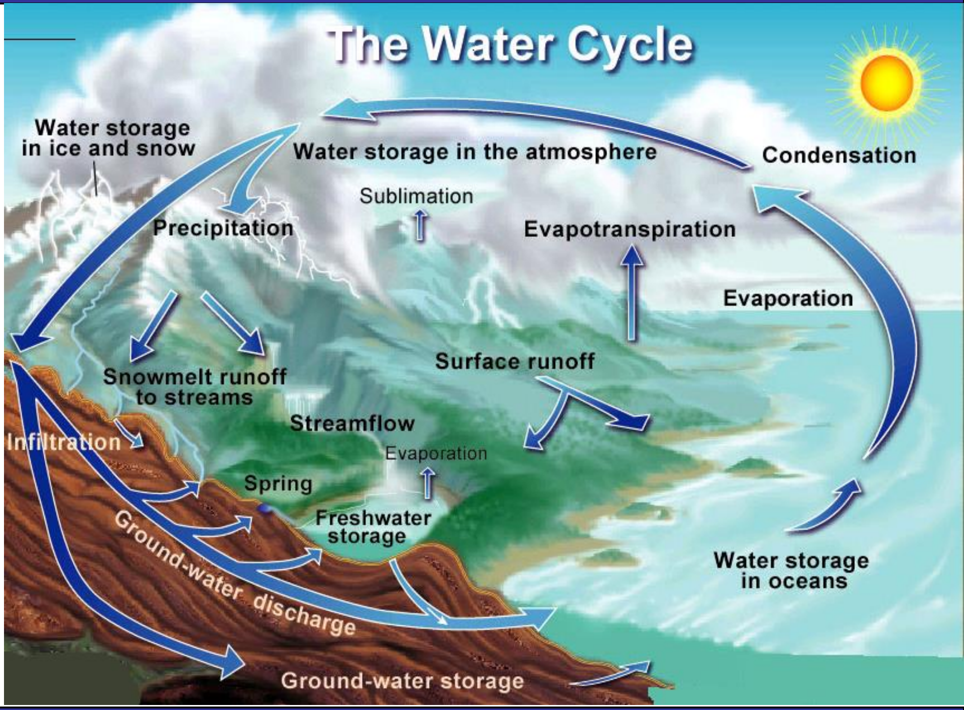
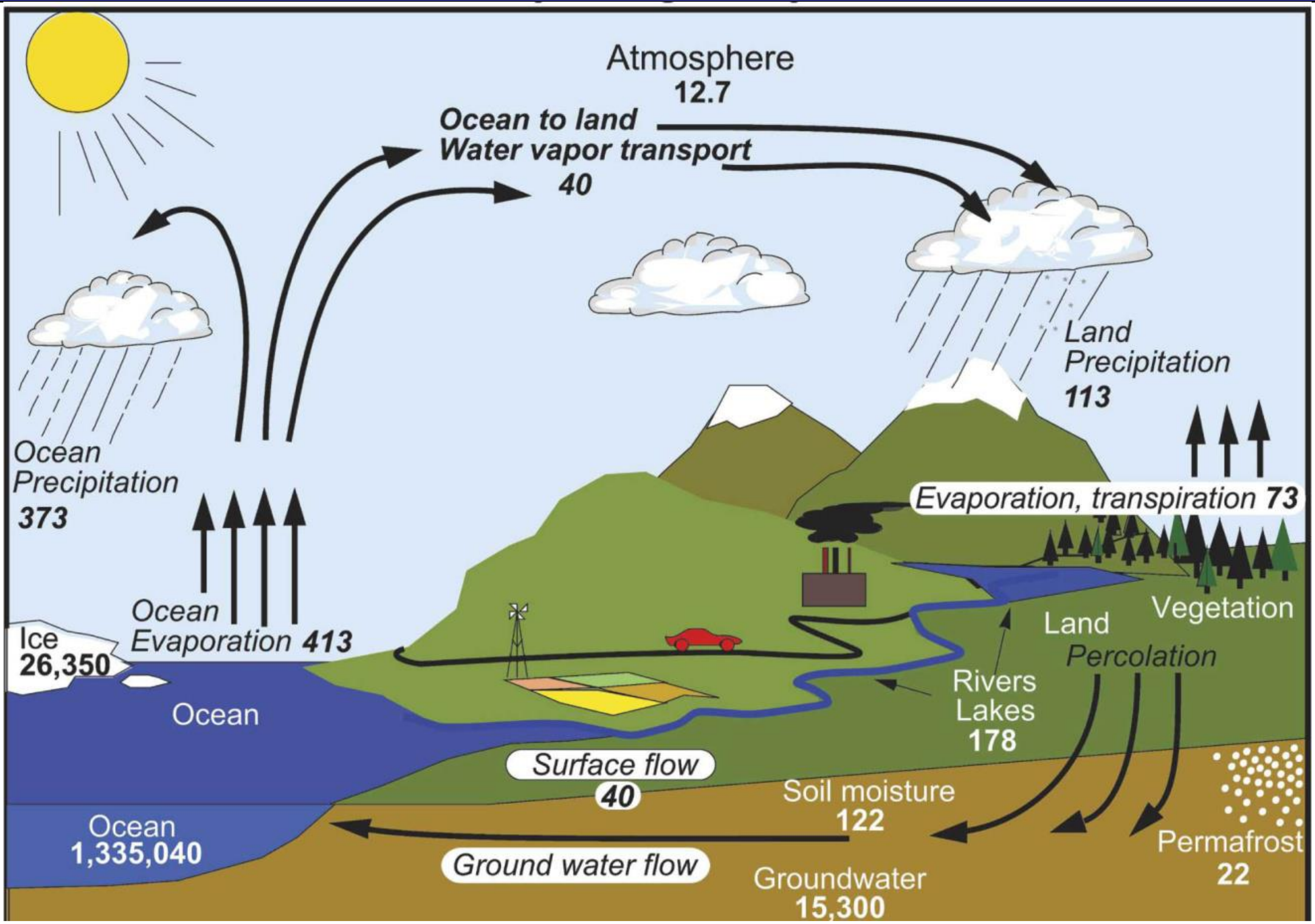
Case Study for Regional Water Cycle

