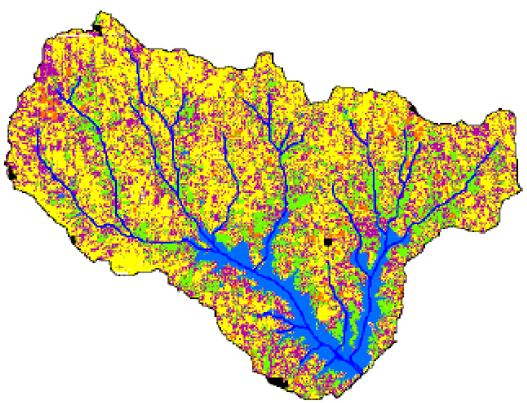
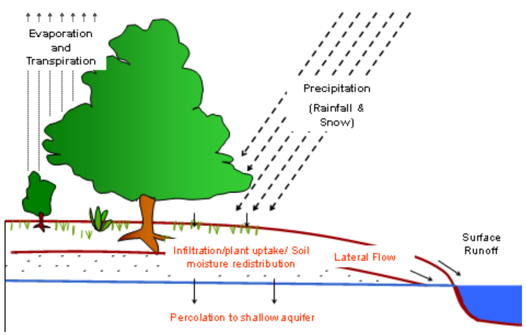
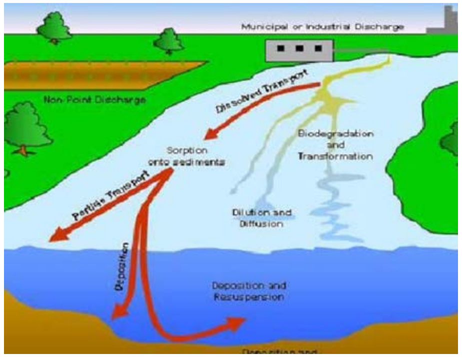
Introduction and latest progress of SWAT model







Ph.D. candidate: Zhou Bin

SWAT – An Overview

- **SWAT** stands for **Soil and Water Assessment Tool**
- **Spatial Scale: watershed or river basin** developed by USDA.
- It focus on **the impact of land management practices** on water, sediment and agricultural chemical yields in large complex watersheds with **varying soils, land use and management conditions** over long periods of time.
- **Data Organization:** sub-basins - hydrologic response units (HRU's)
- **Some characters:**

✓natural mechanistic model.

➢ Based on the DEM data to produce the watershed and sub-catchment

➢ Based on the precipitation data, soil data, land-use data and agricultural data to stimulated the runoff, SS, nutrient content.

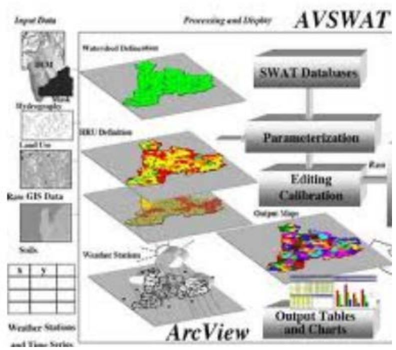
➢ Based on monitoring data to calibration and validation.

✓enables users to study long-term impacts.

✓ It can stimulated the daily resolution.

