SWAT Model

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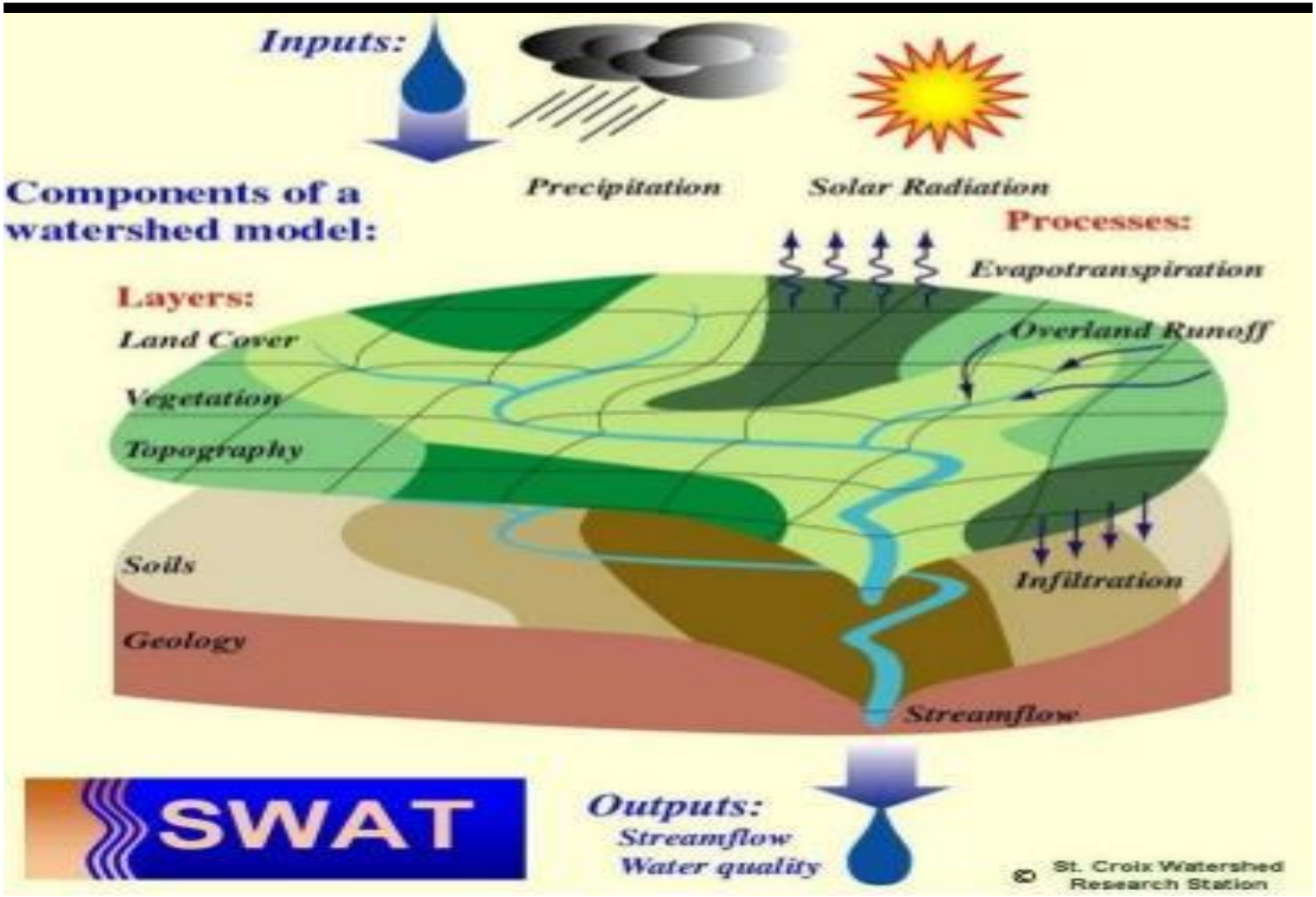
Outline

- **Introduction**
- **SWAT Model Component**
- **Data required SWAT**
- **SWAT set-up**

Hydrologic Cycle

Soil and Water Assessment Tool



Introduction

- A river basin/watershed/scale model
- To predict the impact of land management practices on water, sediment and agricultural chemical yields over long period of time

