BEIJING NORMAL UNIVERSITY
College of water science

Influences of Shifted Vegetation Phenology on Runoff Across a Hydroclimatic Gradient

Shouzhi Chen

Beijing Normal University

College of Water Science

June 20th, 2022

Outlines

1. Climate change and phenology

2. Phenology impacts hydrological cycle

3. Our researches in China

4. Summary and prospective

Outlines

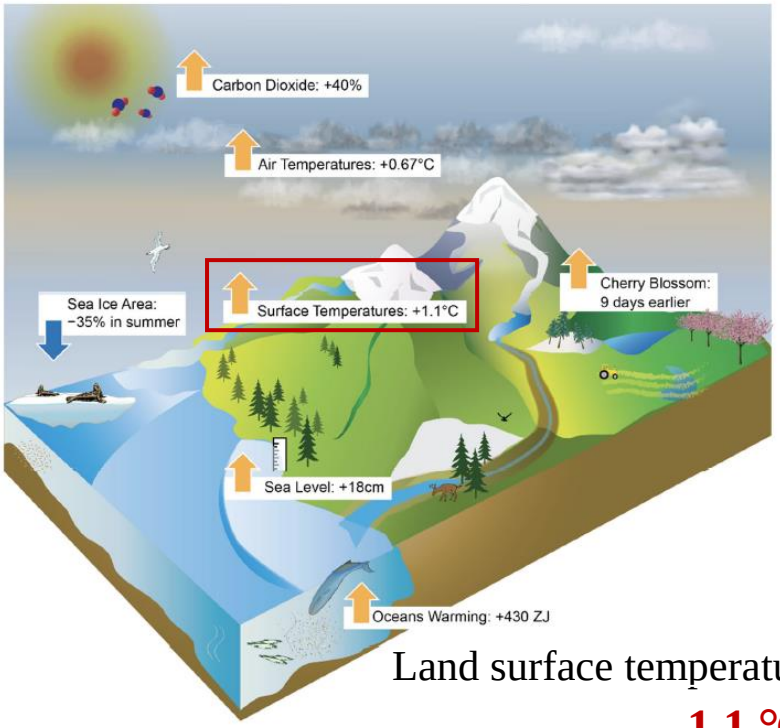
1. Climate change and phenology

2. Phenology impacts hydrological cycle

3. Our researches in China

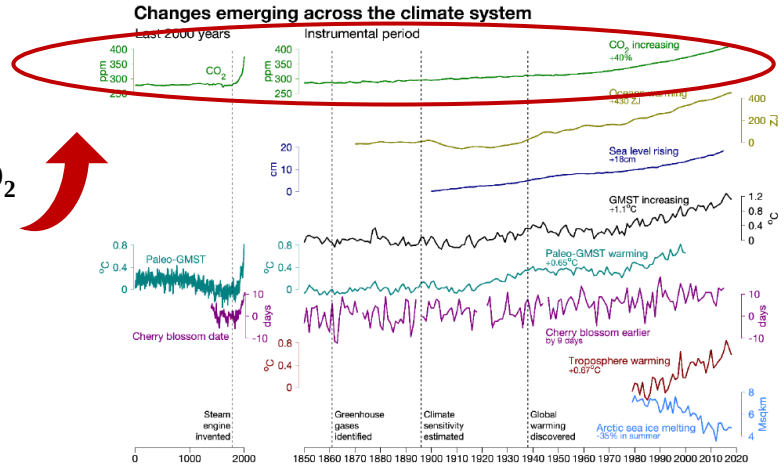
4. Summary and prospective

1. Climate change and phenology



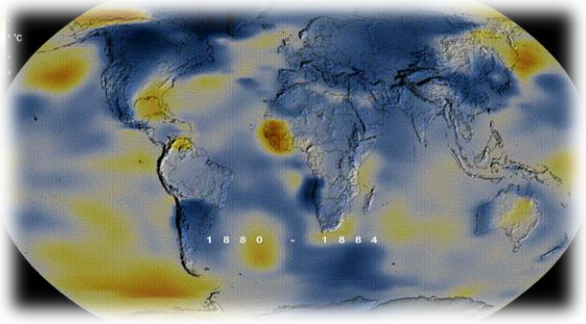
IPCC AR6

CO_2



Land surface temperature

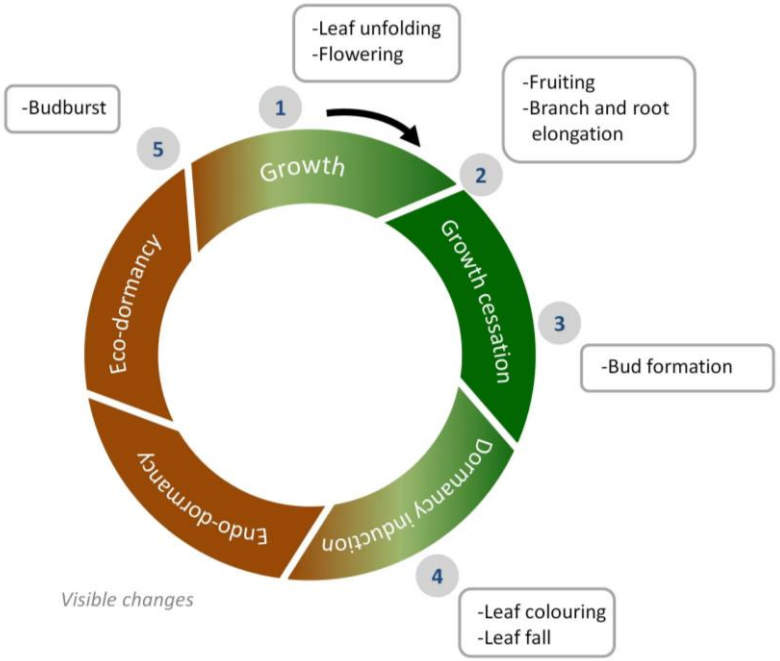
1.1 ℃



https://svs.gsfc.nasa.gov/4546

