Analyzing spatial and temporal variation of water balance components in La Vi catchment, Binh Dinh province, Vietnam

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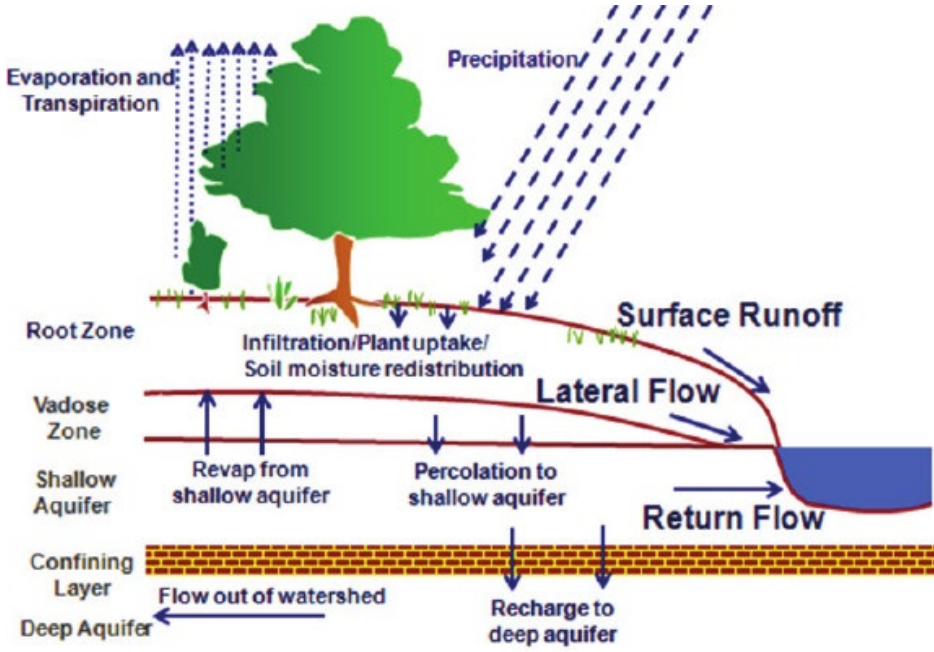

Australian Government
Australian Centre for International Agricultural Research

Project: "Integrated water, soil and nutrient management for sustainable farming systems in south central coastal Vietnam and Australia"

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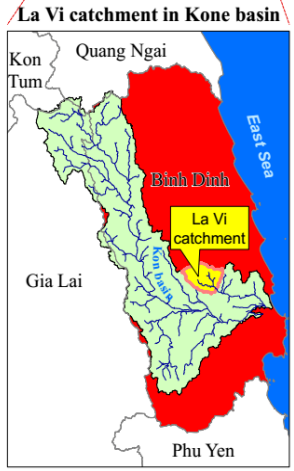
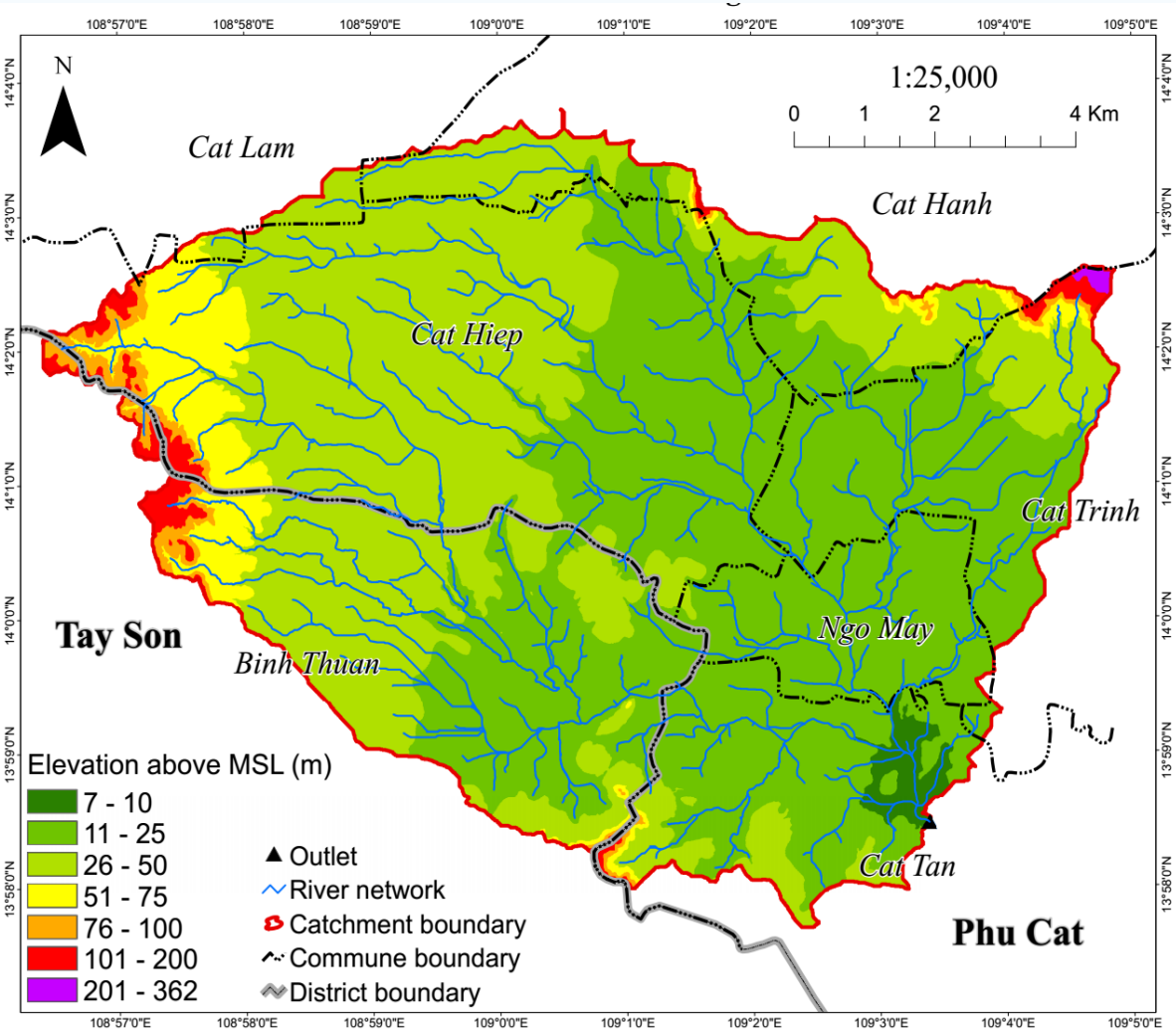
1) Context and Objectives

Where is La Vi catchment?

…a tributary of Kone basin, Binh Dinh province, Vietnam. 10,369.48 ha





362 m

3.27%

Relatively flat terrain

27.3°C

1,919 mm

Tropical wet climate

Sandy loam

Loamy sand

2 main soil textures

~78% (2015)

Dominant agricultural land

1) Context and Objectives

Why was SWAT model chosen?

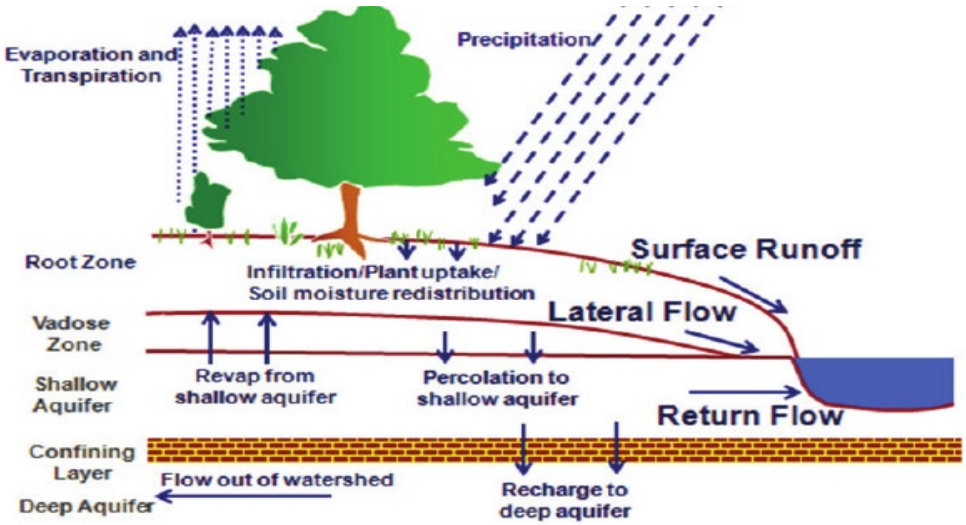
SWAT = **S**oil and **W**ater **A**ssessment **T**ool

A free of charge watershed-scale hydrologic model developed by USDA Agricultural Research Service and Texas A&M AgriLife Research.

A useful model worldwide in simulating and predicting the impact of land use, land management practices, and climate change on the quality and quantity of surface and ground water in watersheds.

SWAT P_r (Popularity index) = 39.2 (no other hydrologic model P_r was close) → Source: Mannschatz et al. 2016. Nexus Tools Platform: Web-based comparison of modelling tools for analysis of water-soil-waste nexus. *Environ. Model. & Software*. 76: 137–153.

