

Application of SWAT to estimate inflows to Bays from ungaged large watersheds

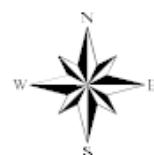
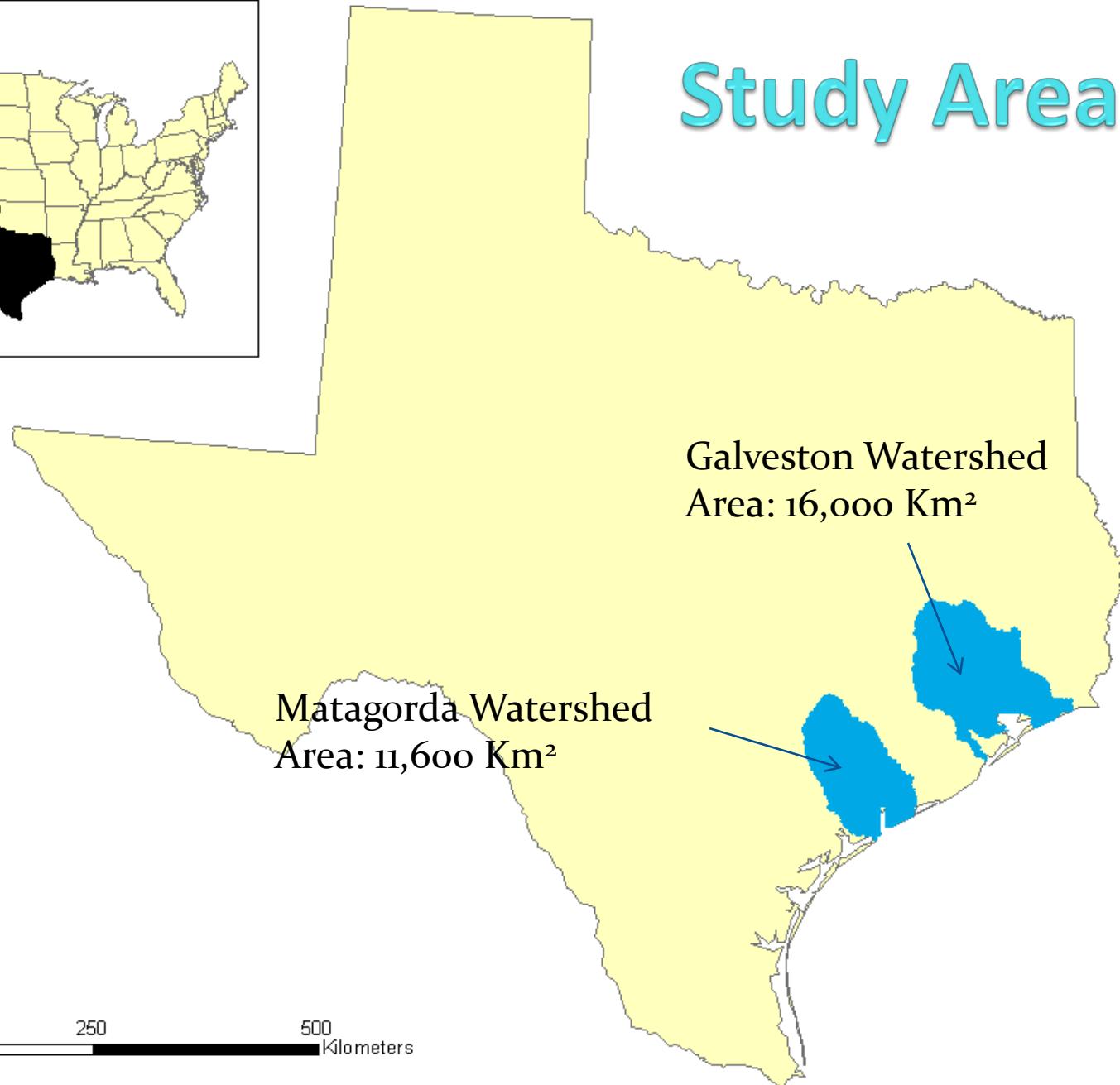
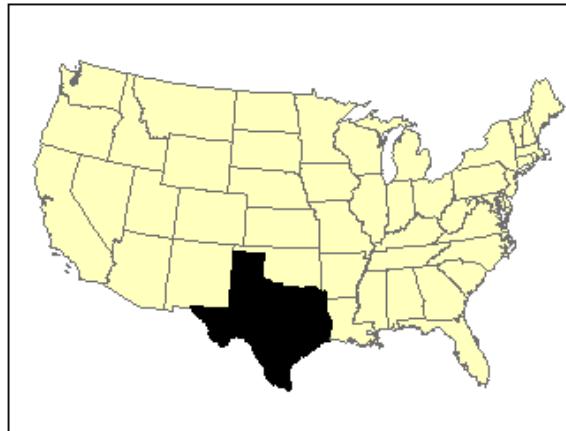
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Introduction

- TWDB (Texas Water Development Board) has estimated water flow to Bays.
- TXRR Model: Rainfall-runoff model using CN
- TWDB requested to test a recent model like SWAT over their TXRR model
- Pilot Study: Galveston Bay Watershed (Urbanized)and Matagorda Bay Watershed (Rural)

