



USING SWAT TO SIMULATE HYDROLOGY IN A ST. MARY WATERSHED

Presentation Outline



- Research objectives
- Soil and Water Assessment Tool (SWAT)
- Model inputs
- Site description
- Calibration and validation methodology
- Hydrological modelling results
- Potential for future use within Jamaican irrigation planning

Objectives of Study



- Determine applicability of SWAT for simulating hydrology in the Rio Nuevo sub-basin
 - Calibrate and validate the model with streamflow

- Determine the potential of the model to be used in irrigation planning and management

Soil and Water Assessment Tool



- Continuous, physically based, semi-distributed hydrologic model
- Works on daily and sub-daily time steps
- Computationally efficient
- Can be used to model hydrology, sediment, and nutrient run-off

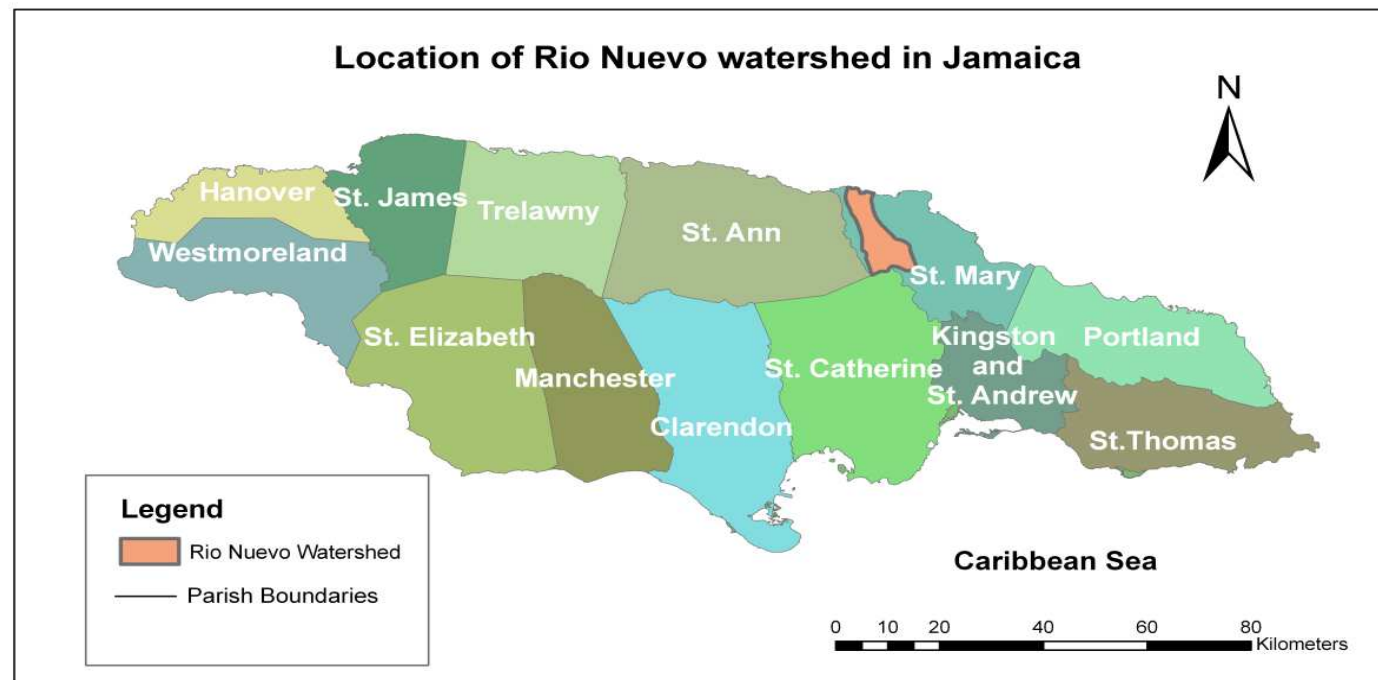
Soil and Water Assessment Tool



- Integrated with Geographical Information Systems (GIS)
 - ArcSwat-2005
- Allows for efficient input of spatially distributed data:
 - Landuse
 - Topography
 - Soil types