Introduction

Developed by USDA-Agricultural Research Service (ARS)

USLE	CREAMS (CLEAN WATER ACT)	EPIC	SWRRB	SWAT
1960's	1970's	1980's		1990's

GLEAMS WEPP AGNPS

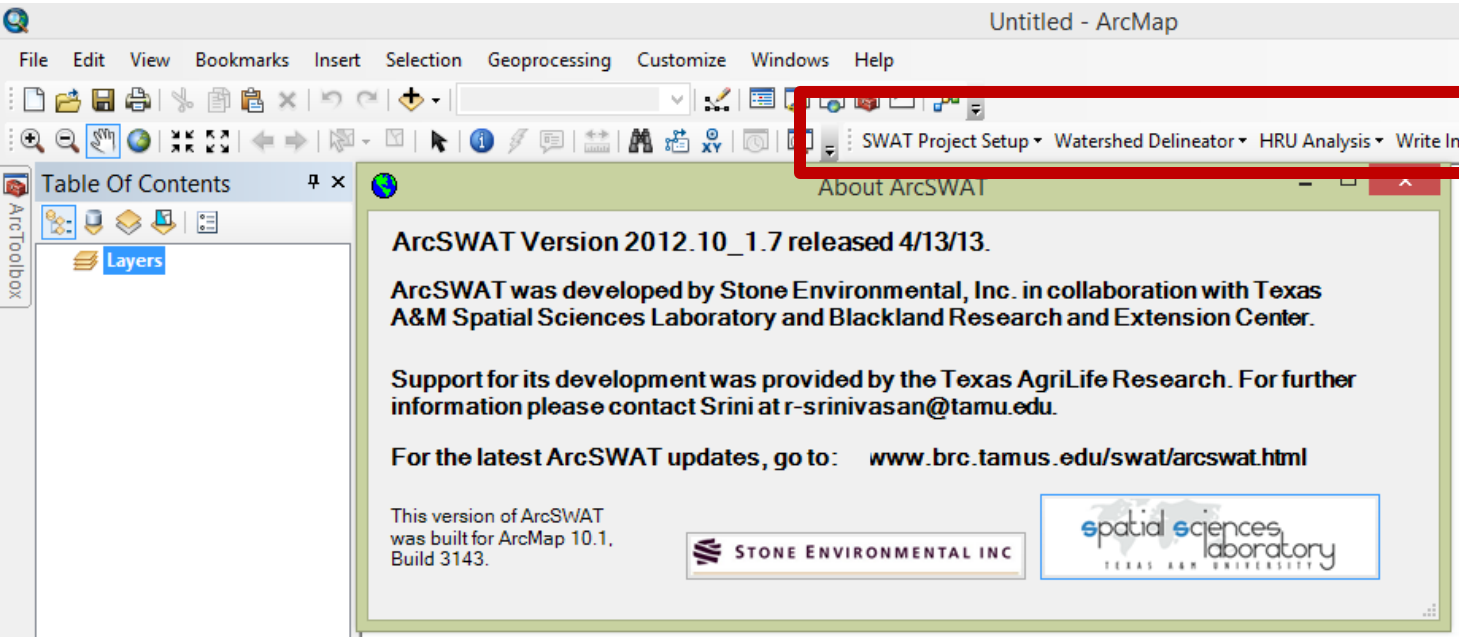
ANN AGNPS

AVSWAT	AVSWAT-X	ARCSWAT
2000's	2003,2005's	2007's

Introduction

ArcSWAT

- Extension of Arcgis
- Freeware (http://swatmodel.tamu.edu)



