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NSFC

Runoff Change and its Adaptive Management
In the Major Rivers in Southwestern China
Major Research Plan, National Natural Science Foundation of China
The fostering project No. 91647111 and Key Project No. 91647203

Geochemical and Isotope Tracers Reveal the Runoff Components Characteristics and the Ecohydrologic Influences at the Qinghai-Tibet Plateau

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Outline

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3. Study Area
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6. Results & Discussion
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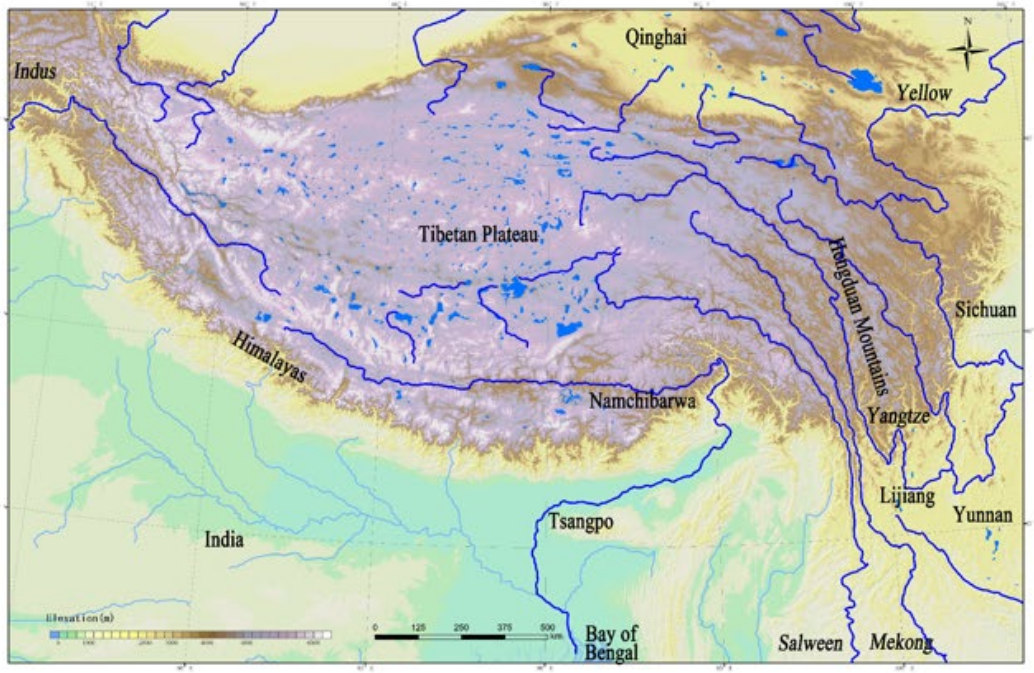
1. Background

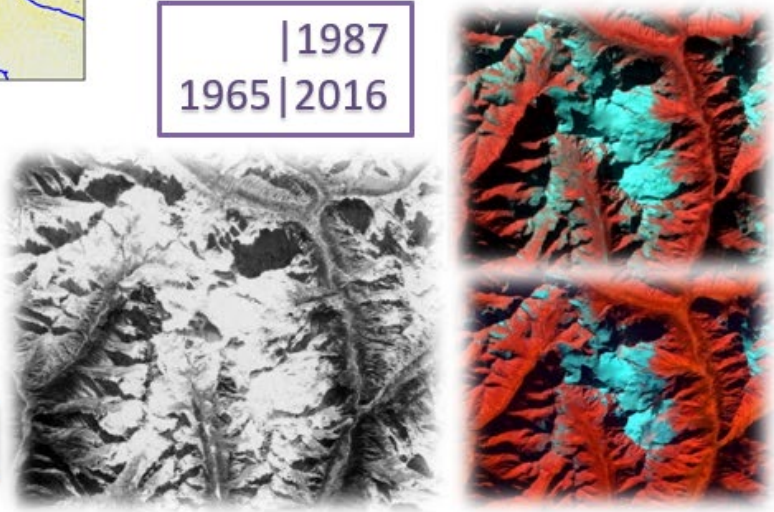


The Qinghai-Tibet plateau is the source of many large rivers in Asia

- Yangtze River
- Yellow River
- Yalung Zangbo River (Brahmaputra River)
- Lancang River
- Nu River
- Indus River

- climate change sensitive
- glaciers retreated
- snow line rised

Runoff is changing, and the trend is unknown



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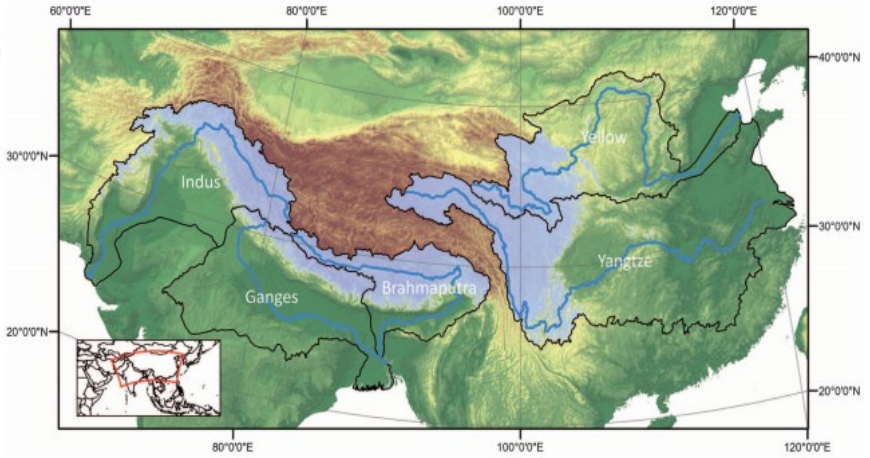
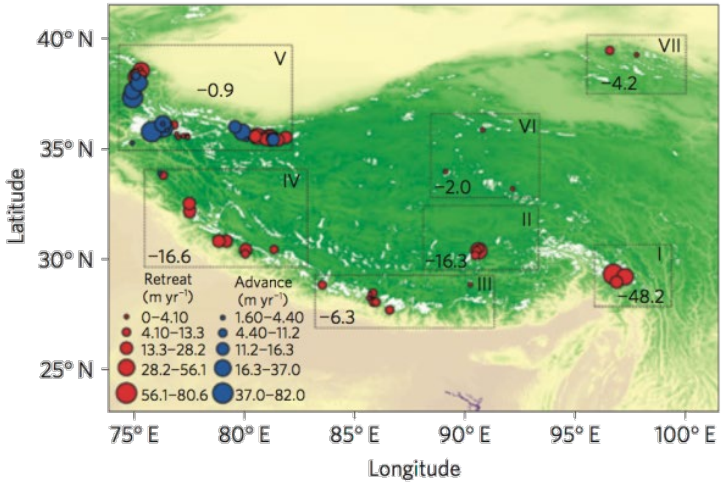
1. Background

- Hight Elevation & Mountainous
- Low Pressure & Temperature
- Few Monitoring station & data
- Difficult to travel & Sampling





- Supply 20%+ runoff of Yangtze River
- Supply 40%+ runoff of Yellow River
- Lancang River
- Nu River
- Yalung Zangbo River

Flow out 500 billion m^3/a

WATER TOWER OF ASIA

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2. Objectives

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Major Research Plan
National Natural Science Foundation of China

Tring to find out

Where is the water from?
What kinds of paths the water goes through?
How to estimate the amount of water from differents sources?
What indicators can reflect the runoff souce efficiently?
How the indicators and runoff change by time and spatial?