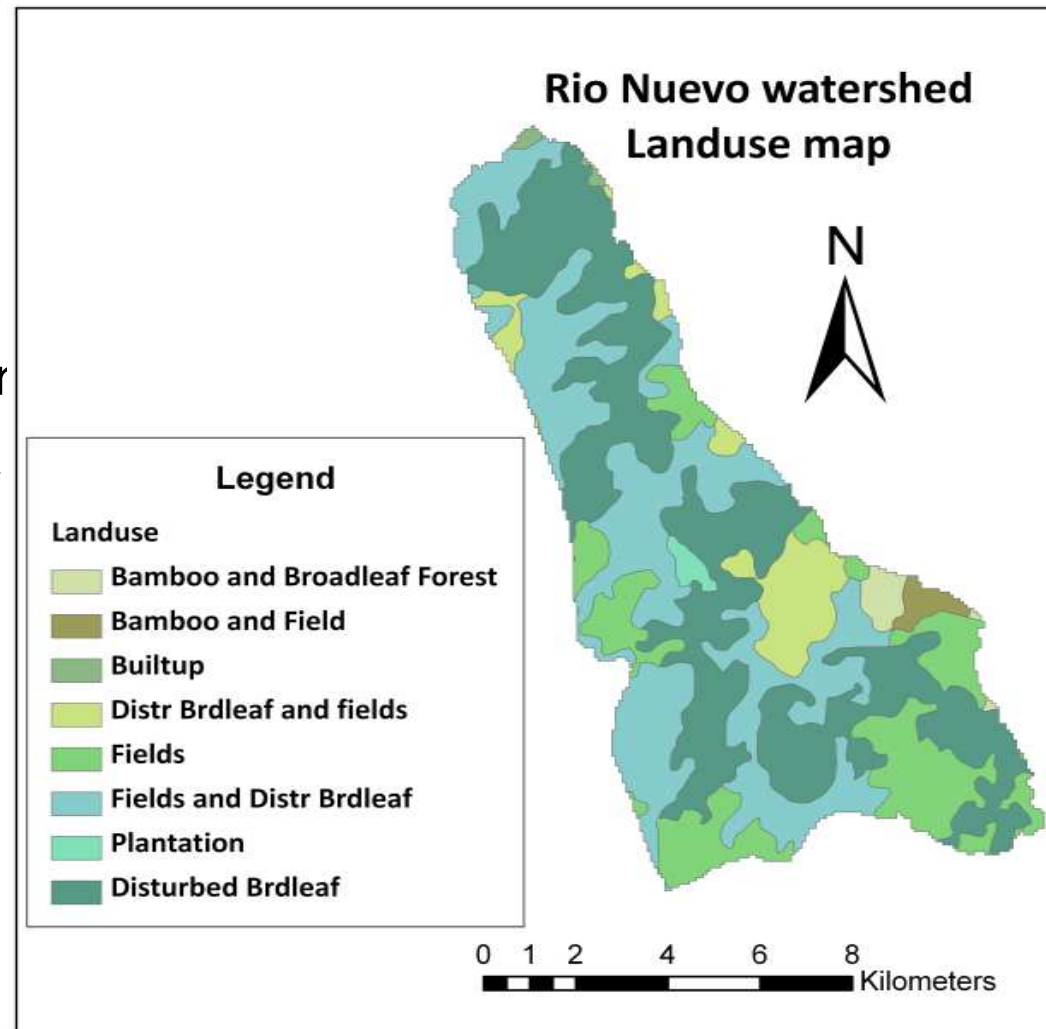
Site Description

- Rio Nuevo watershed is 110 km²
- Location of the CARIWIN pilot site
- Located in the Blue Mountain North Watershed in the parish of St. Mary