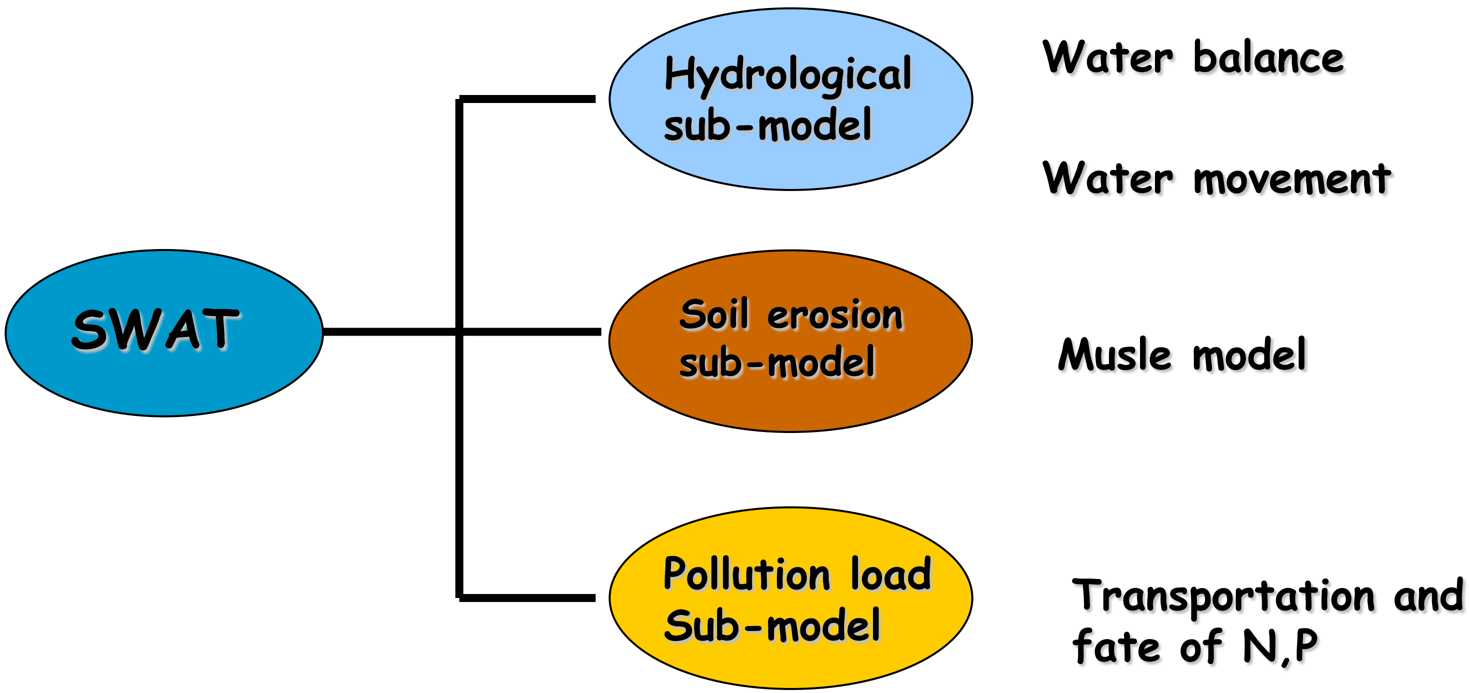
Drawback

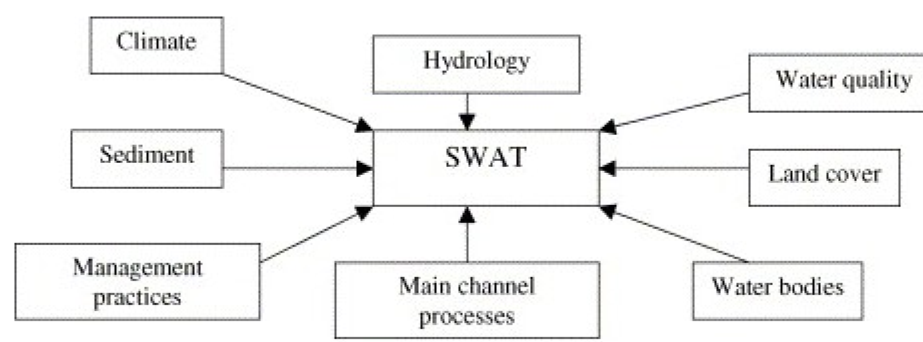
A large amount data input



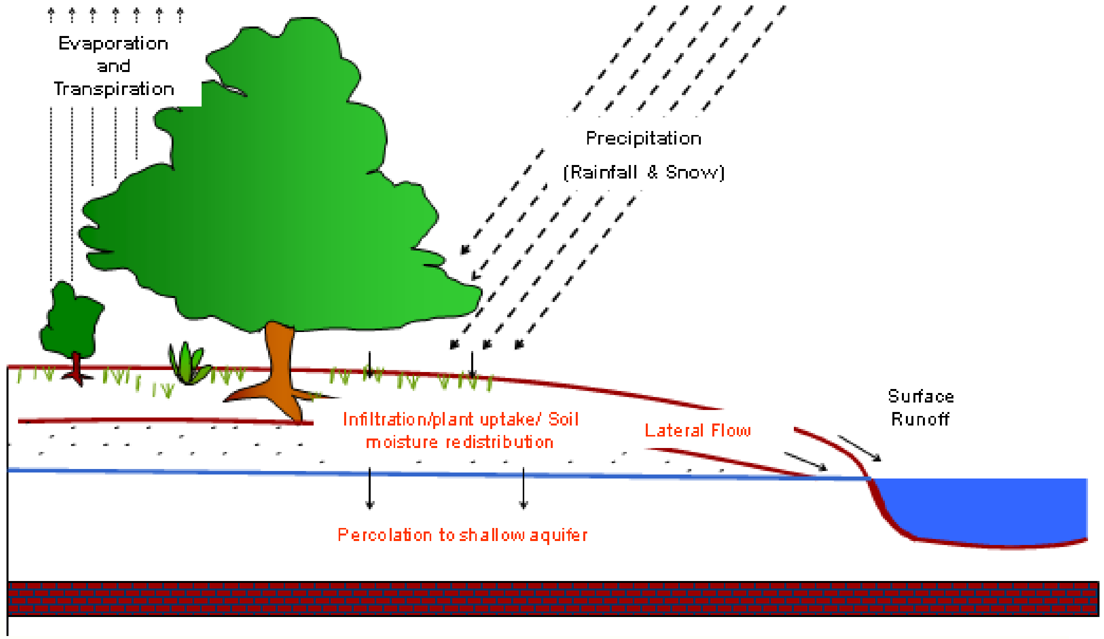
Model Components

Sub-model





Water balance



$$SW_t = SW_0 + \sum_{i=1}^{t}(R_{day} - Q_{surf} - E_a - W_{seep} - Q_{gw})$$

SW_t : the final water content (mm)