Funded by NSFC, No. 91647203
Multi-scale monitoring of hydrological processes in the Yarlung Zangbo River Basin

Funded by NSFC, No. 916471111
Experiment Study on Runoff Components Analysis in Niyang River Watershed Based on the Geochemical Indicative Tracing Factors

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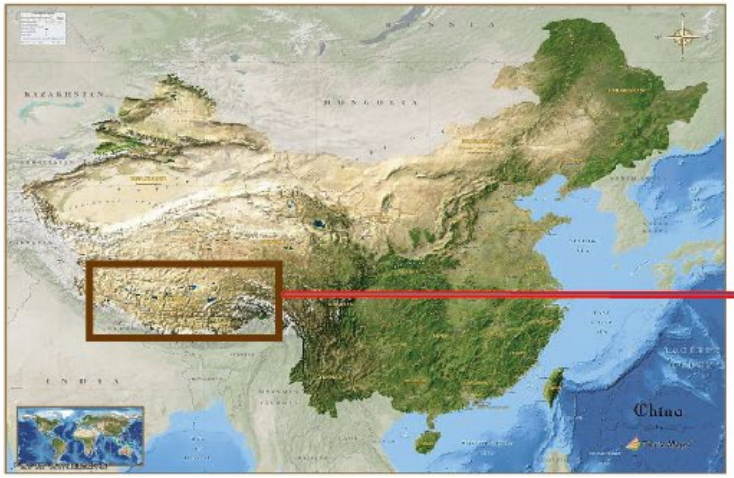
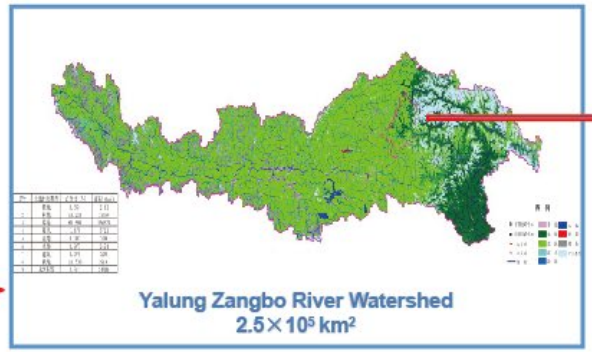
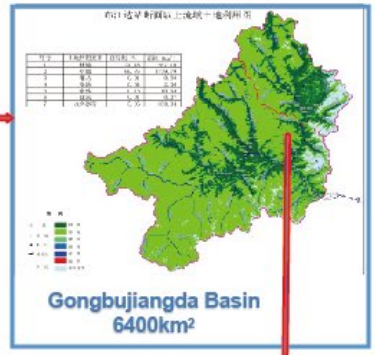
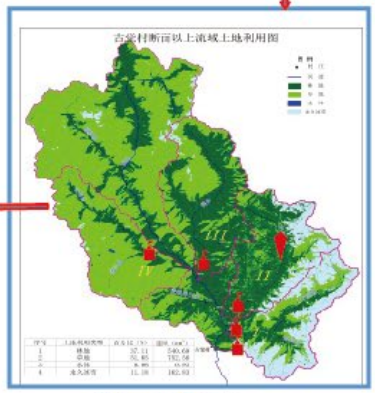
3. Study Area



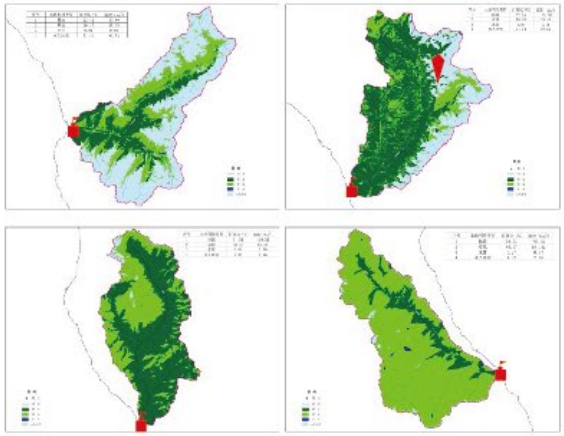






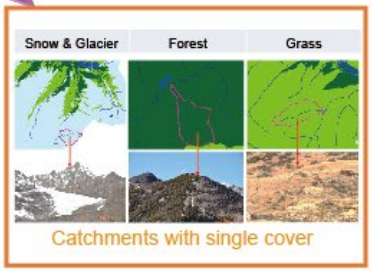
I Burulangqu Creek
182km²
snow & glacier 51.4%

