Simulating Yield using STATSGO and SSURGO soil datasets

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Outline

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2. **Soil Datasets – STATSGO and SSURGO**
3. **Methods**
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    - Subbasin Selection
    - Validation
4. **Results**
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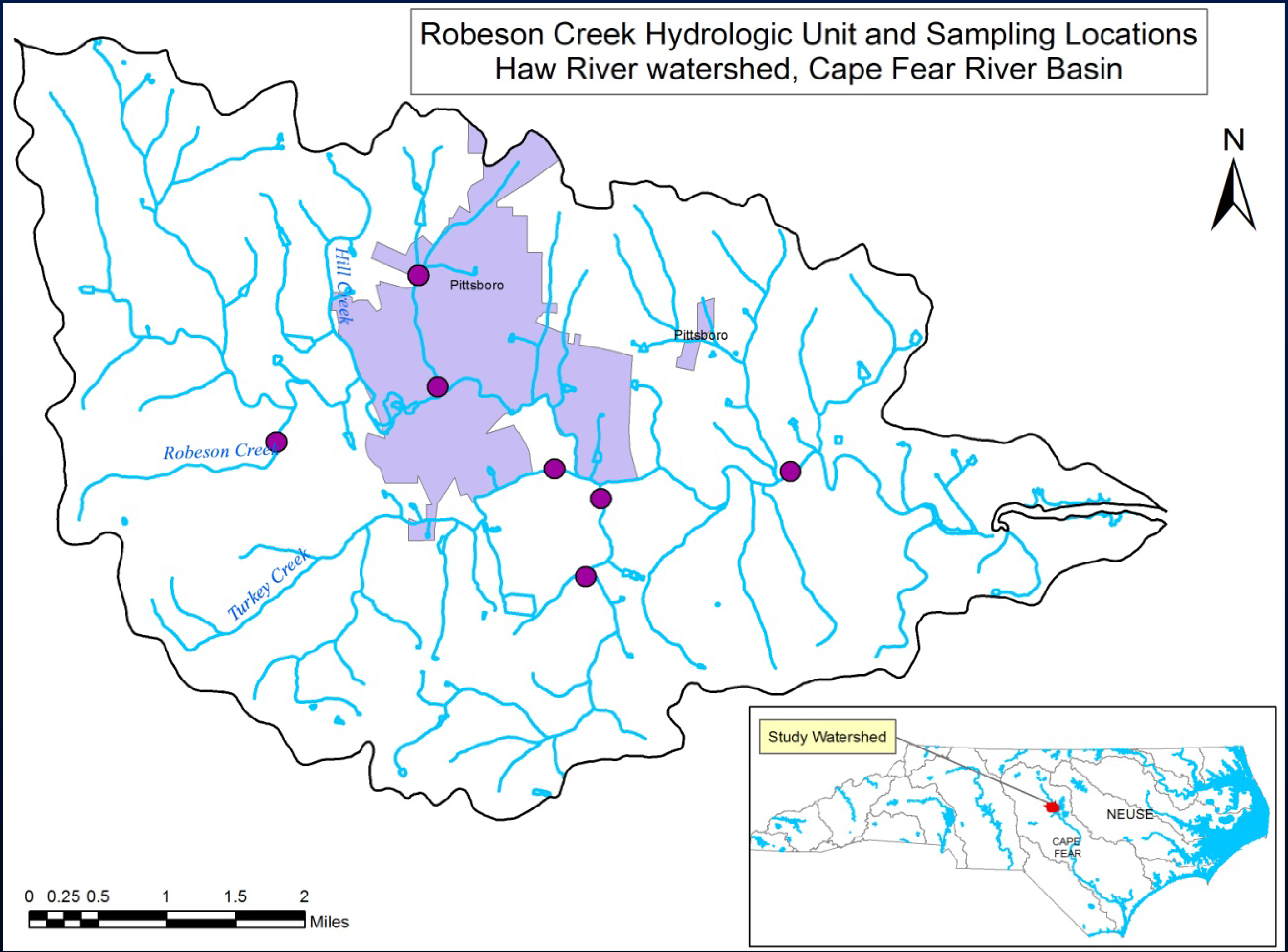
Introduction

Study Area

- Robeson Creek Watershed
- Piedmont, Carolina Slate Belt
- Impaired waterbody, active TMDL for P
- Section 319 funded
- 7 Sampling points
- Mixed land use


Robeson Creek Hydrologic Unit and Sampling Locations
Haw River watershed, Cape Fear River Basin
N
Pittsboro
Pittsboro
Hill Creek
Robeson Creek
Turkey Creek
Study Watershed
NEUSE
CAPE
FEAR
0 0.25 0.5 1 1.5 2
Miles

Introduction

SWAT

- SWAT is a hydrologic modeling tool developed at Texas A&M University.

- Capable of predicting the effect of different land uses on water yield and quality in large complex watersheds.