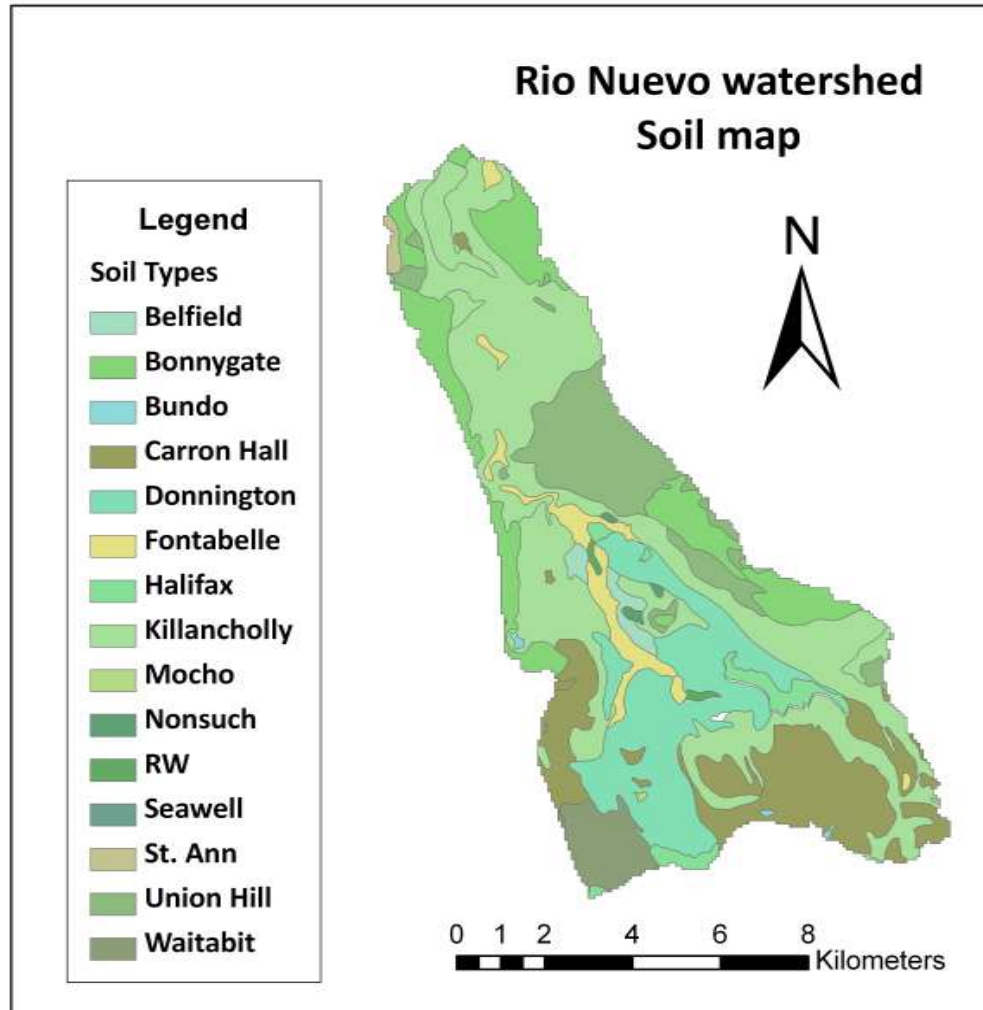


Landuse Distribution

- Rural watershed
- Agriculture is the largest industry
 - ▣ Bananas, scotch bonnet peppers, plantains, vegetables



