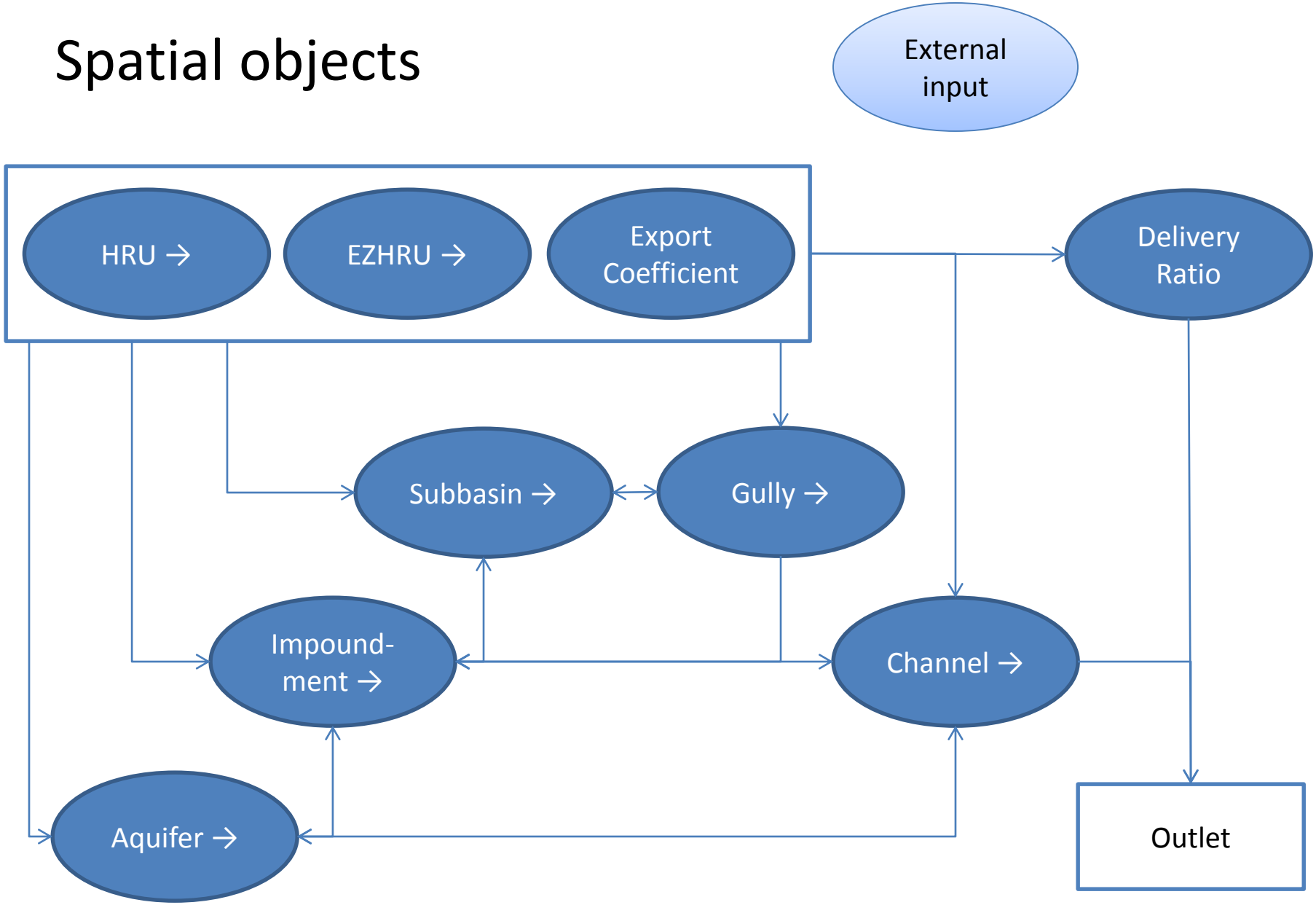
Sardinia, Italy

June 26, 2015

Spatial objects



Connections and properties of spatial objects

subbasin.con: Subbasin spatial connections – Little River Experimental Watershed (Subbasin)

NUMB	NAME	PROPS	SRC_TOT	OBTYP_OUT1	OBTYPNO_OUT1	HTYP_OUT1	FRAC_OUT1	OBTYP_OUT2	OBTYPNO_OUT2	HTYP_OUT2	FRAC_OUT2
1	0	1	2	cha	1	tot	1.0000	aqu	1	rhg	1.0
2	1	2	2	cha	2	tot	1.0000	aqu	2	rhg	1.0
3	2	3	2	cha	3	tot	1.0000	aqu	3	rhg	1.0
4	3	4	2	cha	4	tot	1.0000	aqu	4	rhg	1.0
5	4	5	2	cha	5	tot	1.0000	aqu	5	rhg	1.0
6	5	6	2	cha	6	tot	1.0000	aqu	6	rhg	1.0
7	6	7	2	cha	7	tot	1.0000	aqu	7	rhg	1.0
8	7	8	2	cha	8	tot	1.0000	aqu	8	rhg	1.0
9	8	9	2	cha	9	tot	1.0000	aqu	9	rhg	1.0
10	9	10	2	cha	10	tot	1.0000	aqu	10	rhg	1.0

Points to a file defining the properties of the spatial object

Define the number of locations

- OBTYP_OUT = Type of spatial object the output is sent to
- OBTYPNO_OUT = # of spatial object
- HTYP_OUT = Type of hydrograph that is sent
- FRAC_OUT = Fraction of hydrograph

100% of total flow is sent to the channel in the respective subbasin

100% of recharge is sent to the aquifer in the respective subbasin

HRU properties

hru-data.hru: HRU properties - Little River Experimental Watershed (Subbasin)

NUMB	AREA	NAME	TOPO	HYD	SOIL	LANDUSE	MGTOPS	STROPS	STRINIT	PLANTINI	SOIL_NUT	PESTINIT	BACTINIT	SURFSTOR	SNOW
1	0.1539	1031	1	1	3	1	8	0	0	8	3	0	0	0	1
2	0.0072	1041	2	2	4	1	11	0	0	11	4	0	0	0	1
3	0.7911	1061	3	3	6	1	9	0	0	9	6	0	0	0	1
4	0.0027	1091	4	4	9	1	11	0	0	11	9	0	0	0	1
5	0.0279	1101	5	5	10	1	11	0	0	11	10	0	0	0	1
6	0.0117	2031	6	6	3	2	2	0	0	2	3	0	0	0	1
7	0.0018	2041	7	7	4	2	2	0	0	2	4	0	0	0	1
8	0.0549	2061	8	8	6	2	2	0	0	2	6	0	0	0	1
9	0.0252	2101	9	9	10	2	2	0	0	2	10	0	0	0	1
10	0.0396	3031	10	10	3	3	3	0	0	3	3	0	0	0	1
11	0.0369	3041	11												
12	0.1323	3061	12												
13	0.0567	3091	13												
14	0.0702	3101	14												
15	0.0027	4031	15												
16	0.0072	4041	16												

topography.top: General topographical characteristics - Little River Experimental Watershed (Subbasin)