Objectives

- Determine the influence of soil input dataset spatial resolution on model behaviour
- Determine the variation in this influence for two basins – smaller basin nested in larger

	STATSGO	SSUGRO
WS_A	$WYLD_{AST}$	$WYLD_{ASR}$
WS_B	$WYLD_{BST}$	$WYLD_{BSR}$

WS_A - Entire Basin WS_B – Subbasin 6

Soil Datasets

- STATSGO – lower spatial resolution
- SSURGO – more detailed geography and more recent data (survey conducted 1990s).
  - VBA code created for pre-processing SSURGO 2.2.1
- Only one soil type per polygon was used in SWAT

Methods

Model Selection and Application

- SWAT
  - Commonly used, tested at various spatial scales
  - Allows use of spatial data, Arc SWAT

- Simulation experiment
  - Two different soil datasets
  - Two different watershed sizes
  - Uncalibrated simulations

Methods

Model Selection and Application

Soil Water Balance (*Arnold et al 1999*)

$$SW_t = SW + \sum_{i=1}^{t} (R_i - Q_i - ET_i - P_i - QR_i)$$

R – Rainfall

Q - Runoff

ET – Evapotranspiration

P - Percolation

QR – Return Flow

Calculated for each HRU for each time step, typically daily

Methods

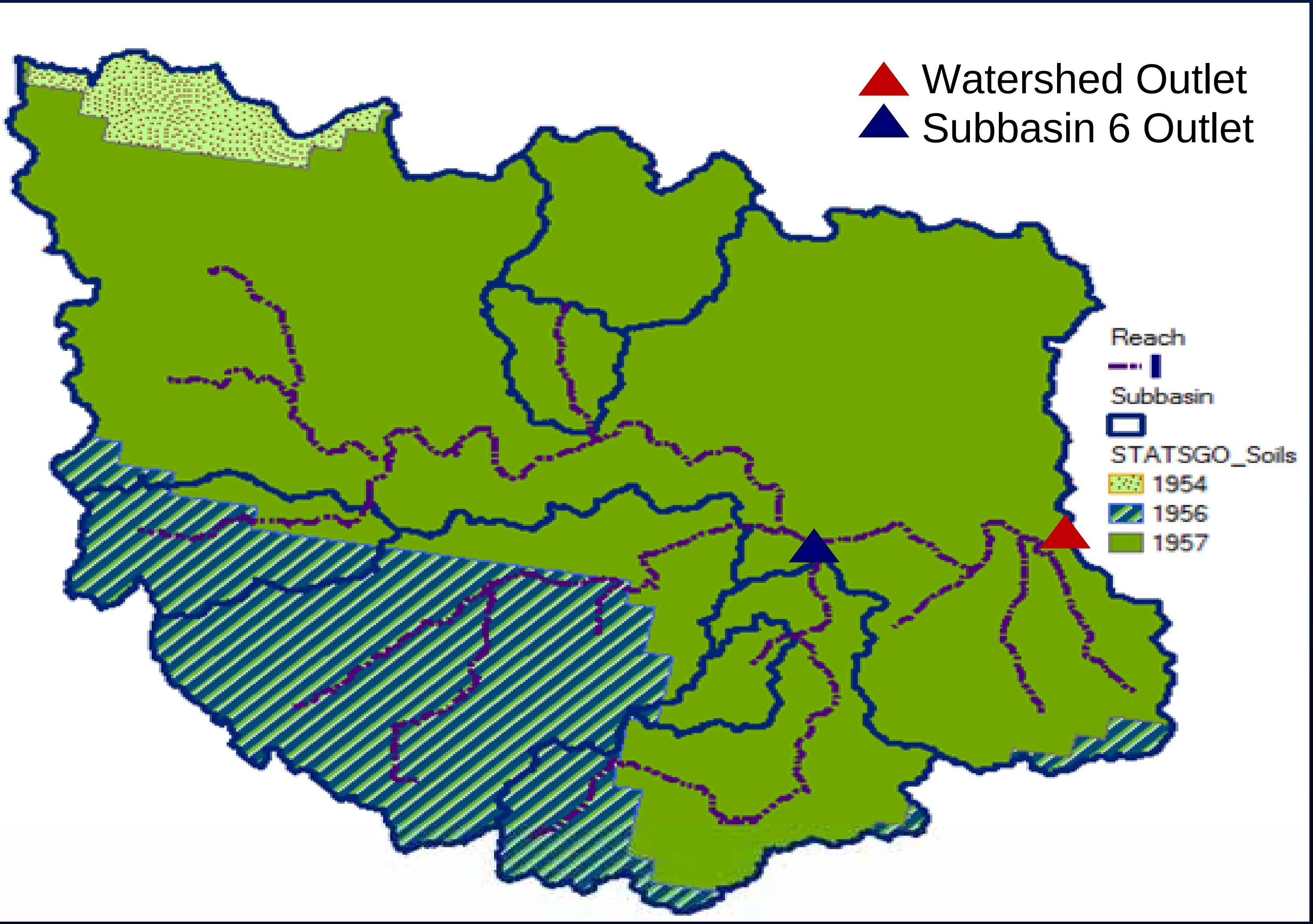
Name	Source	Date	STATSGO Simulation	SSURGO Simulation	Spatial Resolution/ Map Scale
Flow	NCSU WQ	2002 - 2006			
Elevation	NCDOT	8/15/07	X	X	20 foot cell, rounded down to nearest foot
Land Use / Land Cover	MRLC	8/15/07	X	X	30 meter cell, minimum 1 acre Unit
Soil STATSGO	SWAT (modified)	8/15/07	X		1: 250, 000
Soil SSURGO	NRCS	3/20/07		X	1: 24,000