II Yimenlangqu Creek
216km²
forest 57.35%
snow & glacier 24.34%



III Chuqu Creek
243km²
Forest 61.54%
Grass 36.46%

IV Jinnongqu Creek
213km²
Grass 85.17%



outlet of a basin with monitoring equipment
glacier observed

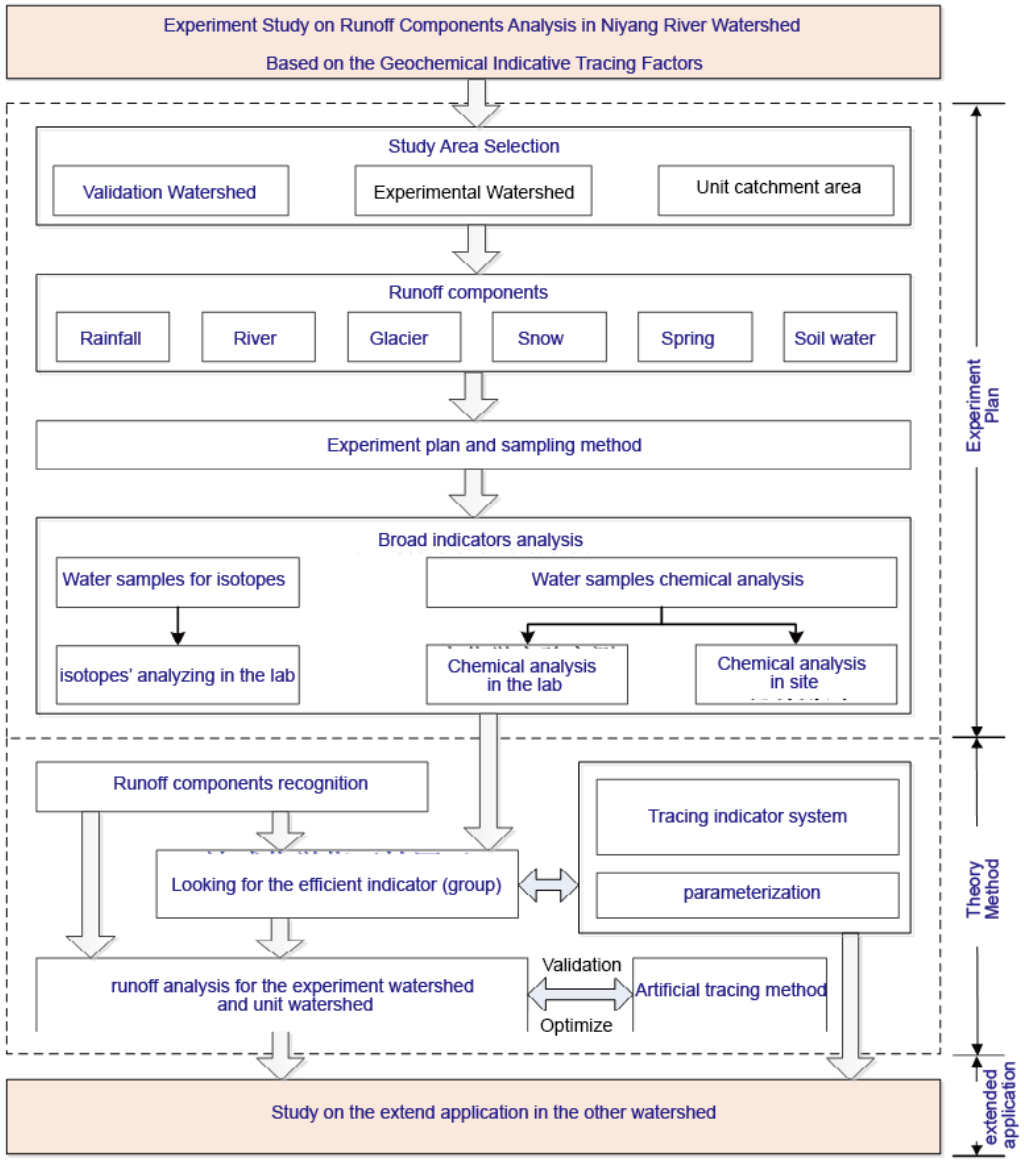
The study area locates in the Niyang River Watershed, which is a tributary of the Yalung Zangbu River. The interest region of Gujuecun Basin is in the Gongbujiangda country belongs to the Tibet autonomous region, with the elevation between 3667 - 6140 m. In the experimental area, the forest, grassland, temperate glacier are the main landuse types (as shown in the following table). Studies shows that the temperate glacier are affected by the climate change strongly, and glaciers here have a tendency to shrink.

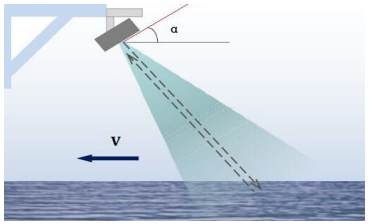
Watershed scale	Watershed name	Area (km²)	Major land types and proportions (%)		
			forest	Grassland	Ice and snow
Application watershed	Yarlung Zangbo	253000	13.21	61.98	9.81
Verification Basin	Gongbujiangda	6400	24.48	69.35	5.95
Experimental Watershed	Burulangqu	182	22.42	26.18	51.40
	Yimenlangqu	216	57.35	18.25	24.34
	Chuqu	243	61.54	36.46	1.95
	Jinnongqu	213	11.54	85.17	1.02
	Gujuecun	1547	37.11	51.65	11.18

3. Study Area

Study Area
3500m
~
6000m+
Gonbujiangda
~3400m
Linzhi City
2900m
比如县
嘉黎县
林周县
墨竹工卡县
拉萨
达孜县
G318
G4218
工布江达县
巴宜区
波密县
墨脱县
米林县
加查县
朗县
曲松县
隆子县

4. Methods





Flow velocity meters

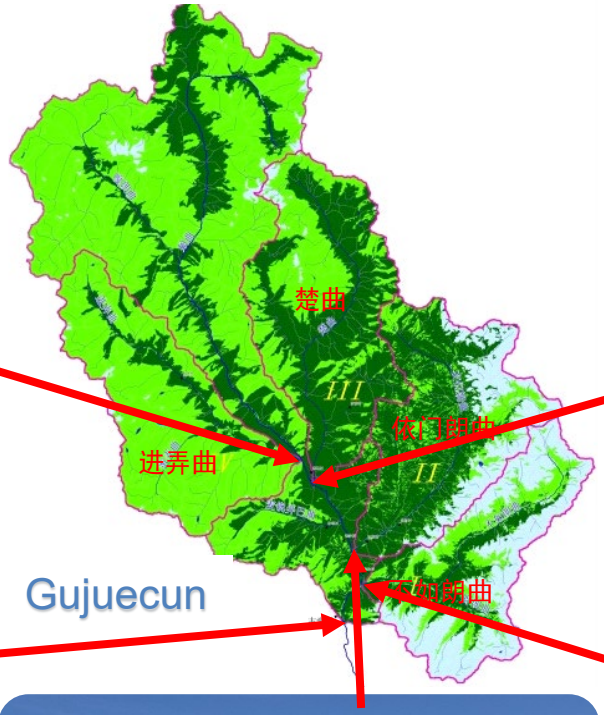
Satellite based obs.

Radar water level gauges

Sampling

4. Methods

The outlet section in Jinnongqu



The outlet section in Chuqu

The section in Gujuecun

The outlet section in Burulangqu

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4. Methods

Observed Objects

rainfall, snow, river, vegetation, soil, glacier, and spring

Monitoring and Sampling Method

Object	Method
Precipitation	Monitoring: tipping-bucket raingauge and snowmelt raingauge
River water	(a) Monitoring: radar level gauges on the outlets of the basins (b) Sampling: (1)sampling in the watershed every 5m×5m grid (2)SVR current meter on the outlets of the basins
Spring water	Sampling: sampling the fissure water each point
Soil water	Sampling: sampling in the watershed every 5m×5m grid
Snow cover	Sampling: sampling in the watershed every 5m×5m grid (if exist)
Glacier	Sampling: (1)sampling the water flows out the glacier (2)sampling the water in the glacier
Vegetation	Sampling: take the stems in the watershed every 5m×5m grid

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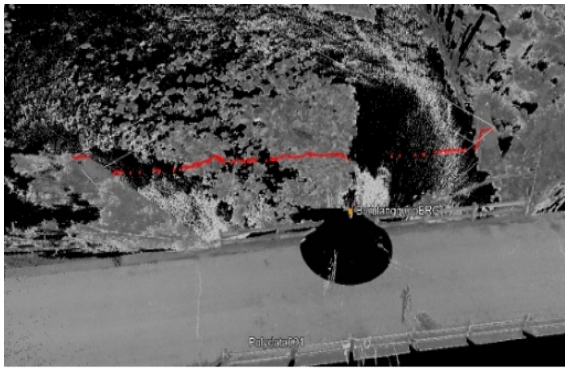
5. Moniter and Sampling