SW_0: the initial soil water content on day i (mm)

t: the time（days）

R_{day}: the amount of precipitation on day i (mm)

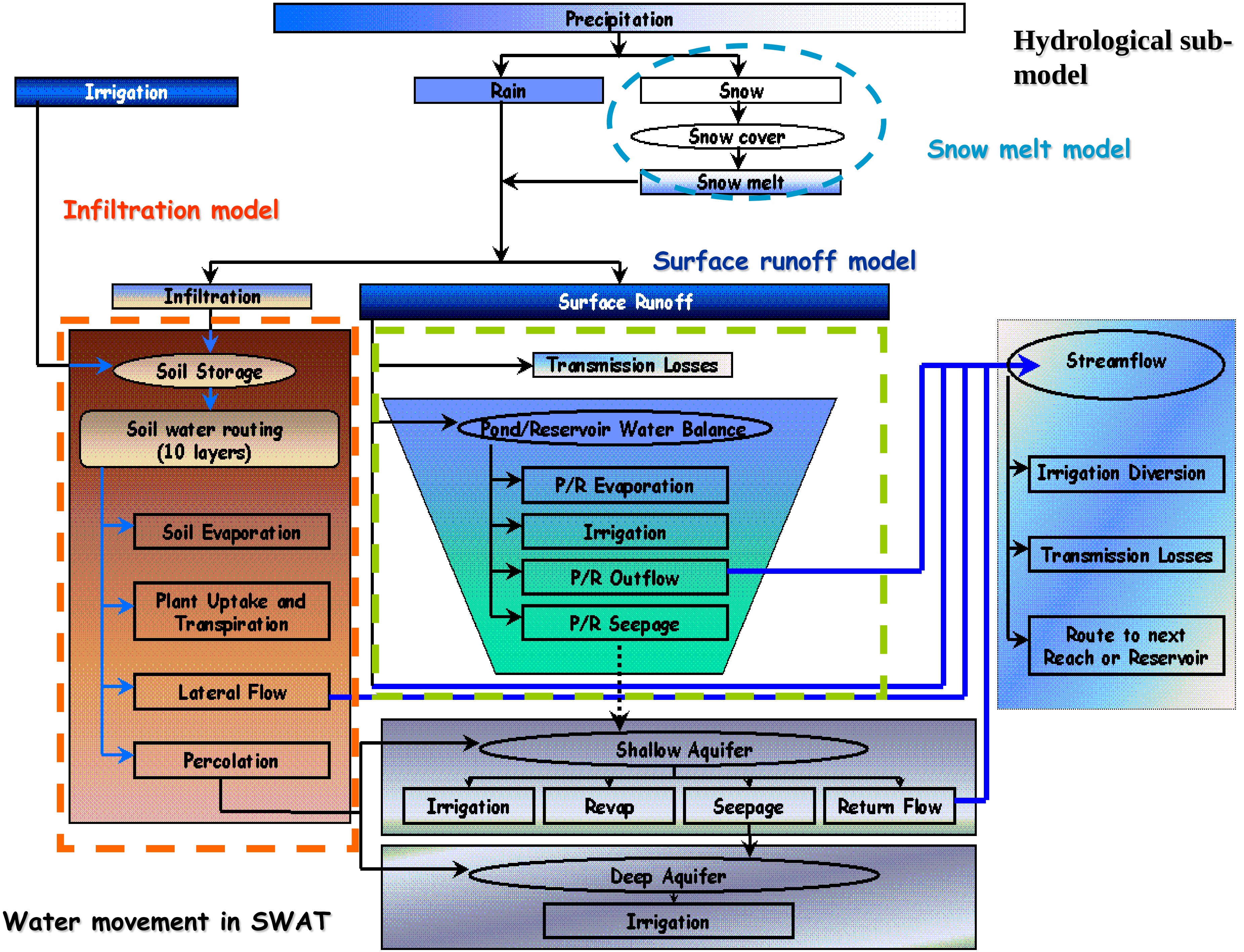
Q_{surf}: the surface runoff on day i （mm）

E_a: the amount of evapotranspiration on day i （mm）

W_{seep} : the amount of water entering the vadose zone from the soil profile on day i (mm)

Q_{gw}: the amount of return flow on day i (mm)

Hydrological sub-model



Water movement in SWAT

Soil erosion sub-model

$$sed = 11.8 \cdot \left(Q_{surf} \cdot q_{peak} \cdot area_{hru}\right)^{0.56} \cdot K_{USLE} \cdot C_{USLE} \cdot P_{USLE} \cdot LS_{USLE} \cdot CFRG$$

Sed: the sediment yield on a given day

Qsurf: the surface runoff volume (mm H_2O/ ha)

Q peak: the peak runoff rate (m^3/s)

Areahru: the aera of the HRU (ha)