Methods

- Subbasins delineated using sampling locations as outlets
- Subbasins characteristics from reports created by SWAT
- Attempt to normalize for Land Use

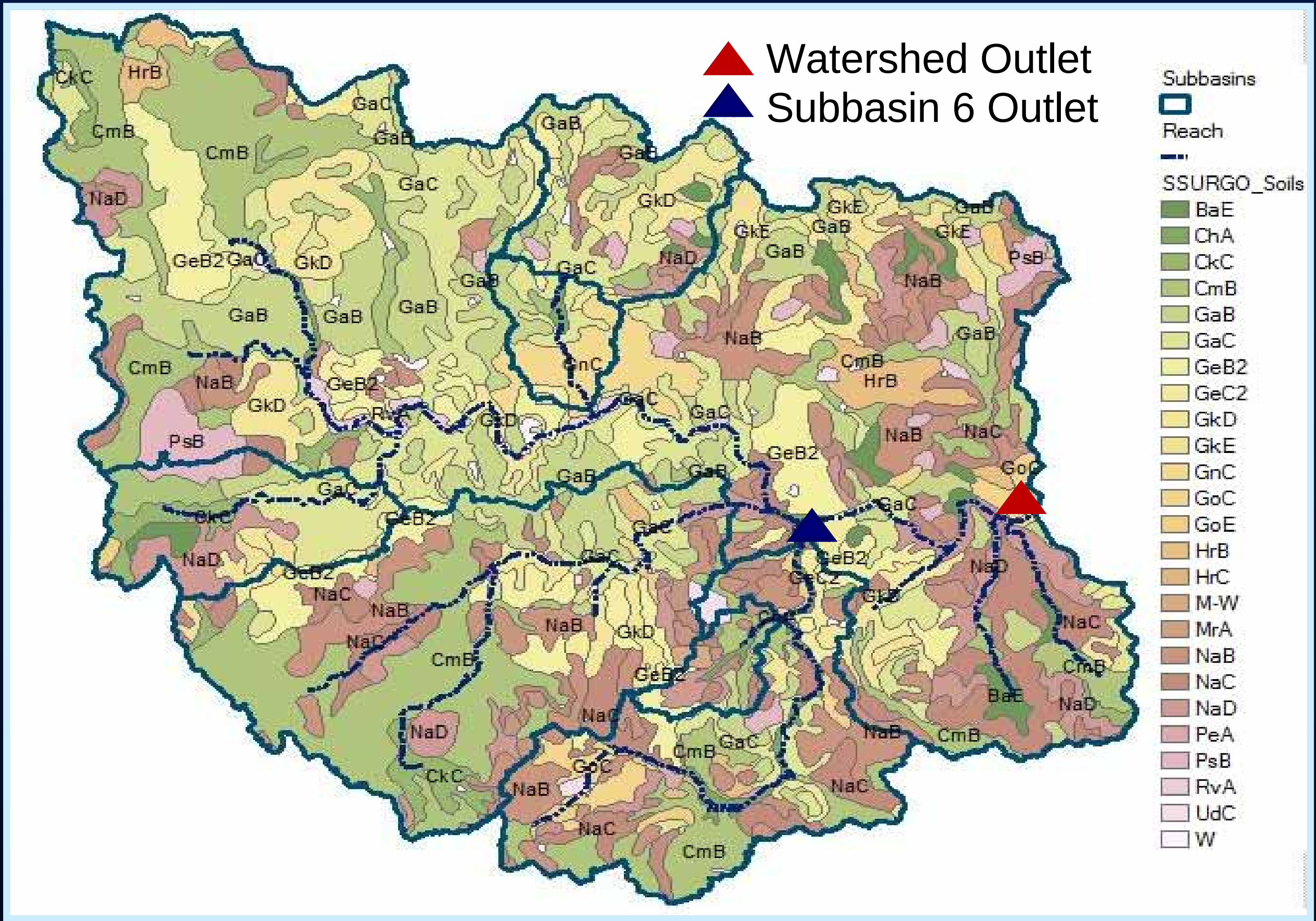
Soil Datasets

STATSGO



Soil Datasets