- Scaning the terrain data with 3D laser scaner (LiDar)
- GCP elevation survey with RTK and Leica total station
- Portable ultrasonic sounder Water depth meter



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5. Moniter and Sampling

Brulangqu

Yimenlangqu

Jinnongqu

Gujuecun

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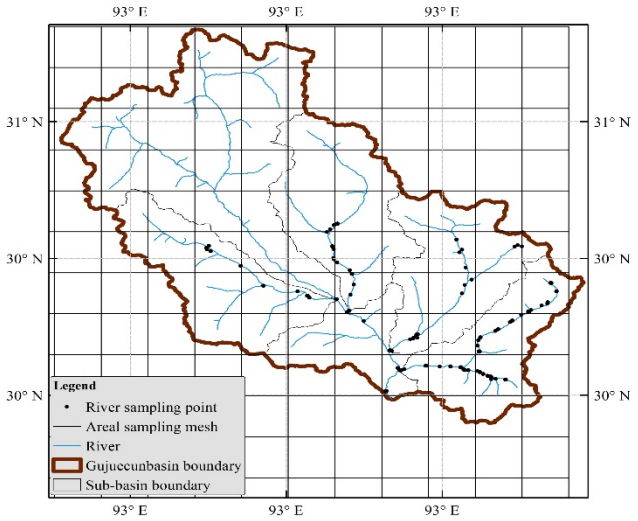
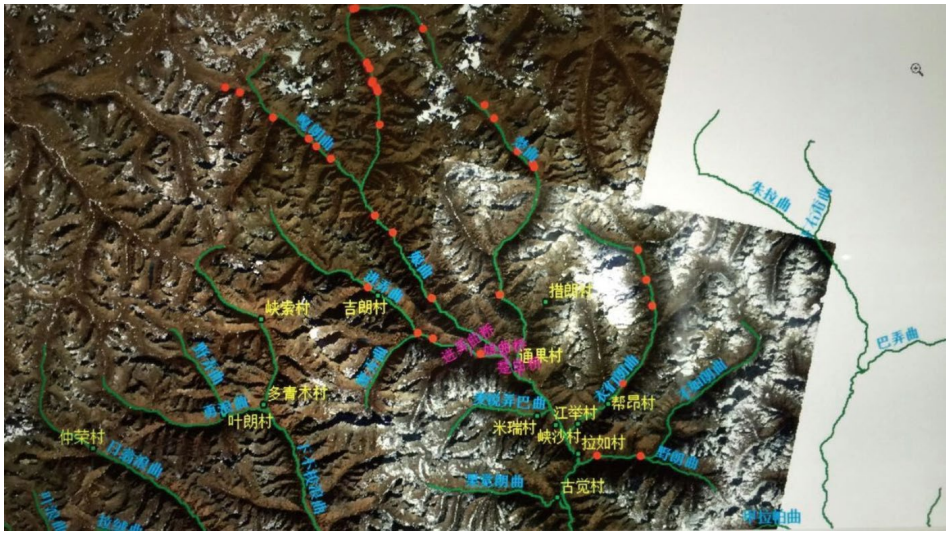
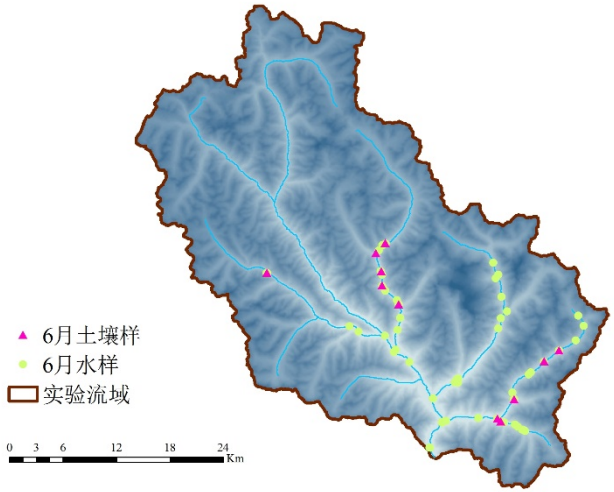
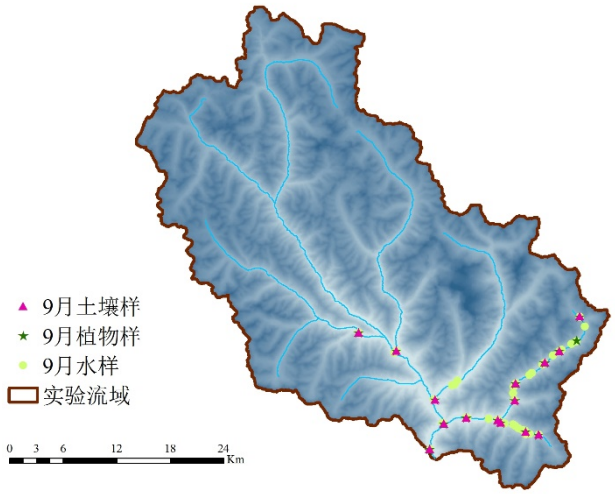
5. Moniter and Sampling