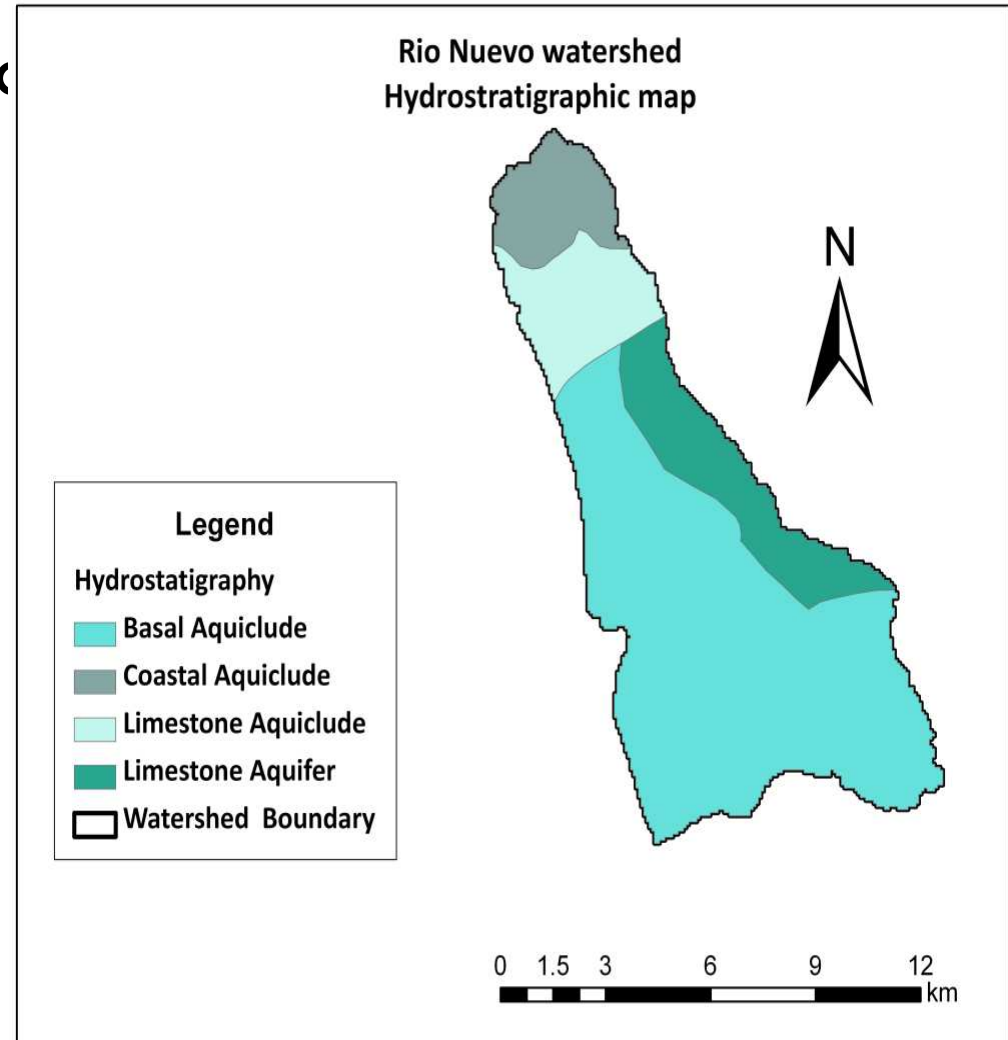
Soil distribution



- Clay soils dominate the watershed
- Soils highly variable throughout the watershed