1. Climate change and phenology

Vegetation phenology



https://foliarduino.com

Beijing Normal University

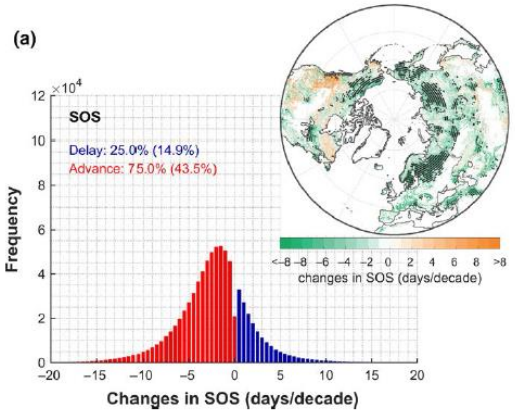
Campus phenological observation network

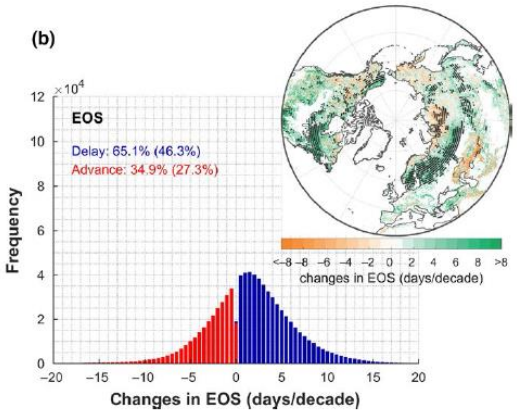
Spring **Summer** **Autumn** **Winter**

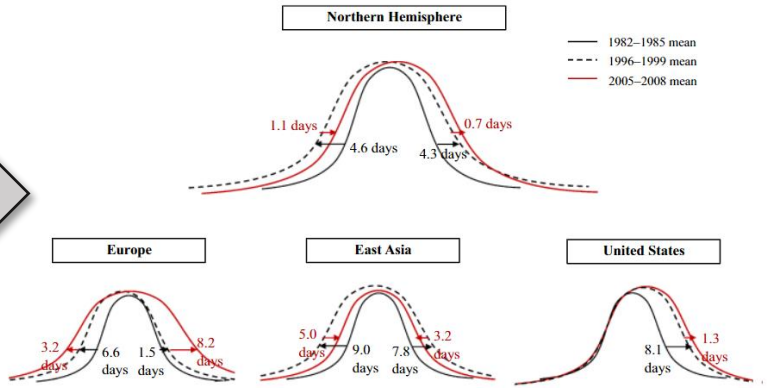
- Vegetation phenology refers to the study of the biological cycle of plants (budburst, flowering, senescence …).

1. Climate change and phenology

Response to climate change







Advanced Spring phenology

Delayed autumn phenology

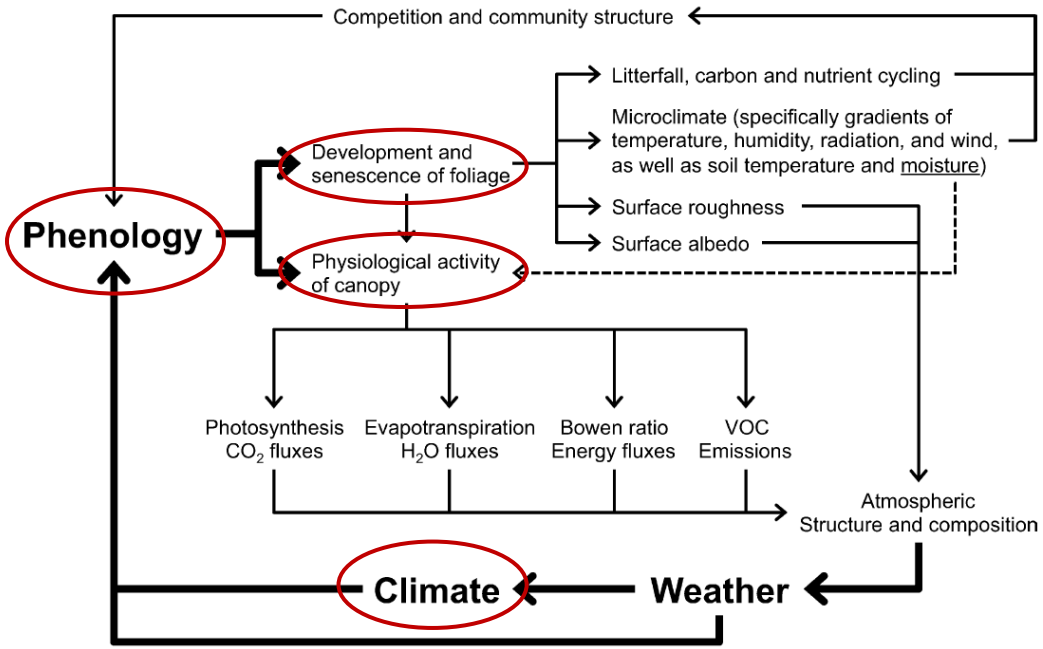
Spatial difference

(Piao, Fu et al. 2019 GCB)

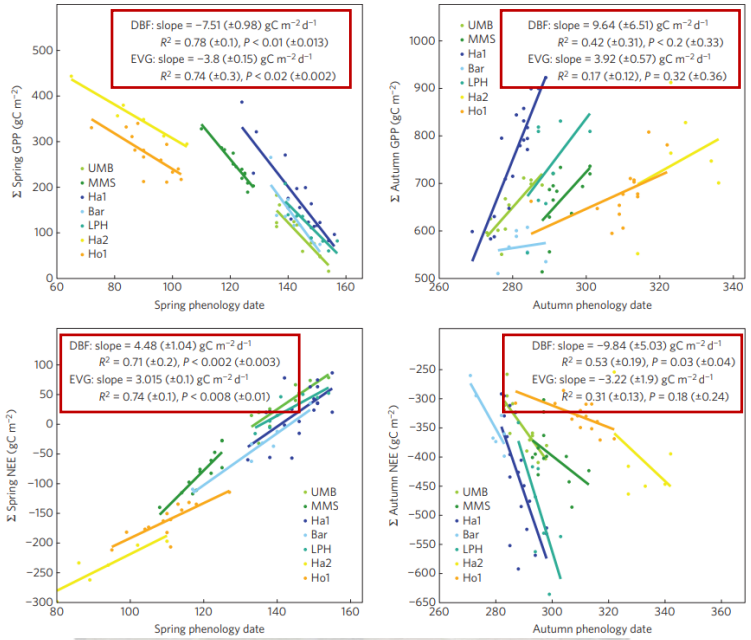
(Jeong et al. 2011 GCB)

1. Climate change and phenology

Feedback to climate



Hydrological cycle ?