5. Moniter and Sampling









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5. Moniter and Sampling

Sampling points in the Yimenlangqu Creek and Burulangqu creek

Measuring in site

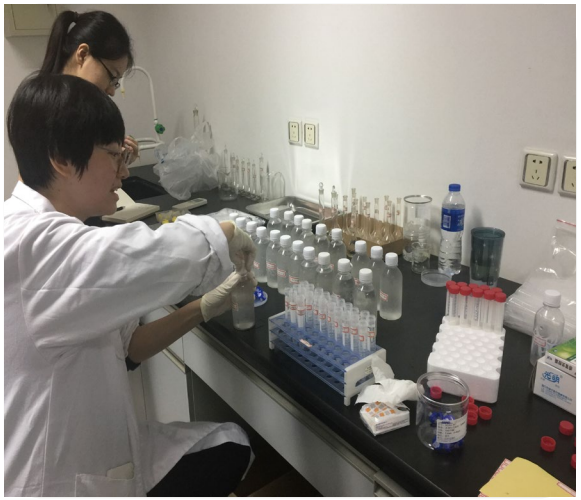
River water sampling

Trees' stems sampling

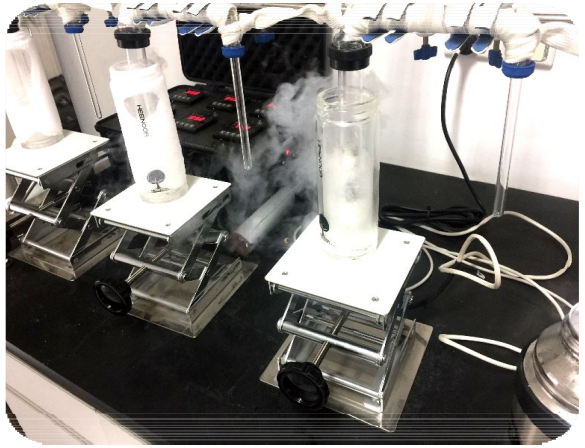
Soil sampling

Spring water sampling

Glacier sampling



Water samples Analysis



Stems & Soil samples Analysis

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5. Moniter and Sampling

LGR
Liquid isotope analyzer for the D and ^{18}O

ISOPRIME 100
Isotope Ratio Mass Spectrometer for the ^{15}N、^{13}C、^{34}S

ICP-OEC, ICS-2100
ICP and ion chromatograph geochemical ions' analyzing

Analysis Objects

Water physical parameters、ions、stable isotopes

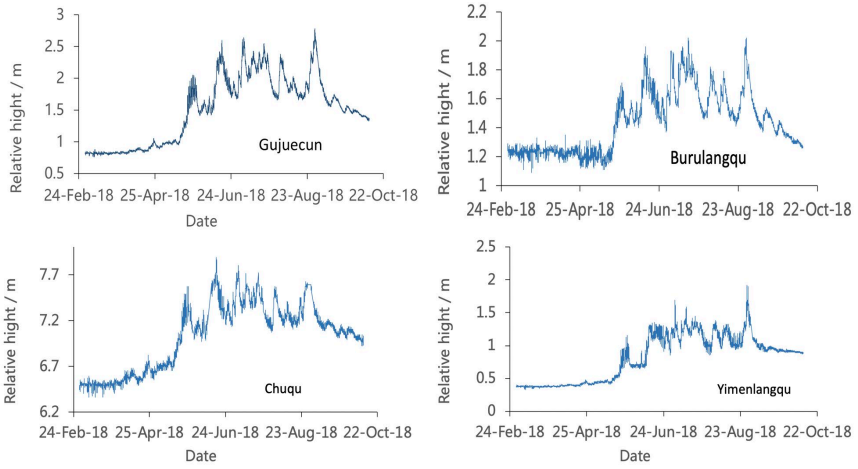
Analysis Methods

Analysis items	Method
^{18}O and ^{2}H	Liquid water isotope analyzer (LGR and Picarro)

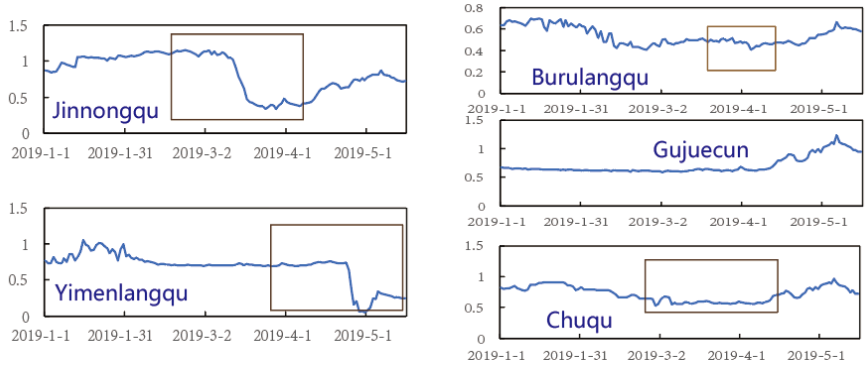
Analysis items	Method
pH、DO、EC、T	Portable instruments (in site measuring)
F^-、Cl^-、NO_3^-、SO_4^{2-}、Br^-、PO_4^{3-}	ICS-2100
K^+、Na^+、Ca^{2+}、Mg^{2+}等	ICP-OEC

6. Results & Discussion

6.1 Hydrological Characteristics



Waterlevel process in 2018



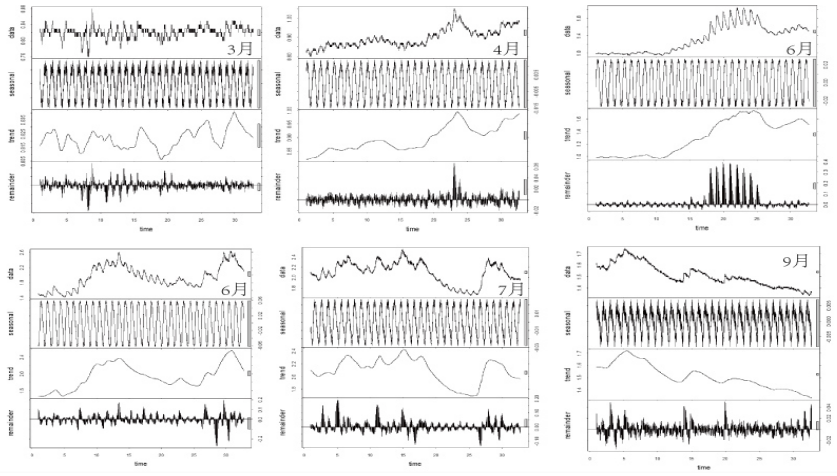
Ice block in river sections

- March and April, the baseflow increase steadily without direct runoff from the rainfall, which implies the baseflow significantly controlled by the temperature.
- The runoff in this period should be from the melting ice, snow and the frozen earth.
- When it gets warm after late April, the rainfall starts to generate runoff, which make the different levels of steep peaks and gradual peaks appear.
- Until mid-late September, there were no more flood peaks, and it gradually fell into the dry season

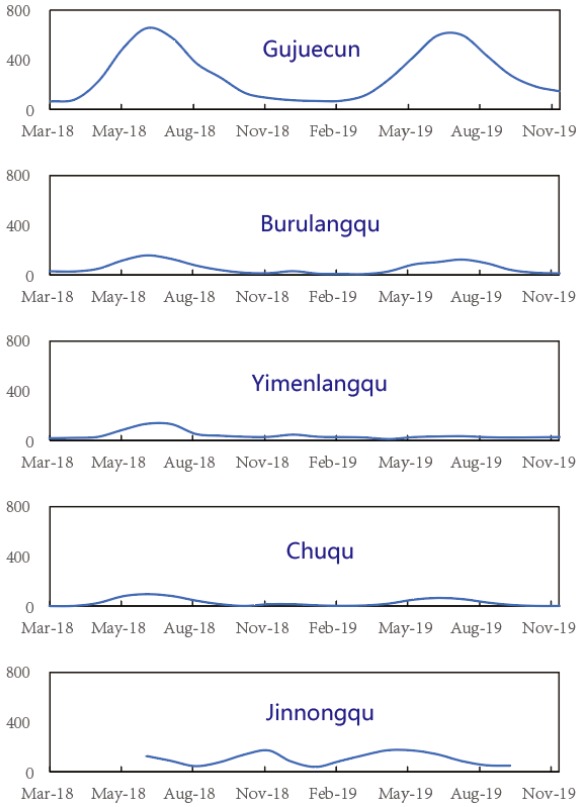
6. Results & Discussion

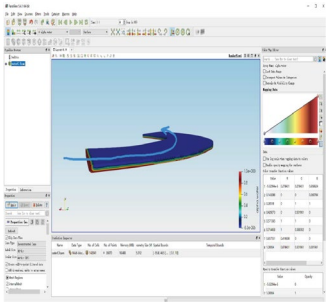
6.1 Hydrological Characteristics

Water level time series decomposition at Gujuecun



- a significant daily periodic change with a daily cycle of rising and falling fluctuations corresponding to the daily temperature changes, which should be formed by the snow and ice melting.
- summer rain-runoff generate and converges rapidly
- the rapid surface runoff flows to the outlet generally in 10 days, (late April, late May, and late July);
- continuous summer rainfall resulting in multiple floods superimposed which can last for more than 20 days, (mid-late June and late August).