Description of hydrostratigraphy

- 85% of the watershed consists of basal aquiclude
- 15% is karstic

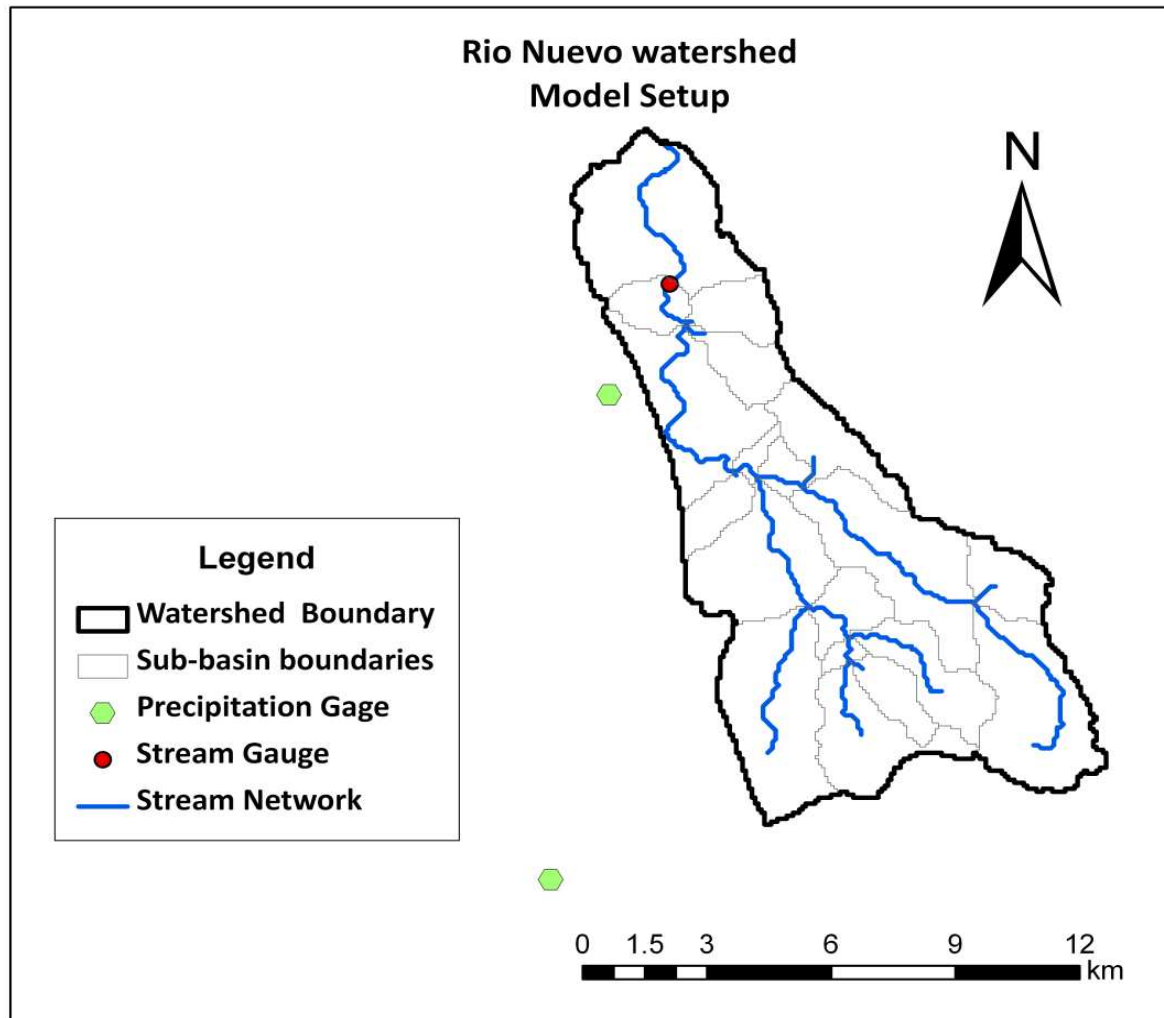


Data Inputs



Data Type	Source
Digital Elevation Model (DEM)	250 ft digital contours provided by the Jamaica Water Resources Authority
2001 Land Use	Forestry Department, Jamaica
Soils data	Rural Physical Planning Unit- Ministry of Agriculture
Stream network	Jamaica Water Resources Authority

Location of monitoring points



Calibration and Validation



- Calibrated on a monthly time scale using data from the period 2002 to 2004
 - Most sensitive model parameters identified and modified to achieve optimal model performance

- Validated on a monthly time scale using data from the period 2005 to 2007
 - Gives an indication of accuracy and robustness of model