(Richardson et al. 2013 AFM)

(Keenan et al. 2014 NCC)

Outlines

1. Climate change and phenology

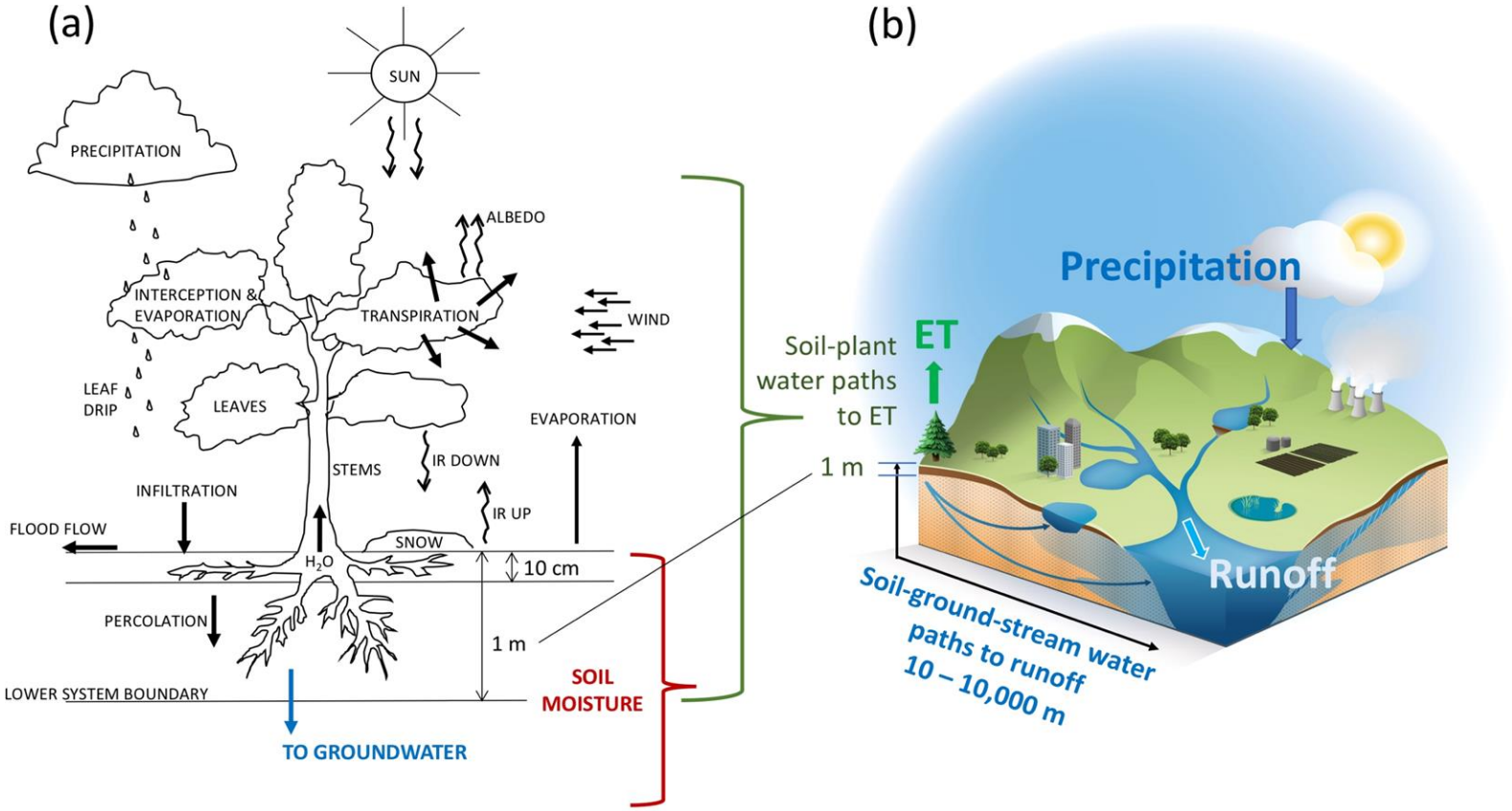
2. Phenology impacts hydrological cycle

3. Our researches in China

4. Summary and prospective

2. Phenology impact hydrological cycle

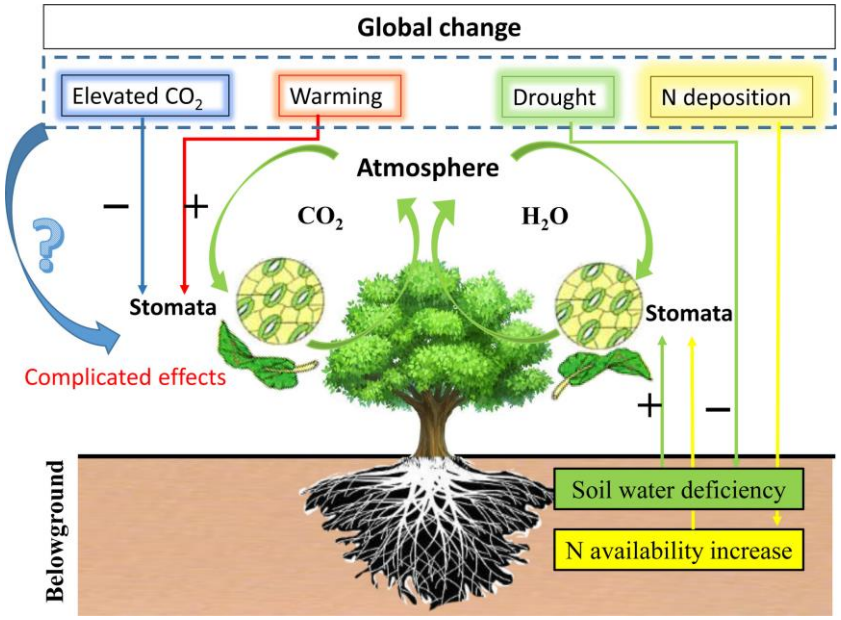
How vegetation participates hydrological cycle ?