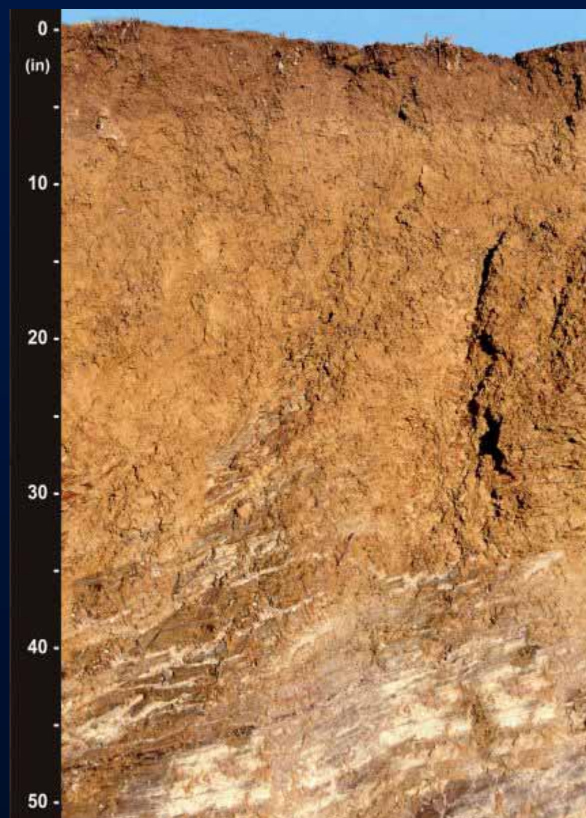
SSURGO



Sample Profiles

Cid

Badin



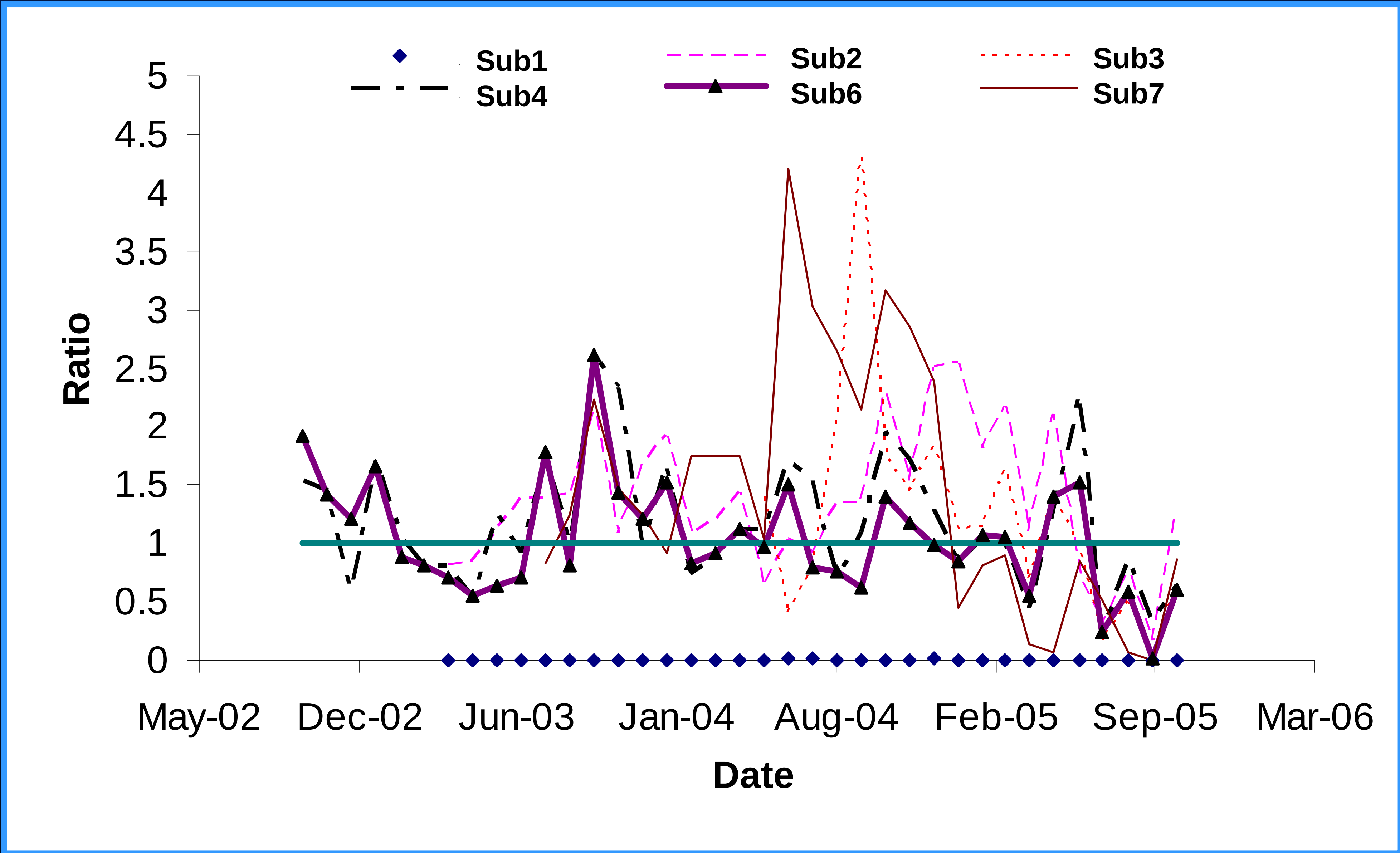
Georgeville

- Clay and Silty Clay Loams
- Variation in depth of profile
- Most commonly low permeability

SSURGO – bottom of C 80 in.