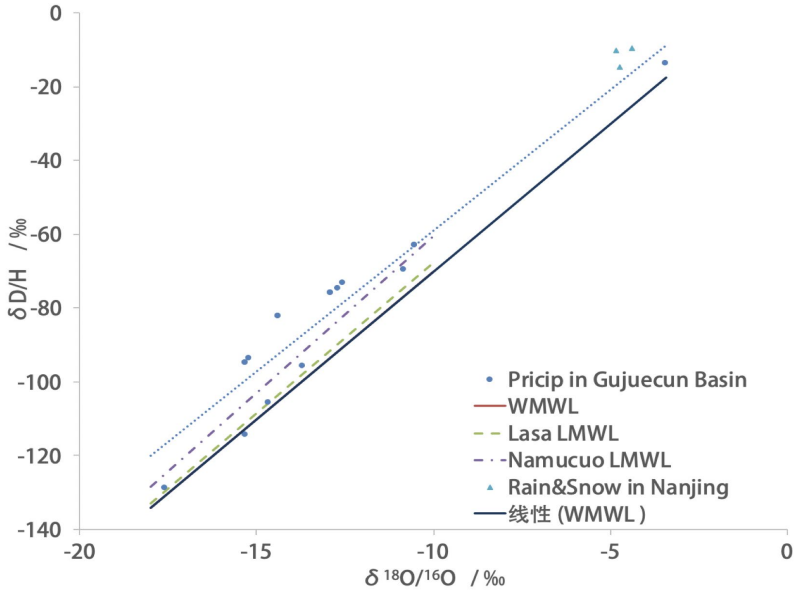




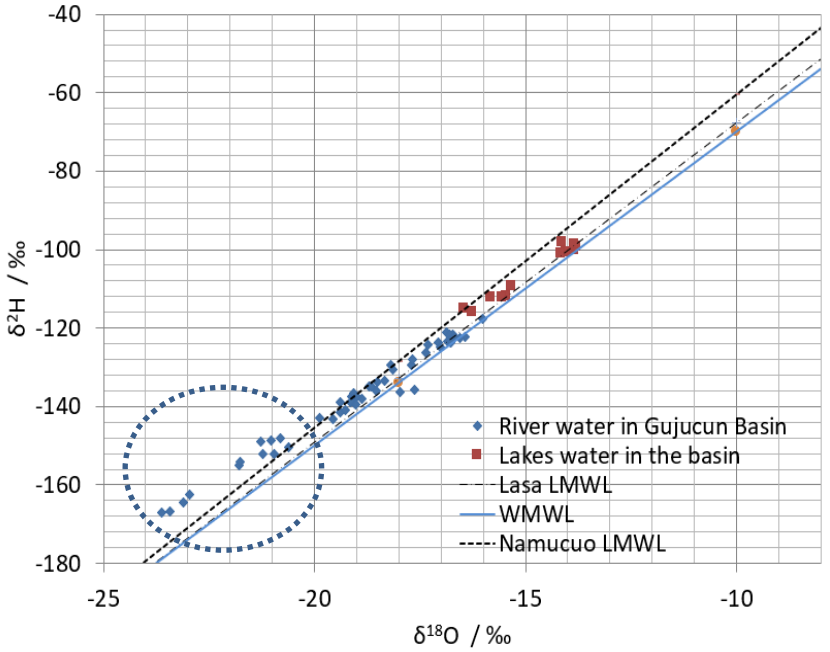
Discharges are estimated with a hydrodynamic model

6. Results & Discussion

6.2 δD and $\delta^{18}O$ Isotopes Characteristics

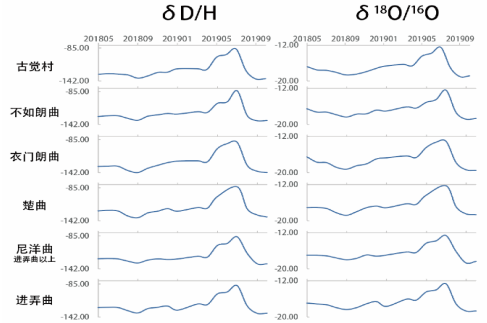


Isotopes of the Precipitation



Isotopes of the surface water

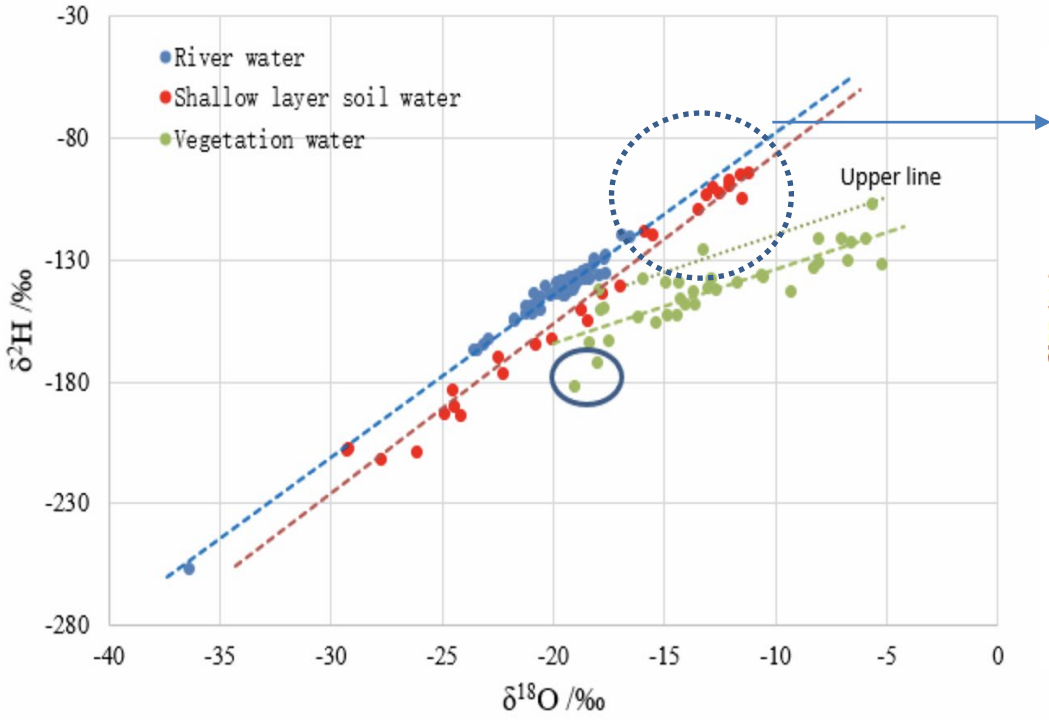
- There are obvious regularities according to the elevation change
- Most Local δD and $\delta^{18}O$ isotope values can meet the LASA's LMWL very well, but different from the NAMUCUO Lake's LMWL
- High altitude points left the 3 lines