2015-12-10



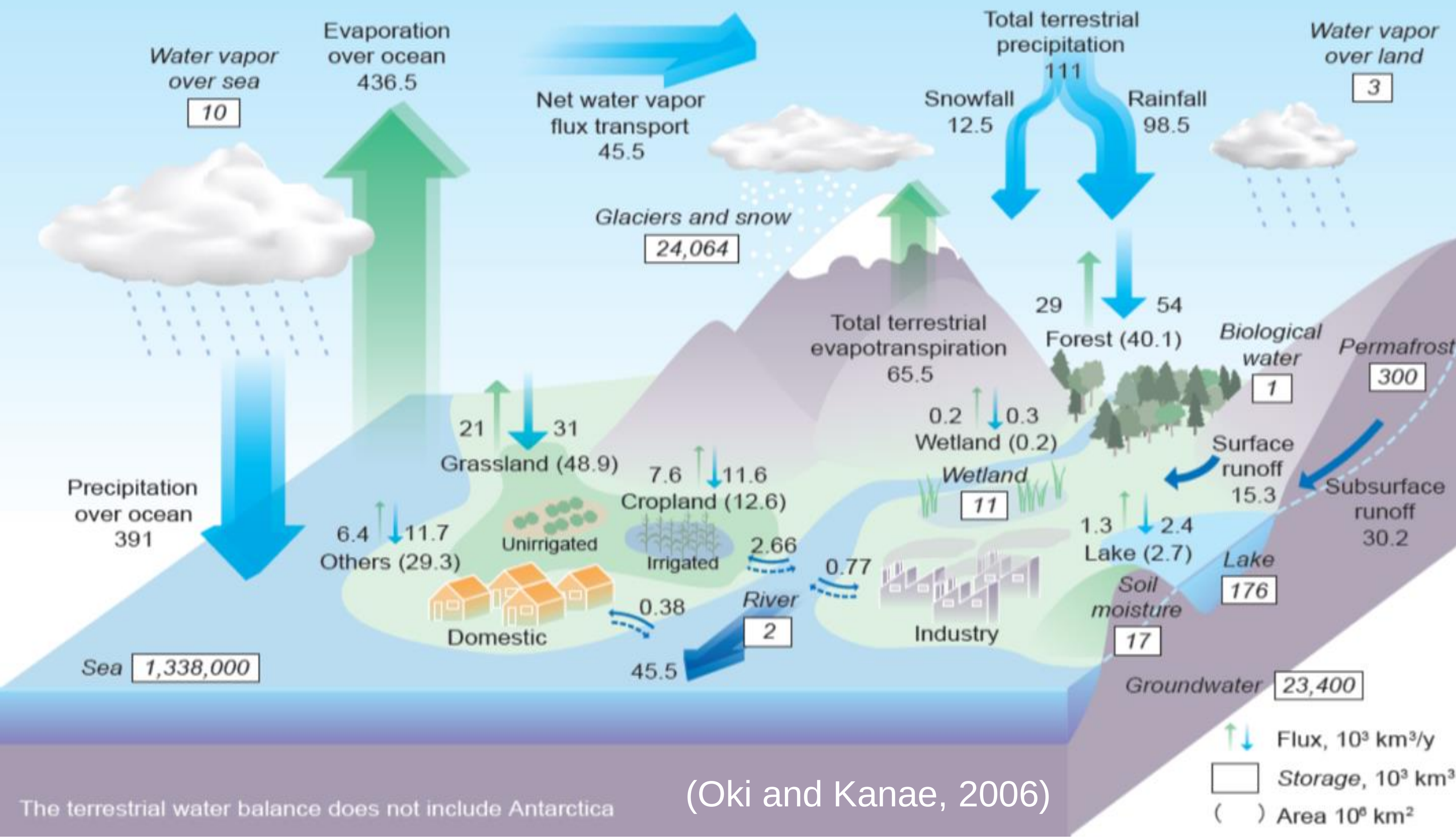
苏 布 达 **Su Buda**

Main phases of water cycle



Trenberth et al (2007）

Main phases of water cycle



(Oki and Kanae, 2006)

Case study

- **Regional water vapor**
- **Regional actual evapo-transpiration**
- **Regional soil moisture**

（1）Atmospheric water vapor

1． ERA-Interim（European centre for medium range weather forecasts)

1）Specific Humidity、U wind, V wind,Geopotential, Surface Pressure
Total Precipitation,Evaporation

2）Spatial resolution: $0.5^{o} \times 0.5^{o}$;
Altitudes: 1000hPa to 1hPa,totally 37 pressure levels;
Temporal resolution: 1979-2013；

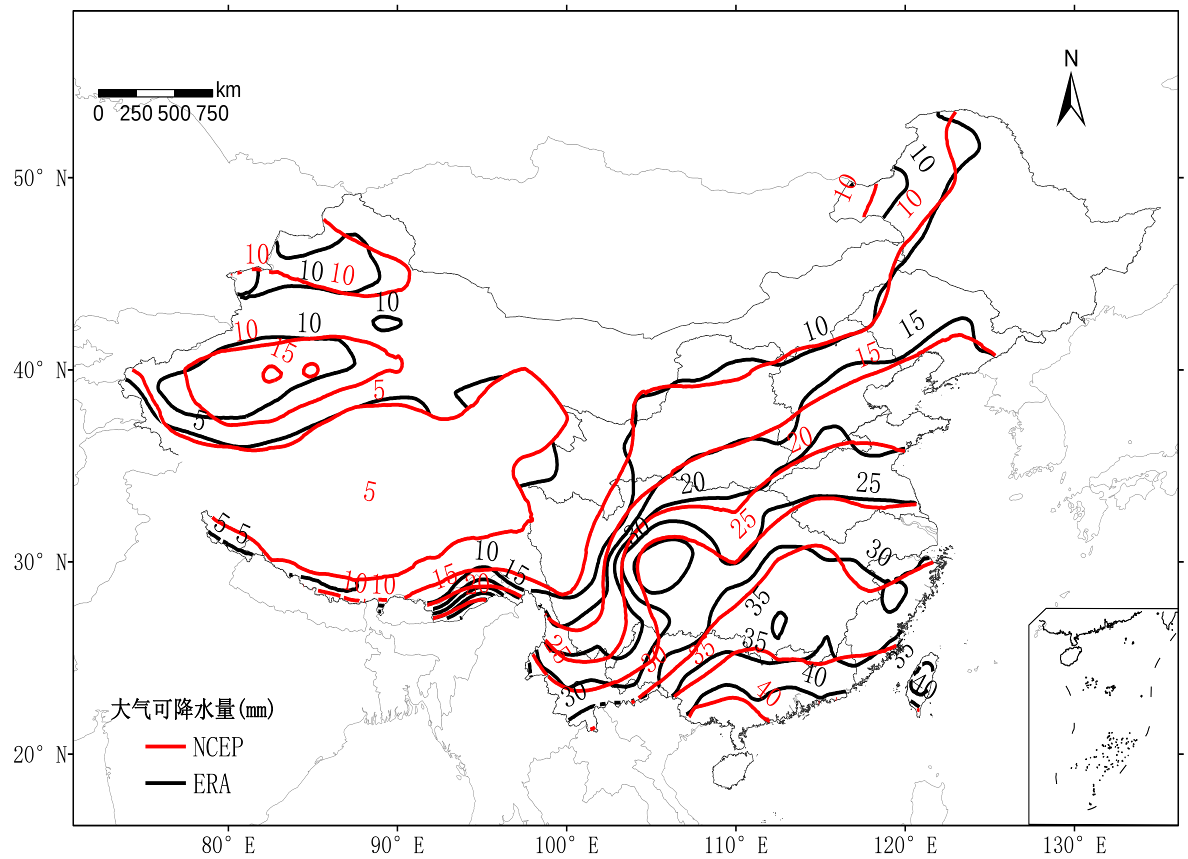
2． NCEP/NCAR（National Centre for Environmental Prediction-National Center for Atmospheric Research）

1） Specific Humidity,U wind, V wind,Geopotential height, pressure

2） Spatial resolution : $2.5^{o} \times 2.5^{o}$，
Uwind,vwind, hgt: 1000-20hPa ,totally 17 pressure levels;
Shum:1000～300hPa , totally 8 pressure levels;
Temporal resolution: 1960-2013