Calibration and Validation

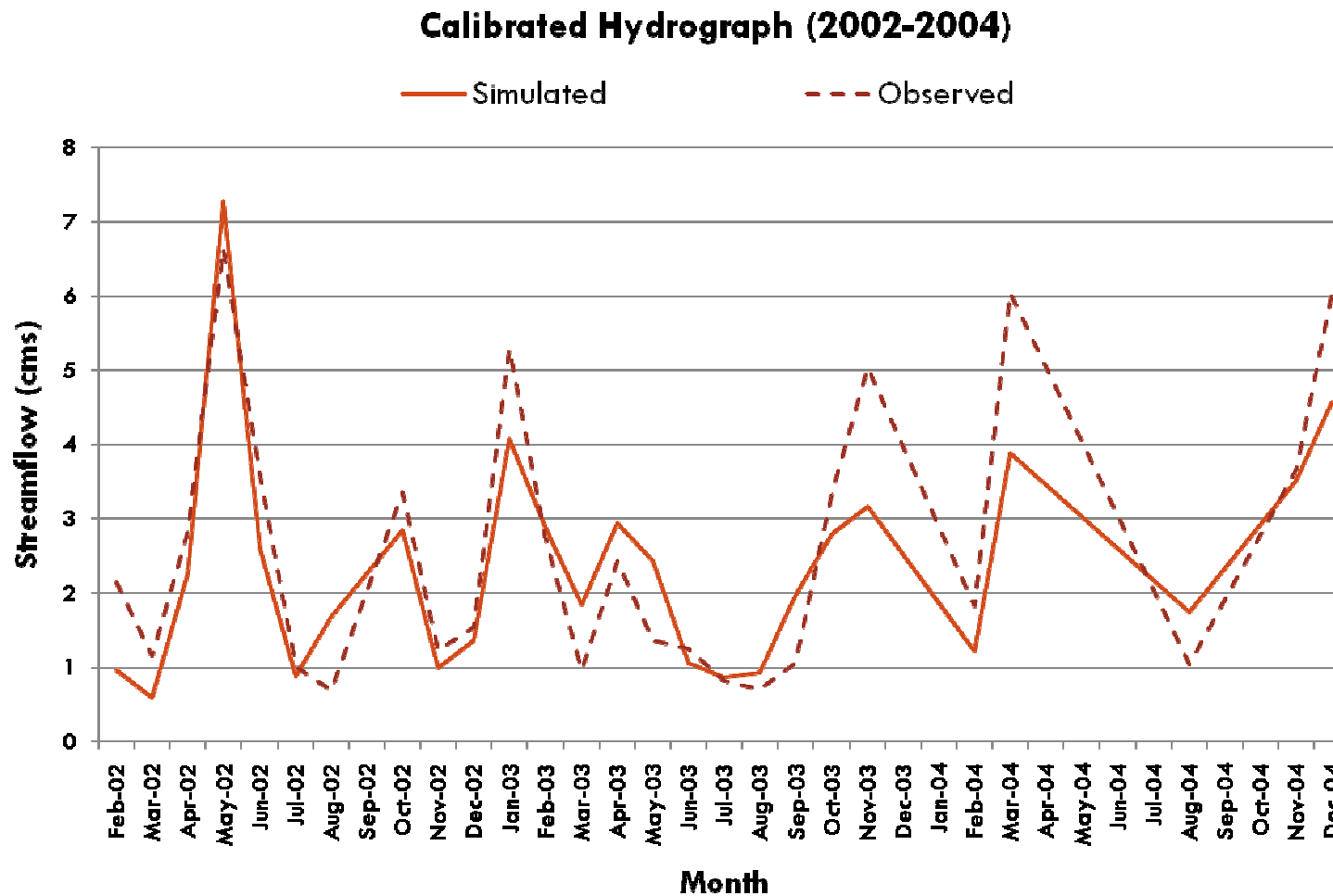
- Model calibrated on a monthly time scale using data from the period 2002 to 2004

Parameter	Units	Description
Groundwater delay (GW_DELAY)	days	The time lag between when water exits the soil profile and enters the shallow aquifer