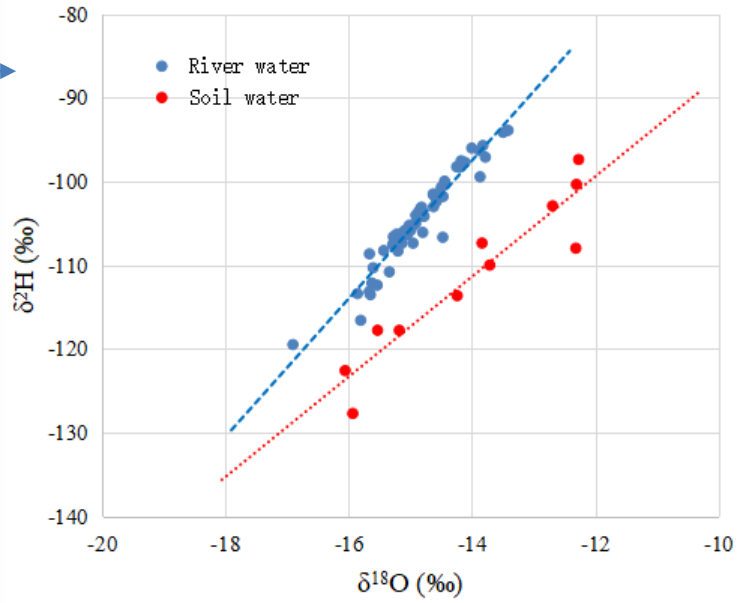


6. Results & Discussion

6.2 δD and $\delta^{18}O$ Isotopes Characteristics

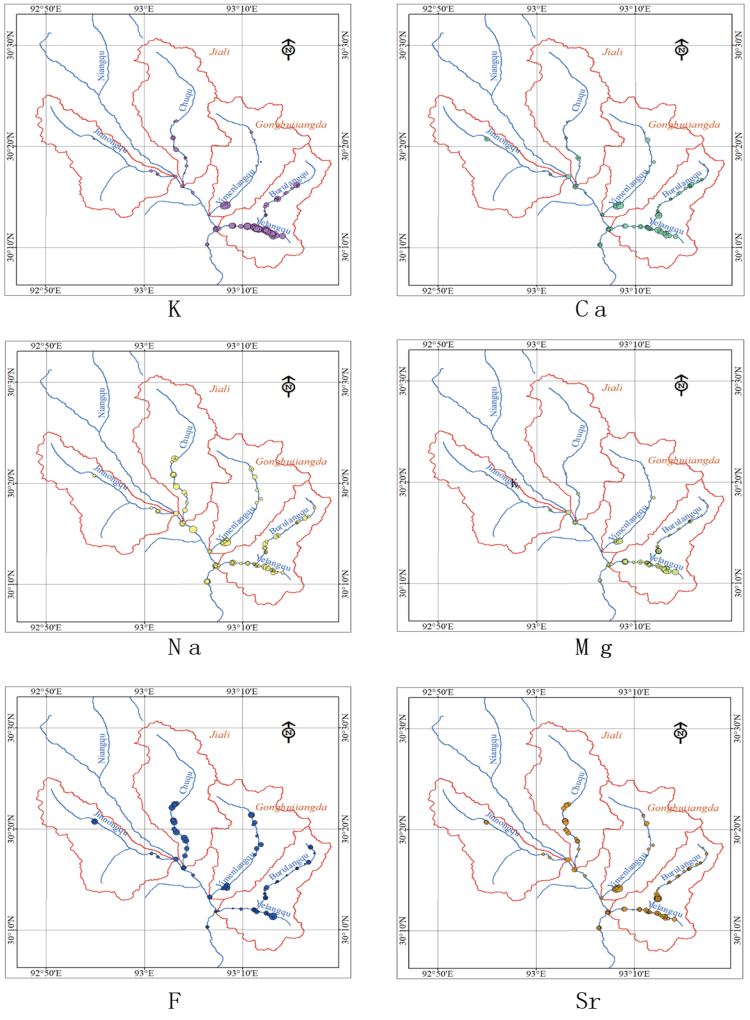
- Most of the vegetation seems comes from the similar water source
  Precipitation / surface runoff
- The points near the upper line and in the lower circle may come from different sources
  Groundwater / fissure water