NUMB	NAME	ELEV	SLOPE	SLOPE_LEN	LAT_LEN	DIS_STREAM	DEP_CO	FIELD_DB	CHANNEL_DB
1	1031	130.0344	0.0379	91.6000	0.0000	35.0000	0.0000	0	0
2	1041	126.5418	0.0060	91.6000	0.0000	35.0000	0.0000	0	0
3	1061	136.4939	0.0348	91.6000	0.0000	35.0000	0.0000	0	0
4	1091	131.1593	0.0303	91.6000	0.0000	35.0000	0.0000	0	0
5	1101	132.4586	0.0411	91.6000	0.0000	35.0000	0.0000	0	0
19	4101	127.9802	0.0289	91.6000	0.0000	35.0000	0.0000	0	0
20	5031	124.5828	0.0080	91.6000	0.0000	35.0000	0.0000	0	0

soils.sol: Soil parameters - Little River Experimental Watershed

NUMB	SNAM	NLY	HYDGRP	ZMX	ANION_EXCL	CRK	TEXTURE	Z1	BD1	AWC1	K1	CBN1	CLAY1	SILT1	SAND1	ROCK1	ALB1	USLE_K1	EC1	CAL1	PH1
1	LREW01	1	A	2290	0.5	0.5	S	2290	1.48	0.04	807.6	0.435	3.0	1.5	95.5	2.00	.37	0.10	0.0	0.0	5.3
2	LREW02	2	A	2160	0.5	0.5	S-S	1520	1.50	0.07	331.2	0.435	5.0	1.4	93.6	6.00	.30	0.10	0.0	0.0	5.3
3	LREW03	3	B	1520	0.5	0.5	LS-SCL-SCL	360	1.45	0.08	100.8	0.145	10.0	4.3	85.7	5.00	.30	0.15	0.0	0.0	5.3
4	LREW04	3	B	1930	0.5	0.5	SL-SC-C	180	1.55	0.13	100.8	0.435	14.0	19.2	66.8	7.00	.30	0.28	0.0	0.0	4.6
5	LREW05	3	B	1650	0.5	0.5	LS-SL-SCL	660	1.65	0.07	331.2	0.725	6.0	9.1	84.9	5.00	.30	0.15	0.0	0.0	5.3
6	LREW06	4	B	1650	0.5	0.5	LS-SL-SCL-SCL	250	1.43	0.06	331.2	0.435	5.5	9.2	85.3	13.00	.30	0.15	0.0	0.0	5.3
7	LREW07	3	C	1650	0.5	0.5	LS-SCL-SCL	360	1.50	0.10	100.8	1.015	6.0	9.1	84.9	6.00	.30	0.15	0.0	0.0	5.5
8	LREW08	3	C	1650	0.5	0.5	SL-SCL-SCL	100	1.48	0.11	100.8	1.160	12.5	19.6	67.9	5.00	.30	0.24	0.0	0.0	5.0
9	LREW09	3	C	1650	0.5	0.5	LS-SL-SCL	790	1.53	0.06	331.2	0.870	7.5	9.0	83.5	3.00	.23	0.10	0.0	0.0	5.3
10	LREW10	3	D	1780	0.5	0.5	LS-SCL-SCL	710	1.53	0.07	331.2	0.870	7.0	9.2	83.8	1.00	.16	0.10	0.0	0.0	5.0
11	LREW11	3	D	1650	0.5	0.5	SL-SCL-SC	200	1.35	0.13	32.4	1.450	17.5	15.3	67.2	1.00	.23	0.10	0.0	0.0	4.6
12	LREW12	1	D	25.4	0.5	0.5	water	25.4	0.01	0.00	600.0	0.000	0.0	0.0	0.0	0.00	.23	0.00	0.0	0.0	0.0

General land use parameters

landuse.lum: General land use properties - Little River Experimental Watershed

NUMB	NAME	CN_LU	USLE_P	IURBAN	URB_LU	OVN
1	AGRL	7	1.00	0	0	0.14
2	PAST	36	1.00	0	0	0.35
3	FRSE	46	1.00	0	0	0.45
4	FRSD	46	1.00	0	0	0.45
5	WETF	46	1.00	0	0	0.45
6	WATR	1	1.00	0	0	0.01
7	URLD	47	1.00	1	4	0.10

cntable.lum: Typical curve number values - General

urban.urb: Urban parameters - General

NUMB	NAME	FIMP	FCIMP	CURBDEN	URBCOEF	DIRTMX	THALF	TNCONC	TPCONC	TNO3CONC	URBCN2	Description
1	URHD	0.60	0.44	0.24	0.18	225.00	0.75	550.00	223.00	7.20	98.00	Residential-High Density
2	URMD	0.38	0.30	0.24	0.18	225.00	0.75	550.00	223.00	7.20	98.00	Residential-Medium Density
3	URML	0.20	0.17	0.24	0.18	225.00	0.75	460.00	196.00	6.00	98.00	Residential-Med/Low Density
4	URLD	0.12	0.10	0.24	0.18	225.00	0.75	460.00	196.00	6.00	98.00	Residential-Low Density
5	UCOM	0.67	0.62	0.28	0.18	200.00	1.60	420.00	240.00	5.50	98.00	Commercial
6	UIDU	0.84	0.79	0.14	0.18	400.00	2.35	430.00	104.00	5.60	98.00	Industrial
7	UTRN	0.98	0.95	0.12	0.18	340.00	3.90	480.00	212.00	6.30	98.00	Transportation
8	UINS	0.51	0.47	0.12	0.18	340.00	3.90	480.00	212.00	6.30	98.00	Institutional
9	URBN	0.38	0.30	0.24	0.18	225.00	0.75	550.00	223.00	7.20	98.00	Residential

14	Row_crops	Contoured_&_terraced_w_residue	Poor	65	73	79	81
15	Row_crops	Contoured_&_terraced_w_residue	Good	61	70	77	80

Management schedules and operations

management.sch: tilla

		OP
1	AGRL	0
2	PAST	3
		2
		3
		4
		20
3	FRSE	0
4	FRSD	0
5	WETF	0
6	WATR	0
7	URLD	3
		2 3
		3 11
		4 11

initial.plt: Plant community initialization - Little River Experimental Watershed

NUMB	NAME	PLANTS_COM	CPNM	DB_NUM	IGRO	PHU	LAI	BIOMS	PHUACC	POP	YRMAT	RSDIN
1	AGRL	1										
			AGRL	1	0	1826.0	0.00	0.00	0.00	0.00	0.00	1000.00
2	PAST	1										
			PAST	12	0	1996.0	0.00	0.00	0.00	0.00	0.00	3000.00
3	FRSE	1										
			FRSE	8	1	5340.3	0.00	0.00	0.00	0.00	0.00	10000.00
4	FRSD	1										
			FRSD	7	1	1826.0	0.00	0.00	0.00	0.00	0.00	1000.00
5	WETF	1										
			WETF	10	1	5340.3	0.00	0.00	0.00	0.00	0.00	10000.00
6	WATR	1										
			WATR	18	0	2256.5	0.00	0.00	0.00	0.00	0.00	0.00
7	URLD	1										
			BERM	40	1	1996.0	0.00	0.00	0.00	0.00	0.00	3000.00
8	AGRL	1										
			PNUT	61	0	699.0	0.00	0.00	0.00	0.00	0.00	1000.00
9	AGRL	1										
			CORN	19	0	1394.0	0.00	0.00	0.00	0.00	0.00	1000.00
10	AGRL	1										
			COTS	66	0	1254.0	0.00	0.00	0.00	0.00	0.00	1000.00
11	AGRL	1										
			COTS	66	0	1254.0	0.00	0.00	0.00	0.00	0.00	1000.00

fertilizer.frt: Fertilizer para

NUMB	FERTNM	FMINN								
1	Elem-N	1.000								
2	Elem-P	0.000								
3	ANH-NH3	0.820								
4	UREA	0.460	0.000	0.000	0.000	1.000	0.000	0.000	0.000	Urea
5	46-00-00	0.460	0.000	0.000	0.000	0.000	0.000	0.000	0.000	46-00-00
6	33-00-00	0.330	0.000	0.000	0.000	0.000	0.000	0.000	0.000	33-00-00
7	31-13-00	0.310	0.057	0.000	0.000	0.000	0.000	0.000	0.000	31-13-00
8	30-80-00	0.300	0.352	0.000	0.000	0.000	0.000	0.000	0.000	30-80-00
9	30-15-00	0.300	0.066	0.000	0.000	0.000	0.000	0.000	0.000	30-15-00
10	28-10-10	0.280	0.044	0.000	0.000	0.000	0.000	0.000	0.000	28-10-10

1	4	2	0.000	9	0	0.0	Establish CORN
10	4	3	0.000	1	0	0.0	Fert
10	4	3	0.000	2	0	0.0	Fert
3	9	1	0.000	1	0	0.0	Harv
4	9	1	0.000	0	0	0.0	Kill

Climate

weather-sta.cli: Weather stations - Little River Experimental Watershed (Subbasin)