Introduction

- Continuous Time

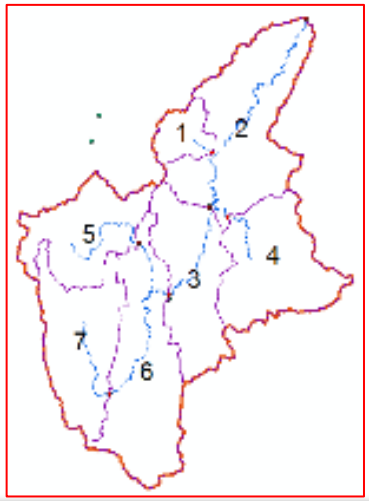
  Daily Time Step

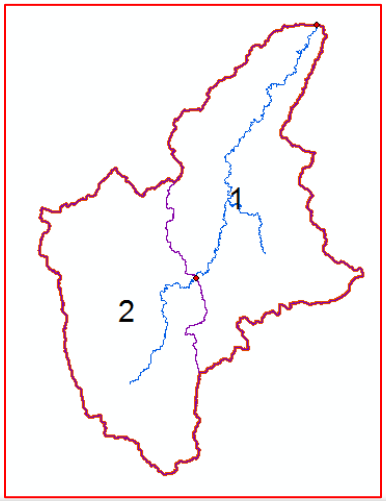
  One Day → Hundreds of Years

  (Depend on Input Weather Data)