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



1) Context and Objectives

What were the objectives of this study?

Modeling water balance components in La Vi catchment from 2000 to 2015 by using SWAT model

Analyzing spatial variation of water balance components in La Vi catchment (sub-catchment, Hydrologic Response Unit)

Analyzing temporal variation of water balance components in La Vi catchment (yearly, monthly)

3) Results and Discussions

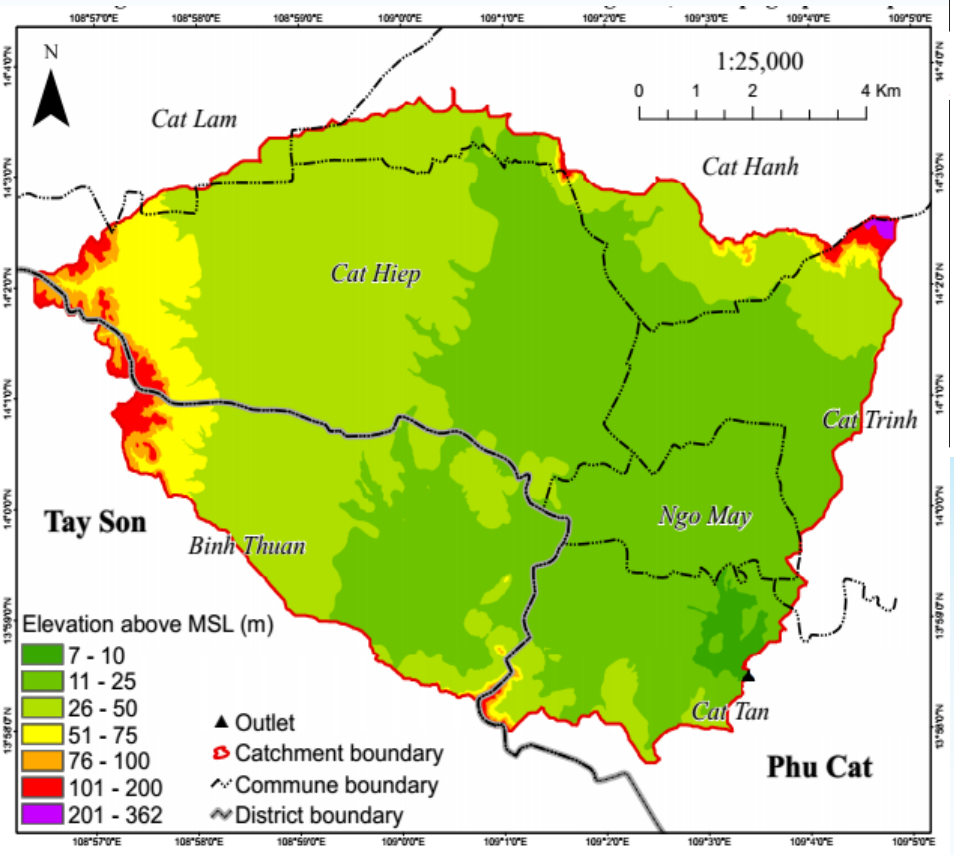
Which input data was collected?

Data type	Description	Source
DEM (Digital Elevation Model)	Interpolated using 5 m contour lines digitized from 1:10,000 topographic map provided by Binh Dinh DoNRE and river longitudinal profiles surveyed by Central Vietnam Division for Water Resources Planning and Investigation; GeoTIFF format, 5 m spatial resolution	Nong Lam University- Ho Chi Minh City
2016 crop pattern map	Classified based on Sentinel-2 satellite images; Shapefile format, scale 1:25,000	Nong Lam University- Ho Chi Minh City
Soil map	Created using 2005 soil map in MapInfo format at scale 1:100,000 provided by Central Sub-Institute of Agricultural Planning and Design and soil profiles in MS Excel format surveyed by Phan Thi Cong et al. (2013) and Nong Lam University- Ho Chi Minh City	Nong Lam University- Ho Chi Minh City
Weather data	Recorded at Quy Nhon surface meteorological station (2008 – 2015), Phu Cat rainfall gauge (2000- 2015) in MS Excel format; Observed variables: Rainfall, Air temperature, Relative humidity, Sunshine hour, Wind speed (daily timestep)	South Central Hydro-Meteorological Center

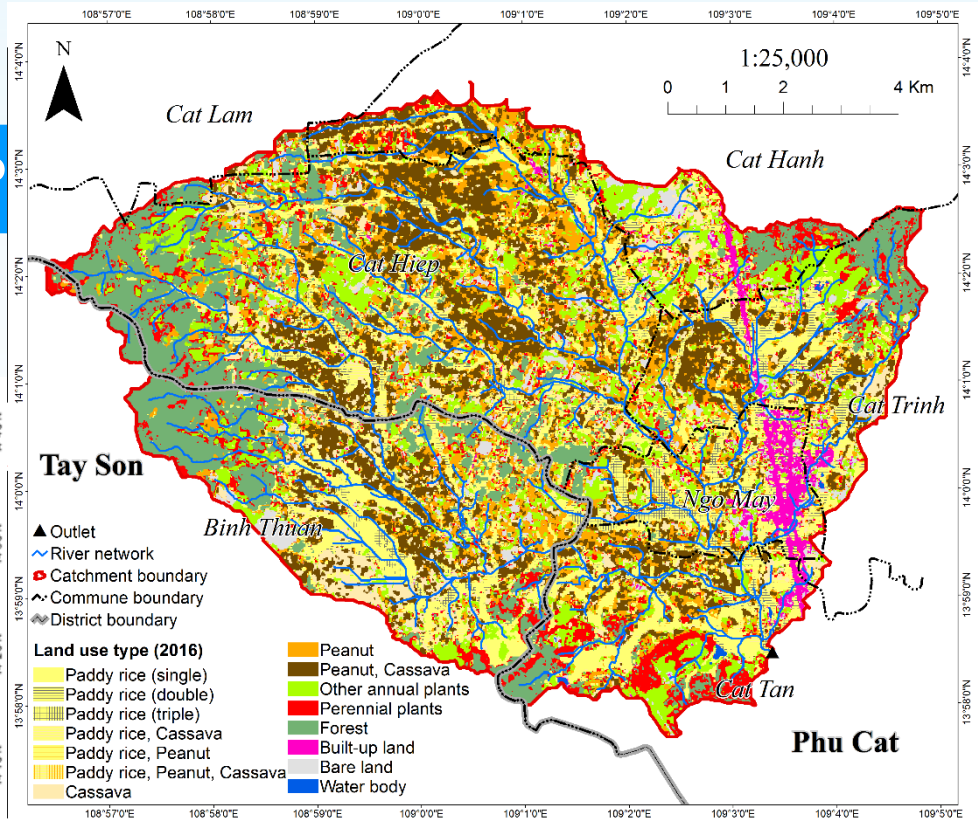
3) Results and Discussions

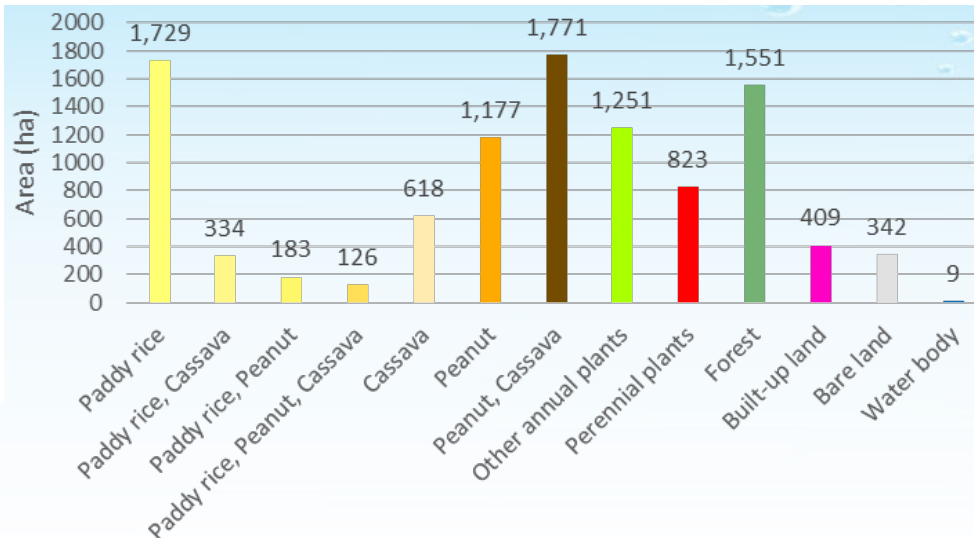
Which input data was collected?