（1）Atmospheric water vapor

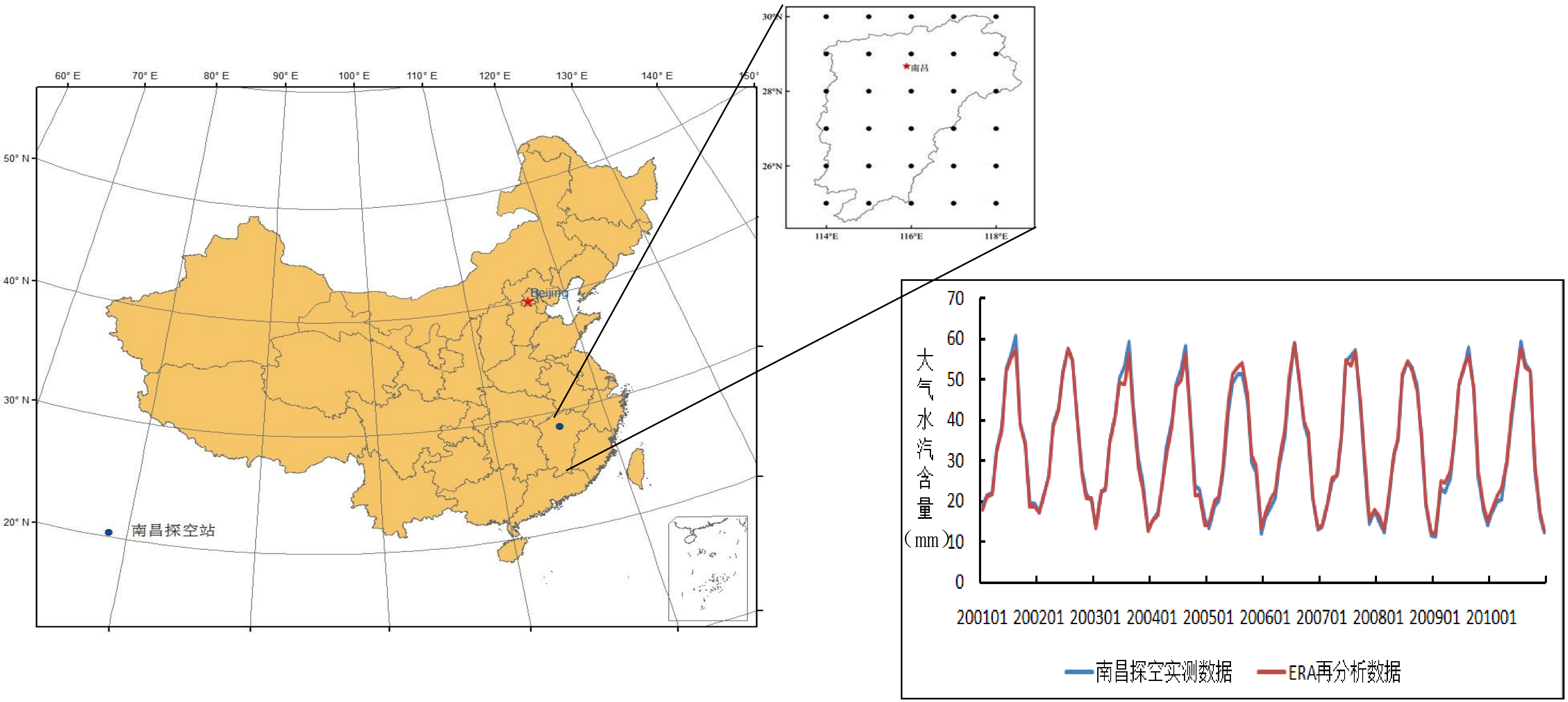
Precipitable water resources



NCEP/NCAR(1980-2013); ERA-Interim (1980-2013)

（1）Atmospheric water vapor

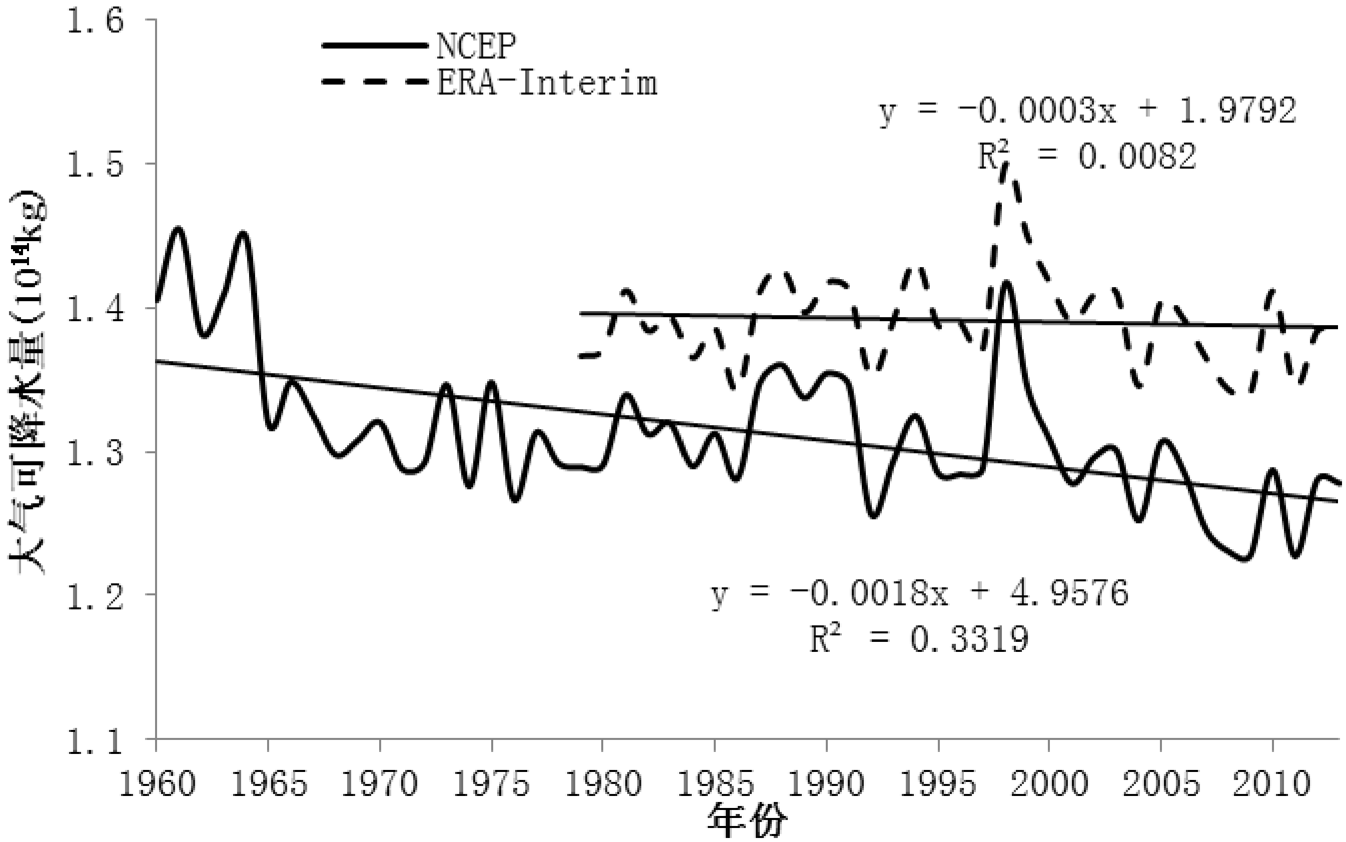
Nanchang （115.89° E，28.68° N）Radiosonde data based monthly water vapor content in the whole atmosphere column