Kusle: the usle cover and the management factor

Pusle: the USLE support practice factor

Lusle: the USLE topographic factor

GFRG: THE coarse fragment factor

$$K_{USLE} = f_{csand} \cdot f_{cl-si} \cdot f_{orgc} \cdot f_{hisand}$$

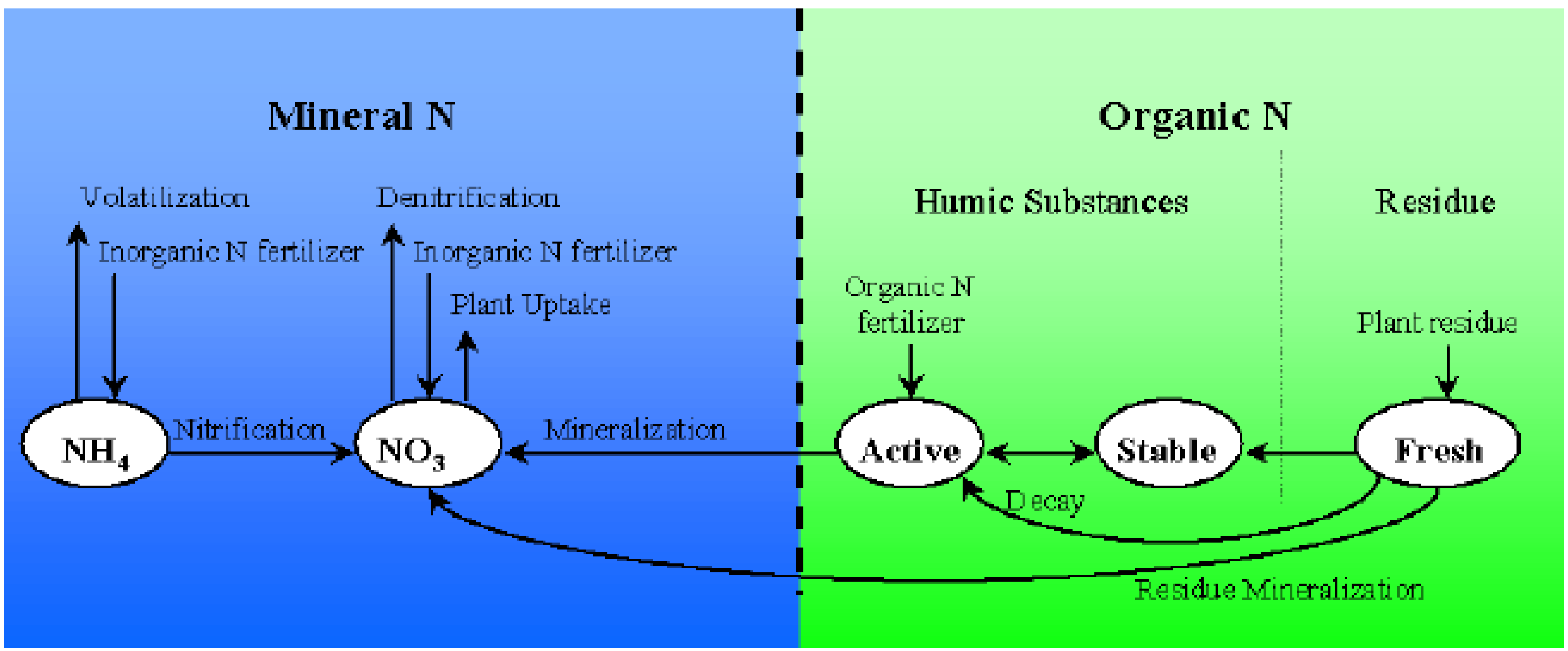
$$C_{USLE,mn} = 1.463 \ln\left[C_{USLE,aa}\right] + 0.1034$$