DEM



2016 crop pattern map

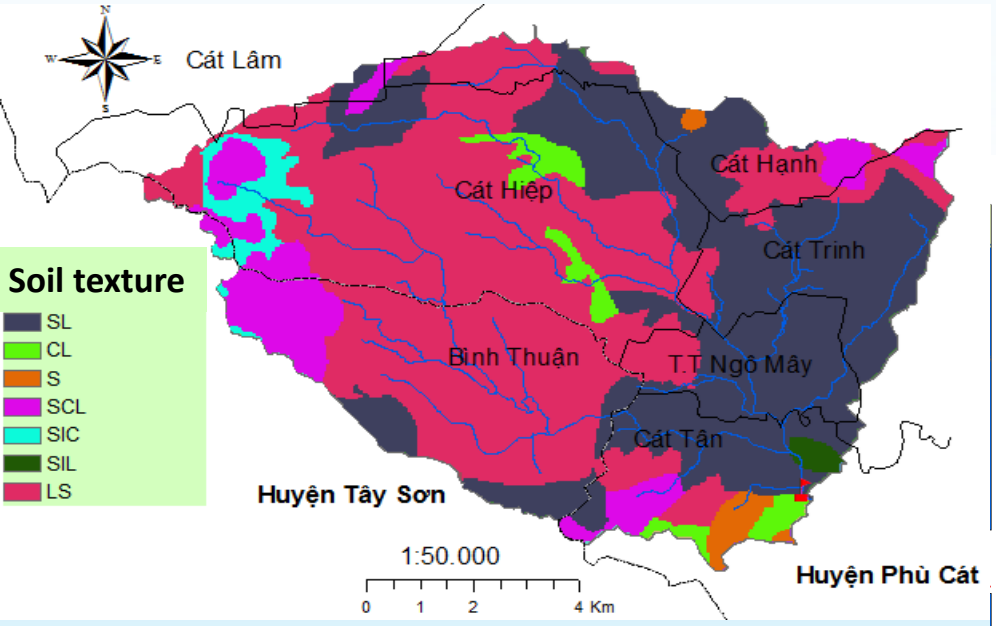




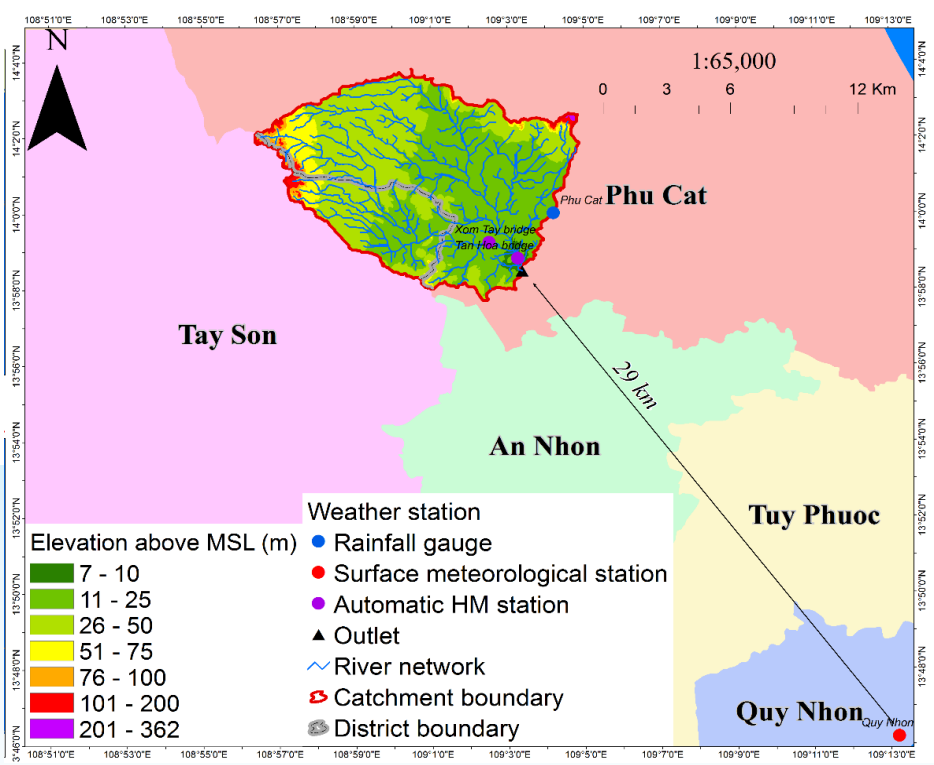
3) Results and Discussions

Which input data was collected?

Soil



Weather

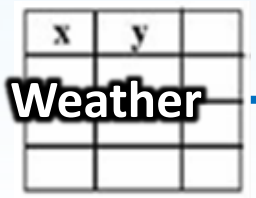


2) Data and Methods

How was SWAT model set up and run?

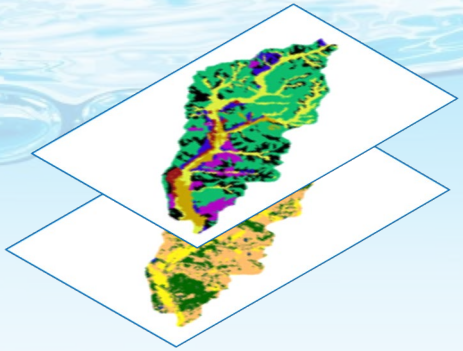
Input Data

Processing and Display

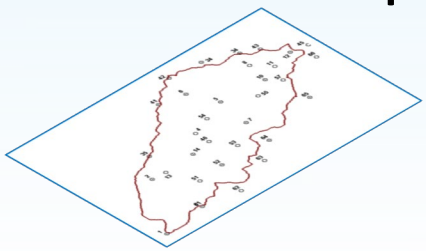


1-Watershed Delineation

2-HRU Definition



3-Weather Data Import



SWAT Databases

Parameterization

4-Run SWAT model

5-Analyzing spatial and temporal variation of water balance components

PRECIP
ET
SW
PERC
SUR_Q
GW_Q

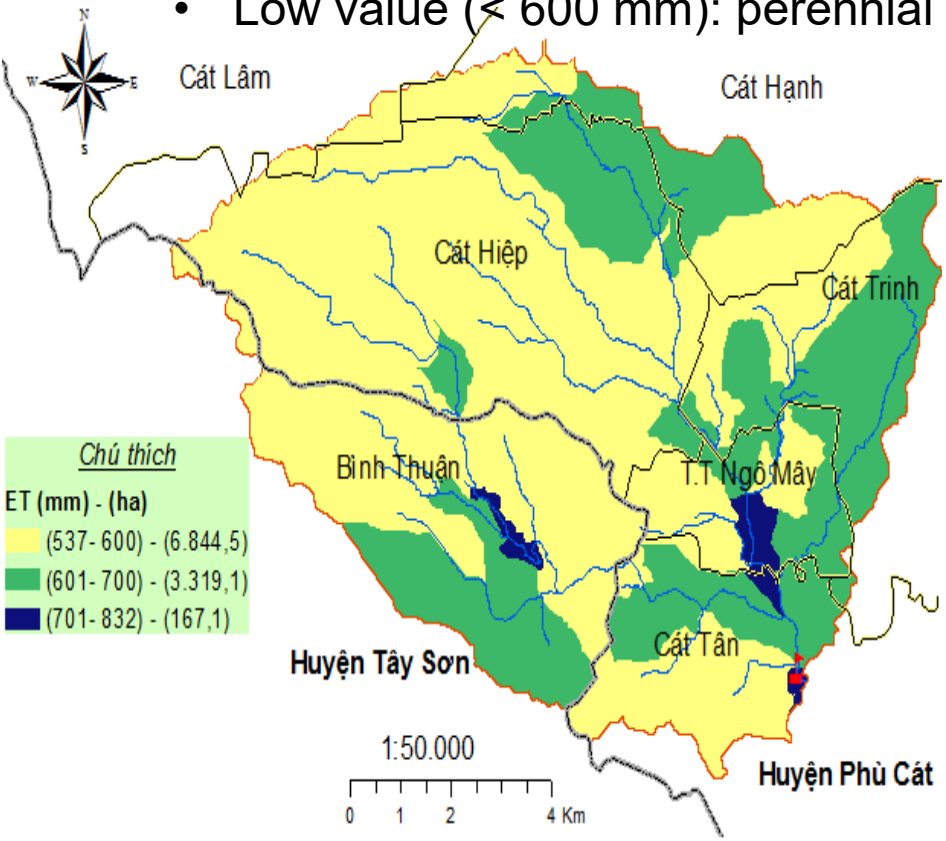
3) Results and Discussions

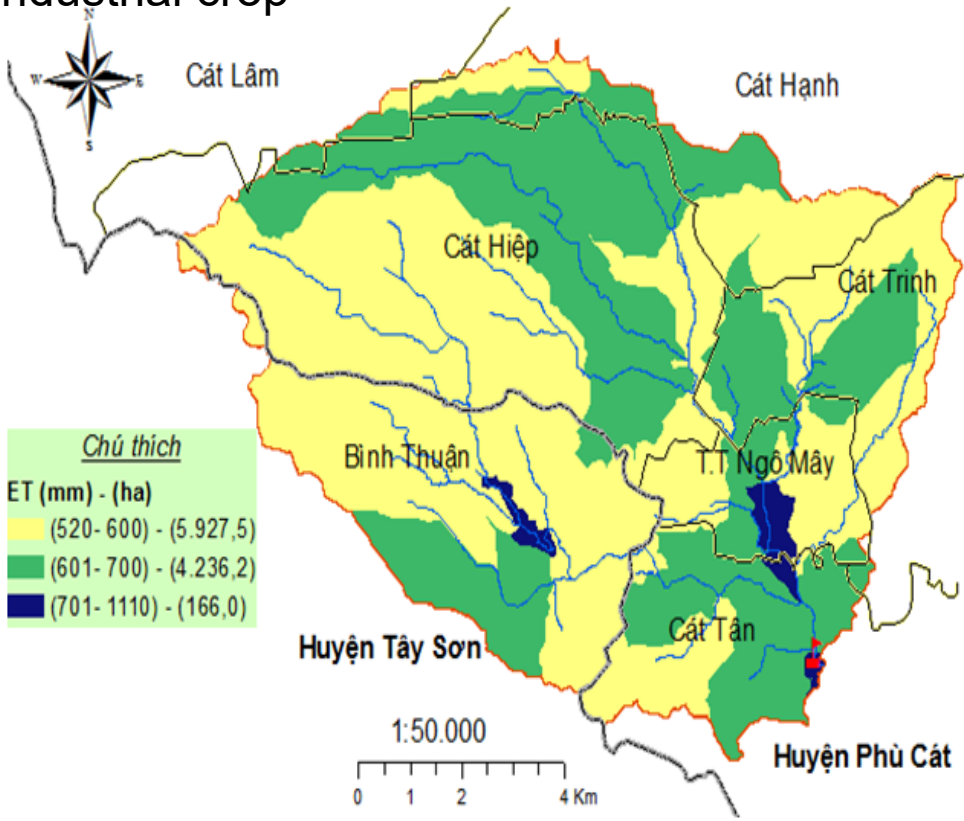
How did water balance components change in spatial aspect?