Study Area

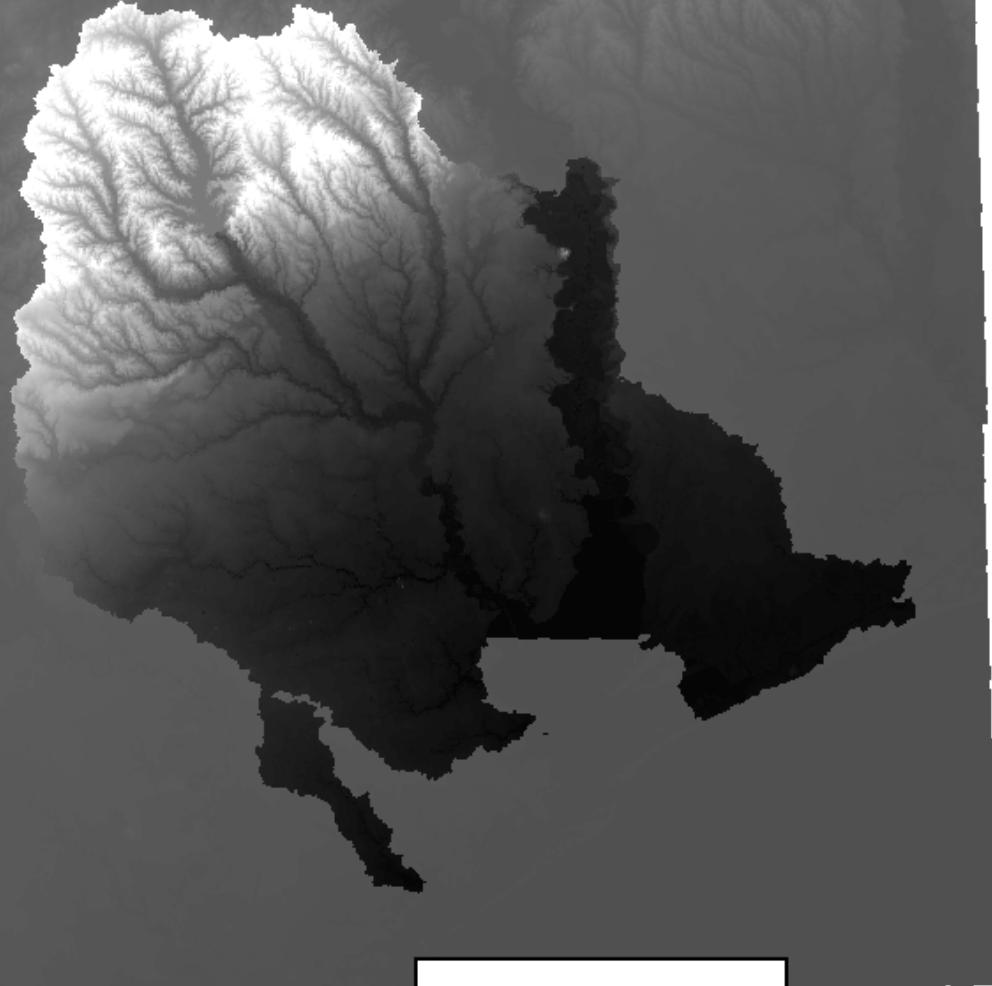


0 125 250 500
Kilometers

Data

DEM:

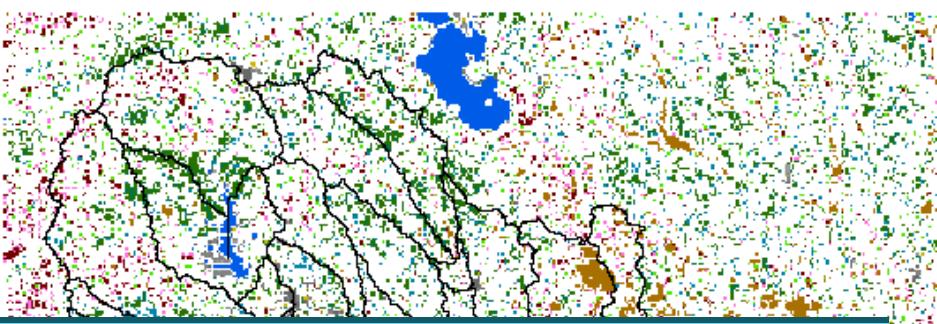
30m NED



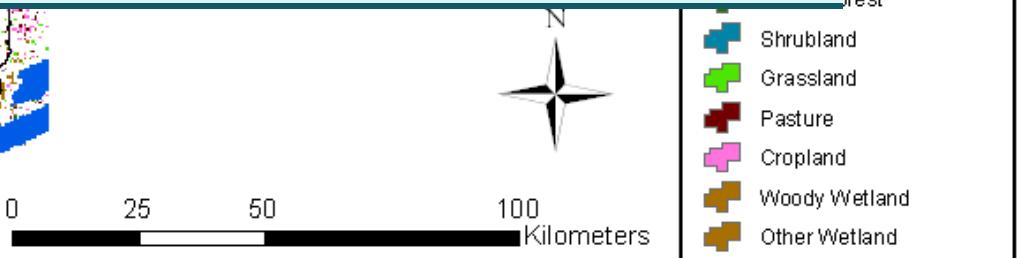
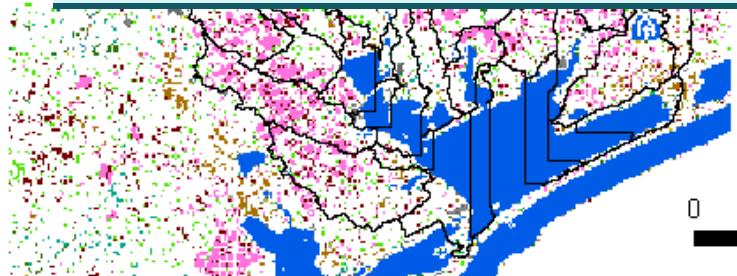
0 25 50 100 Kilometers