NUMB	NAME	WGN	PCPSIM	TMPSIM	RHSIM	SLRSIM	WNDSIM	PGAGE	TGAGE	SGAGE	HGAGE	WGAGE	WNDIR	ATMODEP
1	CLI1	1	1	1	2	2	2	1	1	0	0	0	0	0

Use observed data

Use weather generator

pcp.cli: Precipitation file names - Little River Experimental Watershed

NUMB	FILENAME
1	LREW01.pcp

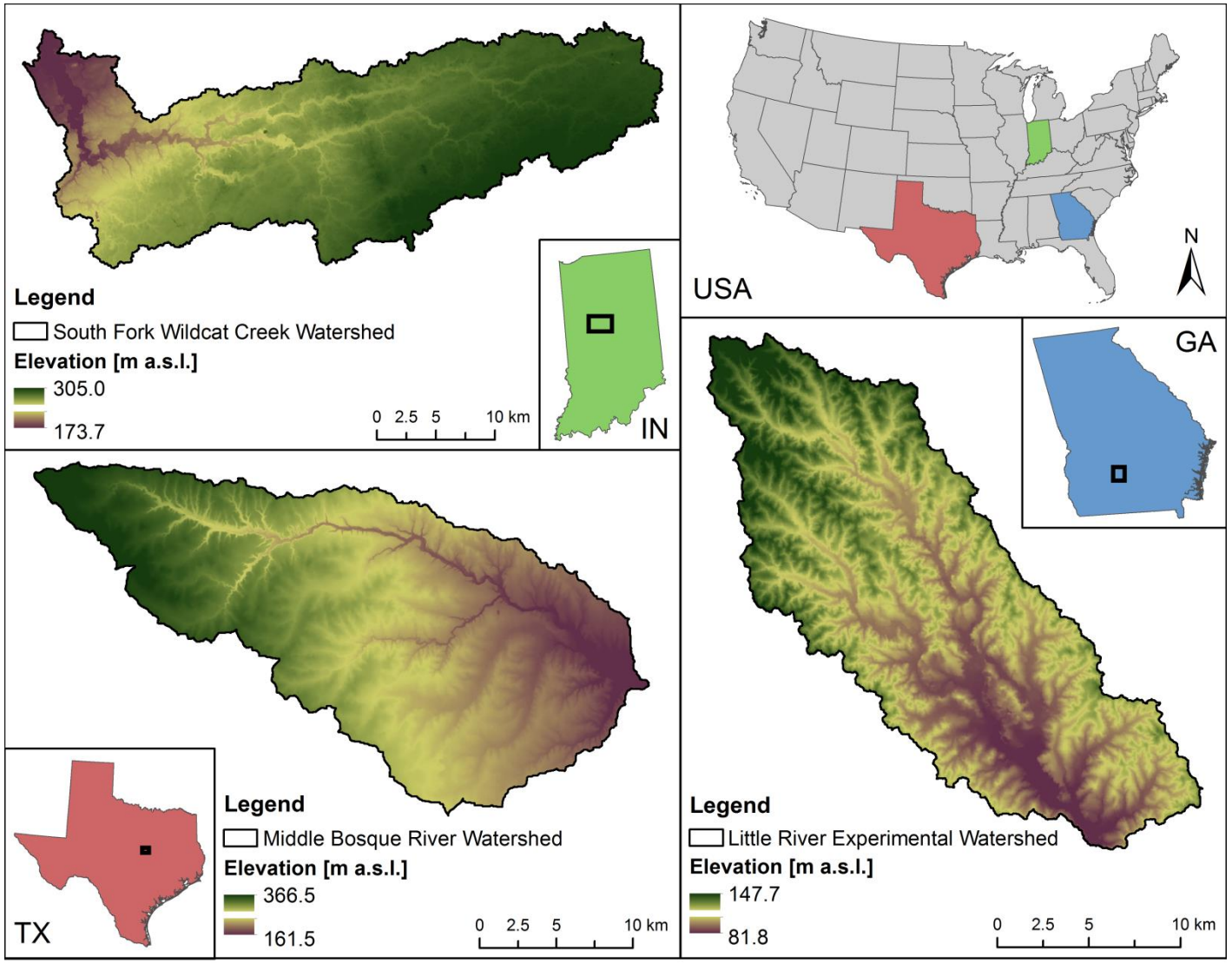
LREW01.pcp: Precipitation data gage NOAA C098703 - Little River Experimental Watershed

NBYR	TSTEP	LAT	LONG	ELEV
25	0	31.45	-83.48	115.8
1988	1	0.0		
1988	2	10.2		
1988	3	12.7		
1988	4	9.1		
1988	5	0.0		
1988	6	0.0		
1988	7	0.0		
1988	8	18.0		
1988	9	4.6		
1988	10	0.0		
1988	11	0.0		
1988	12	0.0		
1988	13	0.0		
1988	14	0.0		

weather-gen.cli: Weather generator data - Little River Experimental Watershed

NUMB	STATE	STATION	LSTATION	ID	LAT	LONG	ELEV	R_YRS	TMX1	2	3
1	GA	2N	GATIFTON	1	31.47	-83.53	112.8	10	16.12	17.53	20.88

Test watersheds: Location and topography

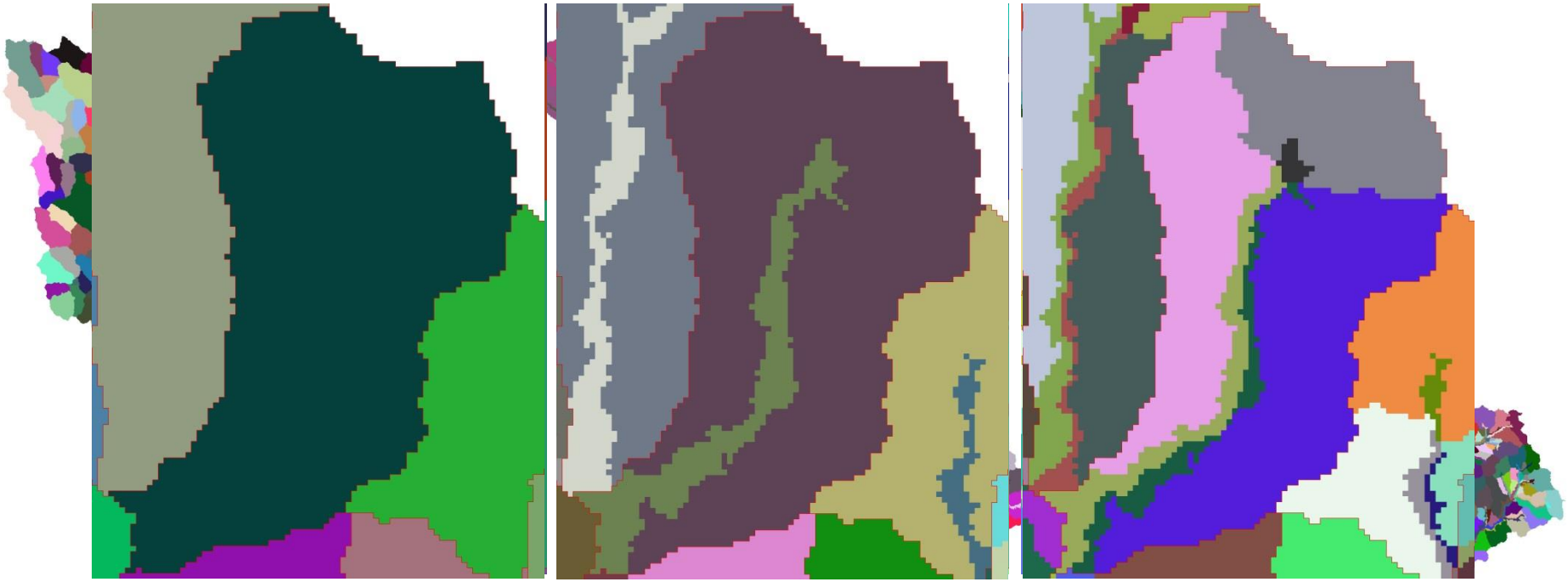


Test watersheds: Characteristics

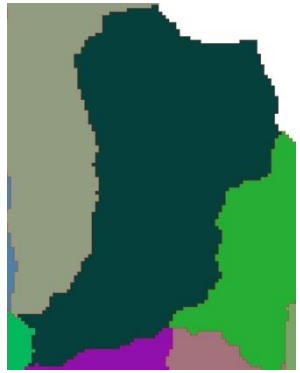
	LREW	MBRW	WCSW
Area (km^2)	334	471	629
Average annual PCP (mm)	1208	750	1422
Average TMP (°C)	19.1	18.5	10.5
Average Q (m^3/s)	2.95	2.60	7.00