ERA reanalysis and radiosonde data at Nanchang

（1）Atmospheric water vapor

Variation of water vapor over China

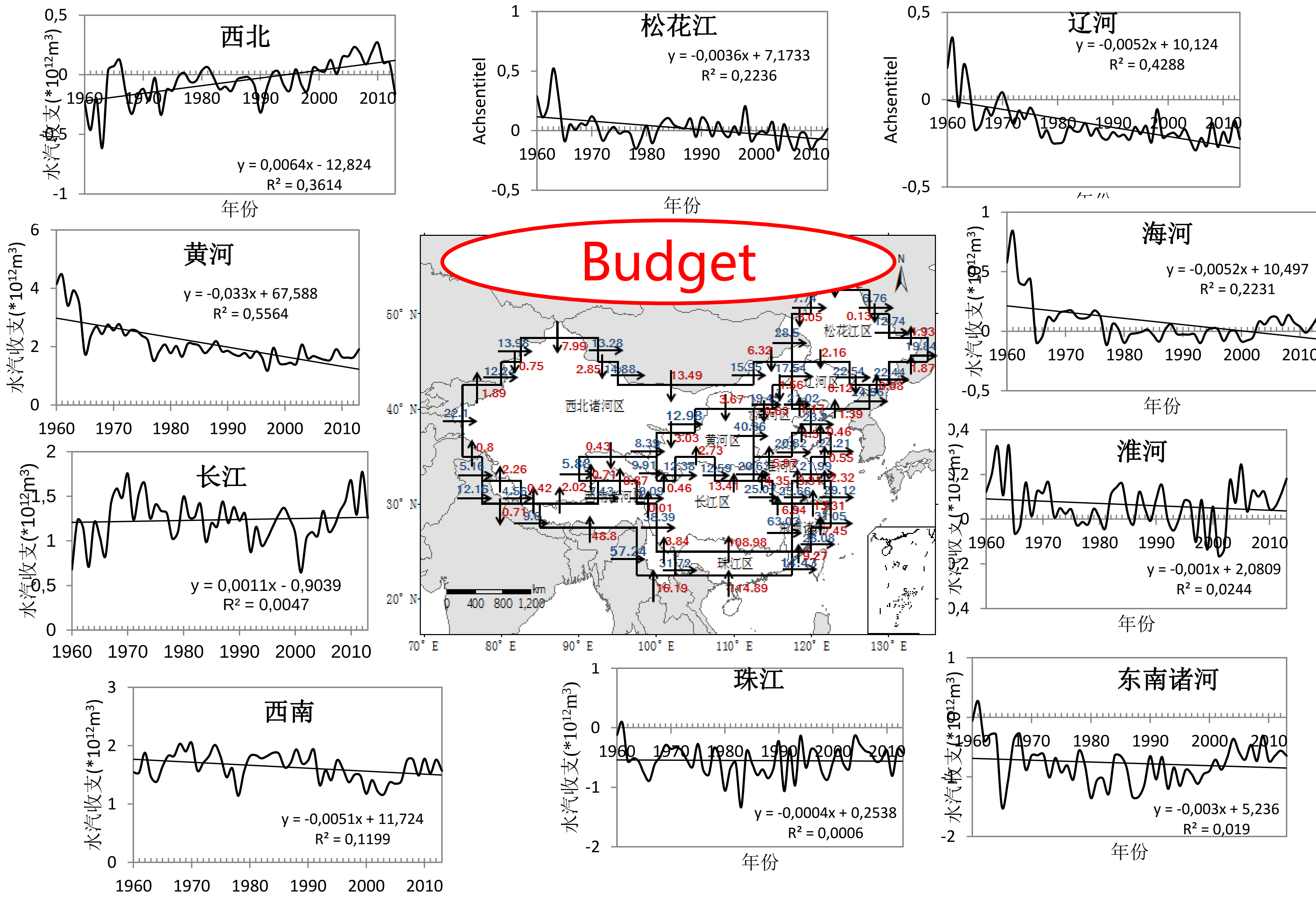


（1）Atmospheric water vapor

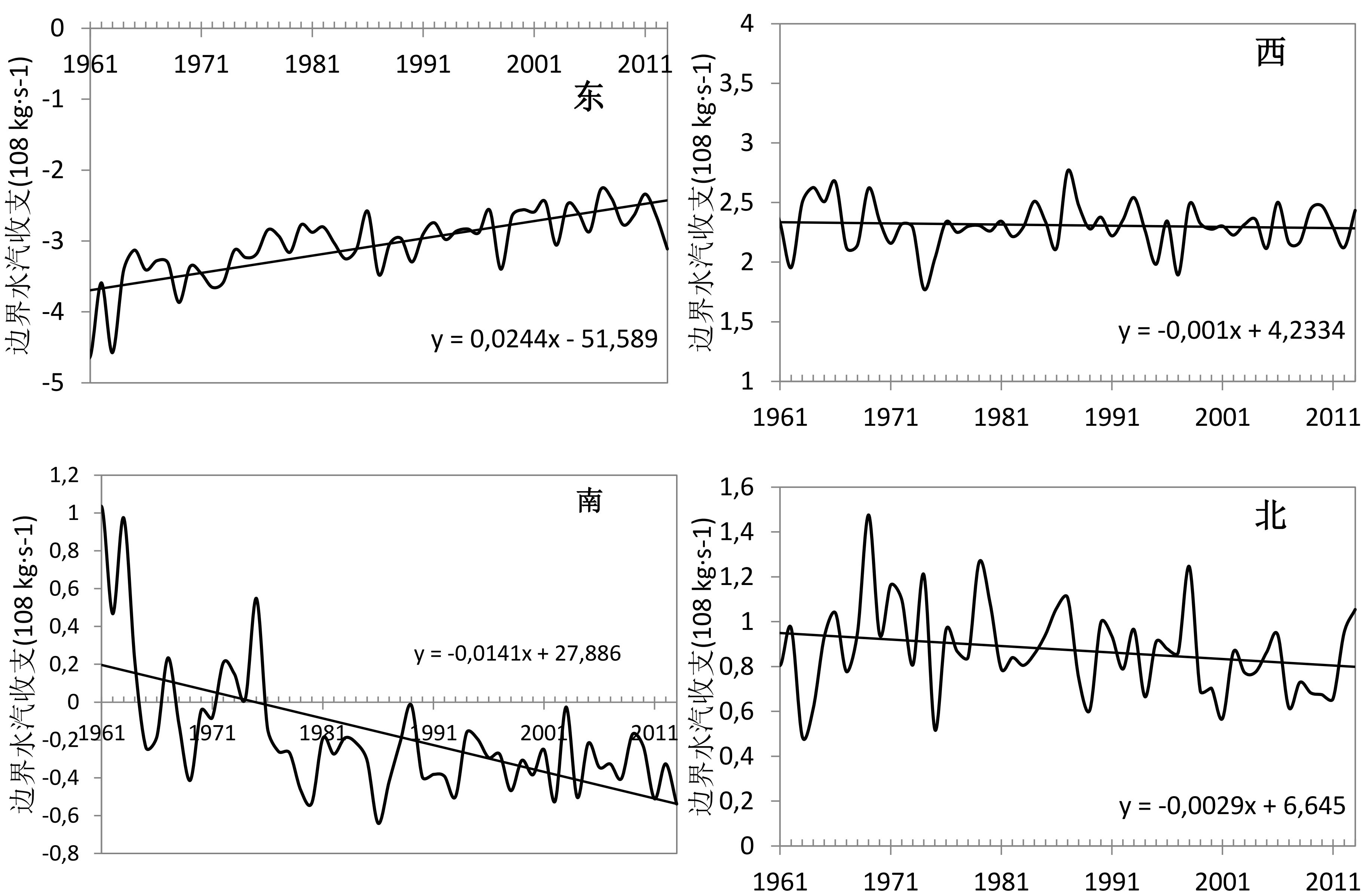
Trends of precipitable water resources over the ten river basins in China