Methods

Subbasin Selection: Yield ratio (measured flows)



Methods

Subbasin characteristics

(value in %)		WATERSHED	SUBBASIN 6
Soil Type	NC061	2.8	0
	NC064	22.2	23.8
	NC068	75	76.2
Land Slope	0 - 2	53.6	52.7
	2 - 6	44	45.4
	6 - 10	2	1.6
	10 - 15	0.15	0.14
	> 15	0.02	0.04
Land Use	URBN	9.3	5.9
	WATR	0.39	0.62
	SWRN	0.15	0.1
	FRST	69	64.8
	RAG	9.6	11.95
	HAY	11.4	15.1

Methods

Validation

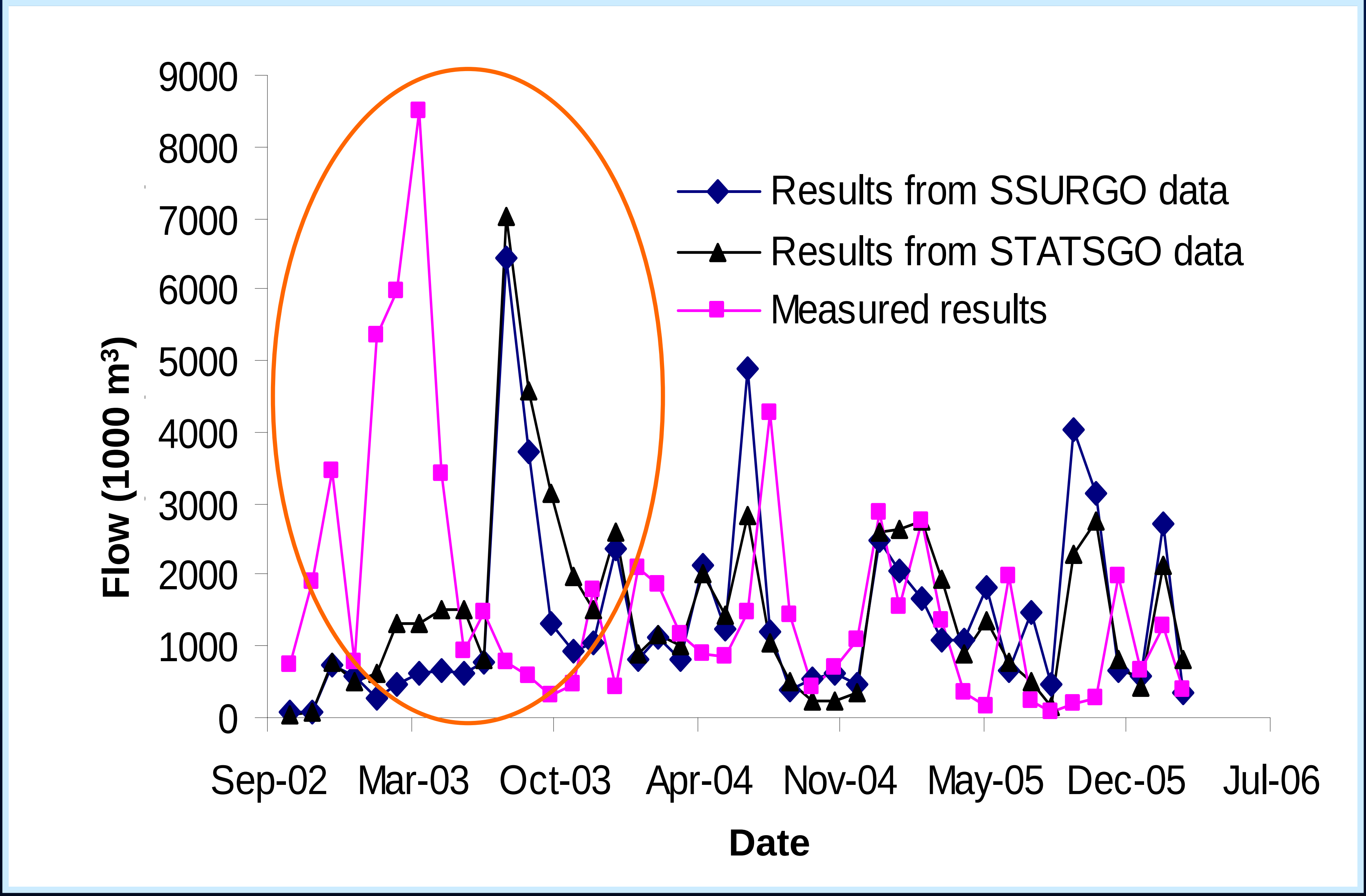
Compared simulated flow to measured data