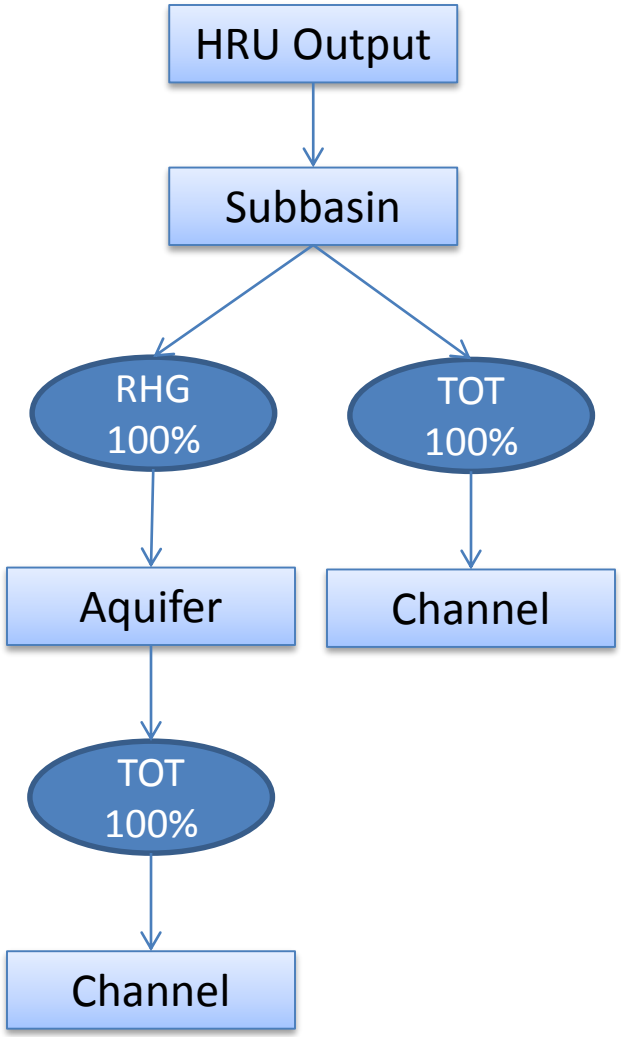
3 setups per watershed

- Subbasin → Regular subbasins
- Landscape 1 → 2 landscape units per subbasin
- Landscape 2 → 4-6 landscape units per subbasin