流域	NCEP(1960-2013)	NCEP(1960-1979)	NCEP(1980-2013)	ERA(1980-2013)
长江	-3.92417 ↓	-2.75776 ↓	-4.29909 ↓	-1.36334 ↓
东南诸河	-2.71559 ↓	-0.81111 ↓	-3.55787 ↓	-1.27813 ↓
海河	-5.46101 ↓	-2.88754 ↓	-2.52016 ↓	-0.31243 ↓
淮河	-4.11814 ↓	-2.30354 ↓	-3.23173 ↓	-0.53965 ↓
黄河	-3.99878 ↓	-3.47154 ↓	-1.3935 ↓	1.050906 ↑
辽河	-4.71497 ↓	-3.21198 ↓	-3.20208 ↓	-0.73847 ↓
松花江	-3.014 ↓	-3.27687 ↓	-2.5498 ↓	0.227223 ↑
西北诸河	-1.90986 ↓	-2.82265 ↓	0.504031 ↑	0.426043 ↑
西南诸河	0.149208 ↑	-1.33022 ↓	-0.38544 ↓	1.19292 ↑
珠江	-1.98447 ↓	-1.13555 ↓	-2.99454 ↓	-1.16452 ↓
中国大陆	-4.47624 ↓	-3.47154 ↓	-3.35032 ↓	-0.71007 ↓

Trends of water vapor budget（1960-2013）

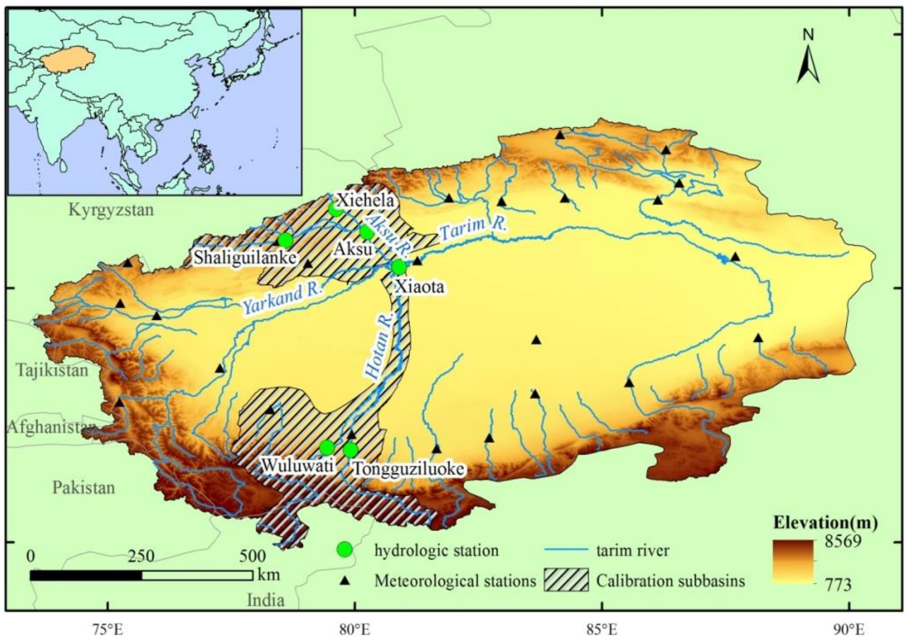


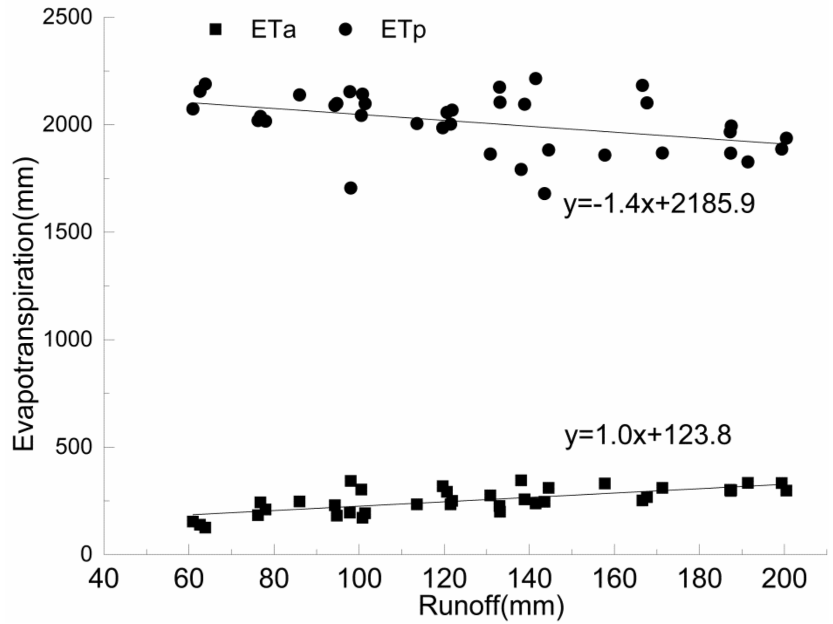
Trends of water budget at the four boundaries in North western river basin（1960-2013）



（2）Actual evapo-transpiration

Complementary theory based evapo-transpiration

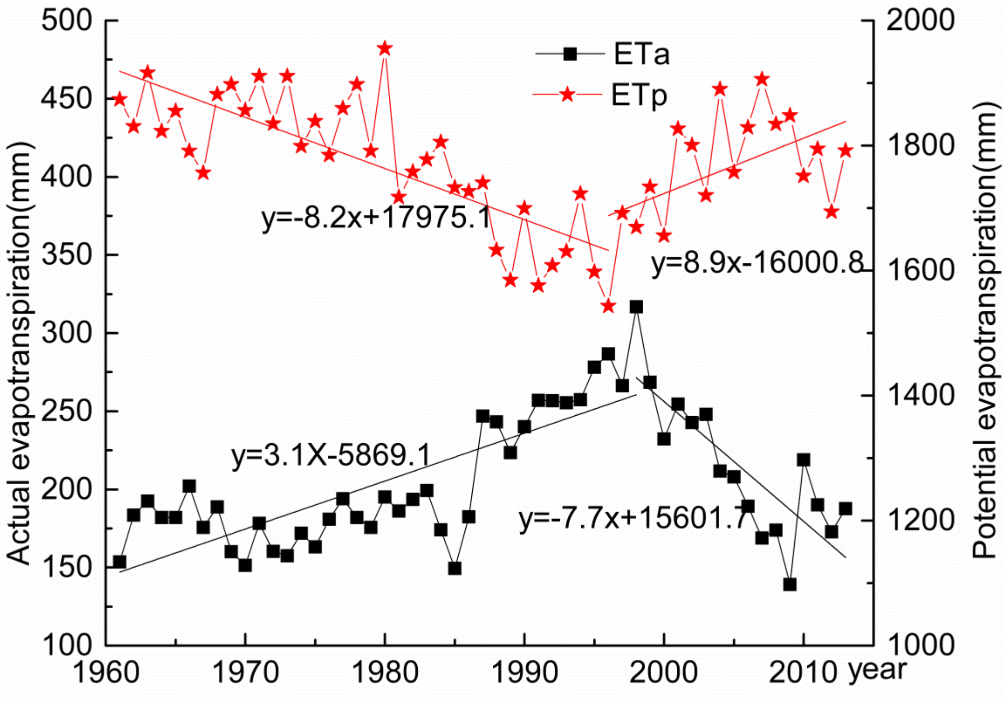




- Based on 1960-2013 several hydrological station’s annual runoff data to calibrate the parameter