Landuse:

NLCD 2001



Landuse Type	Watershed	
	Galveston	Matagorda
Water	4.2%	9.2%
Urban	23.8%	0.0%
Forest	17.7%	9.3%
Agricultural	5.8%	26.2%
Pastureland	21.9%	43.9%
Rangeland	7.0%	8.5%
Wetland	19.5%	2.8%
Total	100.0%	100.0%



Soil: SSURGO

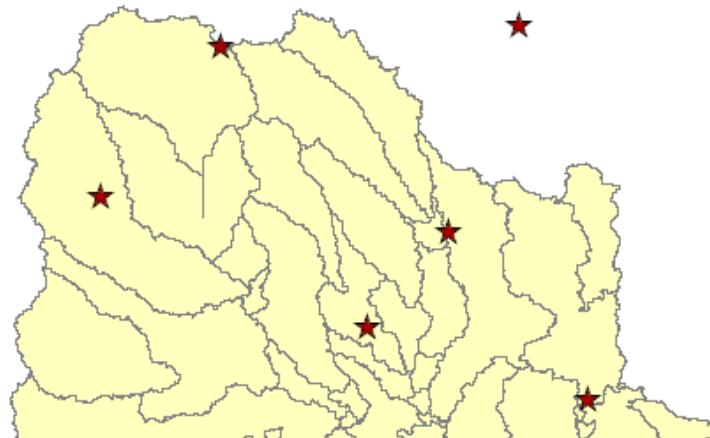
Processed by SSURGO Data Processing Tool



0 25 50 100 Kilometers

Weather Data:

Weather stations + NEXRAD



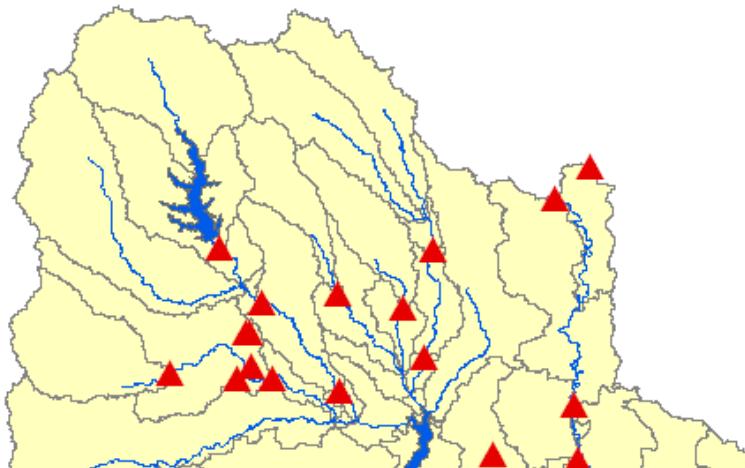
- Weather Station Used: Total 20 stations
(11 for Galveston & 9 for Matagorda)
- NEXRAD data was enhanced by the data from weather stations (NEXRAD Processing Tool)
- Data from Weather Stations: 1975 – 1999
Enhanced NEXRAD: 2000 - 2008



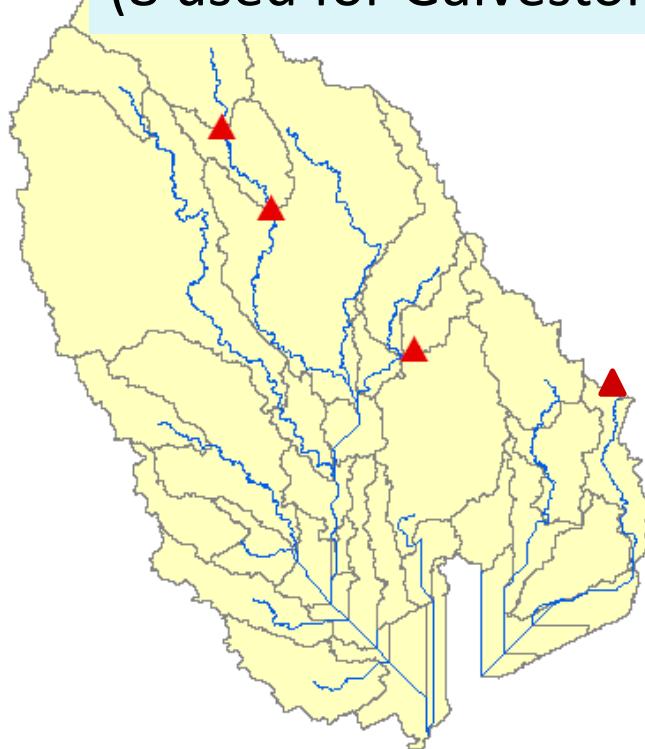
Subbasins
Weather Stations

0 25 50 100 Kilometers

Flow Data: USGS Gage Stations



USGS Gage Stations: Total 21 stations available
(8 used for Galveston & 3 used for Matagorda)