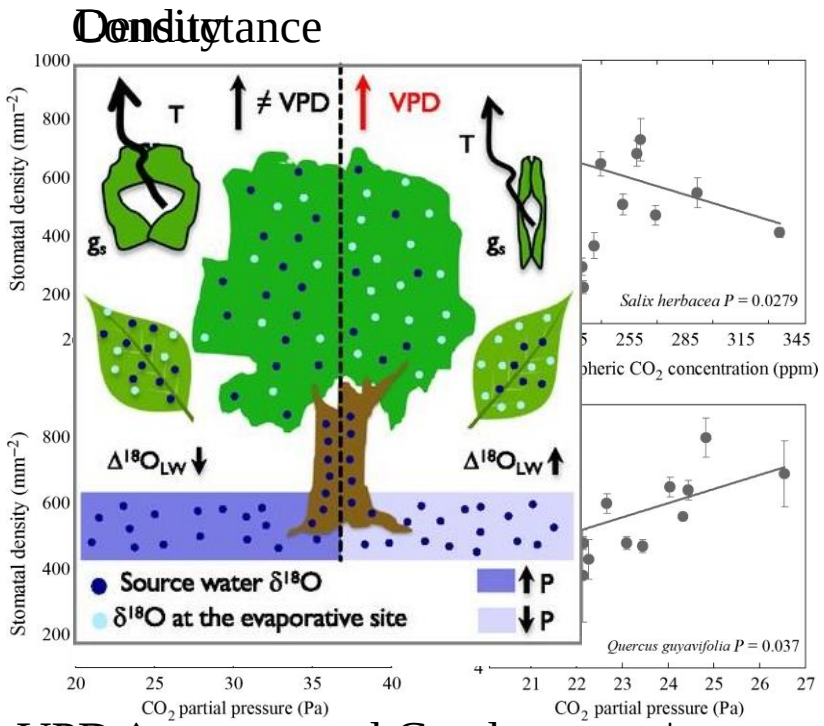


(Navid et al. 2020 Scientific Reports)

2. Phenology impact hydrological cycle

How vegetation participates hydrological cycle ?



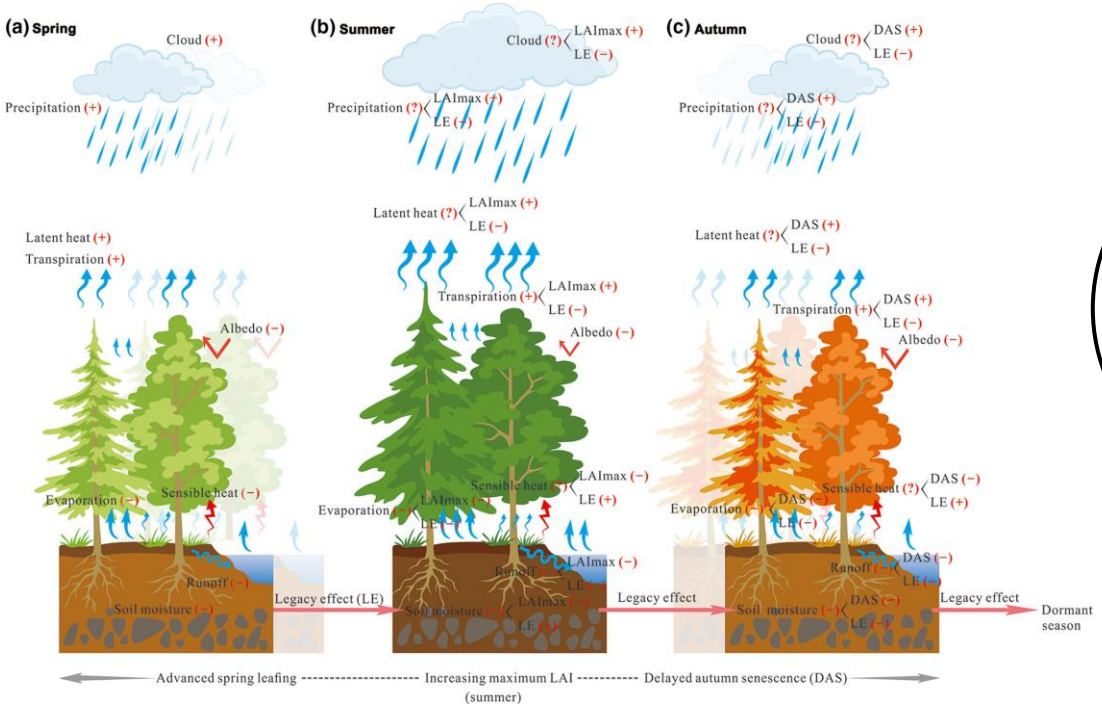


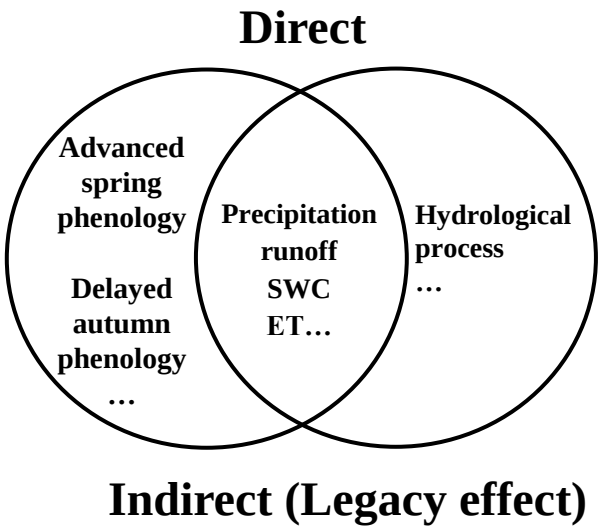
VPD ↑ → stomatal Conductance ↓

(Yan et al. 2017 GCB)