（2）Actual evapo-transpiration

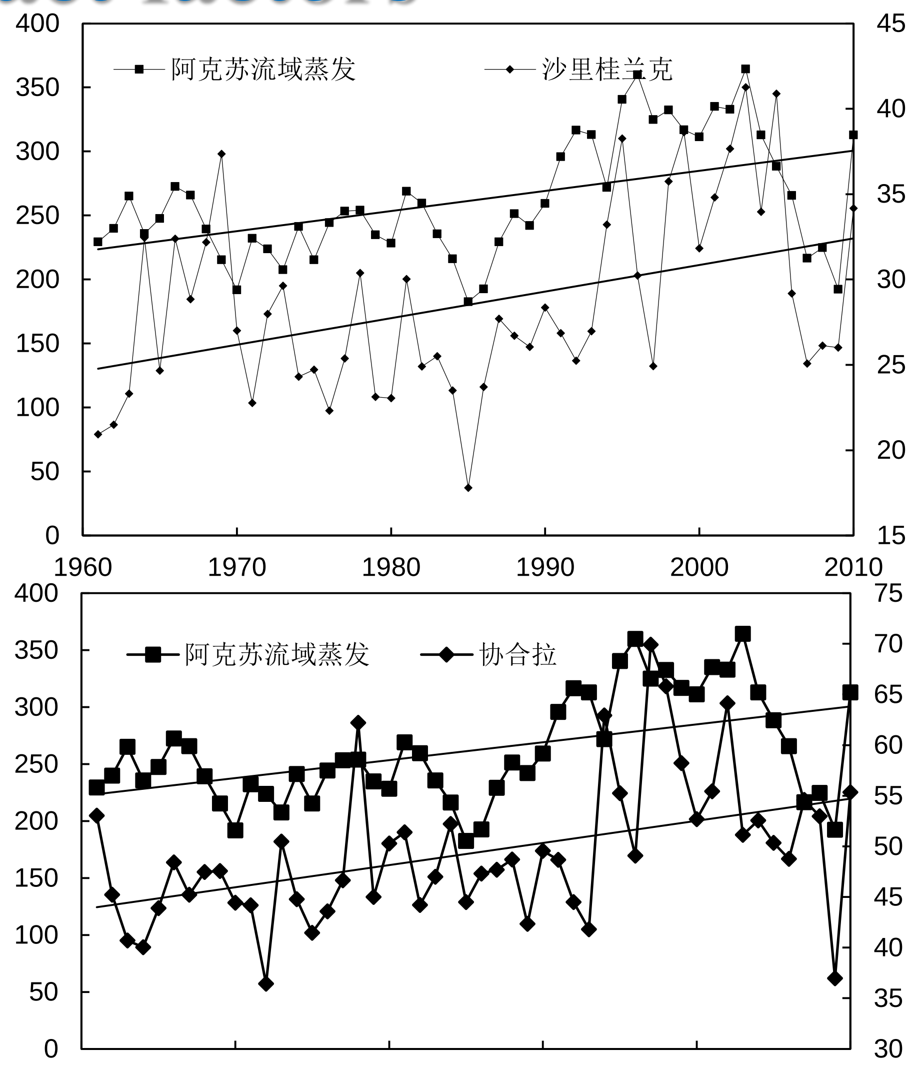
Trends of annual evapo-transpiration in the Tarim



Annua Eta is about 278mm/a in the Tarim river basin.
since 1960, Eta have been increasing significantly at 99% confidence level

（2）Actual evapo-transpiration

Impact factors



Runoff data from two hydrological gauging stations in the upper Tarim sub-tributary have shown statistically significant relationship with that of catchment actual evapo-transpiraton (significant at 99% confident level)

（2）Actual evapo-transpiration

Impact factors

	Tmean	Tmax	Tmin	Trange	Atmospheric pressure	Saturation deficit	Wind Speed	Sunshine Duration	precipitation
Annual	-0.108	-0.221	0.191	-0.51**	0.239	-0.504**	-0.752**	0.041	0.514**
Spring	-0.223	-0.353**	0.06	-0.554**	-0.167	-0.441**	-0.635**	0.338*	0.648**
Summer	-0.247	-0.275*	0.017	-0.293*	0.293*	-0.697**	-0.687**	-0.358**	0.541**
Autumn	0.233	-0.053	0.397**	-0.374**	0.246	-0.46**	-0.784**	0.29*	0.4**

Correlation coefficient of actual evapo-transpiration and climatic factors in the Tarim river basin in 1961-2013： The increase of underlying surface water conditions caused an increase of the ETa, while the decrease of wind speed and saturation deficit decelerated its rising rate.

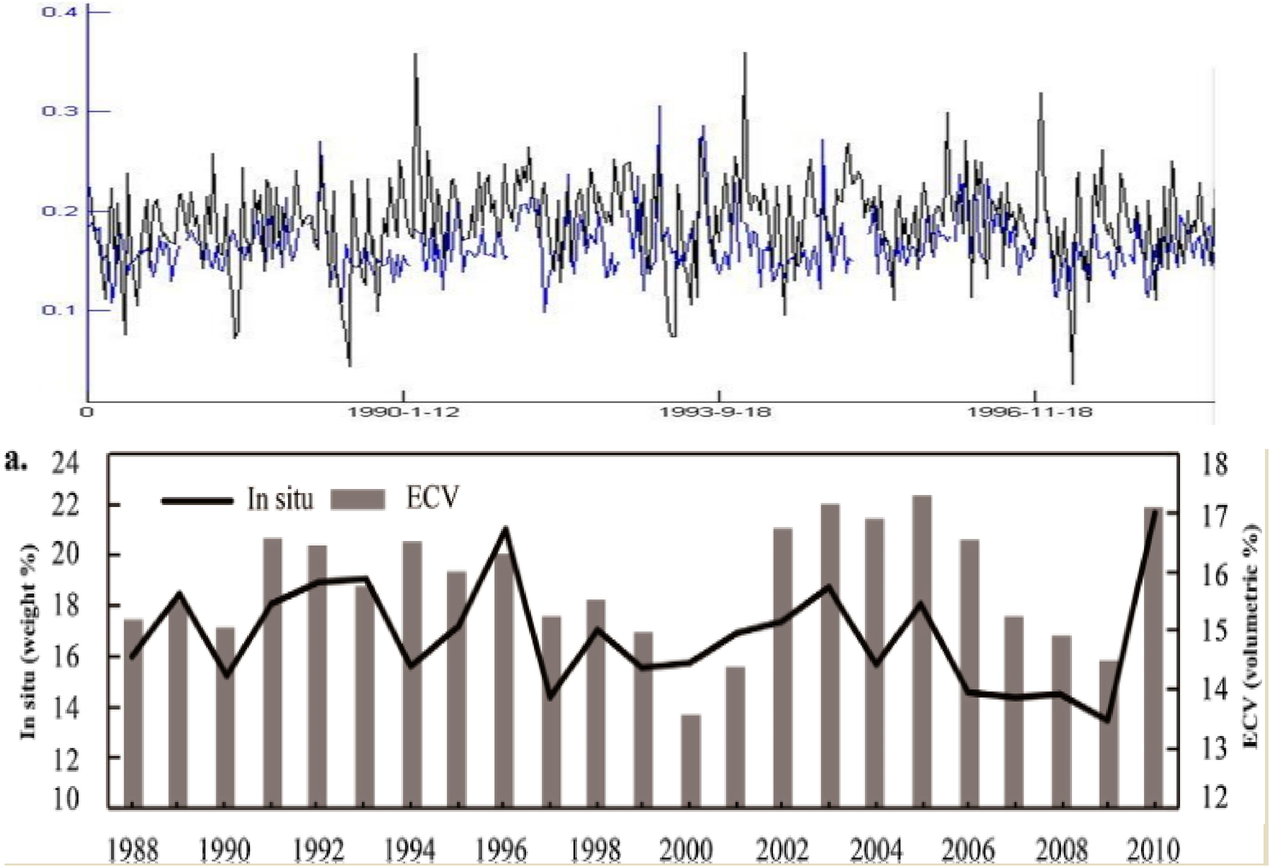
（3）Soil moisture

Getting of soil moisture record

方法	研究进展
monitoring	马柱国等（2000）分析中国东部的土壤湿度、降水和气温资料，提出土壤湿度和降水呈正相关,而与气温呈反相关；郭维栋等（2003）分析近50年中国北方11层土壤湿度特征，不同层次上土壤湿度的变化特征具有很好的一致性。
simulation	Shukla等利用数值模式进行的研究表明，干、湿土壤对后期降水和气温的影响有较大差异；Walker等的敏感性试验结果表明，干土壤可使未来气温升高，湿土壤可使后期降水持续。
RS	刘强等（2013）基于双通道算法和AMSR-E卫星数据反演青藏高原地区表层土壤水分，对青藏高原年平均土壤水分空间分布和月平均土壤水分空间分布的季节性变化进行分析。