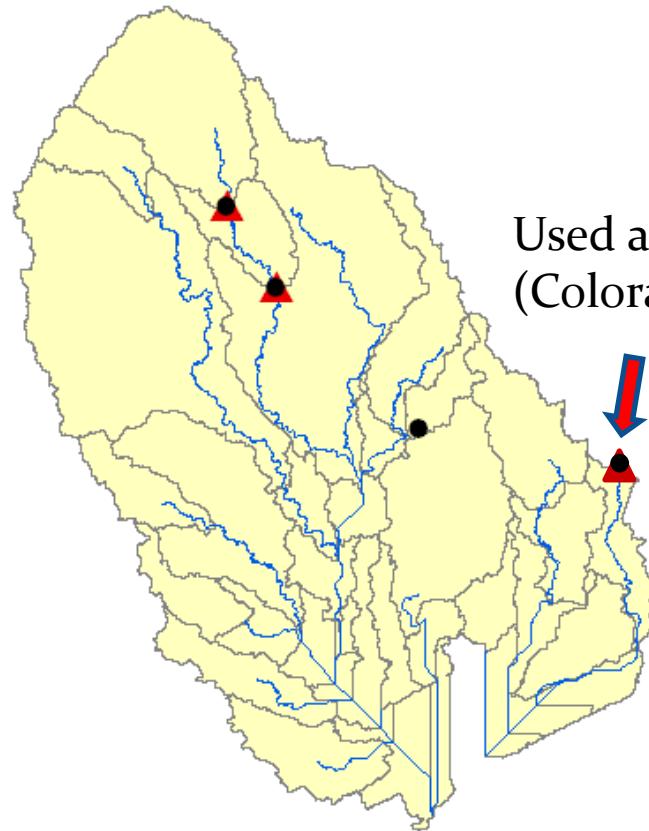


- ▲ USGS Gage Stations
- ~~~~ River
- Lakes
- Yellow Subbasins

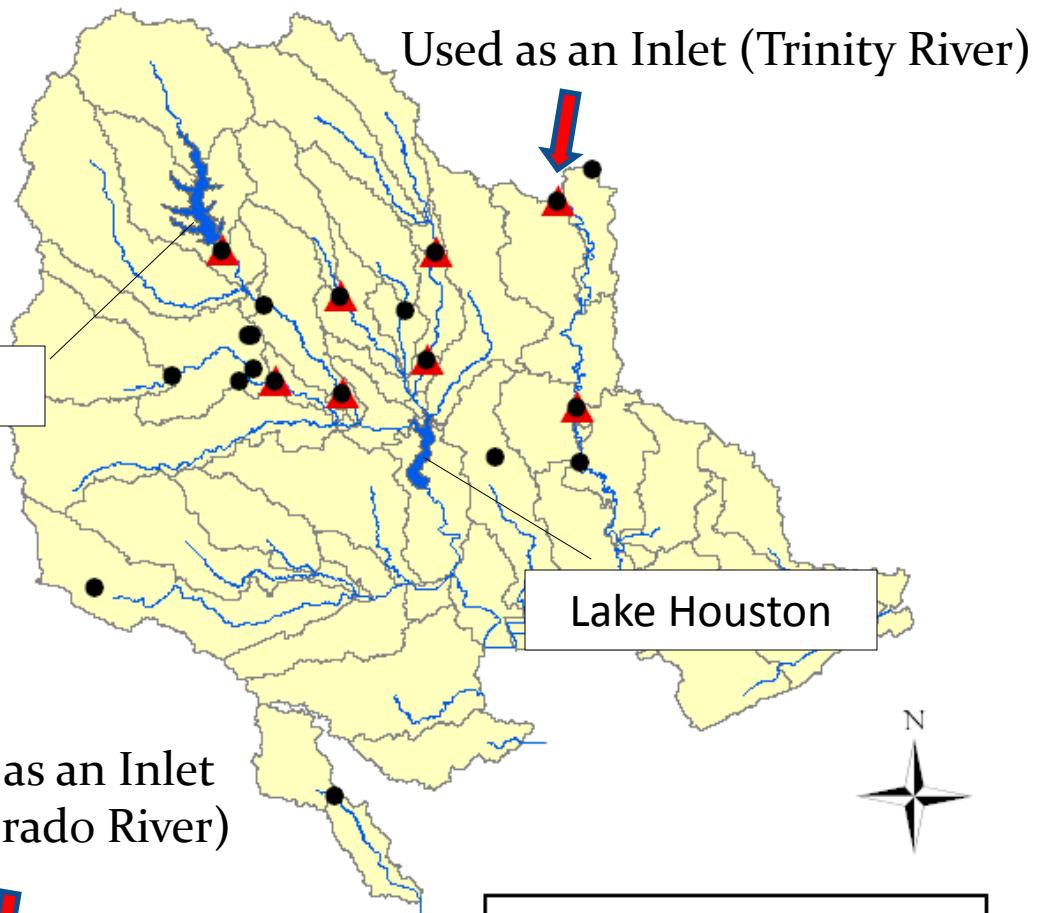
0 25 50 100 Kilometers

Gage Stations

Used in this project



Used as an Inlet
(Colorado River)



Used as an Inlet (Trinity River)

Lake Houston



- USGS Gage Stations
- ▲ Gage Stations Used
- ~~~~ River
- ~~~~~ Lakes
- Subbasins

0 25 50 100 Kilometers

Model Set Up

SWAT Model

- Modeling Period: 1975 – 2008 (34 Years)
- Lake: 2 lakes were added in Galveston Watershed
(Lake Conroe and Lake Houston)
- Inlet Data:
 - Galveston: 08066500 (Trinity River at Romayor)
 - Matagorda: 08162500 (Colorado River near Bay City)