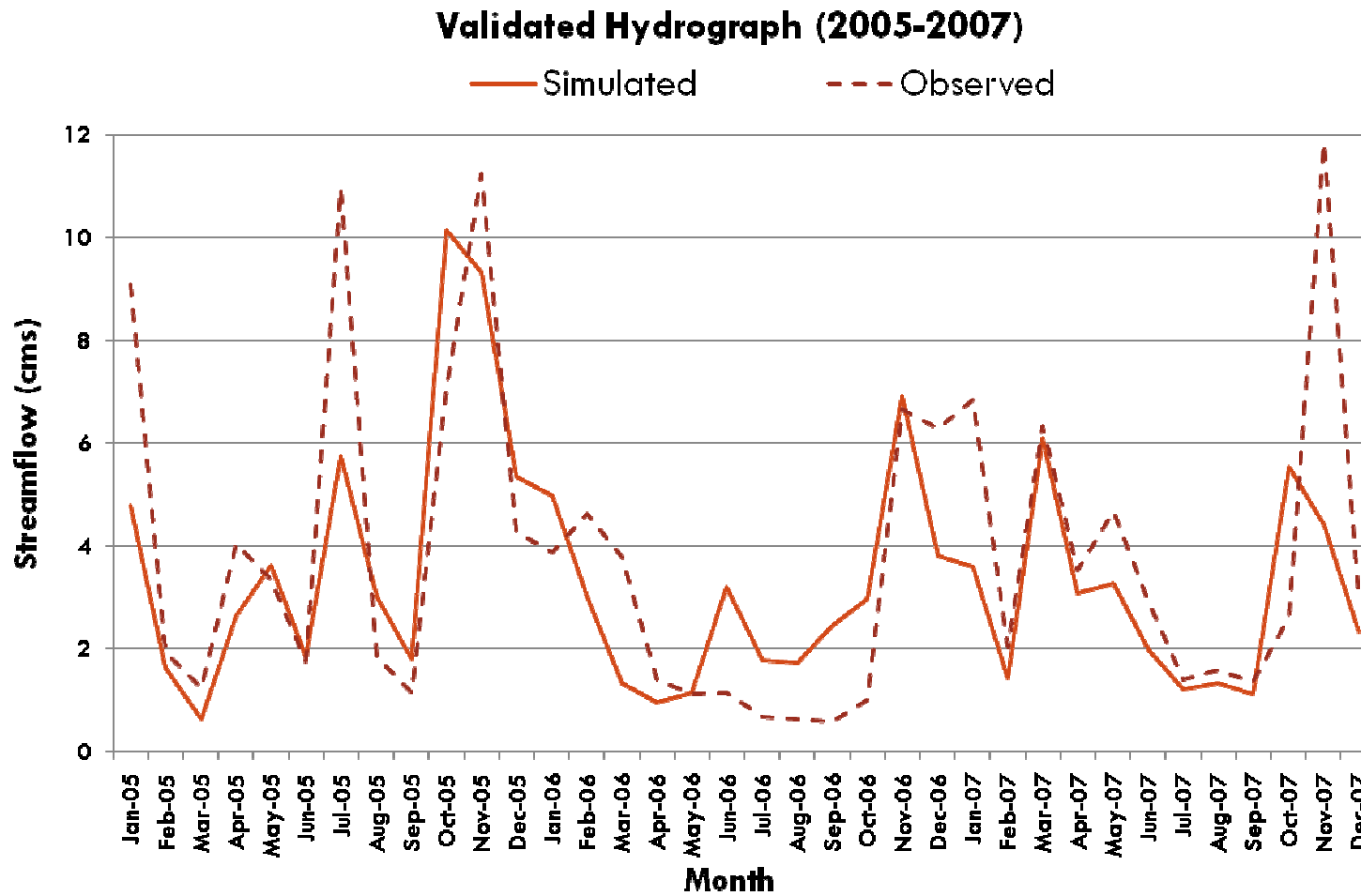
Calibration

Parameter	Range	Unit	Un-calibrated	Calibrated
GW_DELAY	0-500	days	31	35
RCHDP	0-1	-	0.05	0.15
ALPHA_BF	0-1	days	0.048	0.9

Calibrated Streamflow



Results: Validation



Model Performance Evaluation: Overview of model parameters

- Nash-Sutcliffe Efficiency (NSE)
 - ▣ Fit of simulated vs. observed values
- Percent Bias (PBIAS)
 - ▣ Tendency of simulated value to be larger or smaller than it's observed counterpart
- Ratio of the Root Mean Square Error to the standard deviation of measured data (RSR)
 - ▣ Indicates residual variation

Model Performance Evaluation

Performance Indicator	Calibrated	Performance Rating	Validated	Performance Rating	Range	Ideal
NSE	0.8	Very Good	0.5	Satisfactory	- ∞ to 1	1

Model Limitations



- Rain gauges not located in the watershed
- Climatic data from Florida used
 - ▣ Relative humidity, wind speed etc.
- Missing streamflow data
- Karsticity in watershed results in complex ground and surface water interactions

Potential for SWAT to be used in irrigation management

- Basin-wide irrigation management approach
- SWAT can be used in:
 - ▣ Comparing available water resources (streamflow) to irrigation demand
 - ▣ Determining water savings from different water management scenarios
 - ▣ Obtaining a much improved understanding of the water balance

Conclusions

- The Soil and Water Assessment Tool (SWAT) applied to Rio Nuevo Watershed, St. Mary
- SWAT had acceptable model performance
- Potential exists for using SWAT for irrigation demand management
- Hydrological modelling can play a significant role in water resources management throughout the island



McGill



QUESTIONS?