$$CFRG = \exp(-0.053 \cdot rock)$$

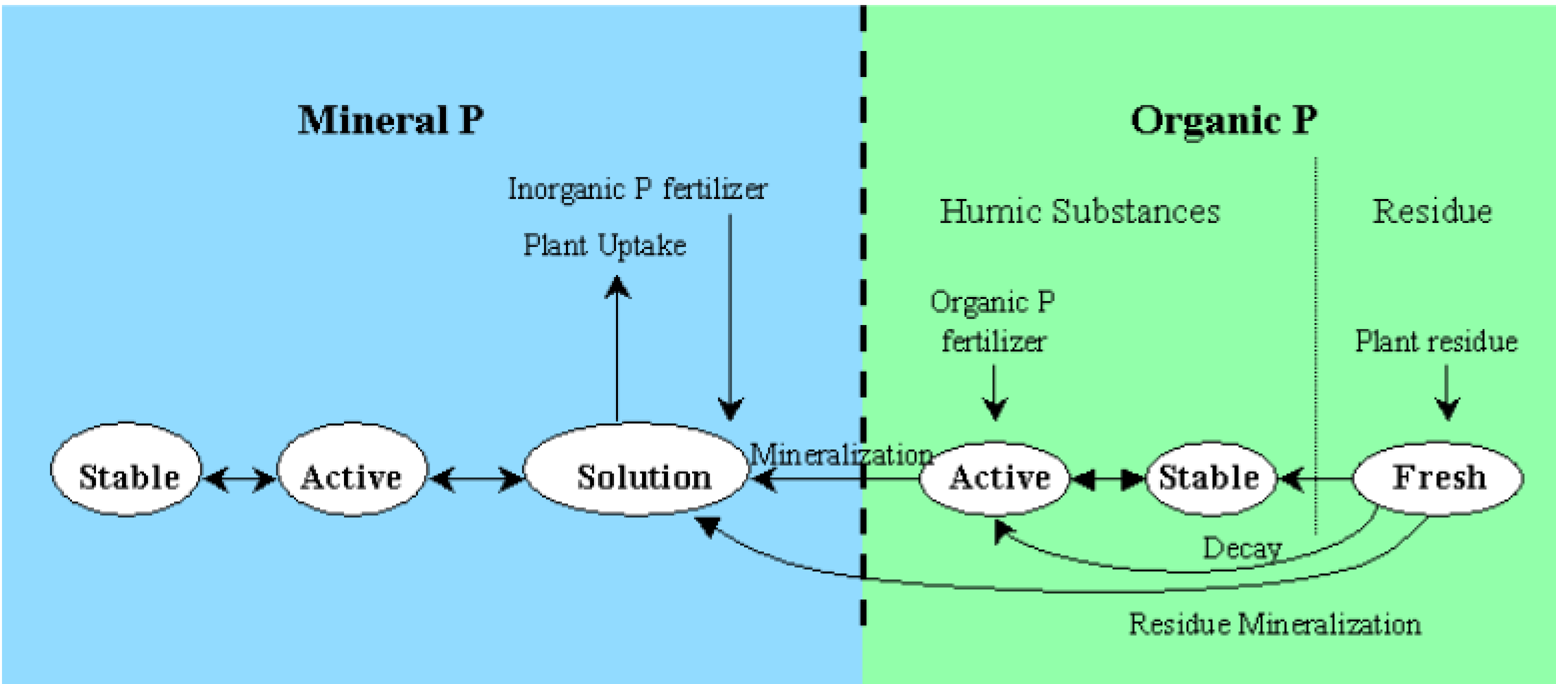
$$LS_{USLE} = \left(\frac{L_{hill}}{22.1}\right)^{m} \cdot \left(65.41 \cdot \sin^2(\alpha_{hill}) + 4.56 \cdot \sin \alpha_{hill} + 0.065\right)$$

SWAT tracks the movement and transformation of several forms of nitrogen and phosphorus in the watershed. Nutrients may be introduced to the main channel and transported downstream through surface runoff and lateral subsurface flow.