Calibration

Daily Flow Calibration

USGS Gage	Daily Average Flow(m ³ /s) (Standard Deviation)		R ² (Slope)	NSME*
	Observed	Modeled		
08067650	15.2 (54.8)	14.2 (56.3)	0.57 (0.77)	0.49
08070000	7.6 (25.2)	7.5 (27.5)	0.42 (0.71)	0.25
08070500	2.6 (10.1)	2.8 (13.3)	0.58 (1.01)	0.28
08070200	8.9 (29.4)	10.9 (36.2)	0.56 (0.92)	0.32
08068500	9.4 (35.3)	9.1 (39.4)	0.57 (0.84)	0.44
08068090	18.9 (79.0)	27.2 (86.2)	0.61 (0.85)	0.50
08067000	-	-	0.91 (1.10)	-
08164300	4.1 (25.7)	3.9 (27.6)	0.55 (0.79)	0.44
08164350	5.2 (25.9)	6.3 (32.5)	0.71 (1.06)	0.56

* NSME: Nash-Sutcliff Model Efficiency

Monthly Flow Calibration

USGS Gage	R ² (Slope)	NSME
08067650	0.81 (0.71)	0.85
08070000	0.65 (0.83)	0.74
08070500	0.63 (1.31)	0.60
08070200	0.80 (1.05)	0.79
08068500	0.62 (0.78)	0.69
08068090	0.83 (1.01)	0.79
08067000	-	-
08164300	0.77 (0.79)	0.82
08164350	0.84 (0.97)	0.84

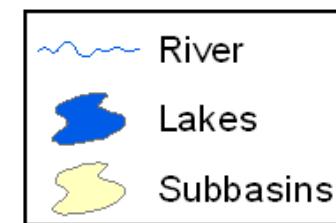
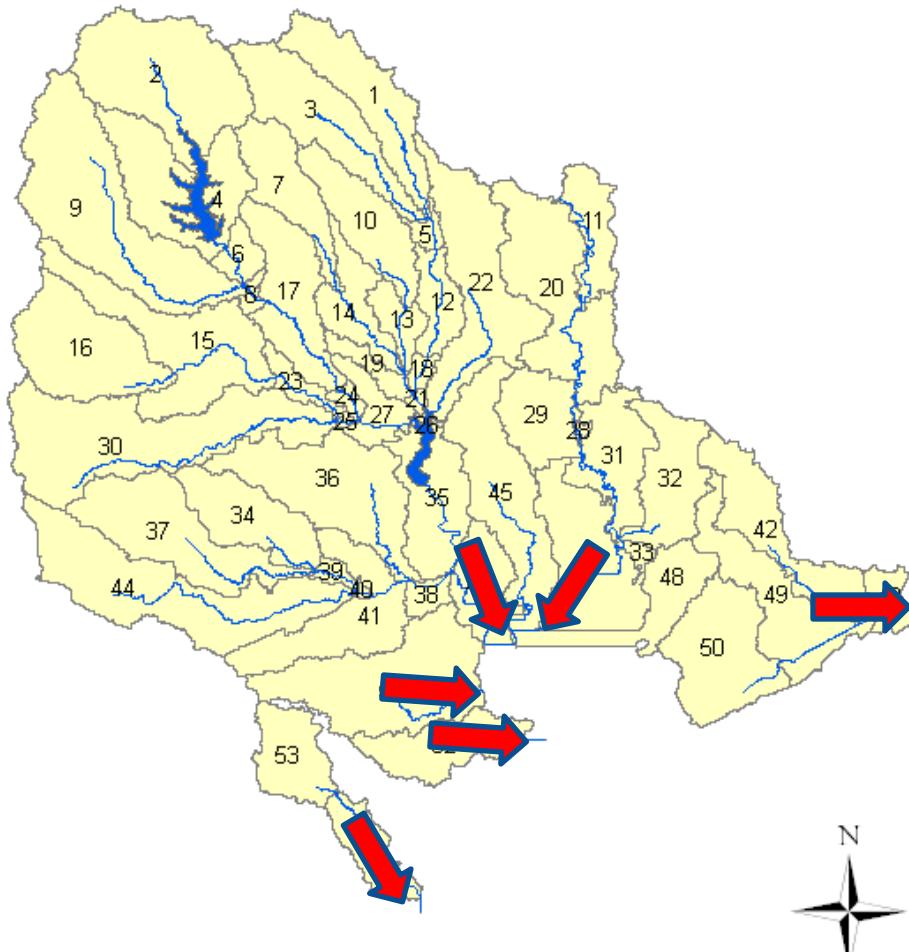
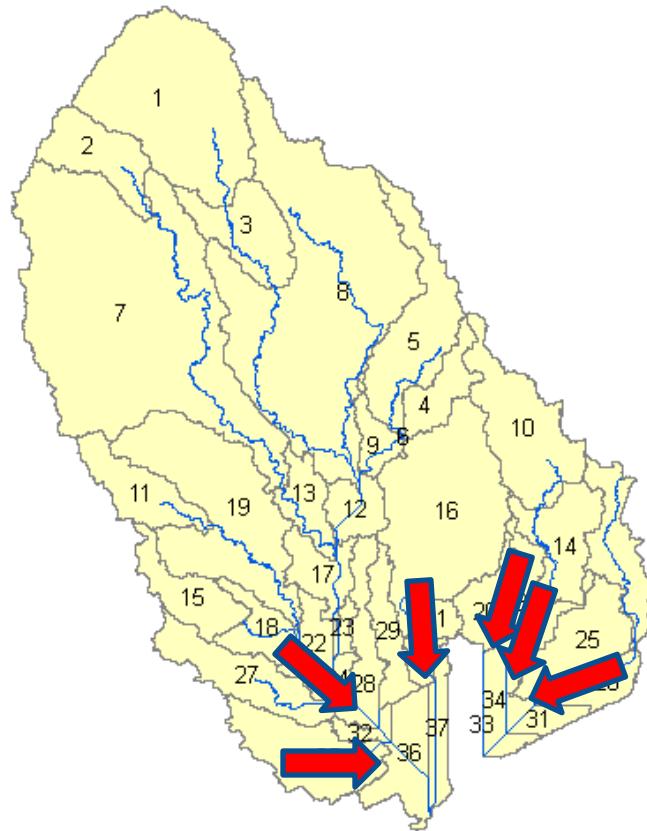
* NSME: Nash-Sutcliff Model Efficiency

Gaged Flow Calibration

Variable	Description	Default Value	Input Value	Units
GW_REVAP	groundwater re-evaporation coefficient	0.02	0.15 – 0.2	
GWQMN	Groundwater storage required for return flow	0	1,000	mm
ALPHA_BF	Baseflow alpha factor	0.048	0.048 - 0.4	Days ⁻¹