2. Phenology impact hydrological cycle

How phenology impact hydrological cycle

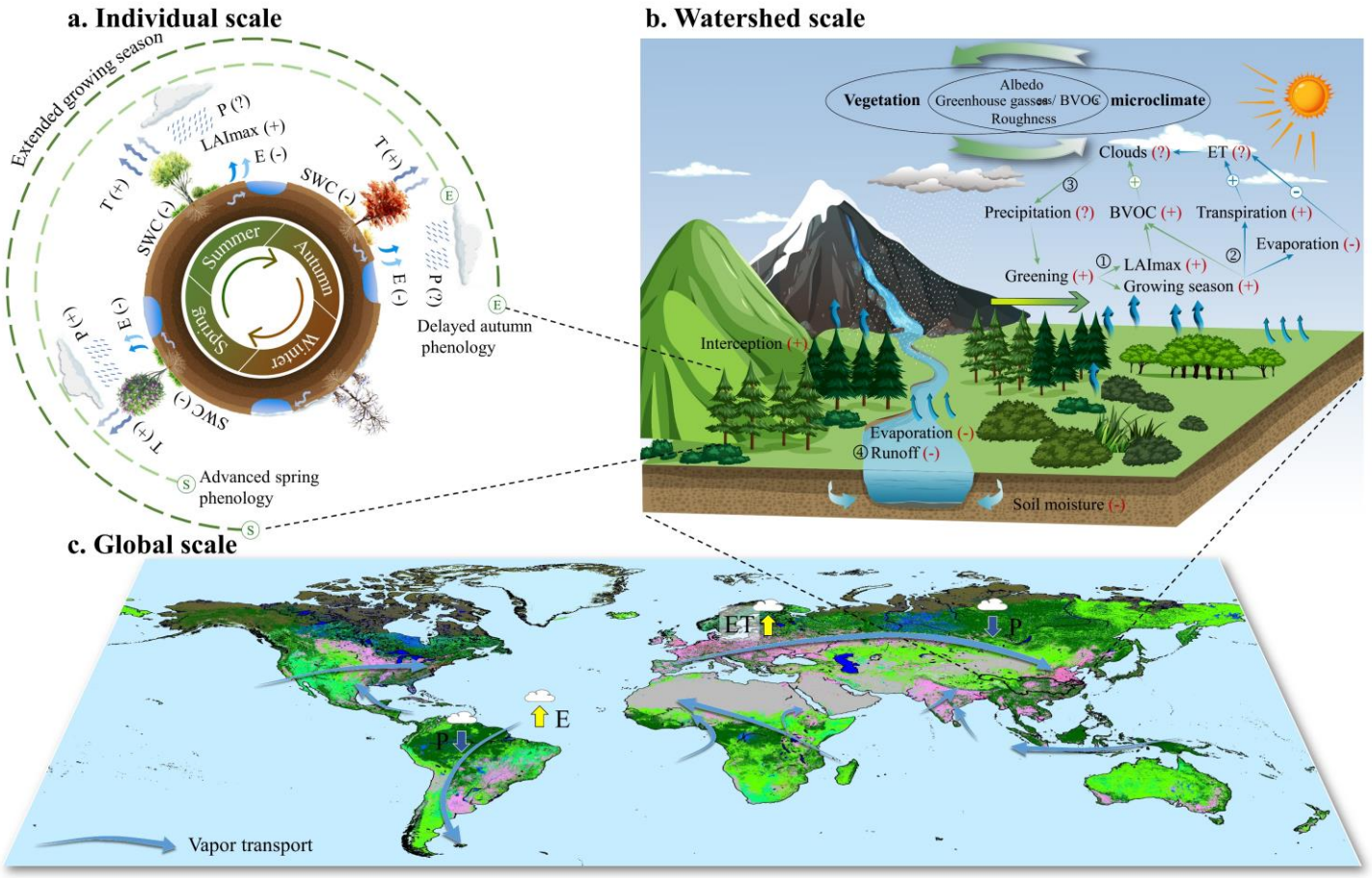




(Piao, Fu et al. 2019 GCB)

2. Phenology impact hydrological cycle

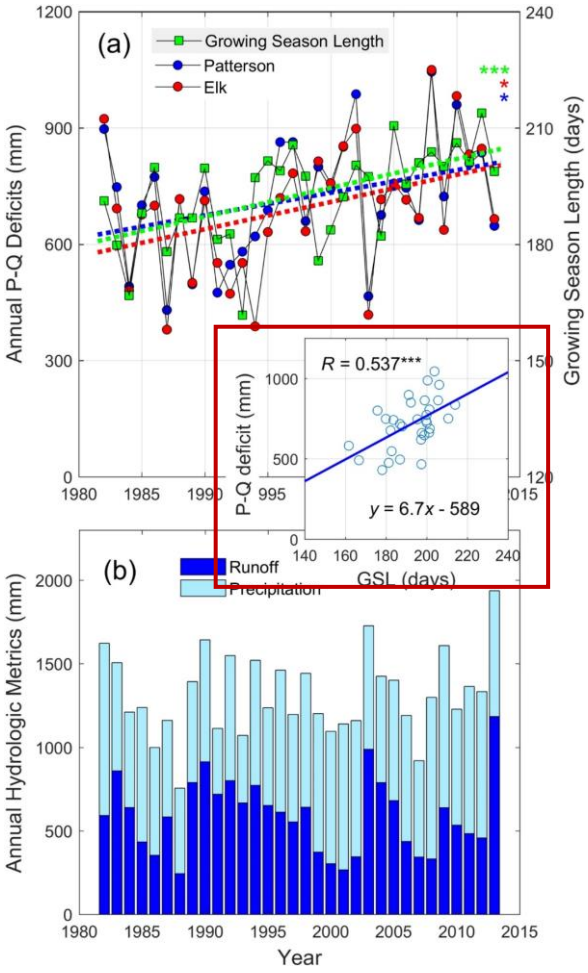
Phenology impact hydrological in different scale