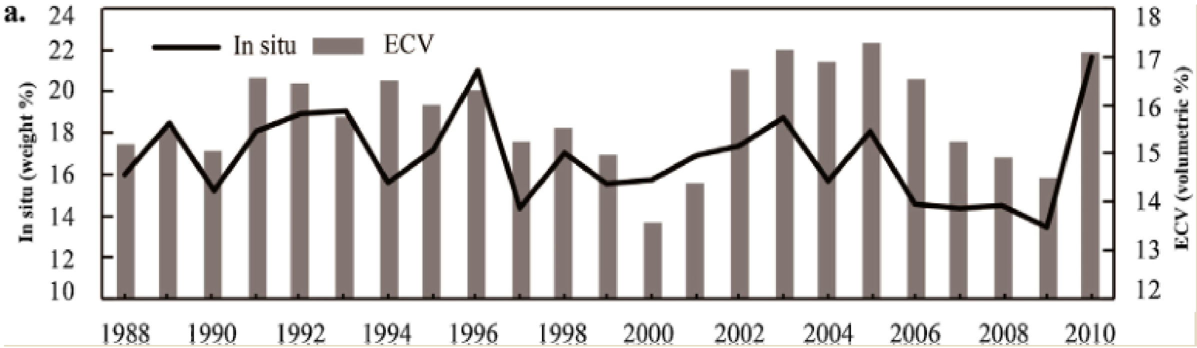
（3）Soil moisture

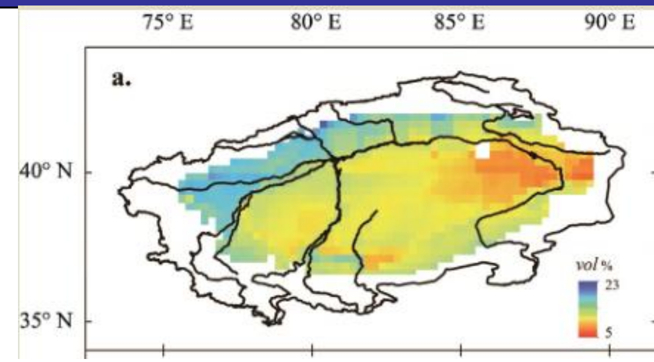
Satellite based soil moisture(ECV)

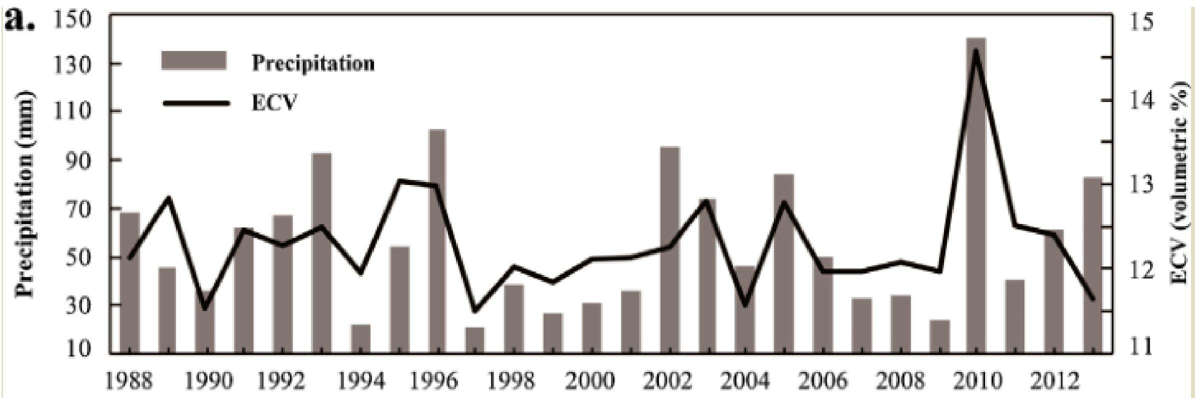


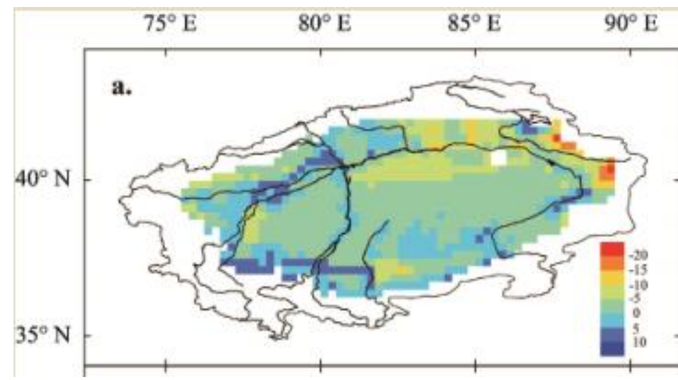
Comparison of soil moisture record retrieved by images from European Space Agency (0.25° ×0.25°) with ground observed record (Shache station)

（3）Soil moisture

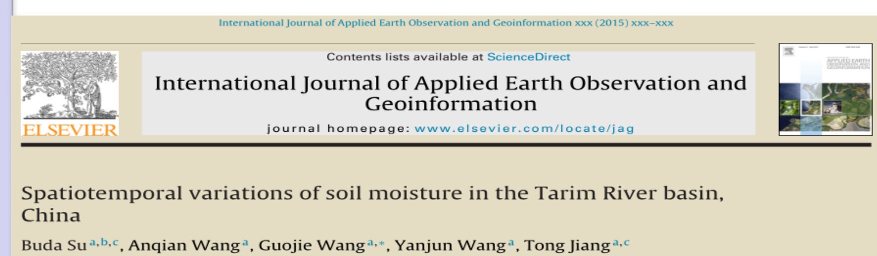








In the period of 1988–2013, soil moisture shows obvious increasing trends in the northwest and the southwest parts of the Tarim River basin, particularly in spring (March–May) and autumn (September–November).