Sub-catchment **Hydrologic Response Unit**

ET (actual evapotranspiration)

- High value (> 600 mm): residential land
- Low value (< 600 mm): perennial industrial crop





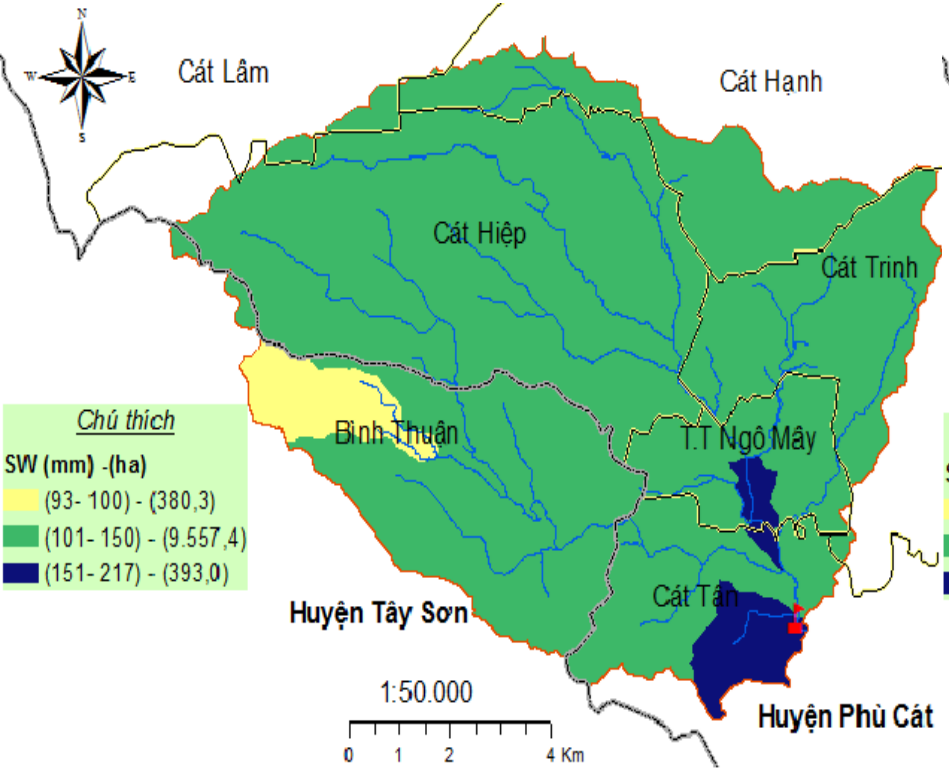
3) Results and Discussions

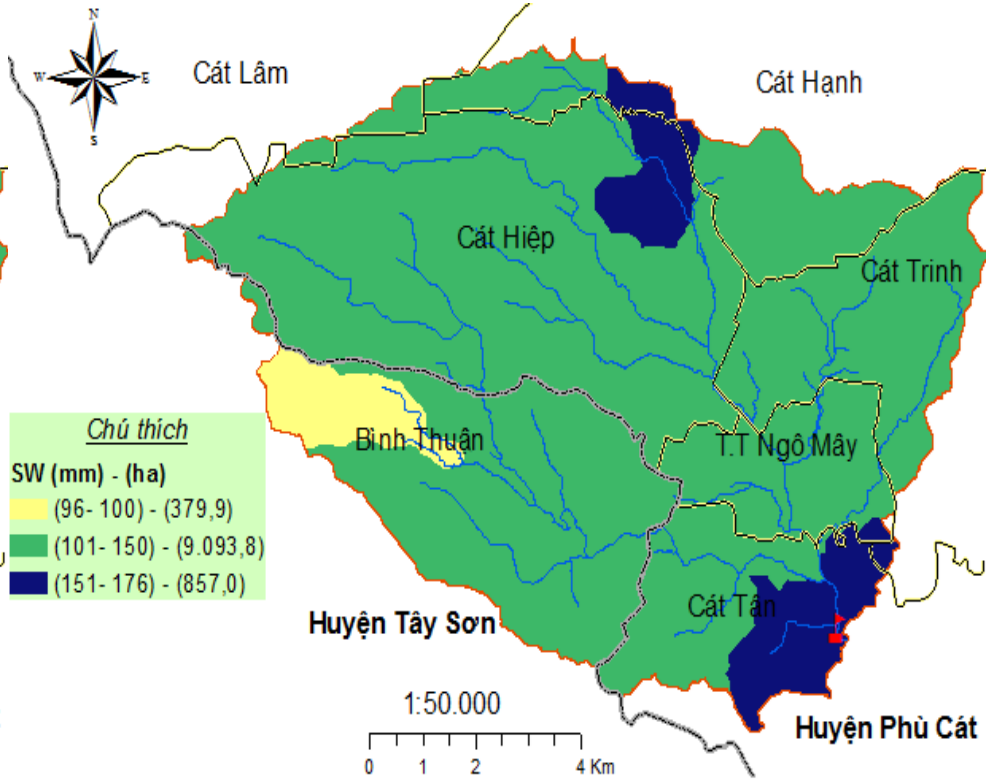
How did water balance components change in spatial aspect?