Nitrogen cycle



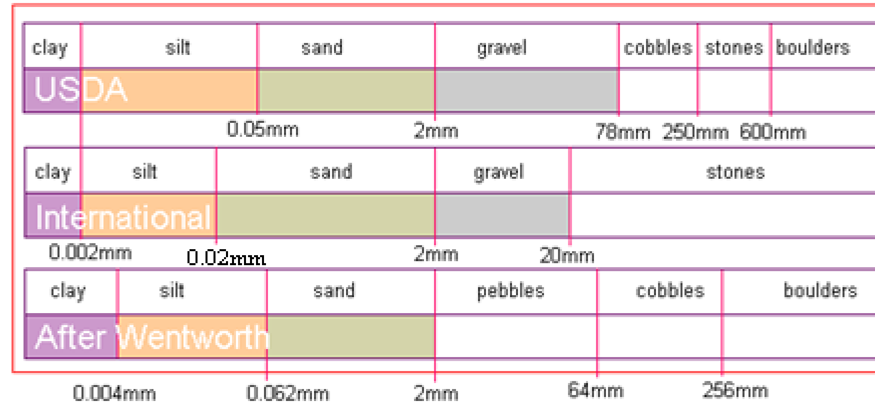
Phosphorus cycle

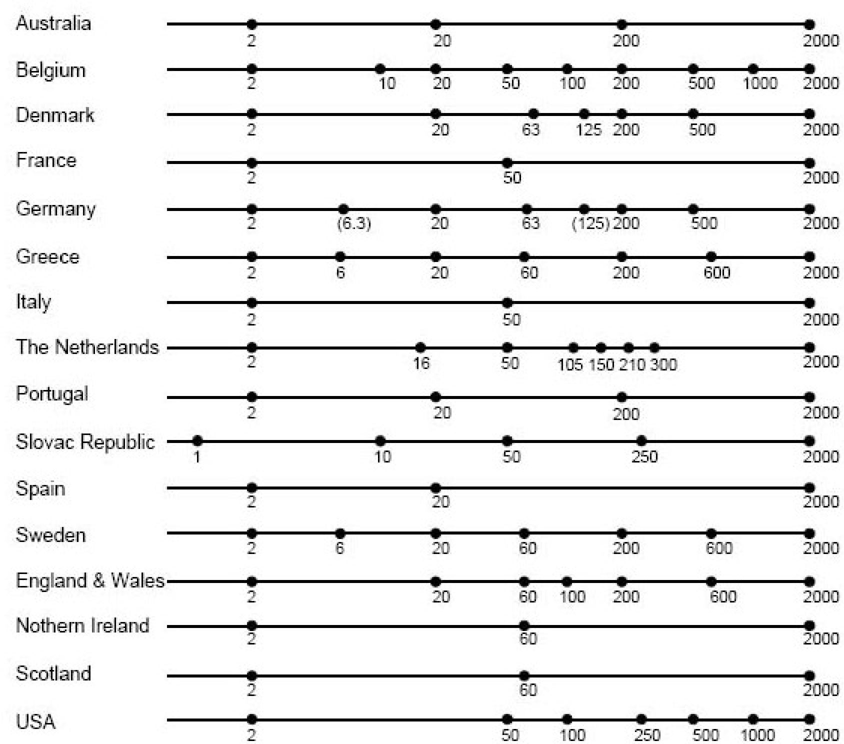


Soil database

Interpolation methods

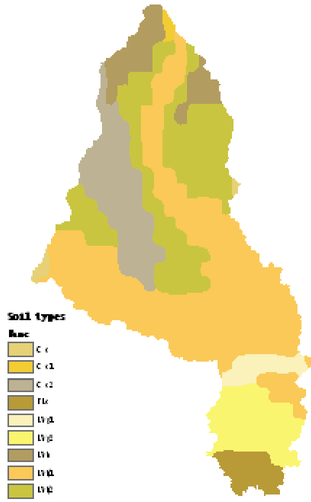
```
load soil.txt; %导入国际制土壤质地文件 soil.txt
rot90(soil);
b1=ans;
flipud(b1);
c1=ans;
x=[0.02,0.2,2];
xx=0.05;
i=1;
n=1;
for j=3:3:231
yy(n)=interp1(x,c1(i:j),xx,'spline'); %一维插值函数
i=i+3;
n=n+1;
end
rot90(yy);
flipud(ans) %得到≤0.05mm 土壤粒径累积百分含量(垂向排列)
```



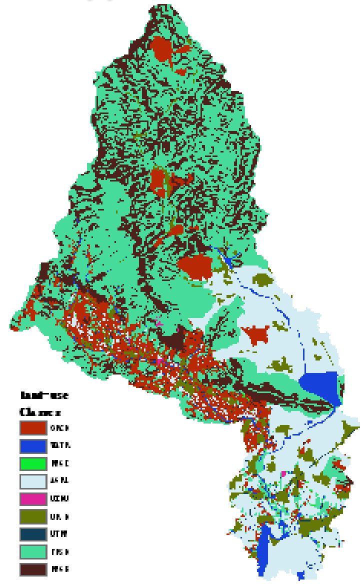



Shuangguan
Xia ying
Xiaogang
Luo zhuangzi
Sun gezhuang
Longmengkou
Ma shengqiao
Chu touling
eservoir Yihongdao
onunty station
Guo River Bri