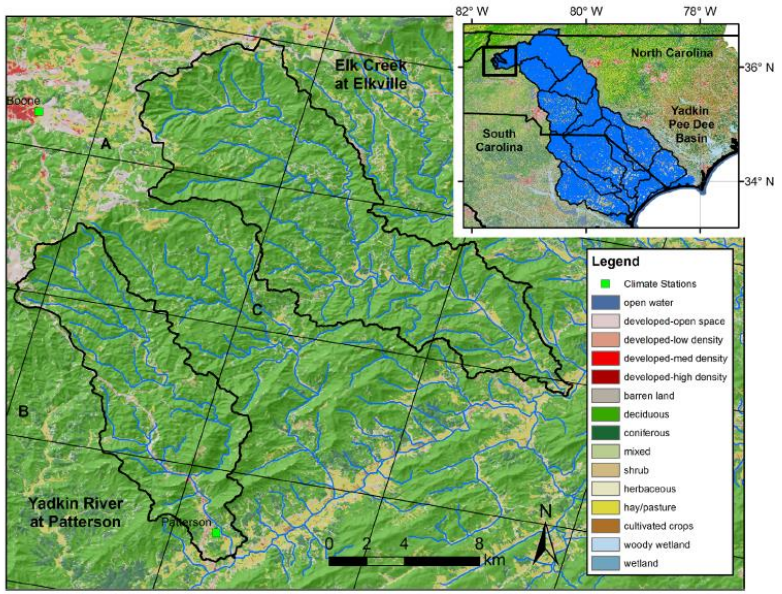


(Chen, Fu* et al, 2022, preparing)

2. Phenology impact hydrological cycle

phenology impact on P-Q





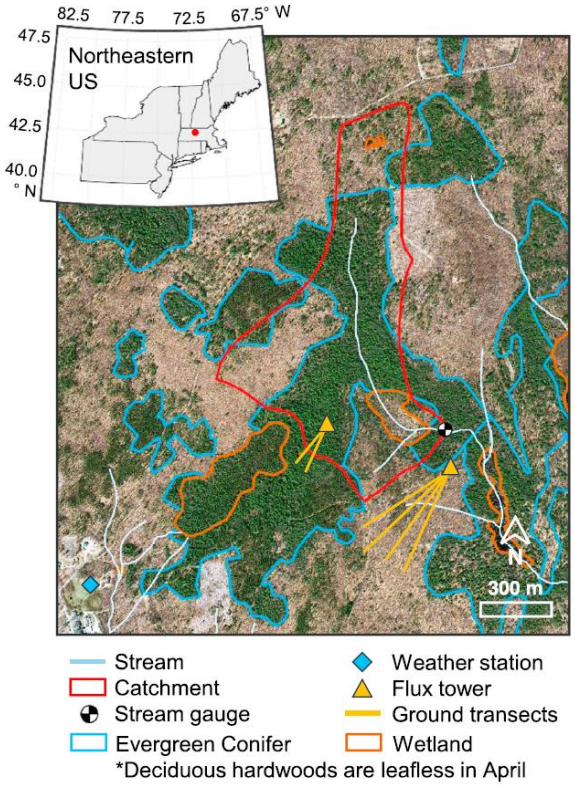
$$P - Q = ET + \Delta S$$

GSL extension 1 day
P-Q deficit increase 6.7 mm

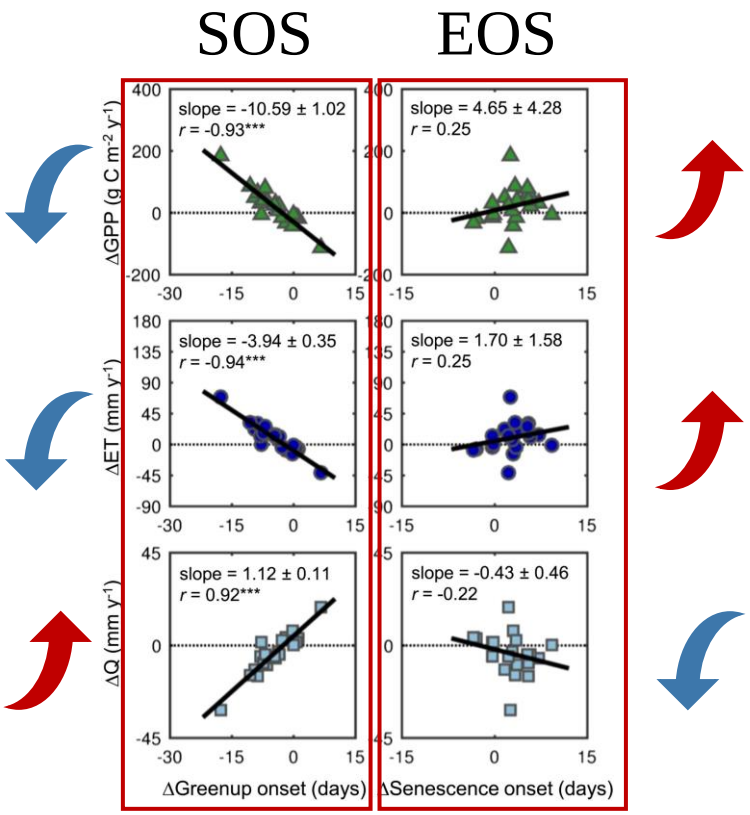
(Hwang et al. 2017 WRR)

2. Phenology impact hydrological cycle

phenology impact runoff



Harvard forest



(Kim et al. 2018 JGR)

Spring phenology > Autumn phenology

2. Phenology impact hydrological cycle

Questions:

1. At the watershed scale, are there differences in the effects of phenology on the hydrological cycle with different land cover?
2. Are there differences in the effects of phenology on the hydrological cycle in humid and semi-humid regions?
3. Do spring phenology and autumn phenology have different effects on the hydrological cycle in humid and semi-humid regions?