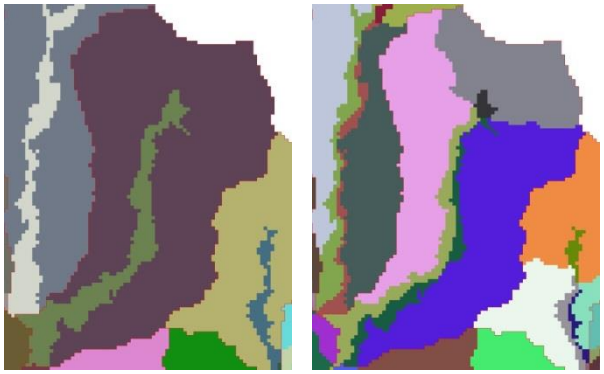


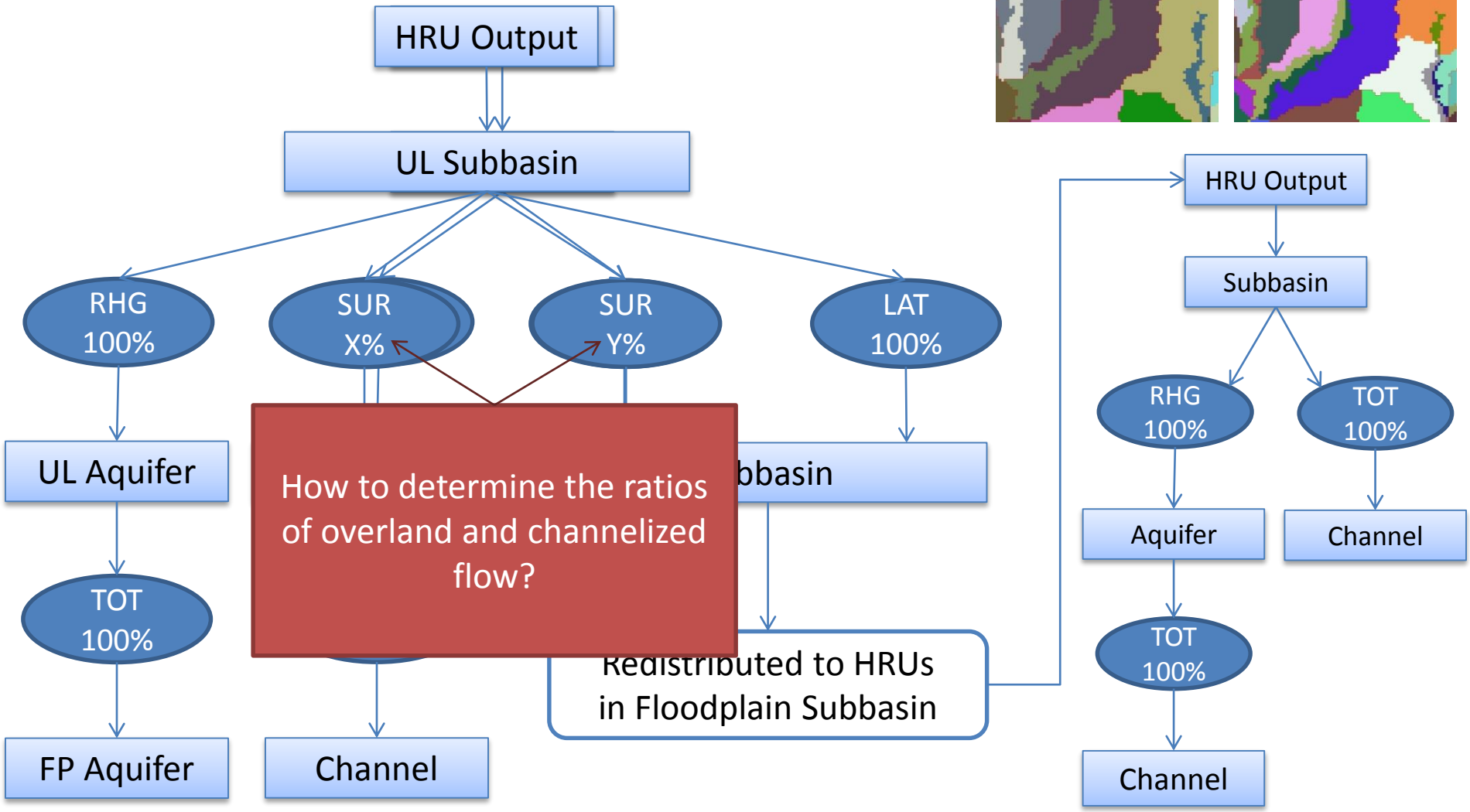
Interaction of spatial objects





Interaction of spatial objects





Flow separation for overland routing

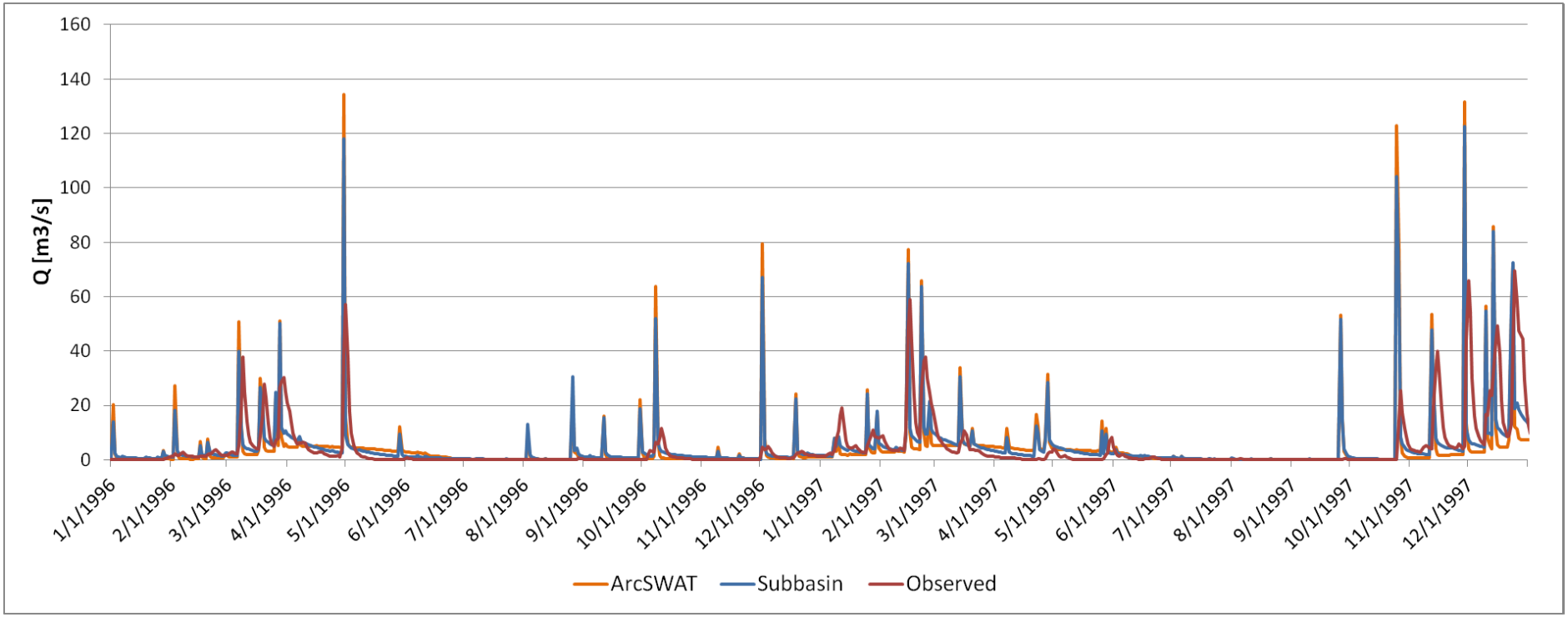
- $\lambda_i = \ln\left(\frac{A_i \cdot r_i}{tan(\beta_i)}\right) \in \mathbb{R}_{>0}$

A_i mean contributing area
r_i ratio of upland and floodplain area
β_i mean slope

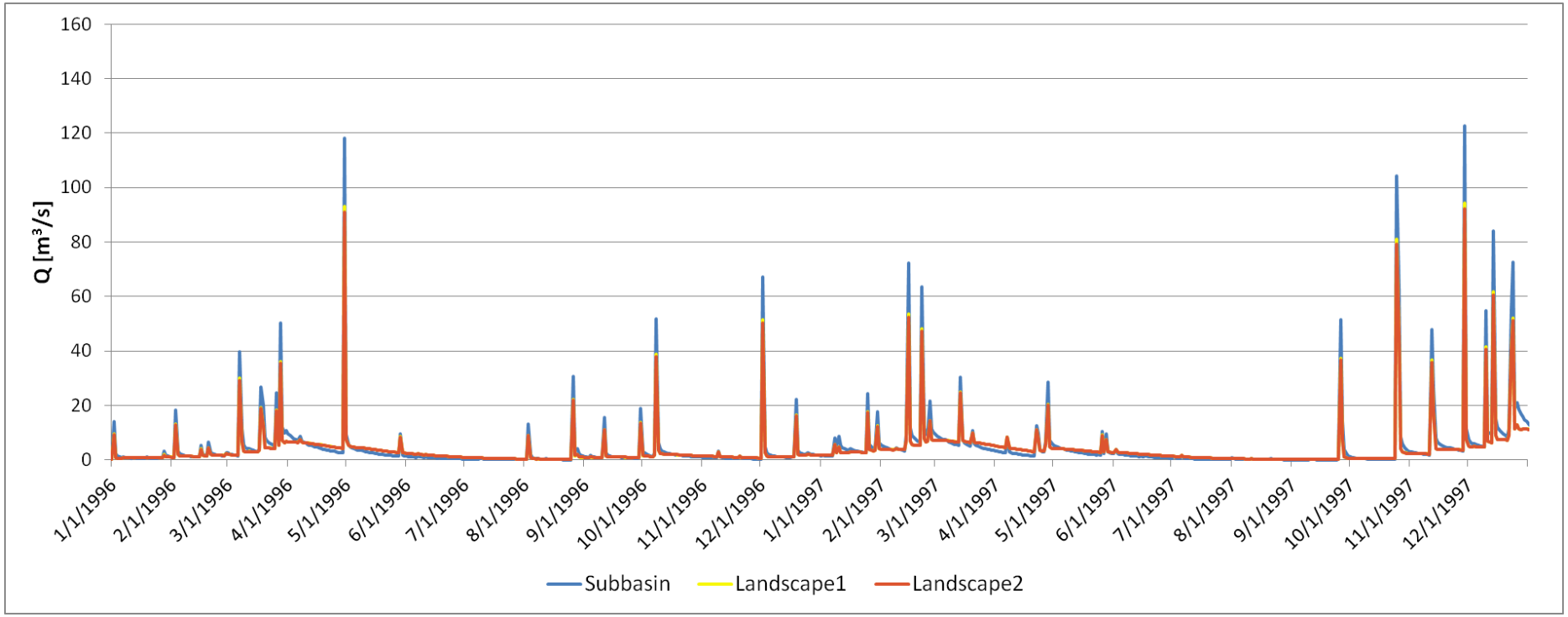
- $f_i = \frac{\lambda_i - \min(\lambda_i)}{\max(\lambda_i) - \min(\lambda_i)} \in [0,1]$