SURLAG	Surface runoff lag time	4	5	hr
SOL_AWC	Soil available water	0.08 – 0.13	0.05 - 0.6	mm
ICN	Landcover/Plant code	Soil moisture	Plant ET	

Estimation of Inflow

Galveston and Matagorda Flow at Bay



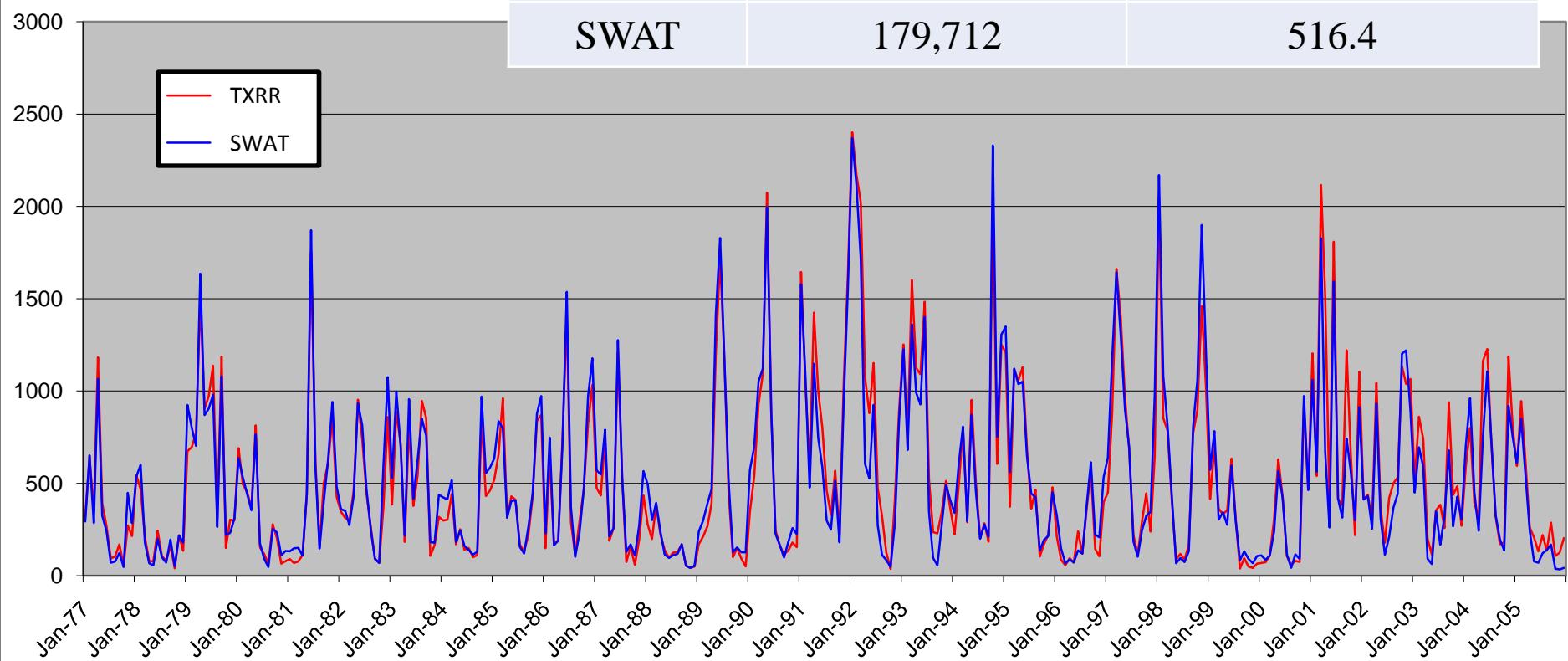
0 25 50 100 Kilometers

Un-Gaged Flow Calibration

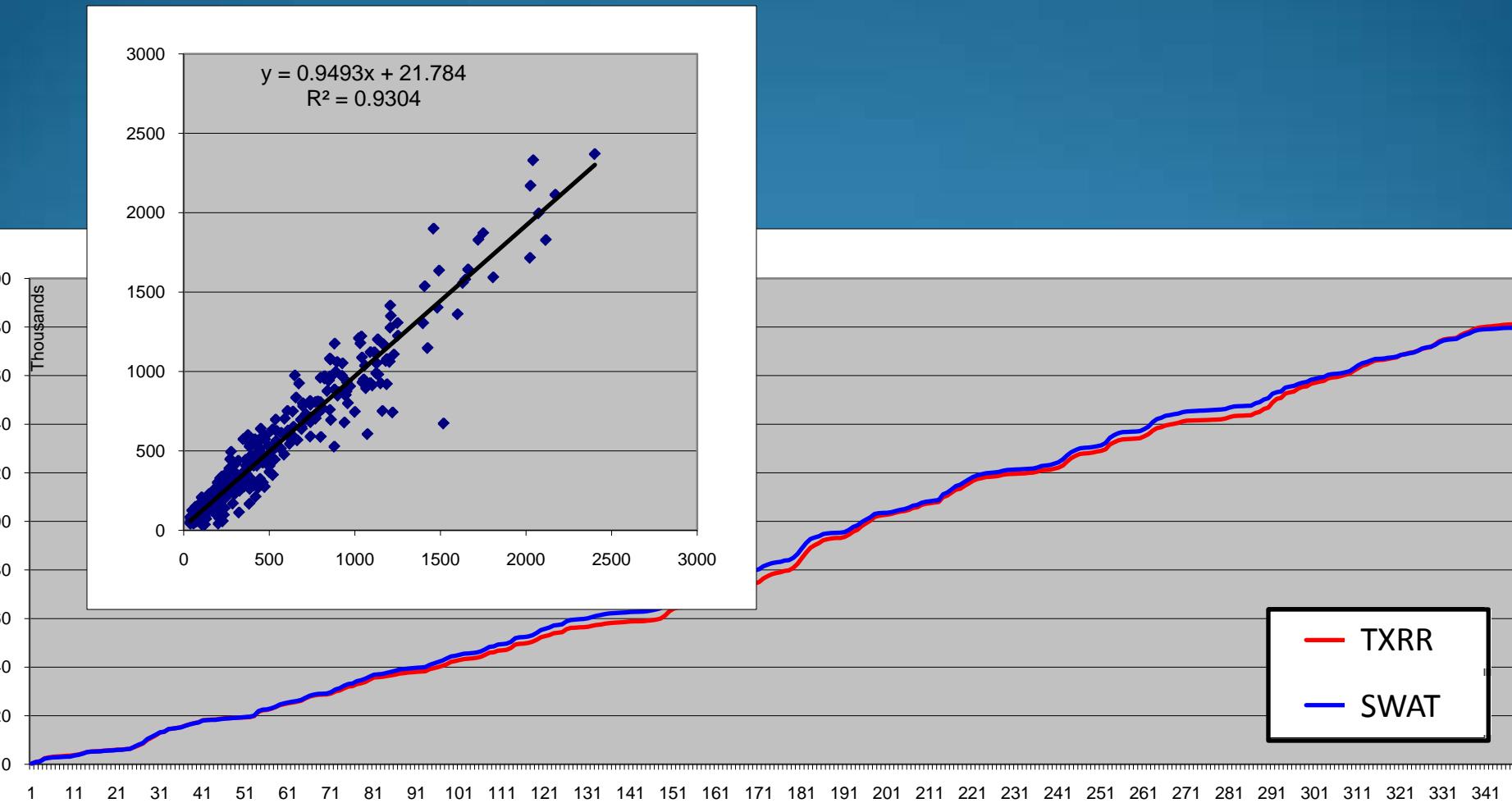
Variable	Description	Default Value	Input Value	Units
GW_REVAP	groundwater re-evaporation coefficient	0.02	0.07 – 0.2	
ALPHA_BF	Baseflow alpha factor	0.048	0.04	Days ⁻¹
SOL_AWC	Soil available water	0.08 – 0.13	0.01	mm

Galveston Bay Monthly Flow at Bay (1977 – 2005)

	Total Flow (m ³ /s)	Monthly Avg. (m ³ /s)
TXRR	181,329	521.1