Sub-catchment **Hydrologic Response Unit**

SW

- High value (> 150 mm): sandy loam
- Low value (< 150 mm): loamy sand





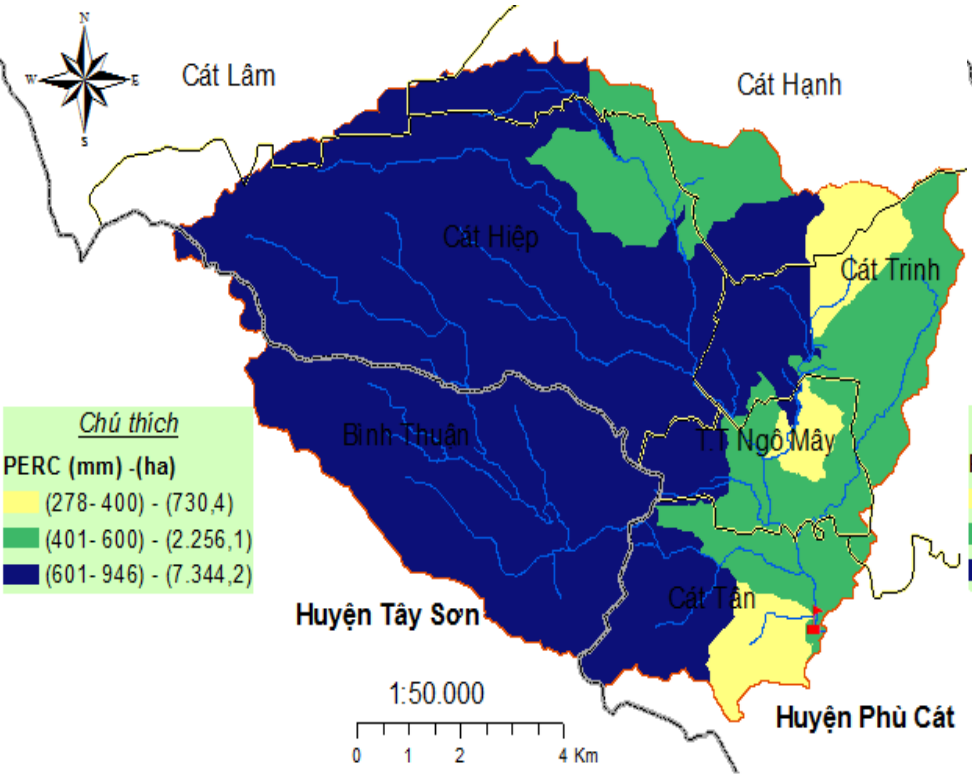
3) Results and Discussions

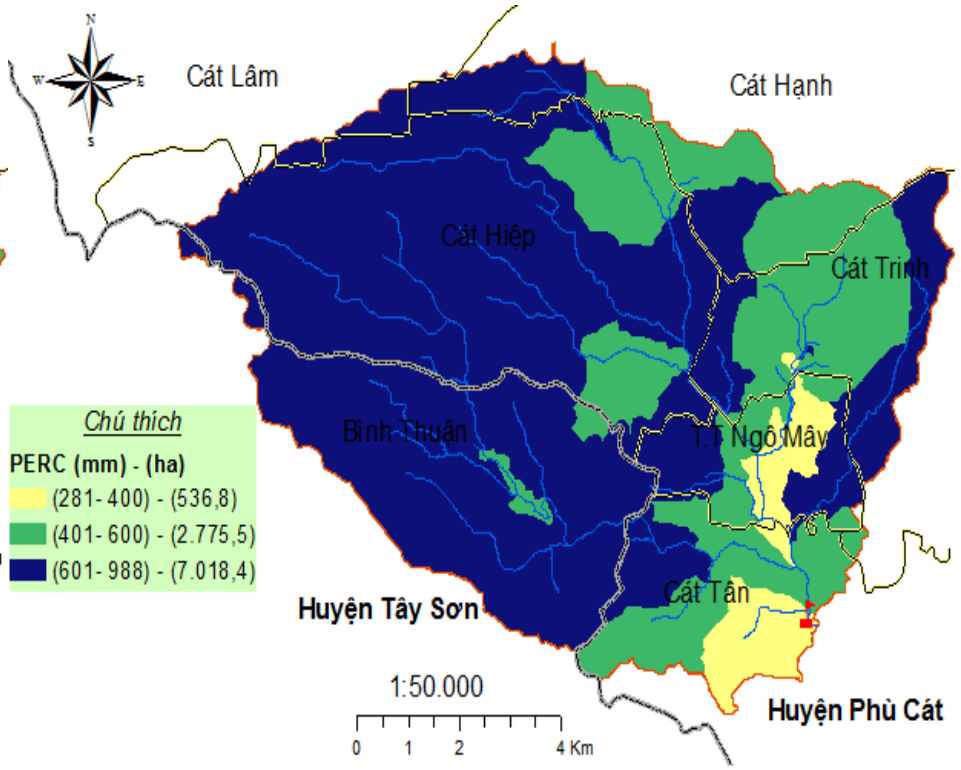
How did water balance components change in spatial aspect?

Sub-catchment **Hydrologic Response Unit**

PERC (Percolation)

- High value (> 600 mm): perennial industrial crop
- Low value (< 400 mm): residential land





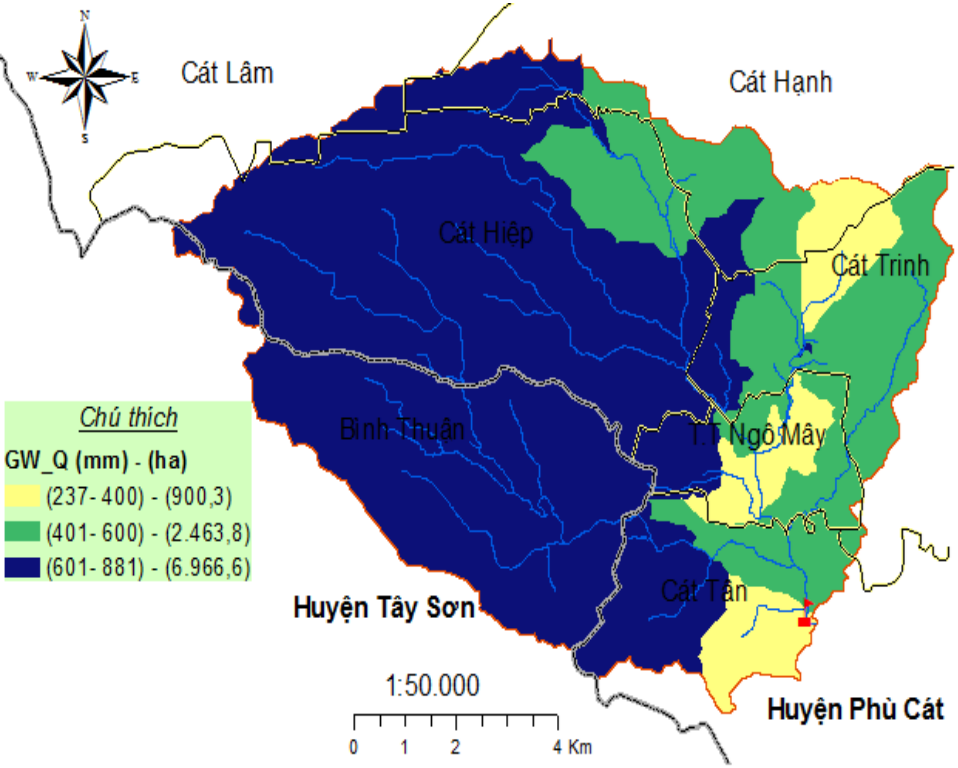
3) Results and Discussions

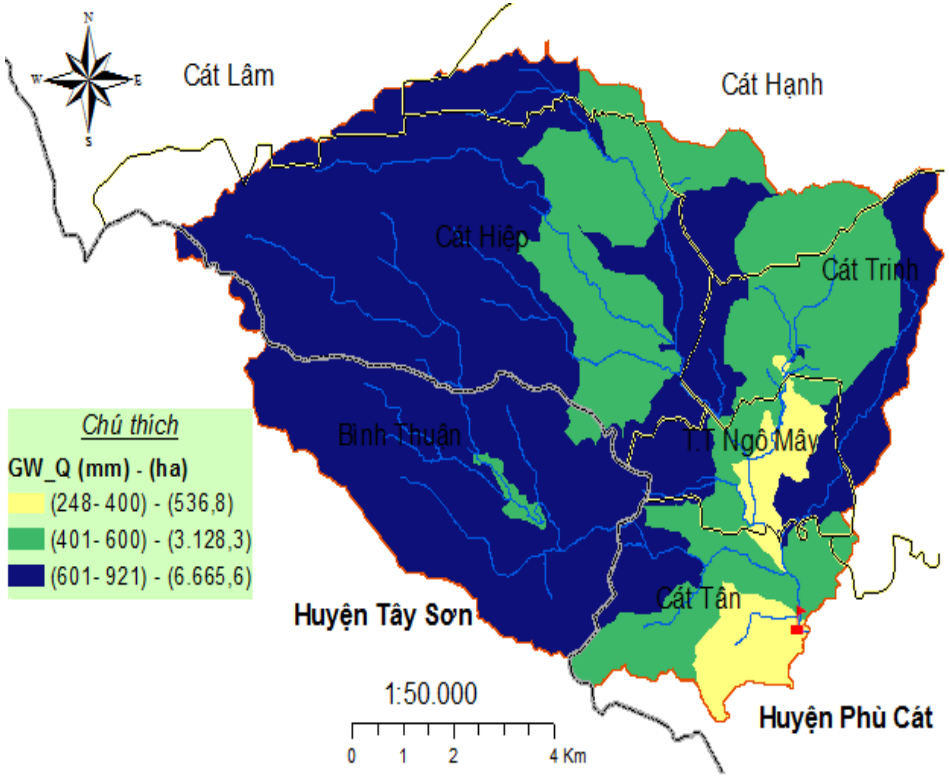
How did water balance components change in spatial aspect?

Sub-catchment **Hydrologic Response Unit**

GW_Q

- High value (> 600 mm): perennial industrial crop
- Low value (< 400 mm): residential land