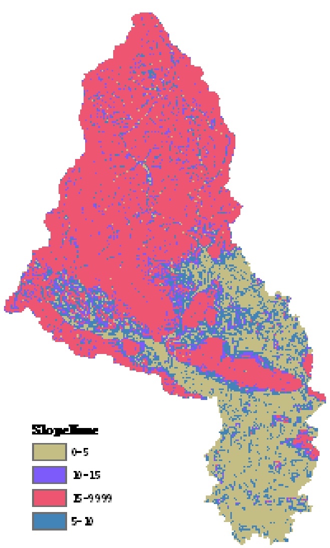
Soil types



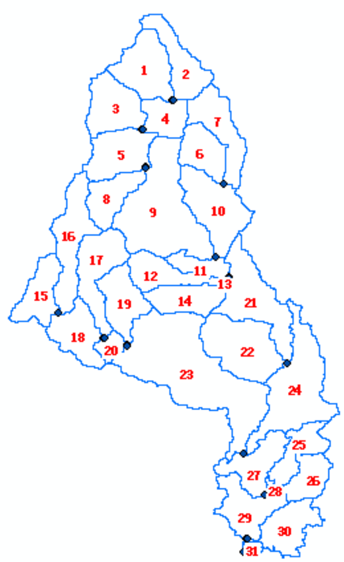
Land-use types

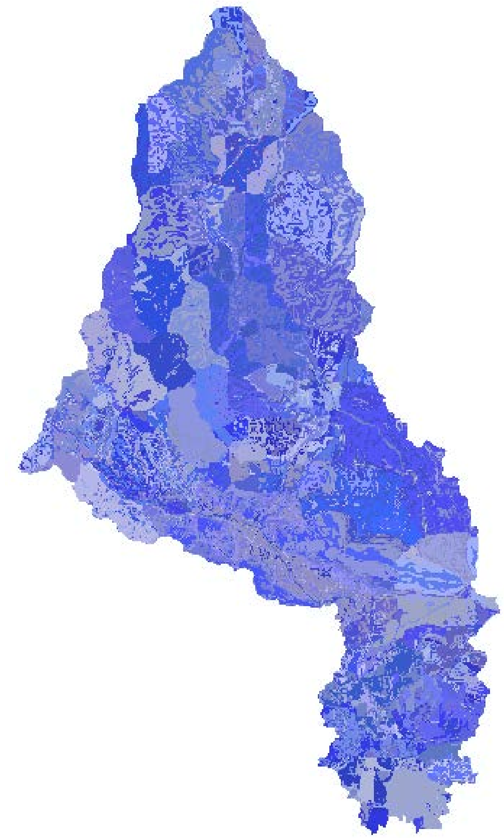


Slope



Sub-catchment



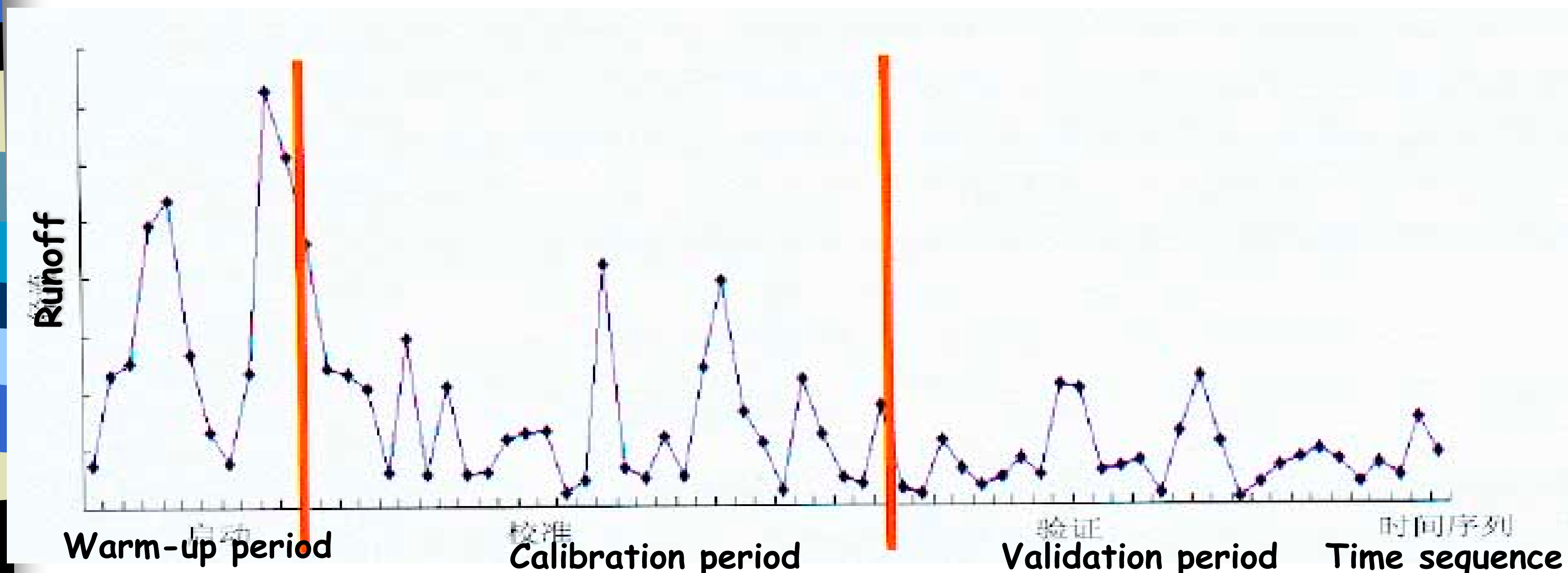


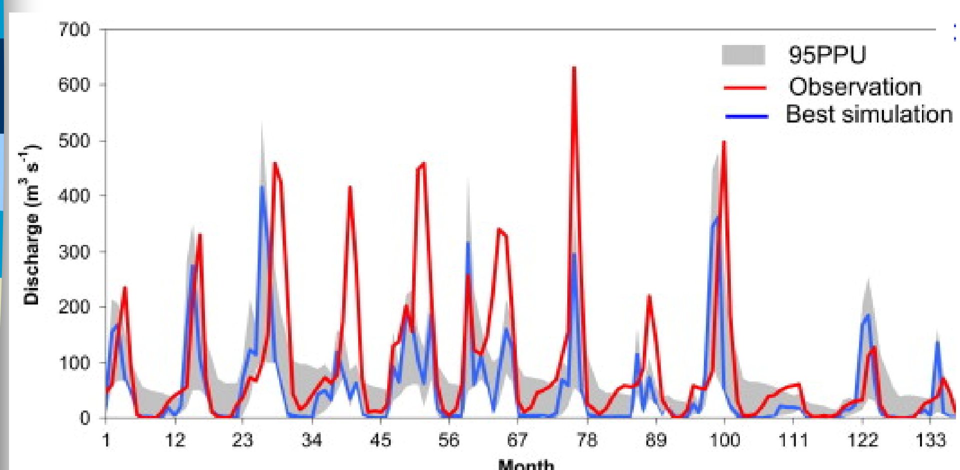