- Distributed Parameter

  Unlimited Number of Sub watersheds

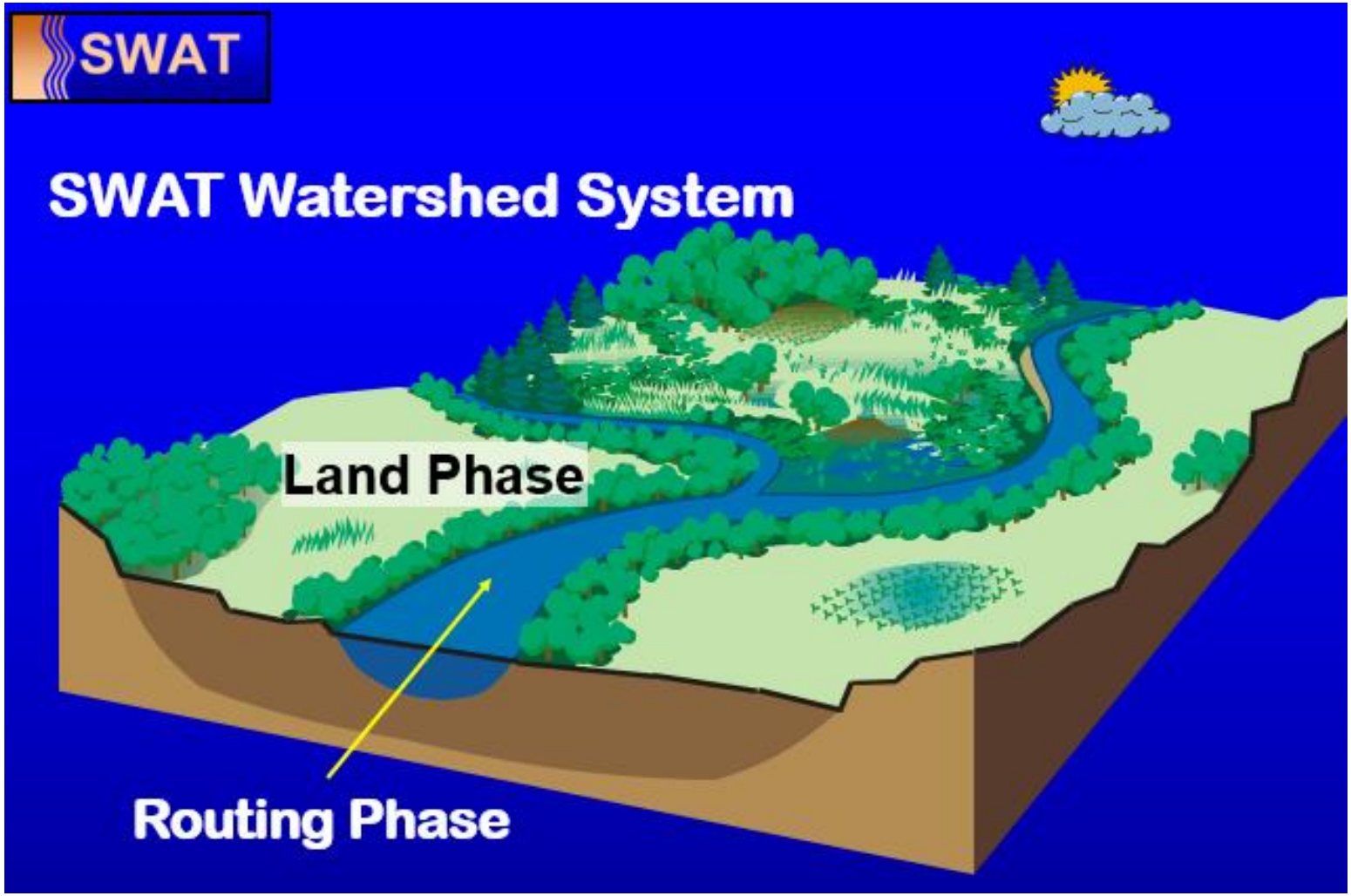




Management

- Crop Rotations
- Removal of Biomass as Harvest/Conversion of Biomass to Residue
- Tillage / Bio mixing of Soil
- Fertilizer Applications
- Grazing
- Pesticide Applications
- Irrigation
- Subsurface (Tile) Drainage
- Water Impoundment (e.g. Rice)
- Urban Areas(Pervious/Impervious Areas, Street Sweeping, Lawn Chemicals)

SWAT Model Component



SWAT Model Component

Land Phase	Routing Phase
• Weather • **Hydrology** • Sedimentation • Plant Growth • Nutrient Cycling • Pesticide Dynamics • Management • Bacteria	• **Flood Routing** • Transmission Losses, Evaporation • Sediment Routing • Nutrient • Pesticide

Land Phase

Routing Phase

Hydrologic Cycle

$$SW_t = Sw_0 + \sum_{i=1}^{t}(R_{day} - Q_{surf} - E_a - w_{seep} - Q_{gw})$$

Where:

SW_t = the soil water content after time step t of day i

SW_0 = the initial soil water content on day i

t = the time

R_{day} = the amount of precipitation on day i

Q_{surf} = the amount of surface runoff

E_a = the amount of evaporation

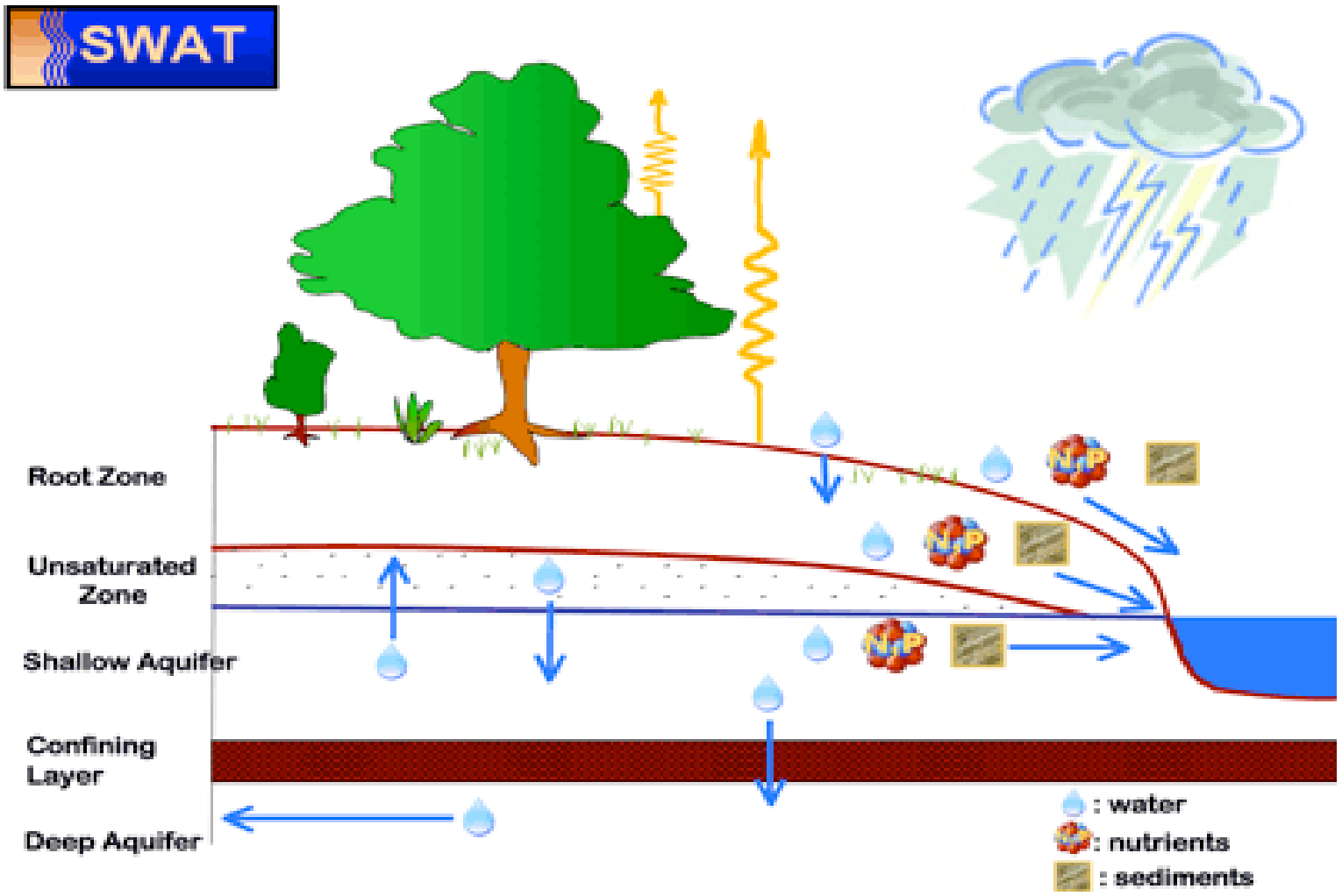
W_{seep} = the amount of water entering the unsaturated zone from the soil profile