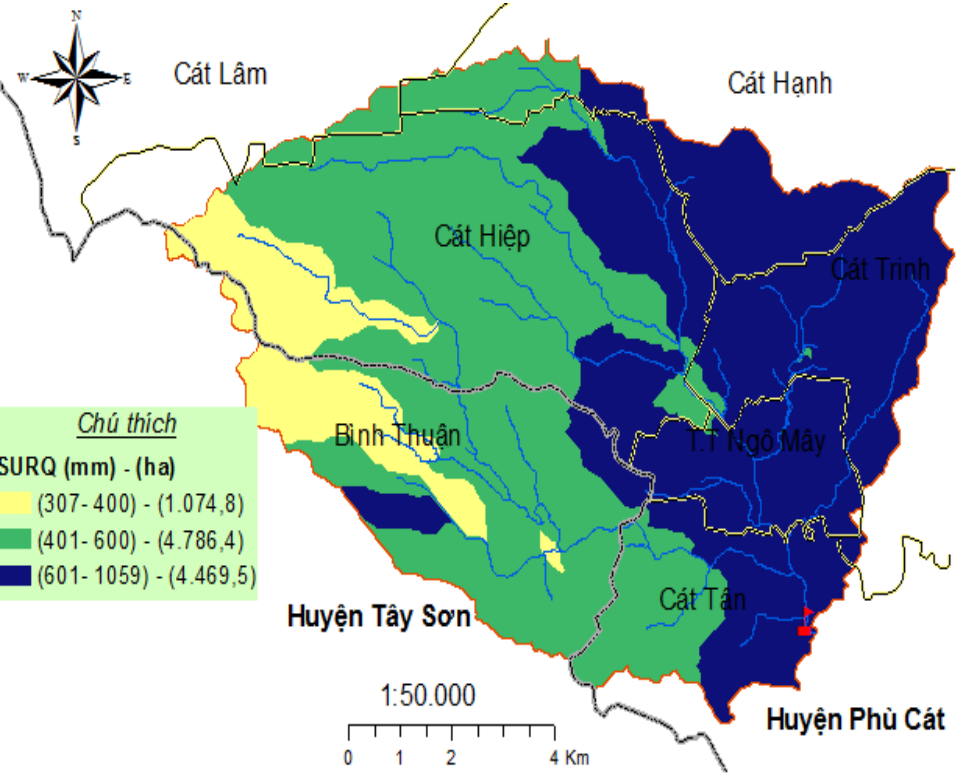
3) Results and Discussions

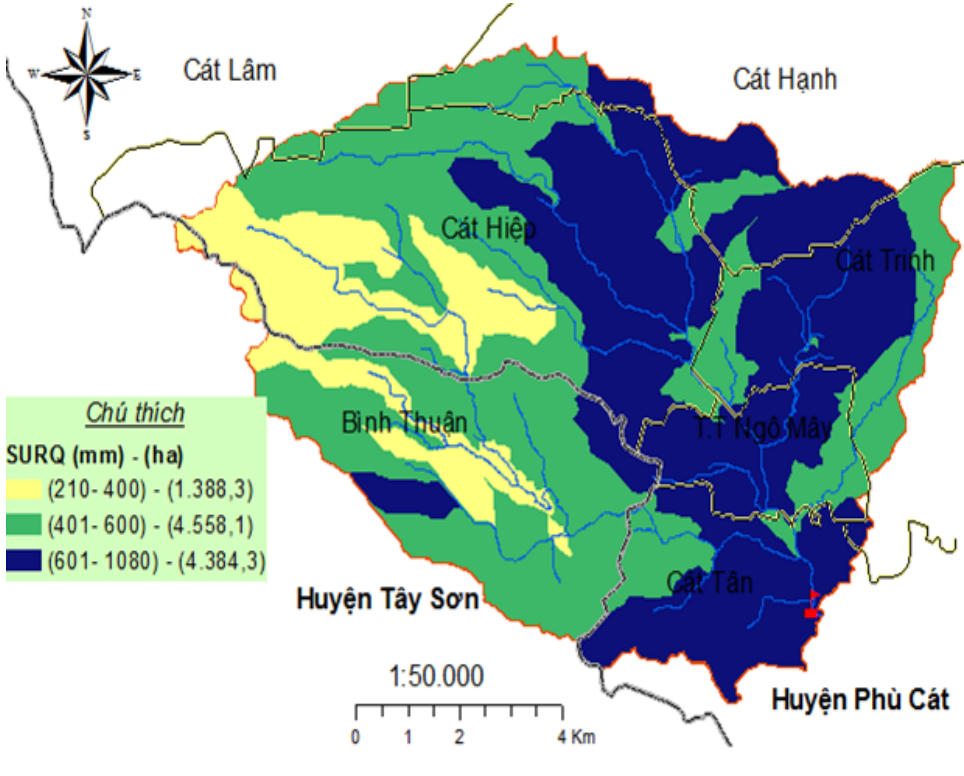
How did water balance components change in spatial aspect?

Sub-catchment **Hydrologic Response Unit**

SUR_Q

- High value (> 600 mm): residential land
- Low value (< 400 mm): perennial industrial crop





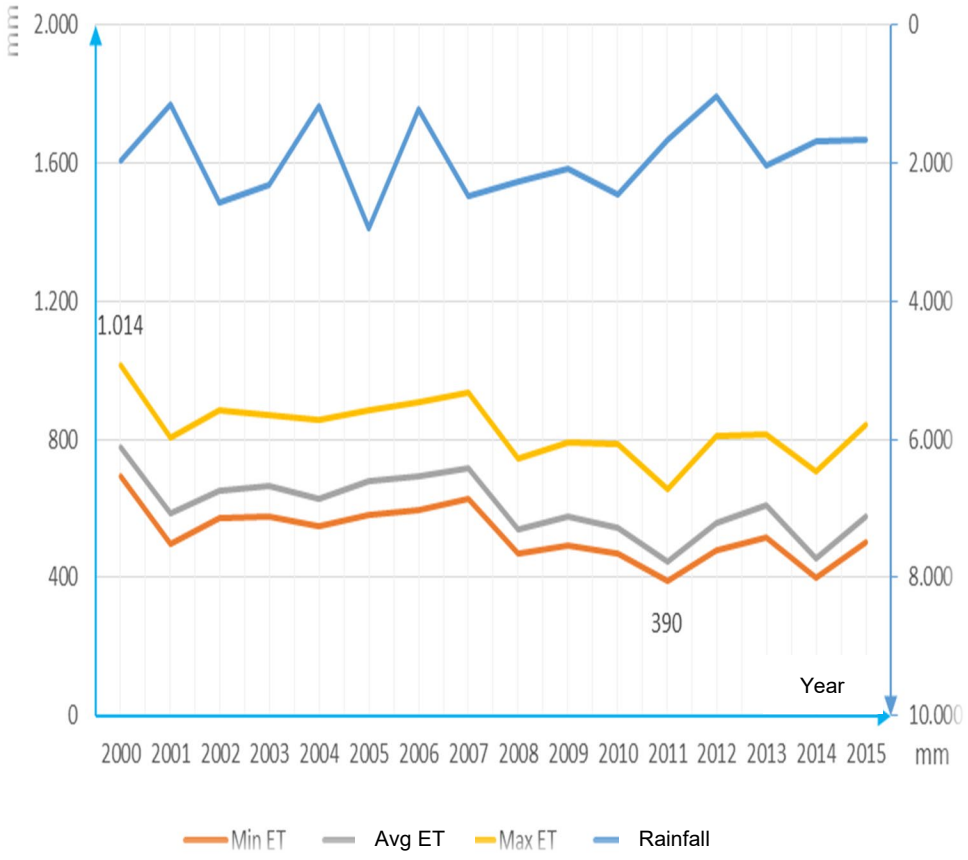
3) Results and Discussions

How did water balance components change in temporal aspect?

Yearly

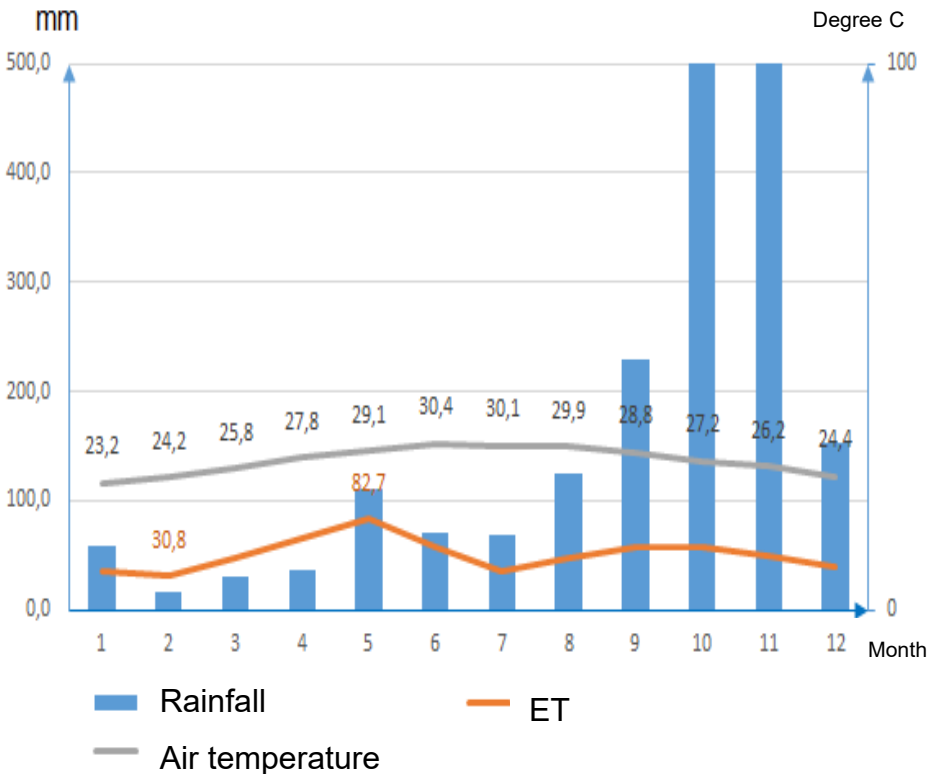
ET

- Small variation (SD = 87 mm)



Monthly

- High value: Apr. – Jun.
- Low value: beginning (Jan., Feb.) and ending (Jul., Aug.) of dry season