f_i Fraction of channelized flow
$1 - f_i$ Fraction of overland (landscape) flow

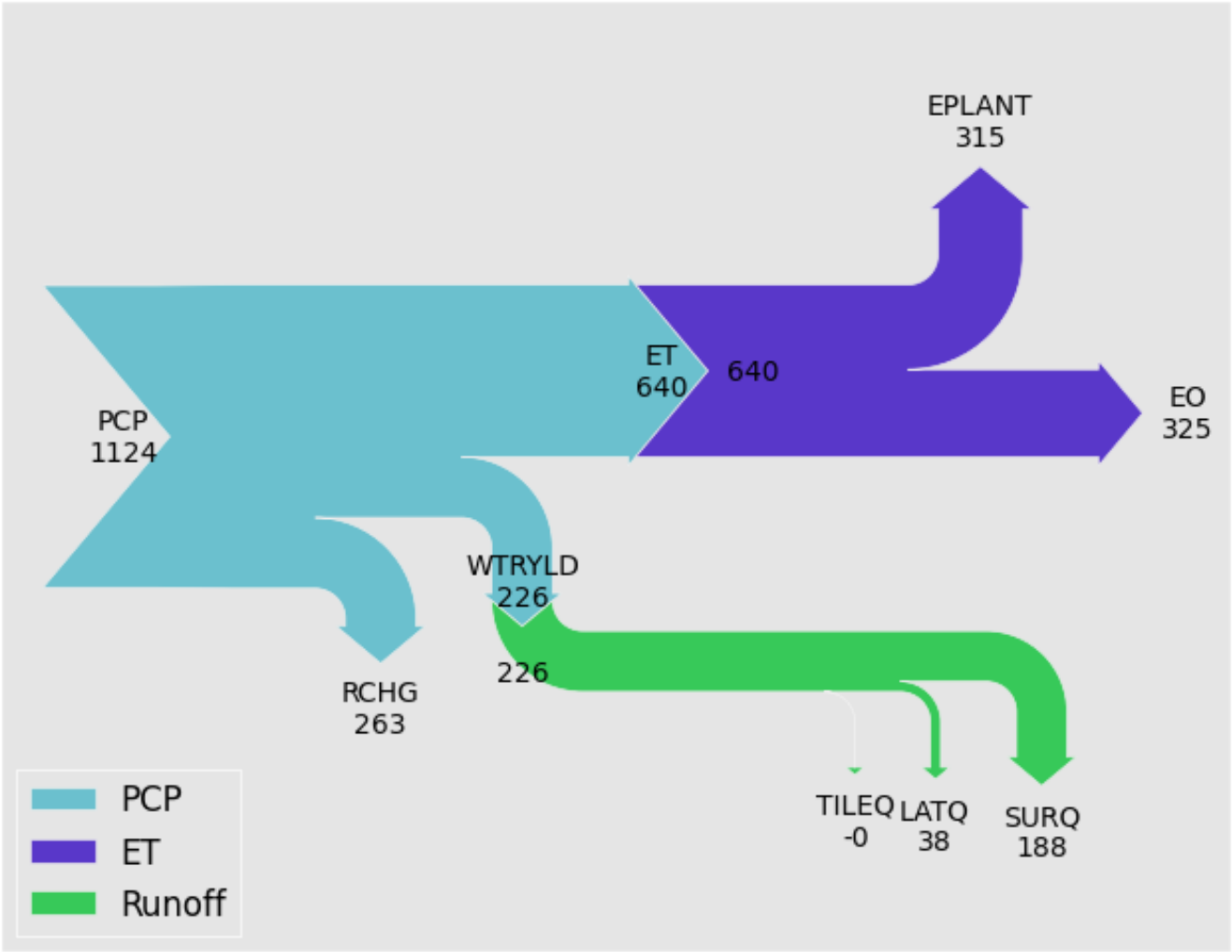
ArcSWAT and modular Subbasin setup

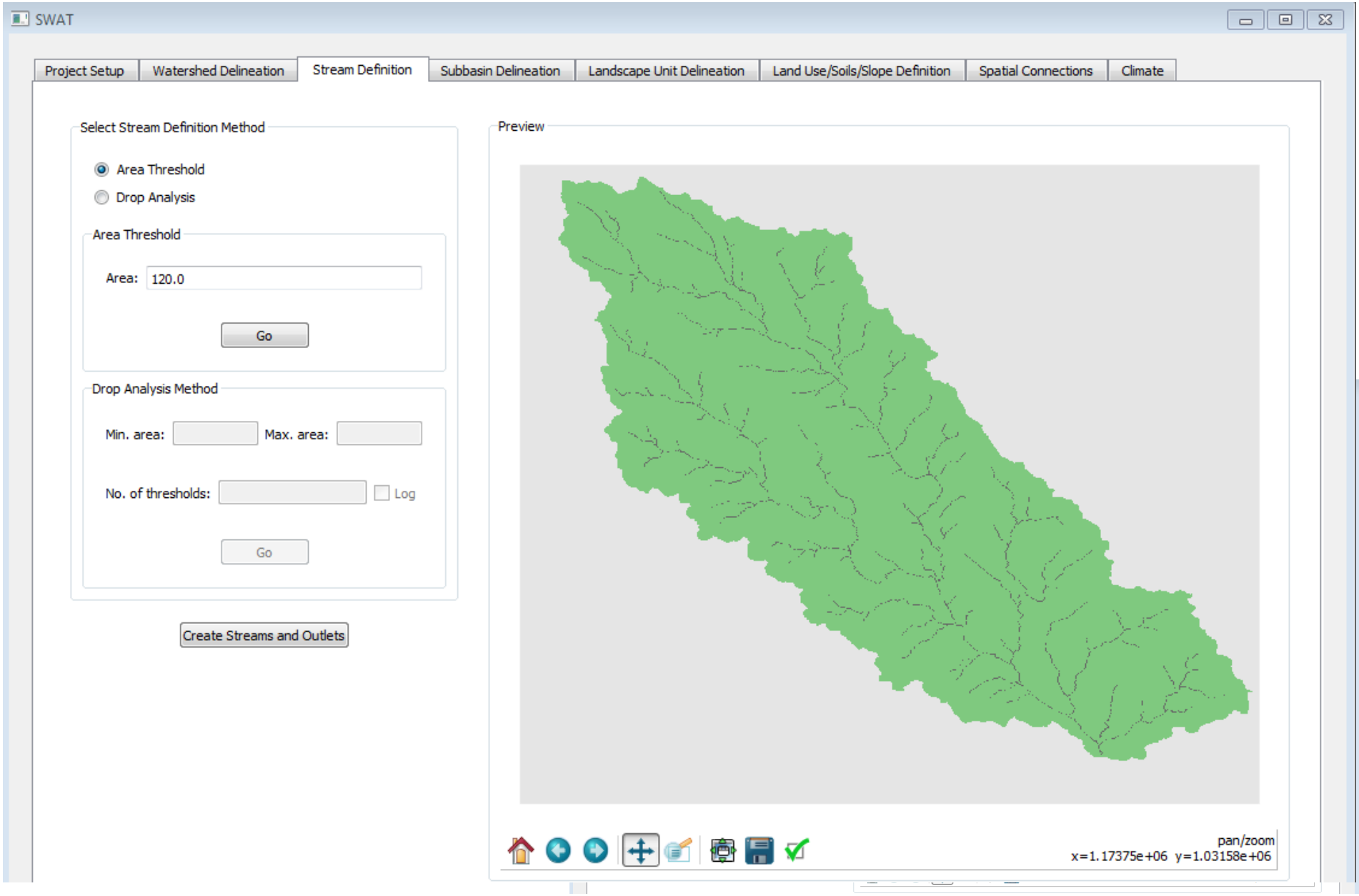


Subbasin and Landscape Unit setups



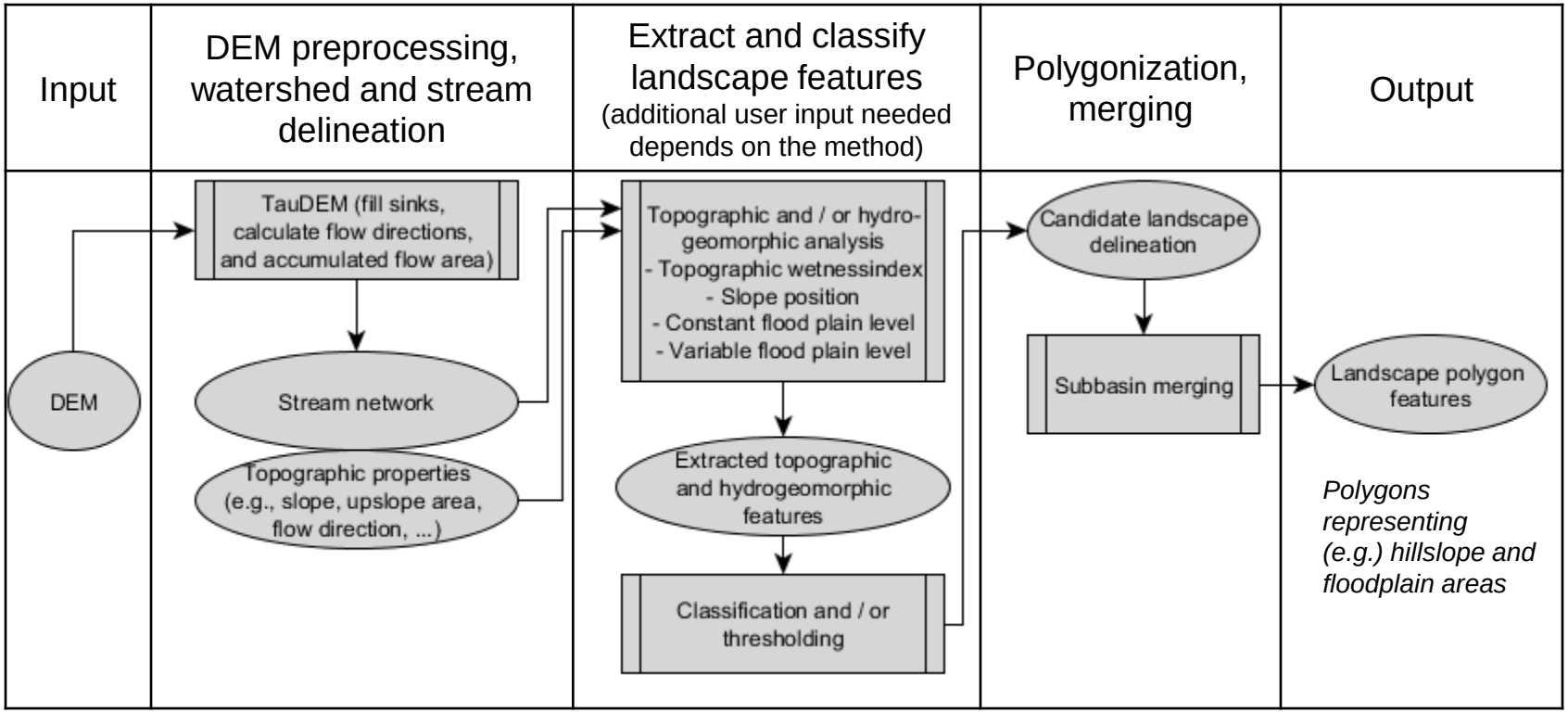
Sankey diagram water balance




SWAT
Project Setup
Watershed Delineation
Stream Definition
Subbasin Delineation
Landscape Unit Delineation
Land Use/Soils/Slope Definition
Spatial Connections
Climate
Select Stream Definition Method
Area Threshold
Drop Analysis
Area Threshold
Area: 120.0
Go
Drop Analysis Method
Min. area:
Max. area:
No. of thresholds:
Log
Go
Create Streams and Outlets
Preview
pan/zoom
x=1.17375e+06 y=1.03158e+06