Outlines

1. Climate change and phenology

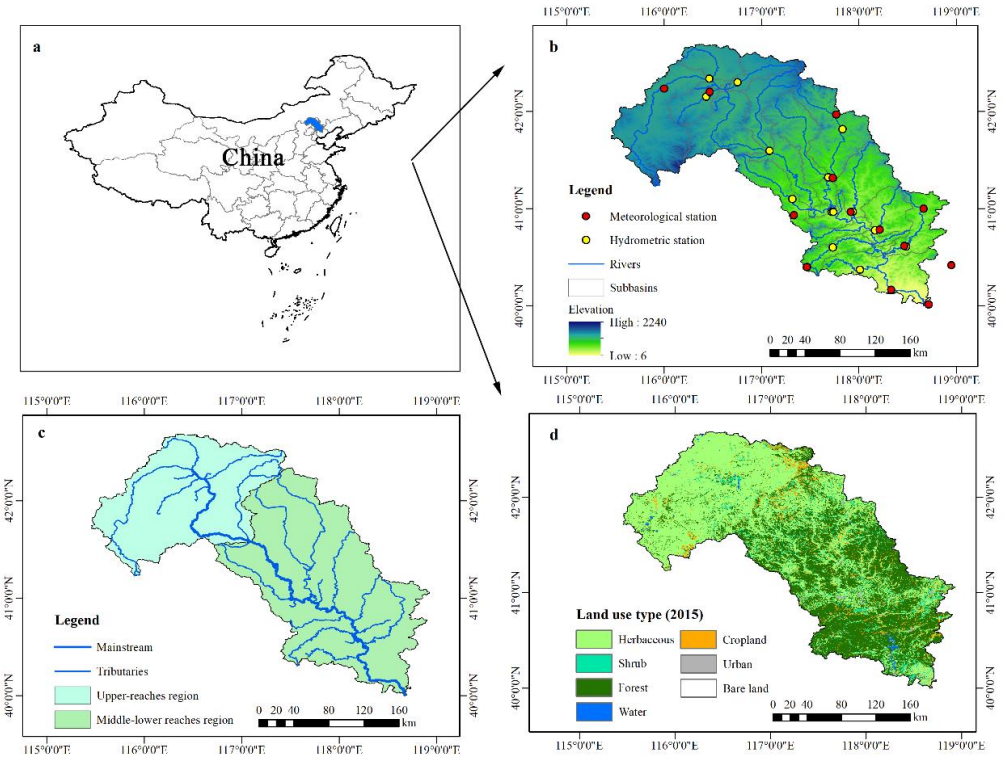
2. Phenology impacts hydrological cycle

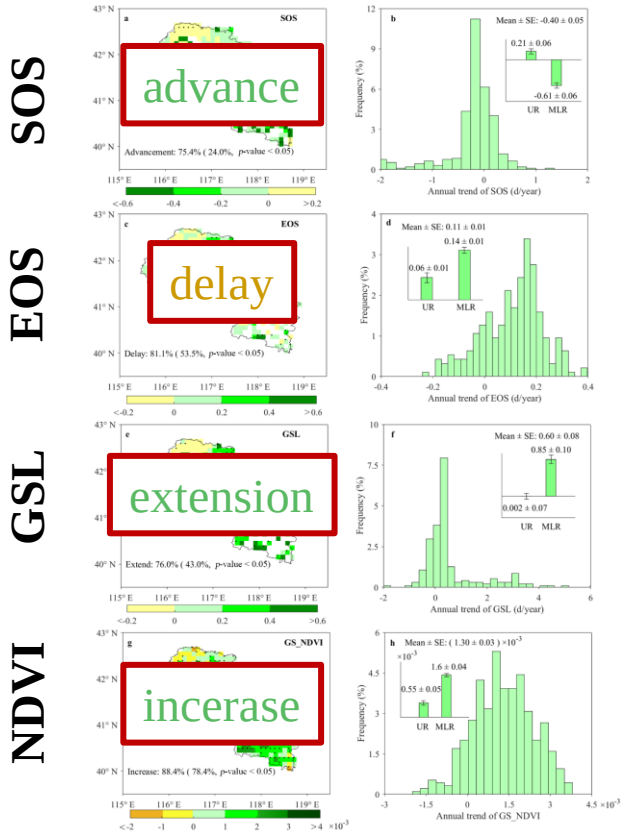
3. Our researches in China

4. Summary and prospective

3. Our researches in China

Luan river basin

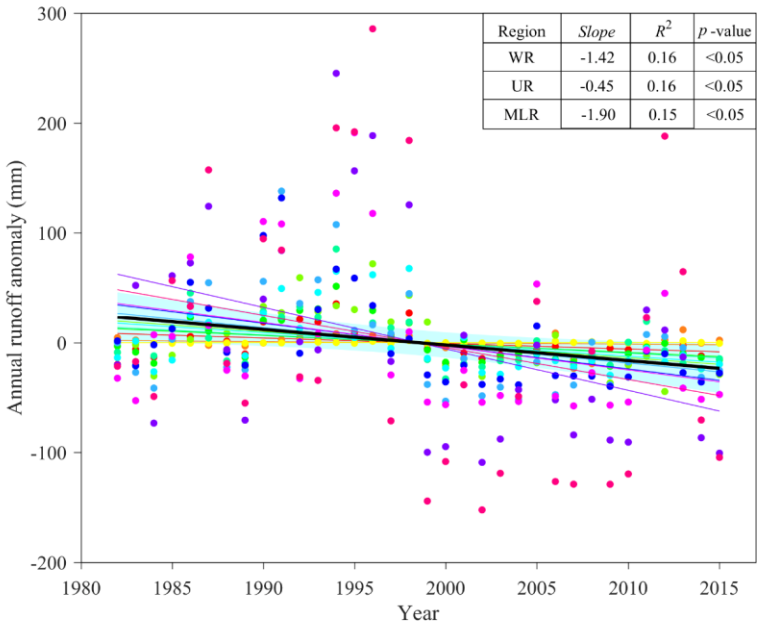


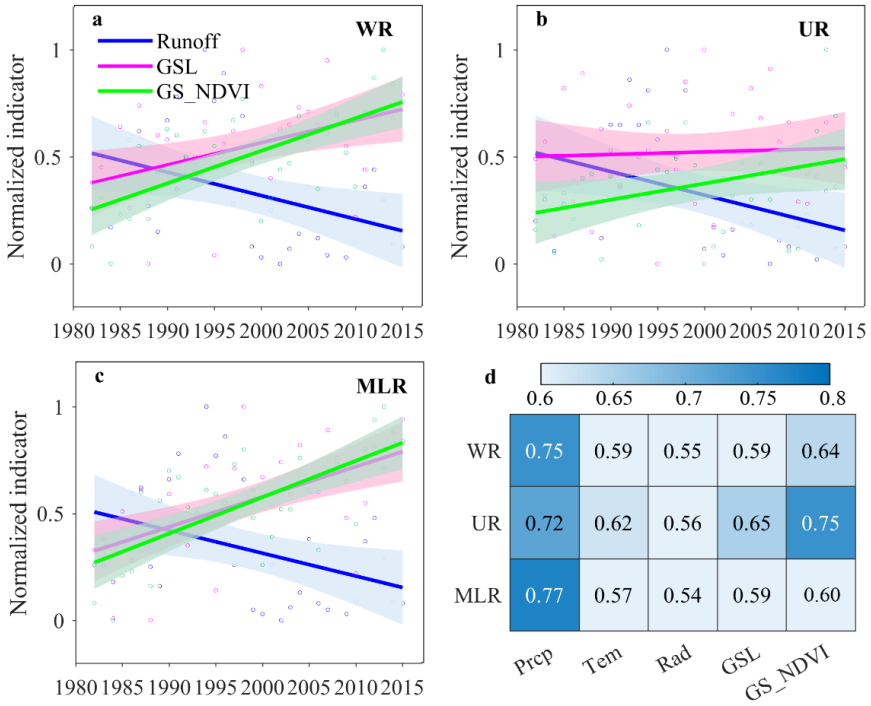