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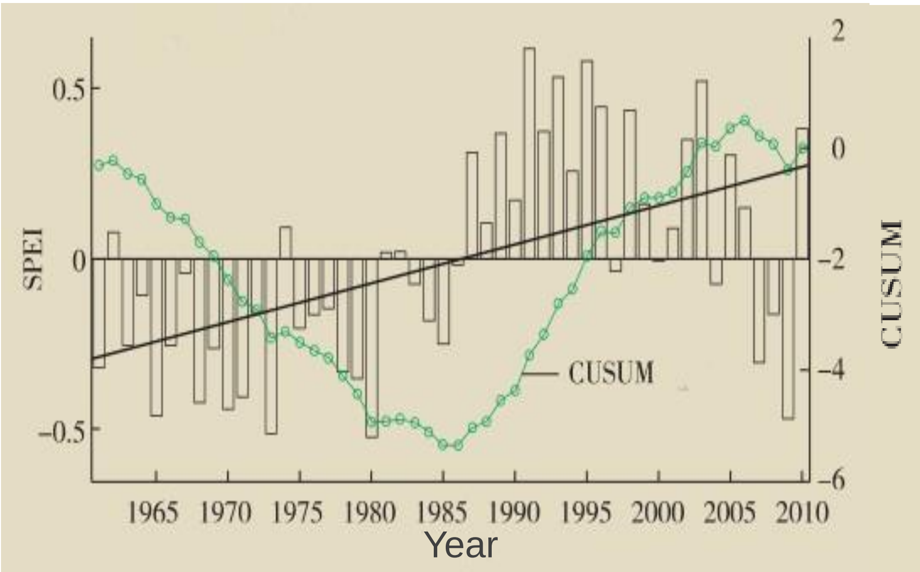
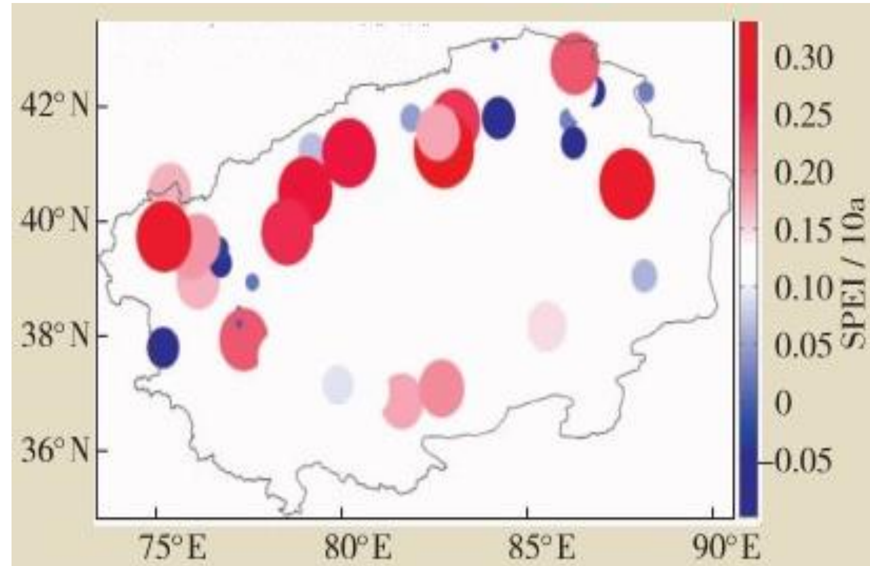
Spatiotemporal variations of soil moisture in the Tarim River basin, China

Buda Su[a,b,c], Anqian Wang[a], Guojie Wang[a,*], Yanjun Wang[a], Tong Jiang[a,c]

（4）Dryness and wetness variability





Variation of annual mean of SPEI value

An increasing trend in annual mean SPEI with a significant change point in 1986 was detected. Most of the stations showed a trend of getting wet in the interannual scale, and obvious trend mainly concentrated in the northern basin.

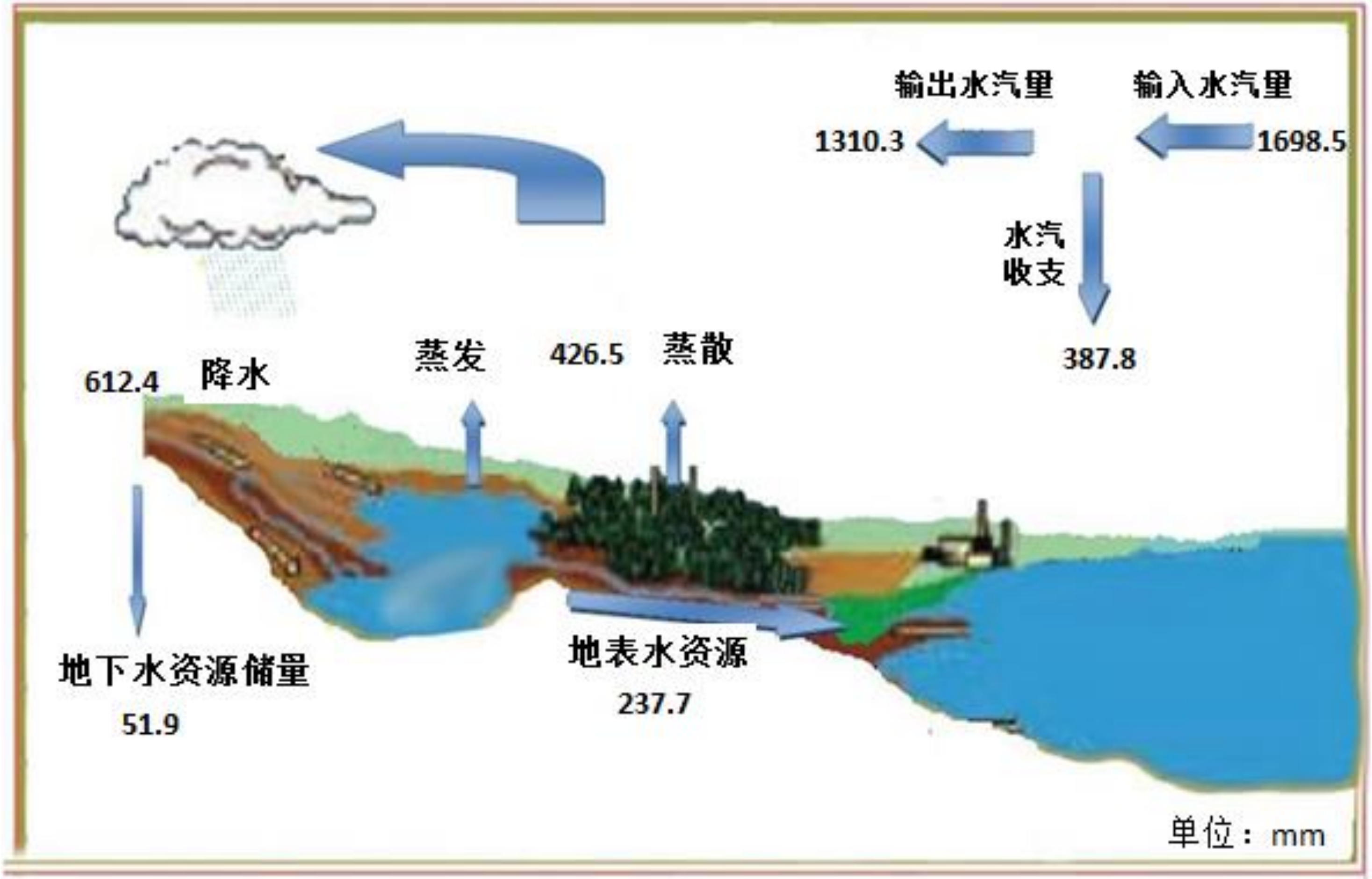
Summary

- **Climate System in the TRB since the year of 1960 is warming. Precipitable water resources have shown weak increasing trend.**

- **ETa has been decreasing since 1998, but an overall significant upward trend at a rate of 10.6 mm / 10a was observed for the period from 1960 to 2013. The increase of underlying surface water conditions caused an increase of the ETa, while the decrease of wind speed and saturation deficit decelerated its rising rate.**

- **Variations of soil moisture in the Tarim River basin are more controlled by precipitation, and temperature is less effective in controlling of soil moisture variations.**

Research Results



Thanks !