Q_{gw} = the amount of return flow as drainage to the surface water.

**All parameters have the unit mm.*

Land Phase

Routing Phase



Land Phase

Routing Phase

Estimation

1.**Surface Runoff** : SCS Curve Number Procedure and Green & Amptinfiltration depend on Land use, Land cover, Soil characteristic, Soil moisture.

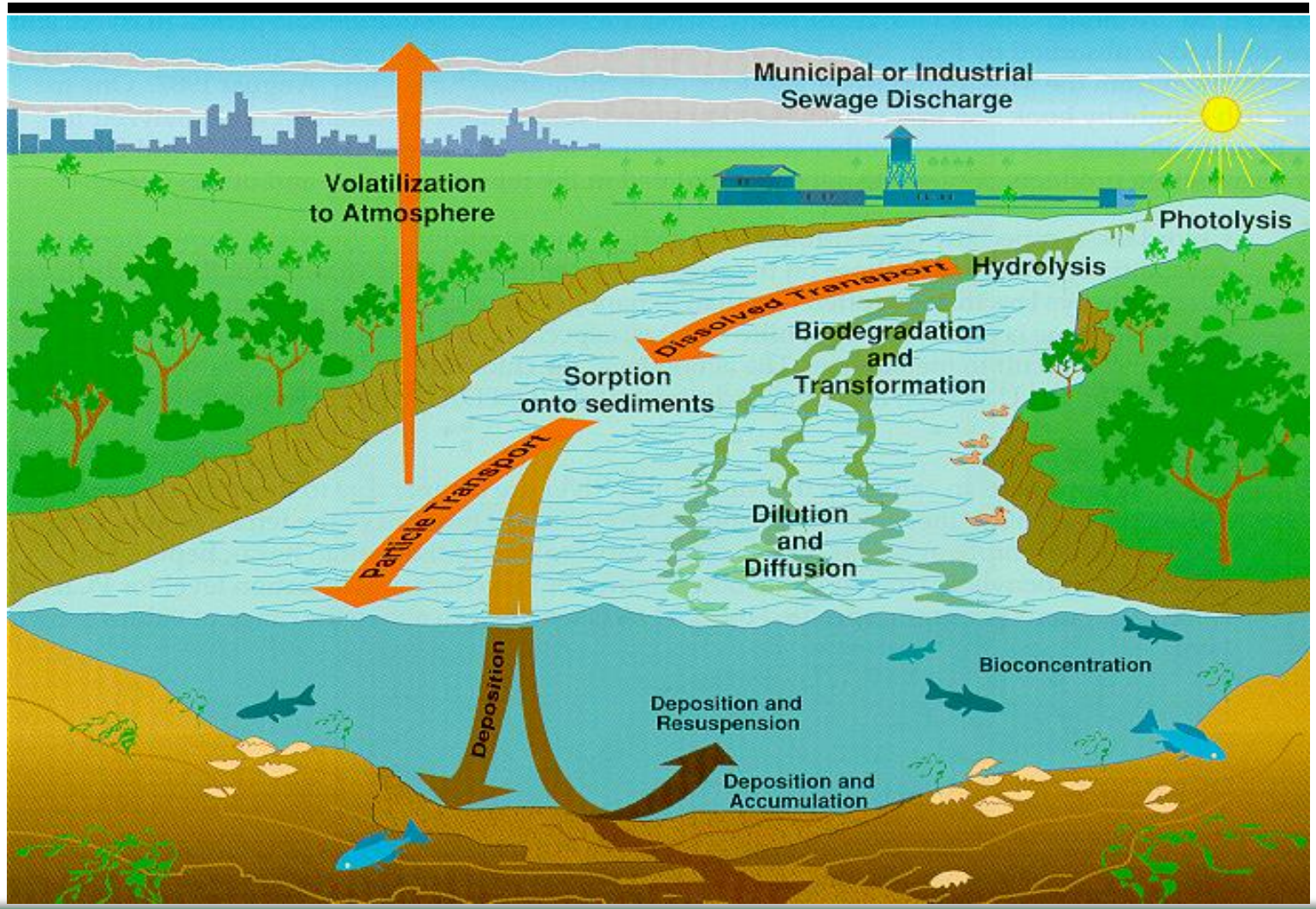
2. **Peak Runoff Rate** : Approximate by Modified Rational Formula