I. Nash Sutcliffe (E)

II. Pearson Product Momentum Coefficient (*r*)

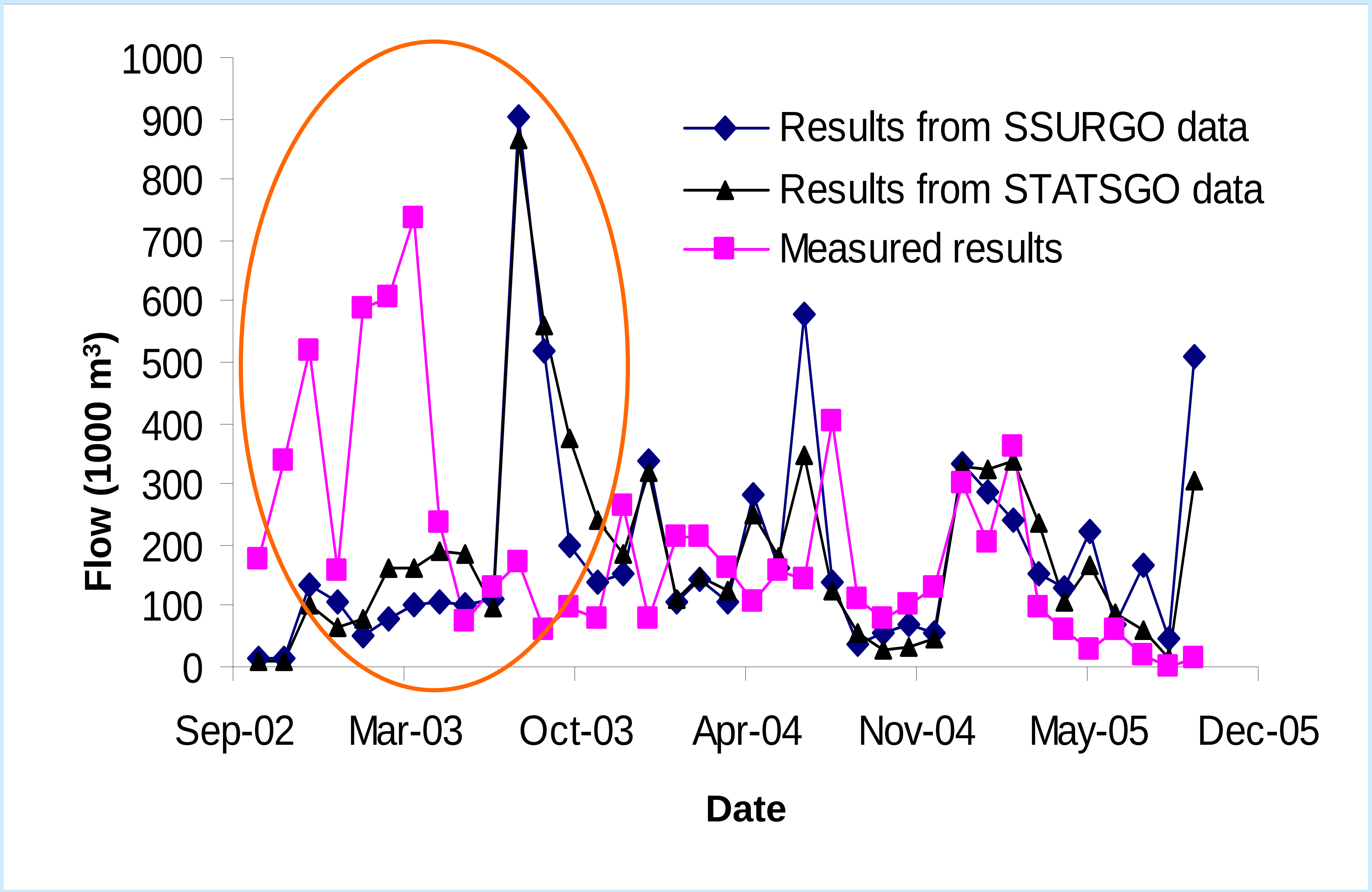
Results

Monthly Flow Entire Watershed



Results

Monthly Flow Subbasin 6



Results

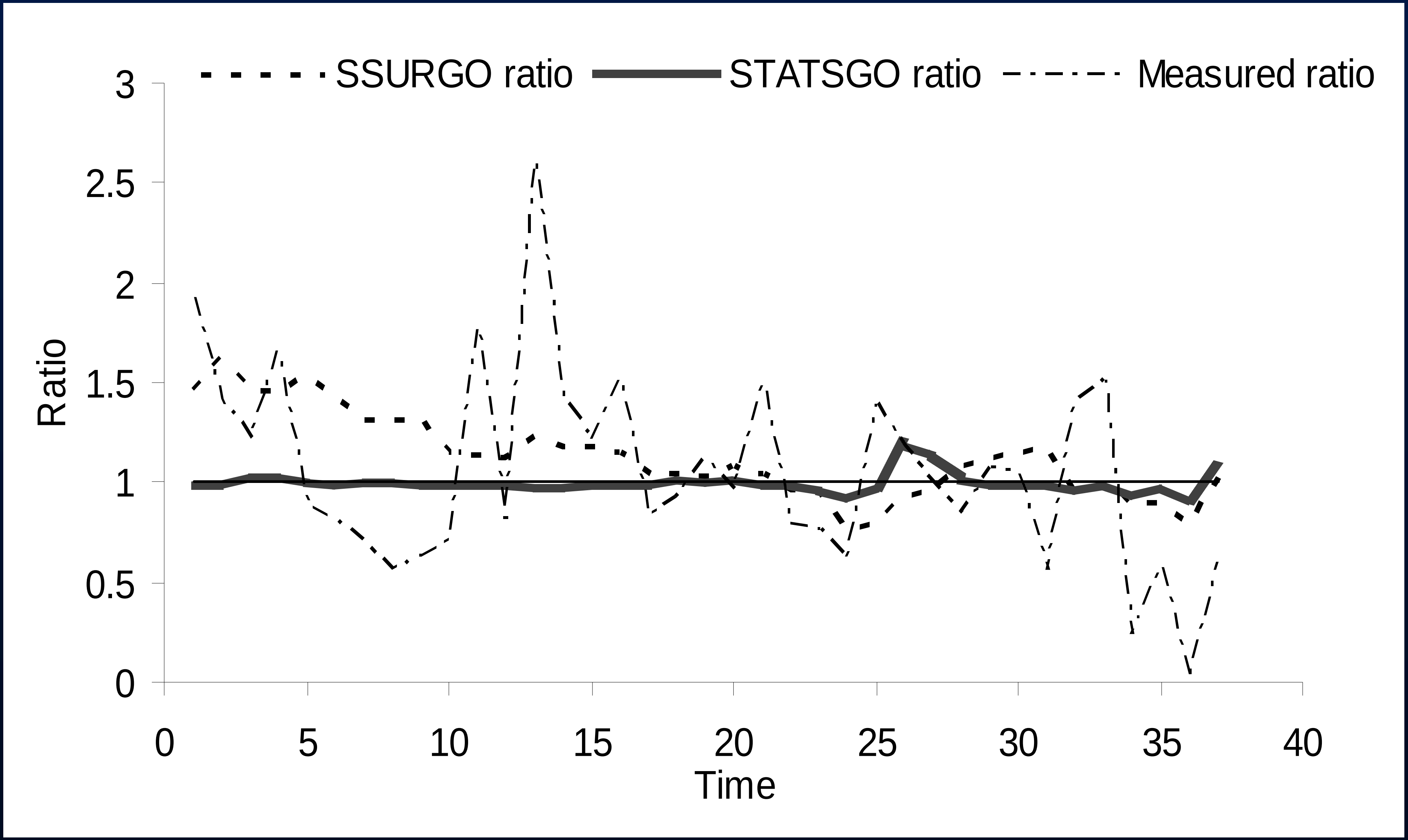
	STATSGO		SSUGRO	
	E	r	E	r
Watershed	-0.75	-0.1	-1	-0.24
Sub basin 6	0.09	-0.07	-1.45	-0.16