HRU distribution

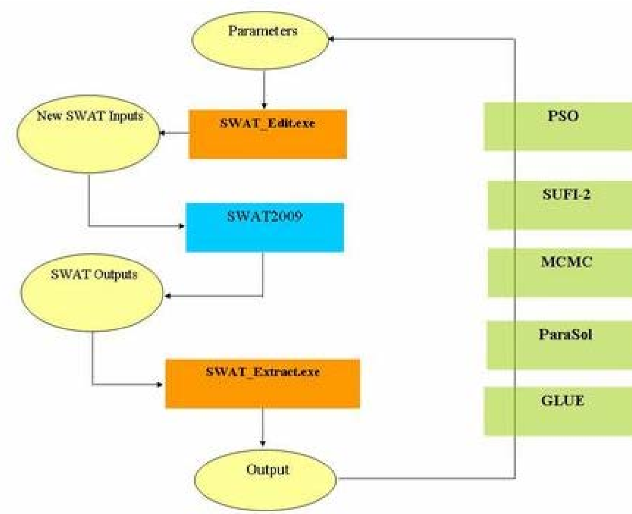
Lin river catchment

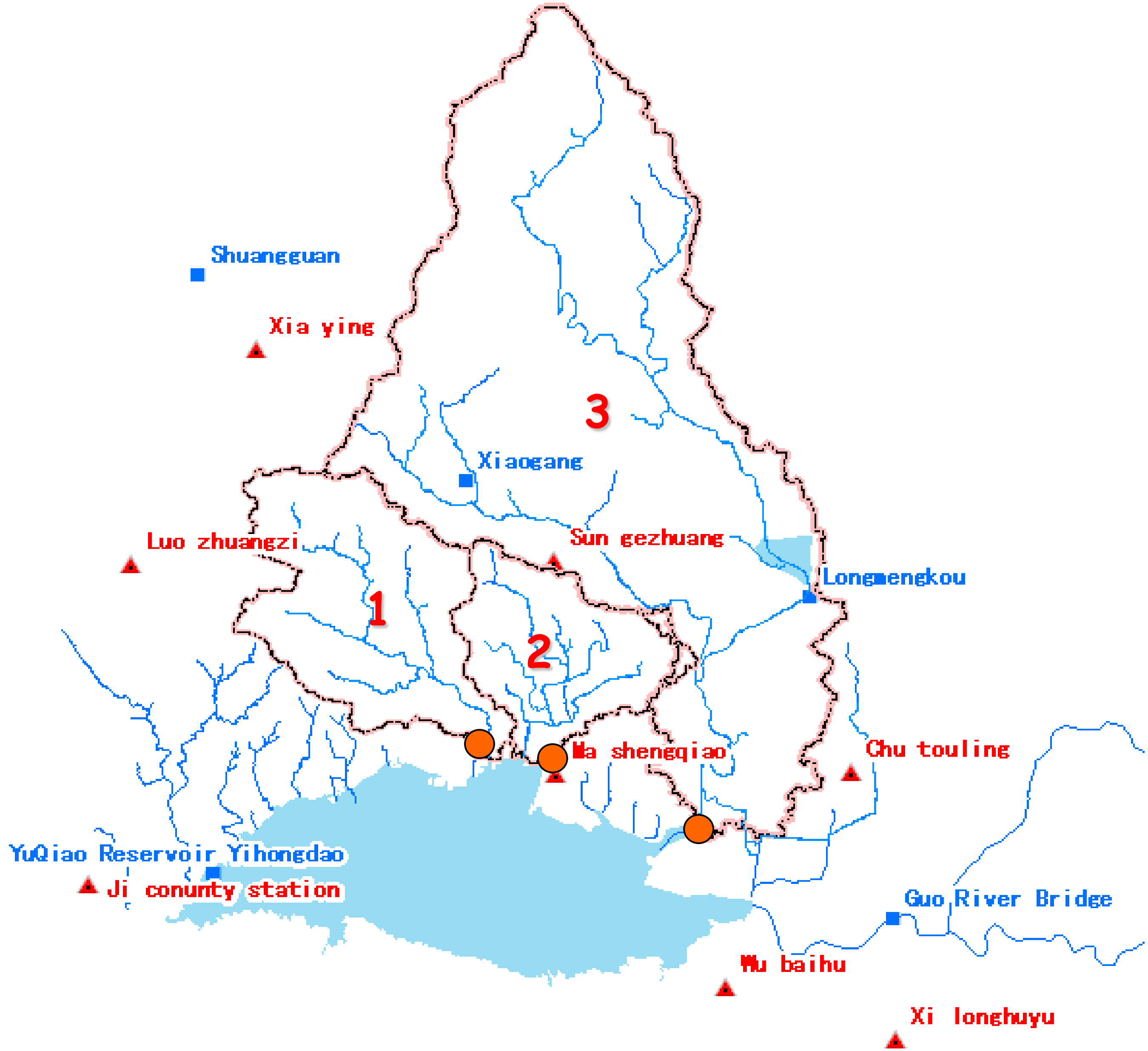
Some challenges ...

The missing data





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Wu baihu
Xi longhuyu