3. **Lateral Subsurface Flow**

4. **Groundwater Flow** Shallow Aquifer & Deep

Land Phase

Routing Phase



Routing Phase

1. Routing in Main Channel or Reach
2. Routing in the Reservoir

Manning's Equation:

$$Q = VA = \left(\frac{1.49}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [U.S.]$$

$$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [SI]$$

Where:

Q = Flow Rate, (ft^3/s)

v = Velocity, (ft/s)

A = Flow Area, (ft^2)

n = Manning's Roughness Coefficient

R = Hydraulic Radius, (ft)

S = Channel Slope, (ft/ft)

SWAT Strengths

Land phase

- Comprehensive Hydrologic Balance
- Physically-Based Inputs
- Plant Growth – Rotations, Crop Yields
- Nutrient Cycling in Soil
- Land Management - BMP

  Tillage, Irrigation, Fertilizer, Pesticides, Grazing, Rotations, Subsurface Drainage, Urban-Lawn Chemicals, Street Sweeping

SWAT Strengths

Routing Phase

- Flexible Watershed Configuration
- Water Transfer—Irrigation Diversions
- Sediment Deposition/Scour
- Nutrient/Pesticide Transport
- Pond, Wetland and Reservoir Impacts

Data required SWAT Model

Spatial Data

- Digital Elevation Model
- Land use /Land cover map
- Soil classification map

Reservoir Data

- Reservoir characteristics
- Release data

Crop Data

- Crop calendar

Data required SWAT Model

Time Series Data

Weather Data

- Maximum / Minimum Temperature (°C)
- Solar radiation (MJ/m²)
- Wind speed (m/s)
- Relative humidity (fraction)
- Rainfall (mm)
- Evaporation

(including the locations of stations)