Not Indicative of accurate modelling

S&R1

Results

Ratio = Q_6 / Q_{ww}



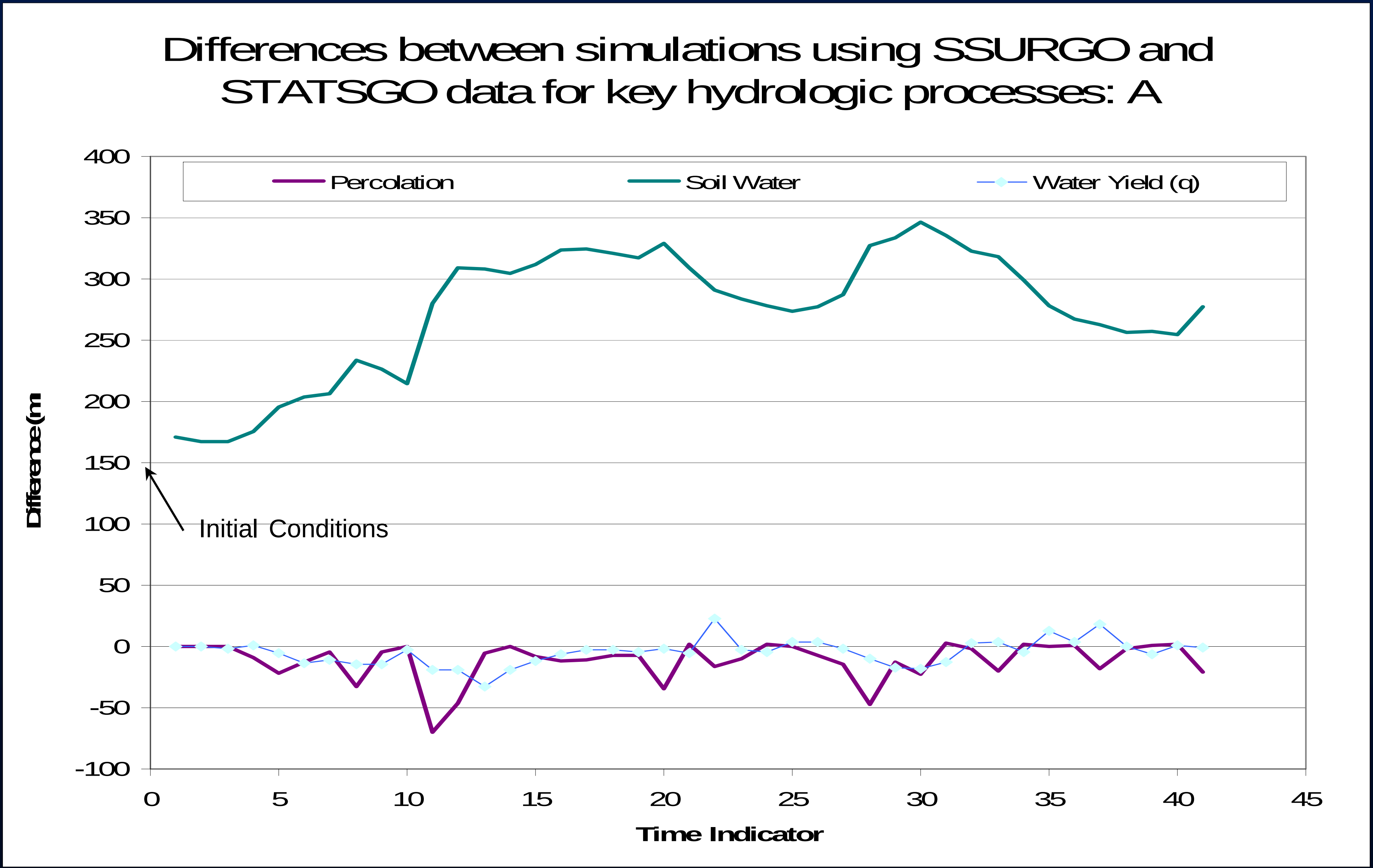
Slide 21

S&R1 this should have been measured ratio and then shown statsgo and ssurgo
Sharon & Raj, 2/20/2008