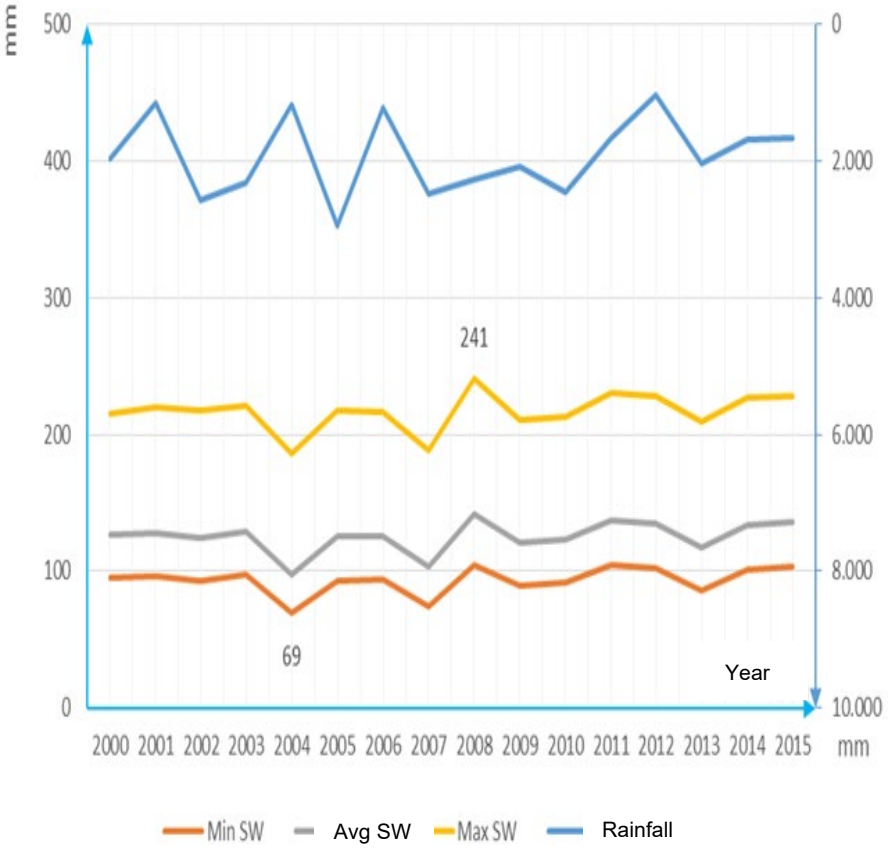
3) Results and Discussions

How did water balance components change in temporal aspect?

Yearly

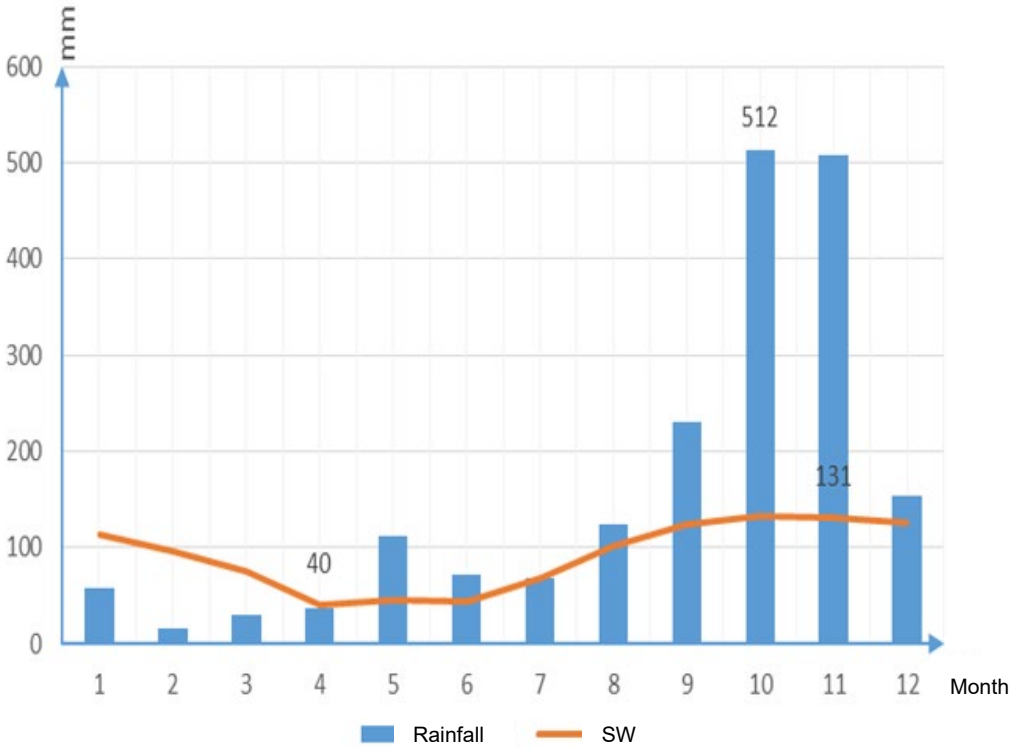
SW

- High stability (SD = 11 mm)



Monthly

- High value: rainy season, beginning of dry season.
- Low value: Apr., Jun.



3) Results and Discussions

How did water balance components change in temporal aspect?

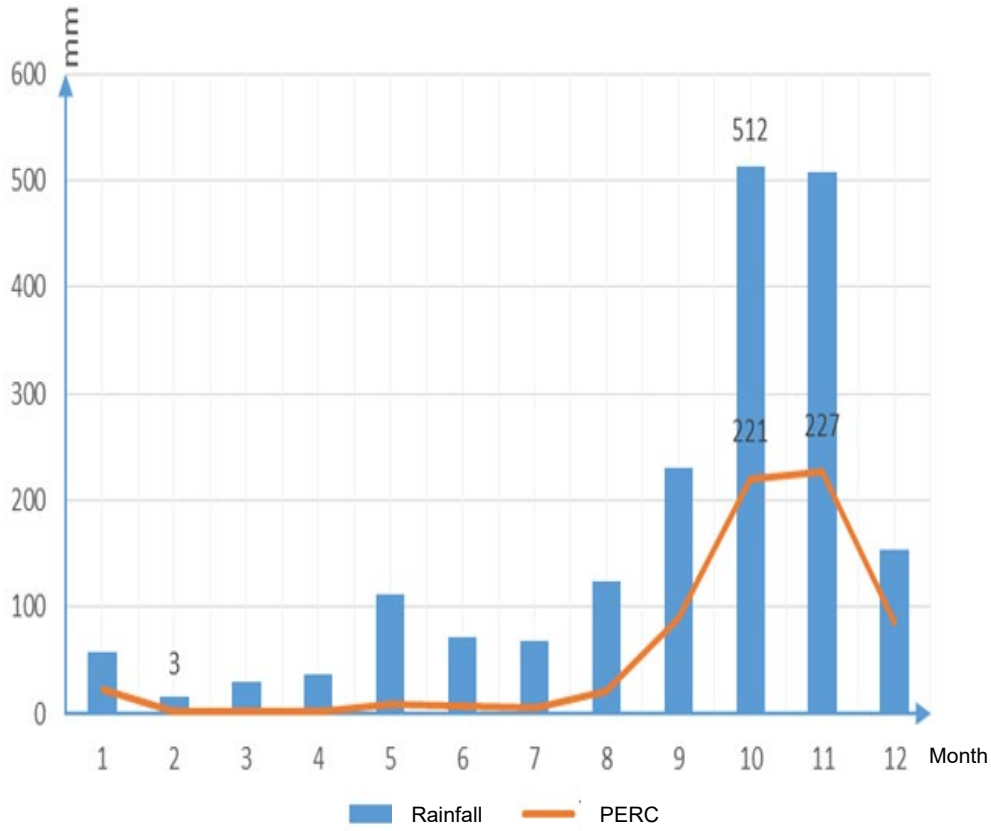
Yearly

PERC

- High variation (SD = 249 mm)

Monthly

- High value: rainy season (Sep. – Dec.)
- Low value: dry season



3) Results and Discussions

How did water balance components change in temporal aspect?