SWAT	179,712	516.4

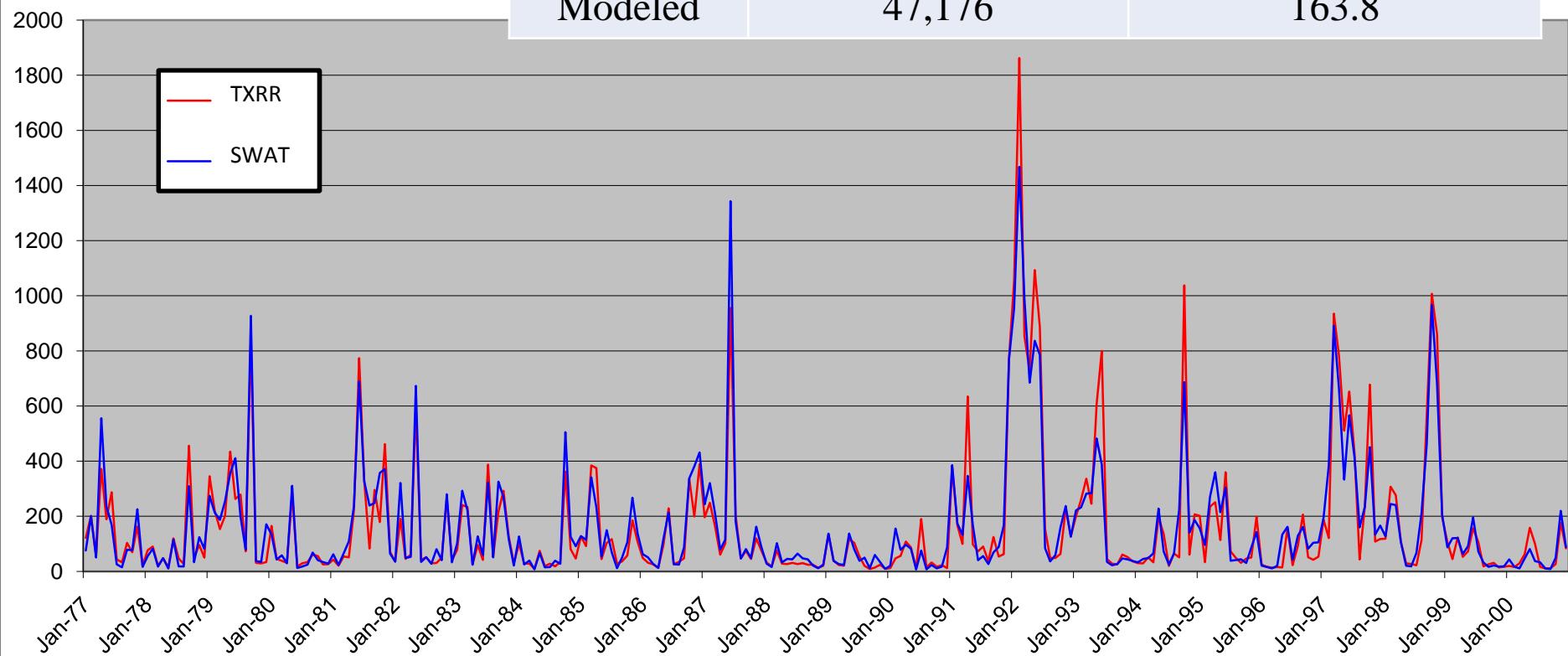


Galveston Bay Monthly Flow at Bay (1977 – 2005)

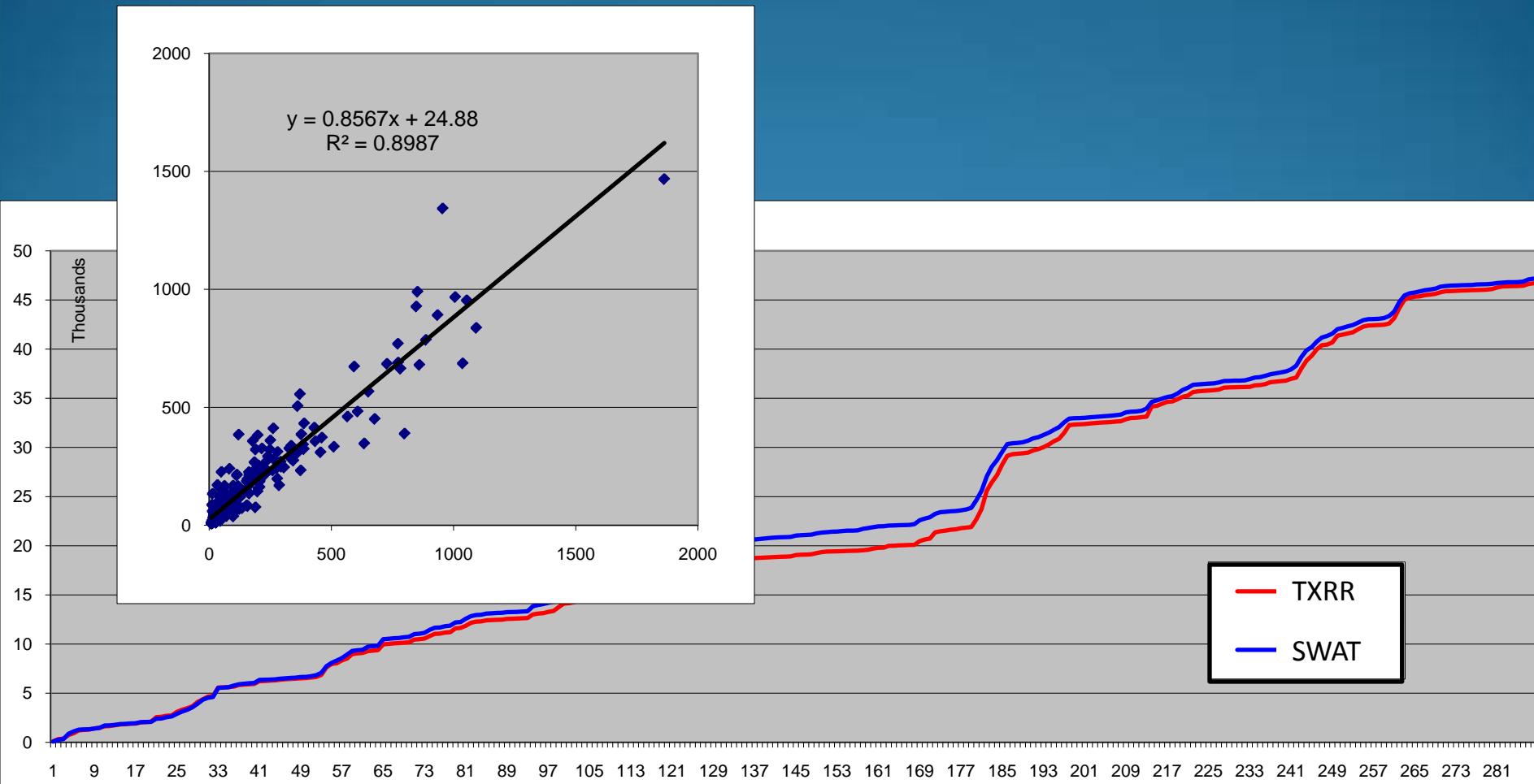


Matagorda Bay Monthly Flow at Bay (1977 – 2000)

	Total Flow (m ³ /s)	Monthly Avg. (m ³ /s)
Observed	46,702	162.2
Modeled	47,176	163.8



Matagorda Bay Monthly Flow at Bay (1977 – 2000)



Conclusion and Discussion

- Transition from TXRR to SWAT was successful
- Flow from ungaged watersheds can be estimated using calibration experiences from gaged watersheds
- Parameter adjustments can be limited due to a large unknown area
- Model to model comparison can lead another uncertainty

Questions?