Thank you for your attention!
kbieger@brc.tamus.edu
hrathjen@purdue.edu

Landscape Unit Delineation



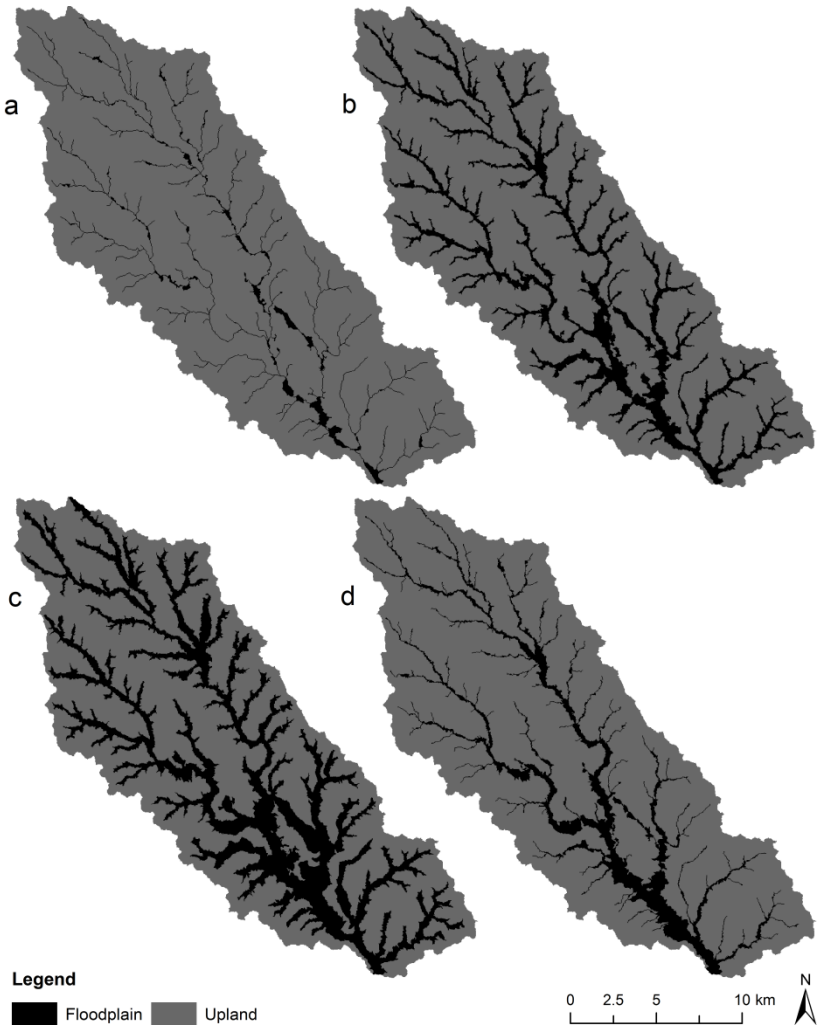
Four delineation methods

a) Topographic Wetness Index

b) Slope Position

c) Uniform Flood Stage

d) Variable Flood Stage

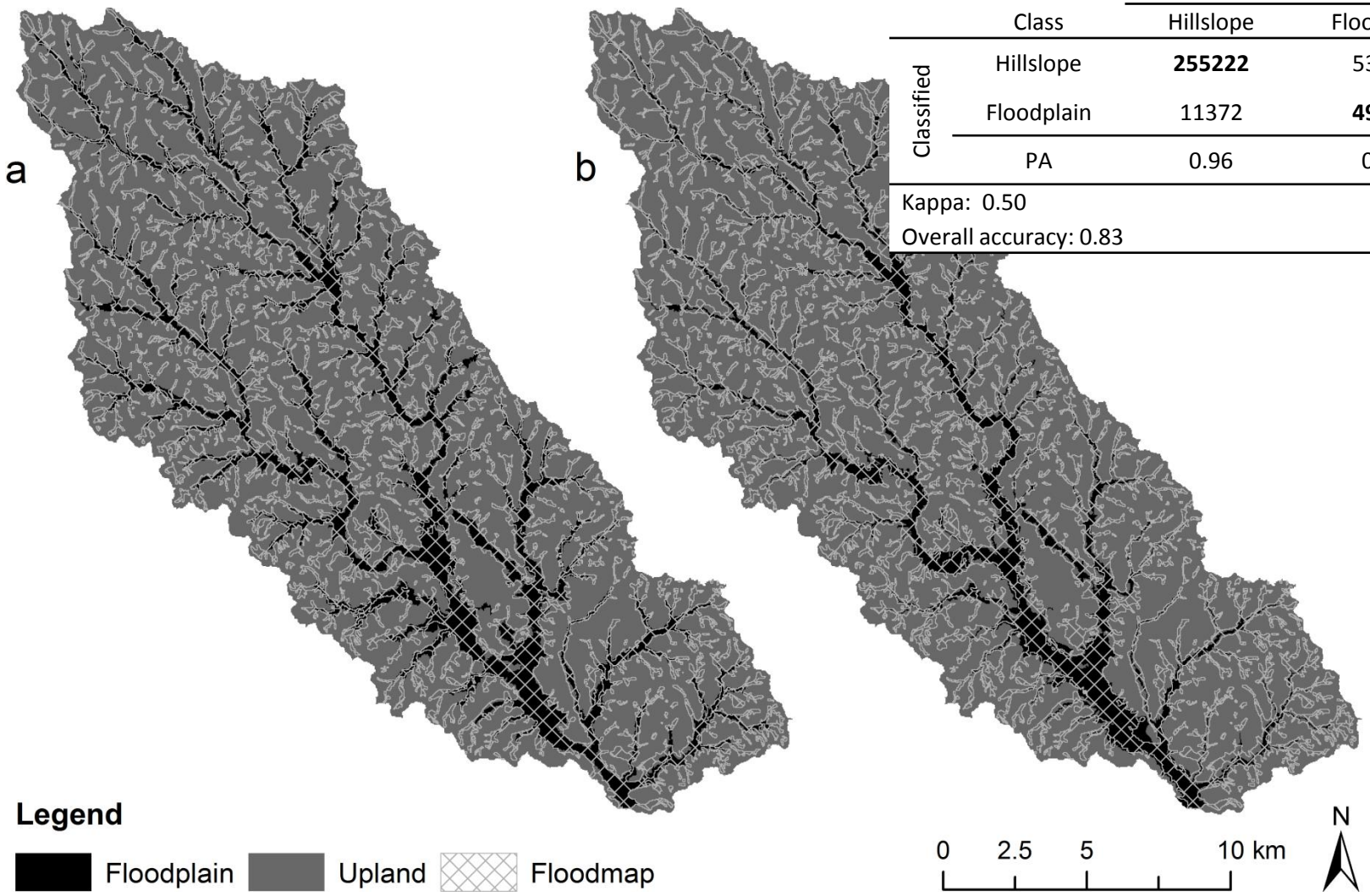


Validation using SSURGO and FEMA flood maps

		Reference data		