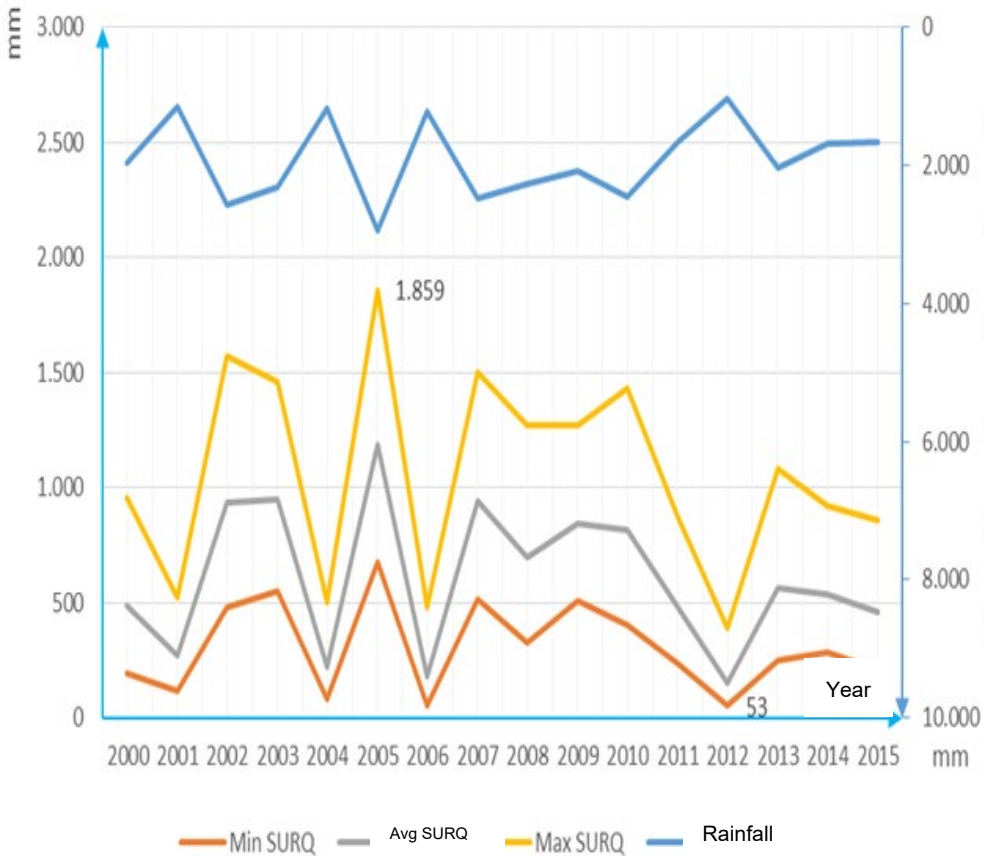
Yearly

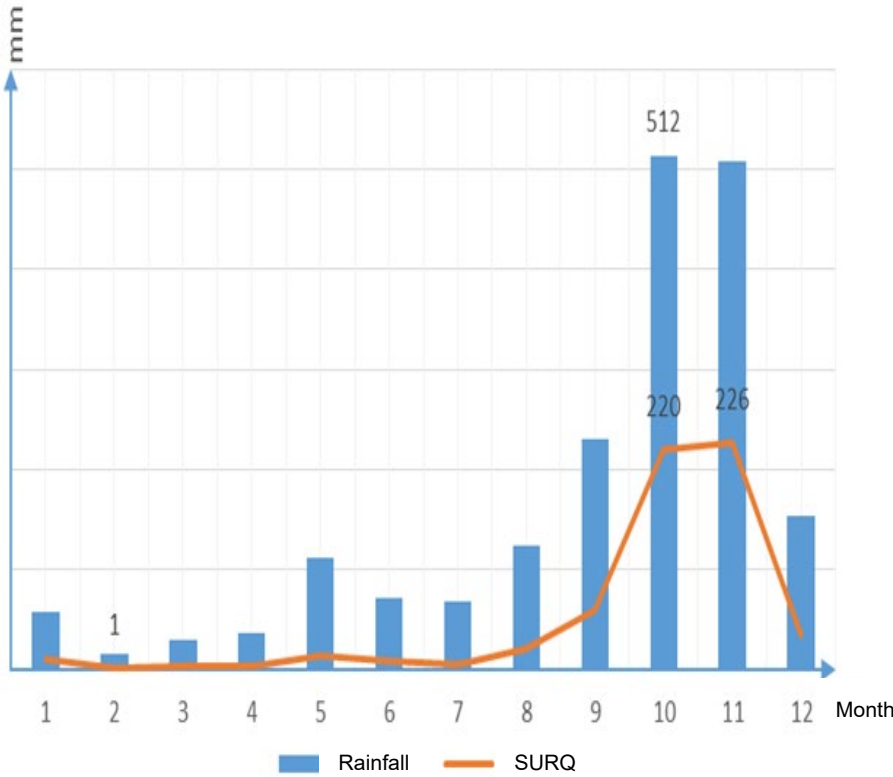
SUR_Q

- High variation (SD = 306 mm)

Monthly

- High value: rainy season
- Low value: dry season, ending of rainy season





3) Results and Discussions

How did water balance components change in temporal aspect?

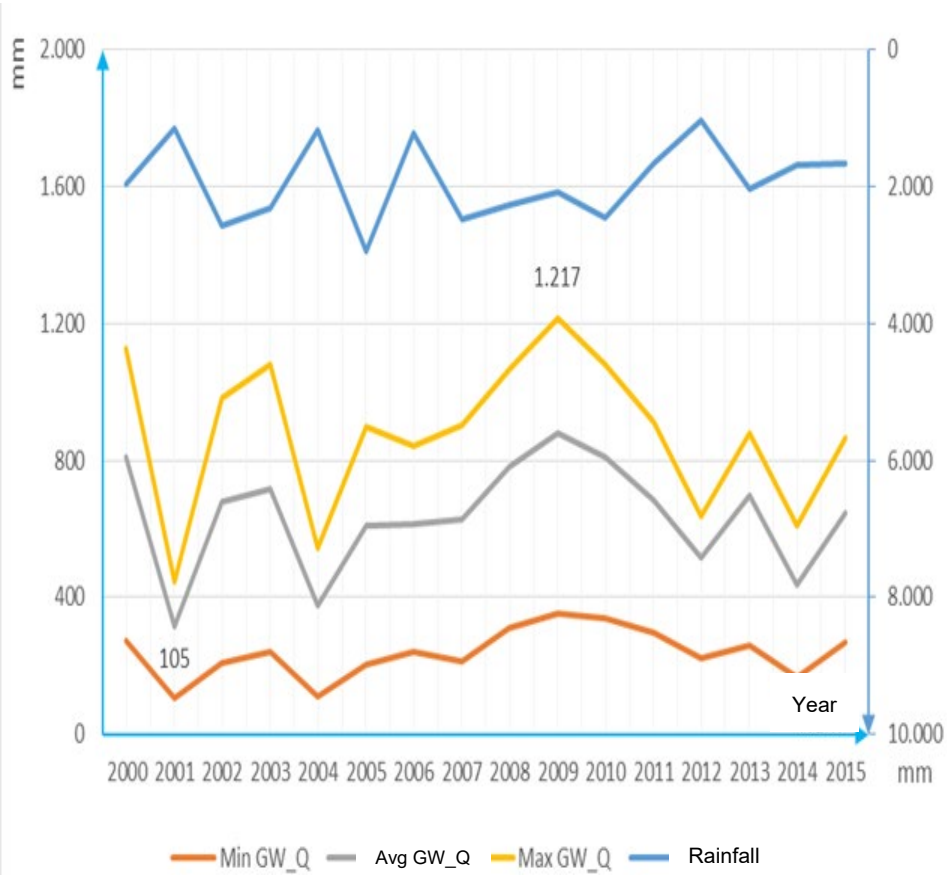
Yearly

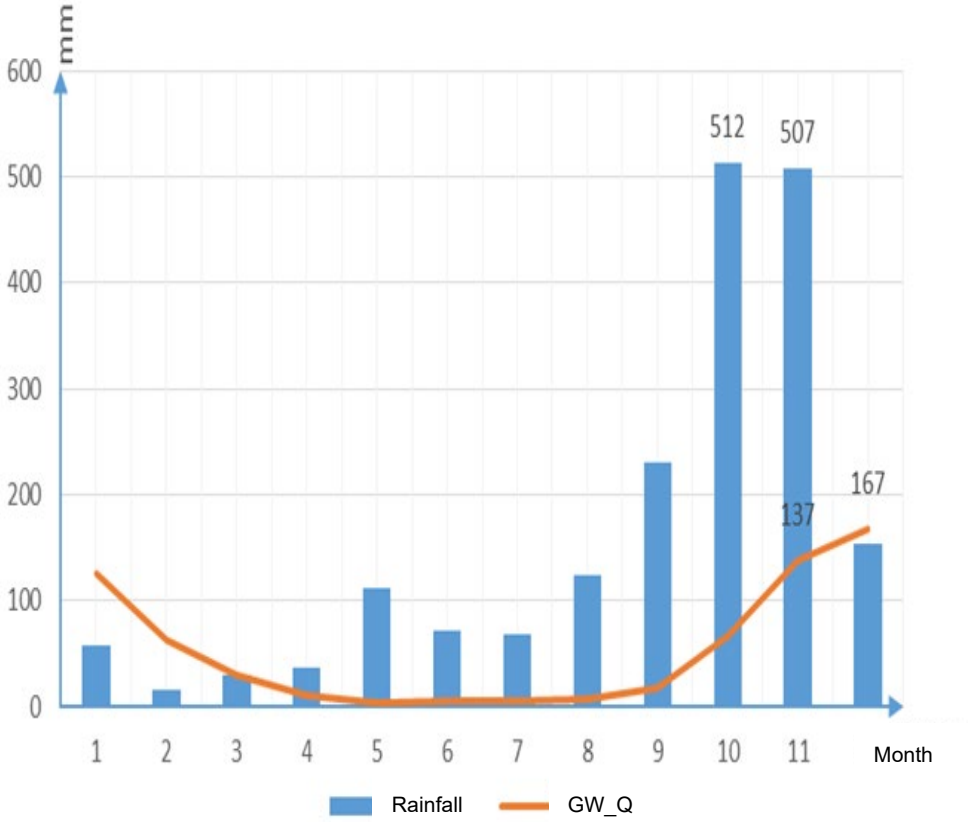
GW_Q

- High variation (SD = 154 mm)

Monthly

- High value: Oct. - Jan.
- Low value: Feb. – ending of dry season





4) Conclusions and Recommendations

What were the main findings of this study?

Actual evapotranspiration mainly depended on land use.
Soil moisture has been altered by soil texture.
Percolation to shallow aquifer varied inversely with the impervious surface and directly with rainfall.
Surface flow positively correlated with both the impervious surface and rainfall.
Base flow, high values occurred in perennial industrial crop areas while small values occurred in residential land with a time lag of more than one month compared to the rainy season.

These findings were expected to provide **a reference for water resource management and planning** in La Vi catchment as well as other similar basins in Vietnam.

What is research orientation?

Model calibration and validation (using ET data from MODIS satellite imagery/ crop yield).
Assessing the impact of land use change, climate change on water balance components.

Thank you for your attention!

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