Hydrological Data

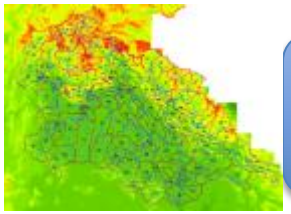
- River flow for calibrating the model

SWAT set-up

SWAT2012LMB.mdb

Prepare Database:
Land use, Soil, Weather

Process of model set-up

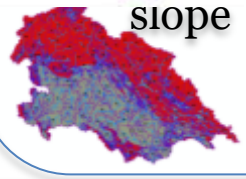


Watershed Delineation

Land use

Soil

slope



HRU Definition

Input Weather data

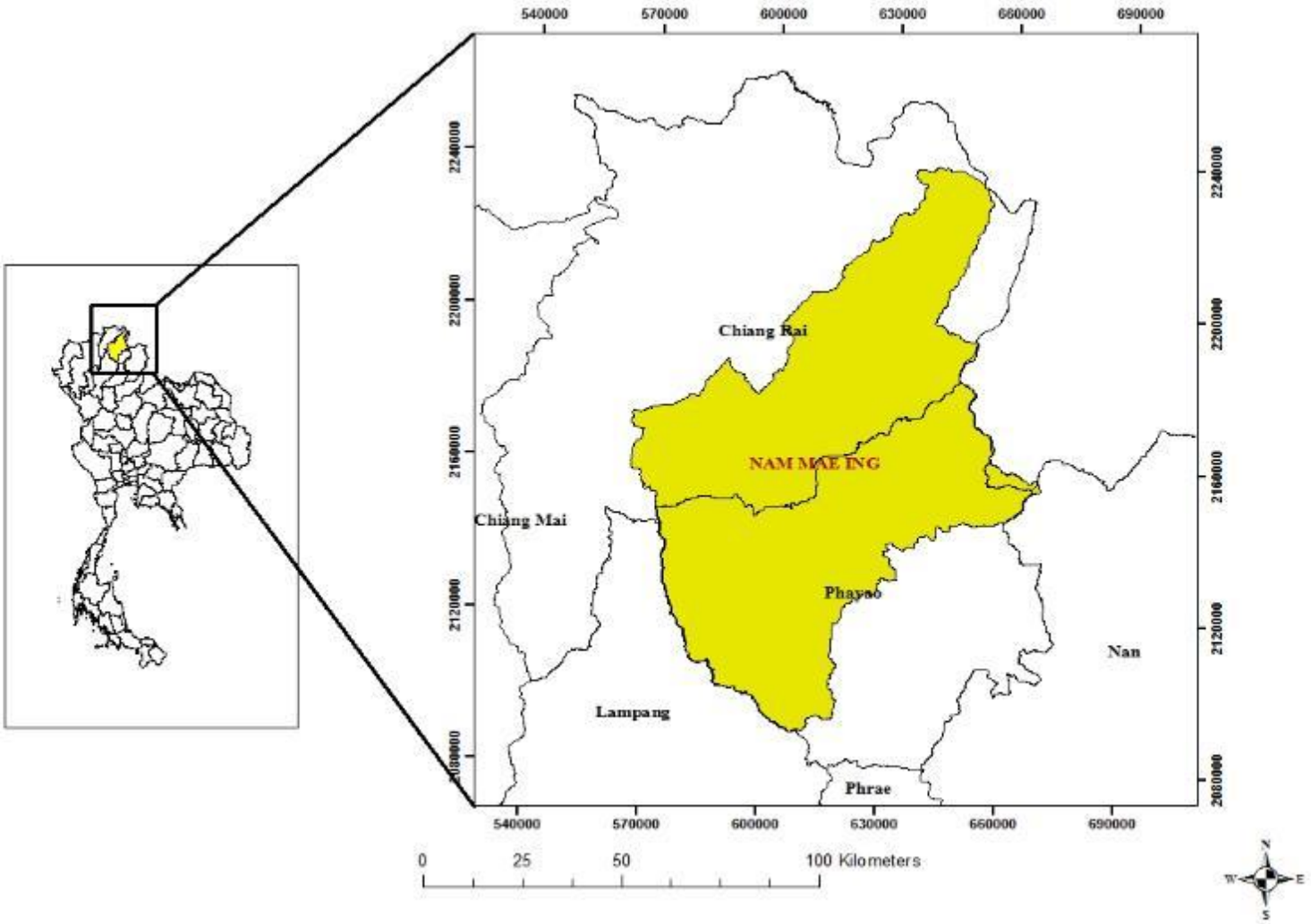
PCP,TMP,SLR, HMD,WND

Input
- Crop Management
- Reservoir data
- Inlet data
- Water Demand (if have)

START Calibration Process (1985-2000)
- Auto by SWAT CUP
- Manual

Evaluate Calibrated Result and apple with Validation year

Study Area : Nam-Mae-Ing basin



Exercise

- preparing weather data
- set up SWAT model
- run and see results

Contract
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