	Class	Hillslope	Floodplain	UA
Classified	Hillslope	**255222**	53087	0.83
	Floodplain	11372	**49077**	0.81
	PA	0.96	0.48	

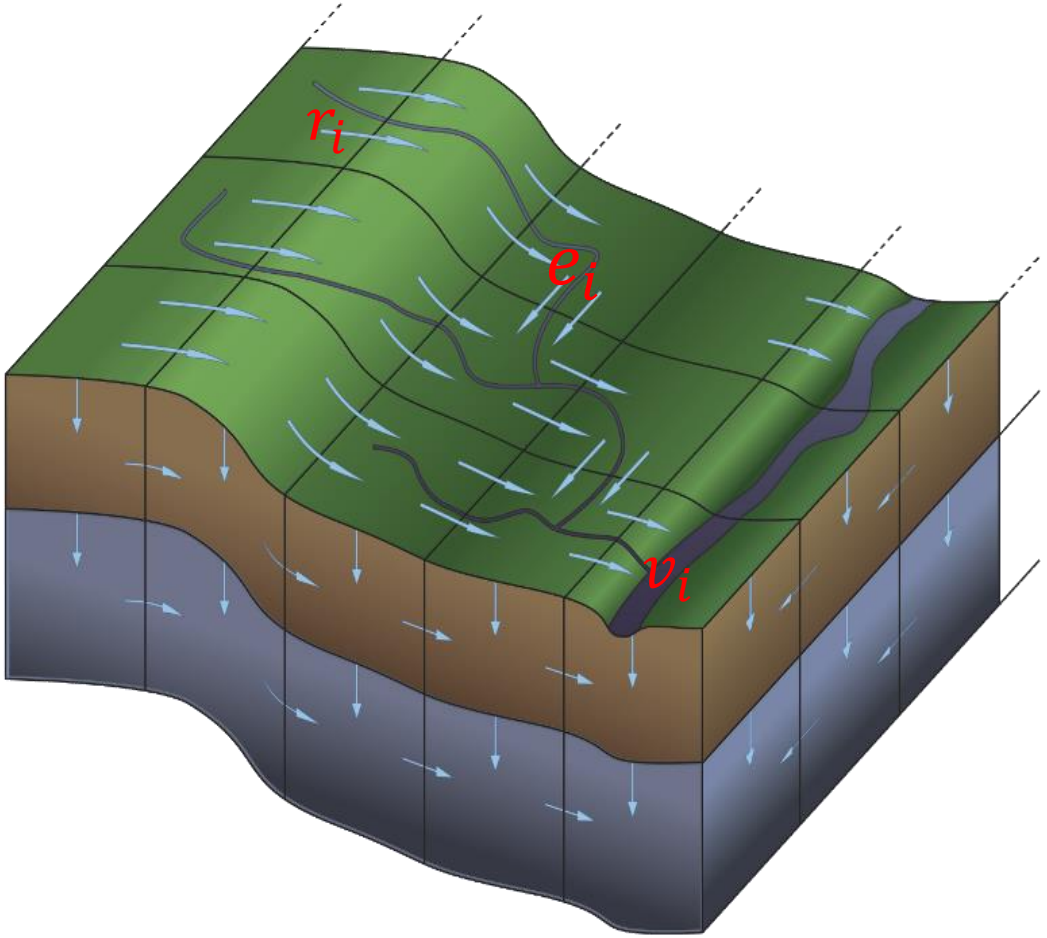
Kappa: 0.50

Overall accuracy: 0.83



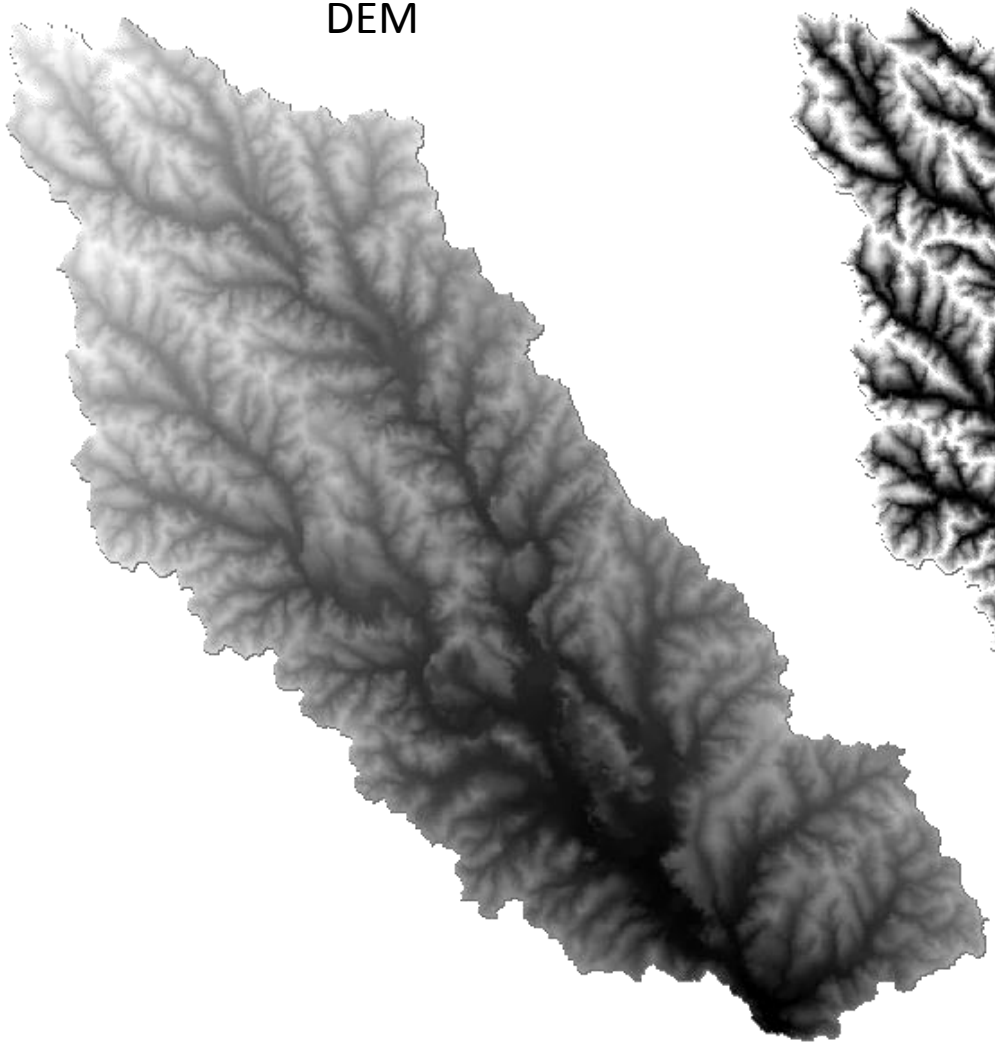
Slope position method: equation

$$\sigma_i = \frac{e_i - v_i}{r_i - v_i} \in [0, 1]$$



Slope position method: Spatial input and output

DEM



Slope position