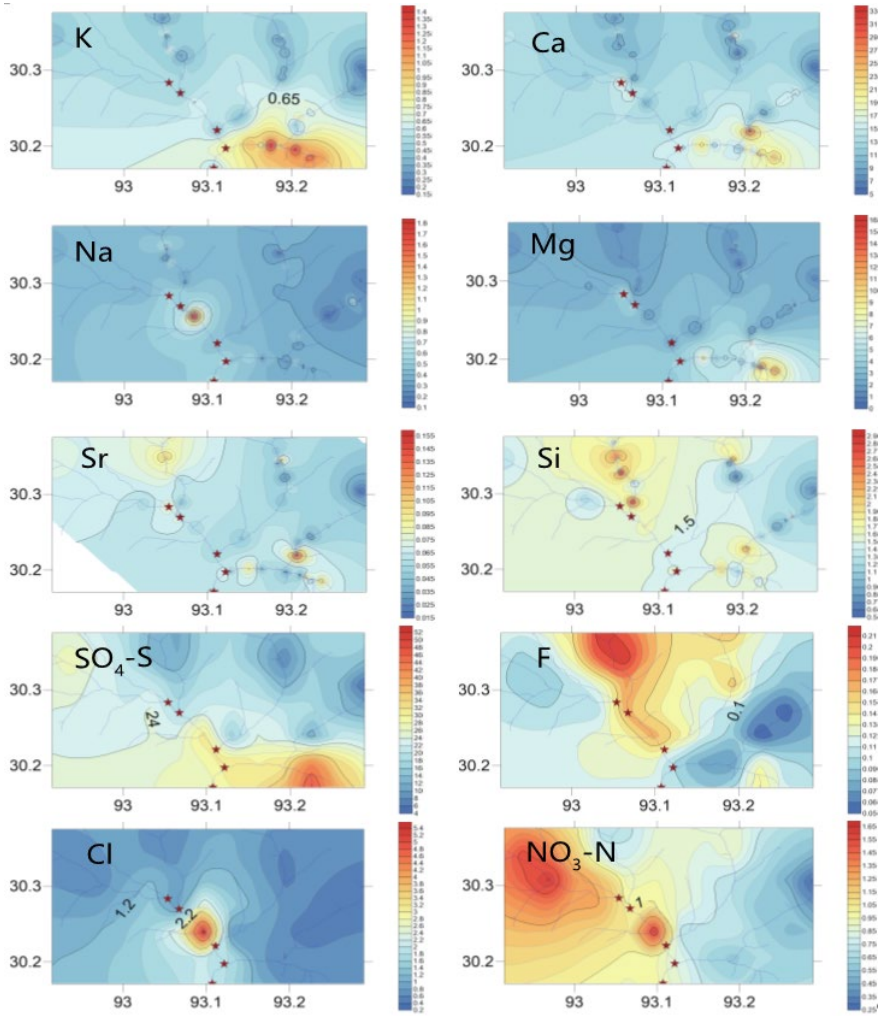




6. Results & Discussion

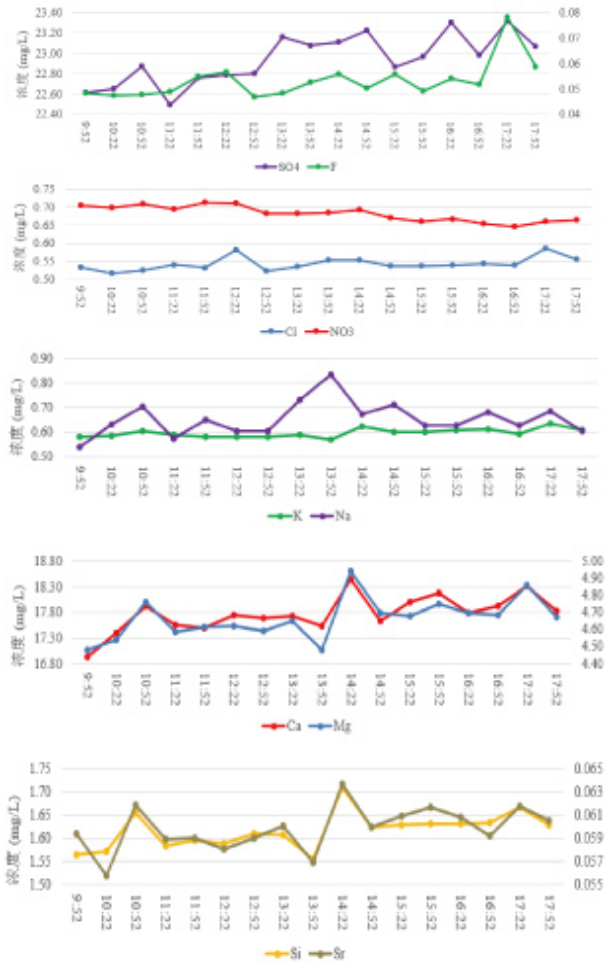
6.3 Geochemical Elements Characteristics



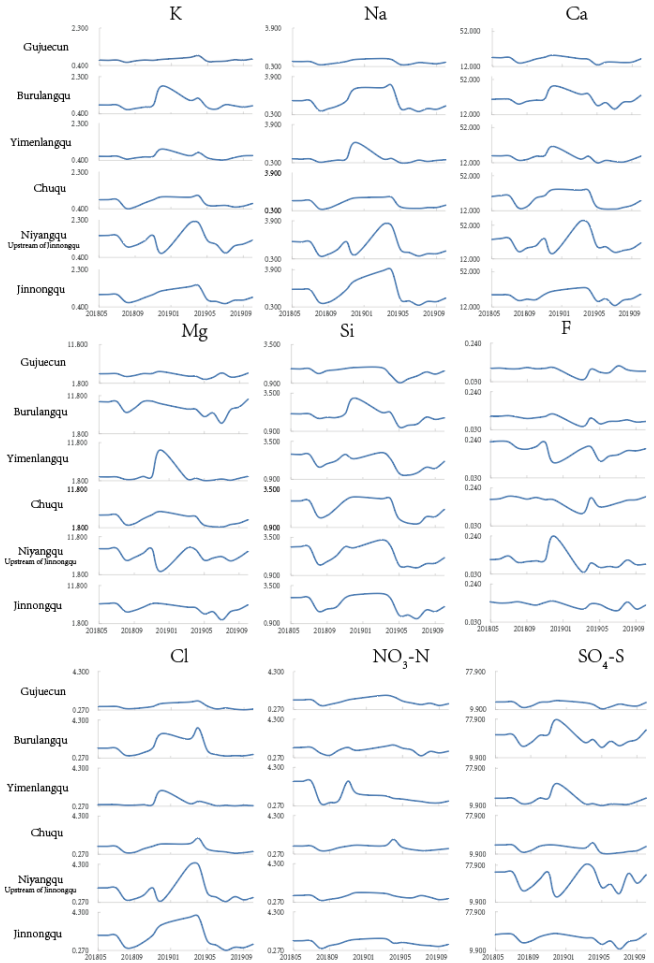


6. Results & Discussion

6.3 Geochemical Elements Characteristics



Daily variation



Monthly variation

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7. Summary

- ✓ The future hydrological cycle and water resources conditions in Qinghai-Tibet Plateau region will be severely challenged by climate change and have a potential significant impact on regional rivers runoff and social-economic development. The adaption strategies must be made based on the ability of the estimation or prediction of the future water resources situation, which highly depend on the knowledge and method of the runoff composition analysis in the region. In this paper, in order to solve this problem, the experimental observation and method research of runoff analysis were launched in the sub-basion of Niyang River Basin.

- ✓ According to the high mountainous and low air pressure environment, automatically experimental gauges were established. Although the automatically instrument could monitor the water level data, but lack of public transition signal and the low guarantee degree of Beidou satellite channel, the received data are not quite complete. The equipment is still adjusting and improving.

- ✓ Survey and sampling are still necessary for the study of the hydrological scheme of the alpine basin lack of observation data. Hydrogen and oxygen isotopes and geochemical elements were examined in the interest basin. Results show that δD and δ18O stable isotopes of the precipitation, river water, lake water was analyzed, and there are obvious regularities according to the elevation change. The steady isotopes show regularities in the stable isotopic composition of the precipitation water and surface water along the river according to the elevation. The river water δD and δ18O generally meet the local meteoric water line nearby, which shows the main source of the runoff is the precipitation and snow. Different geochemical elements indicate the different spatial sources of the runoff water, which could further analyze with the end member algorithm methods later.

- ✓ Vegetation water in the stems must be mainly from the river water and precipitation event most recently. Although the trees seem mainly take use of the similar water sources, but a few observation data also show different sources existence, such as fractured water formed by the multiple precipitation events or supplied by the higher place.

- ✓ More observation and analysis will be done in the coming 3-4, which should help to understand the hydrological and the ecohydrological processes characteristics better in the plateau area. Further quantitative analysis and modeling research is in progress, which is already be involved in the Second Tibetan Plateau Scientific Expedition and Research (STEP) since 2019.

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