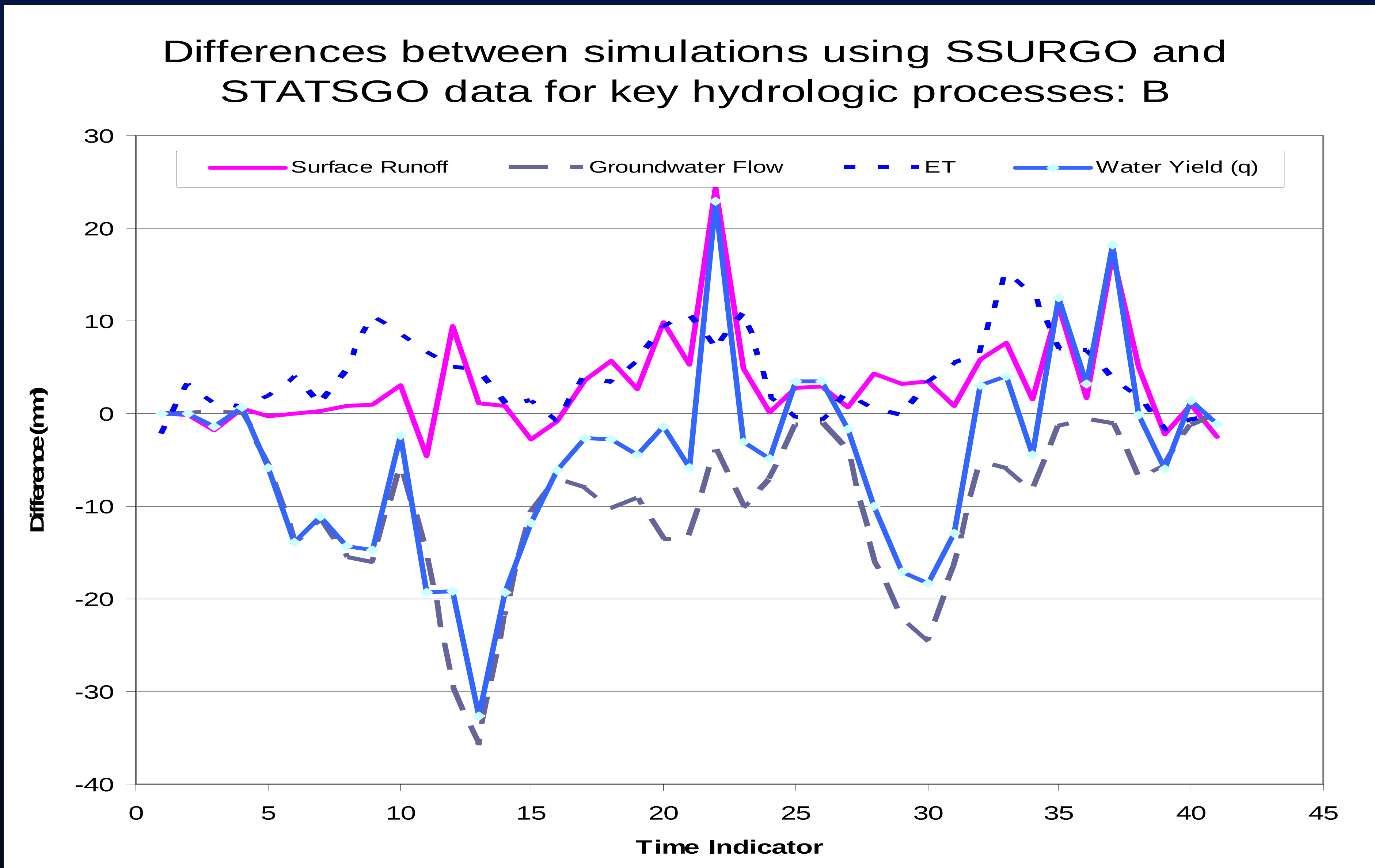
Results

- In our case SSURGO yields were lower than STATSGO. Others also running uncalibrated models (Peschel et al, 2006) have found different results

Results Entire Watershed



Results Entire Watershed



Results

T-test Analysis Comparing Yield (mm) Results from STATSGO and SSURGO

Values in cells are t (P)	STATSGO WW	SSURGO SB6
STATSGO SB6	-0.79 (0.433)	-0.17 (0.8687)
SSURGO WW	-2.97 (0.0054)	3.67 (0.0008)

Conclusions

- Results using SSURGO data showed differences between the entire watershed and the nested subasin.
- Need to perform further sensitivity analysis and compare calibrated results

Future Steps

- Calibration and sensitivity analysis may lead to different conclusions
- Factor in saprolite and restrictive layers

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