(Geng et al. 2020 Journal of Hydrology)

3. Our researches in China

Spring & autumn



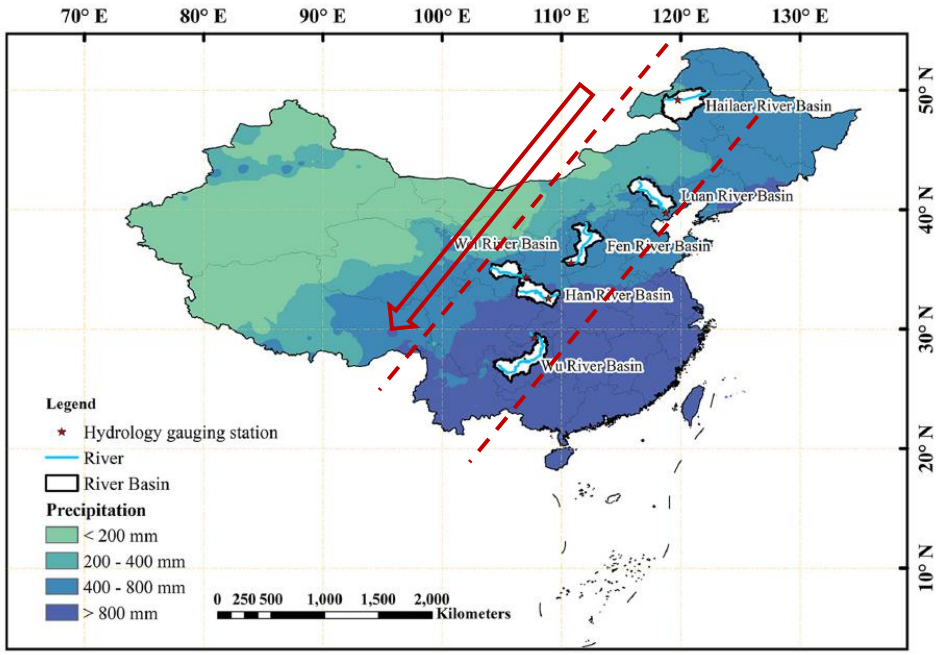


GSL extension ⇒ Runoff decrease

Upper reaches (Grassland) < Middle and lower reaches (Forest)

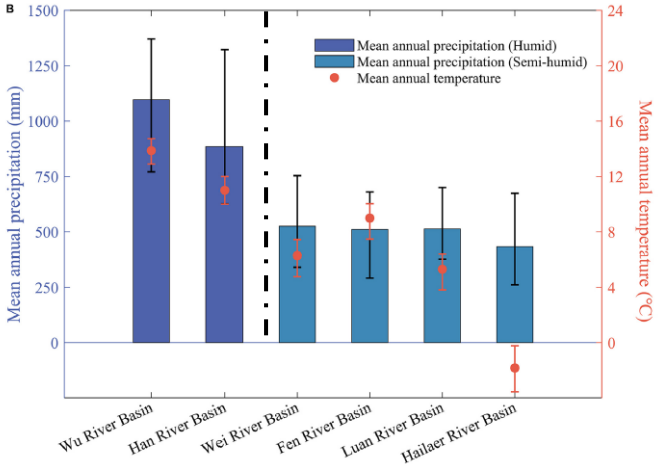
3. Our researches in China

Across a hydroclimatic gradient



Humid region:
Wu, Han;

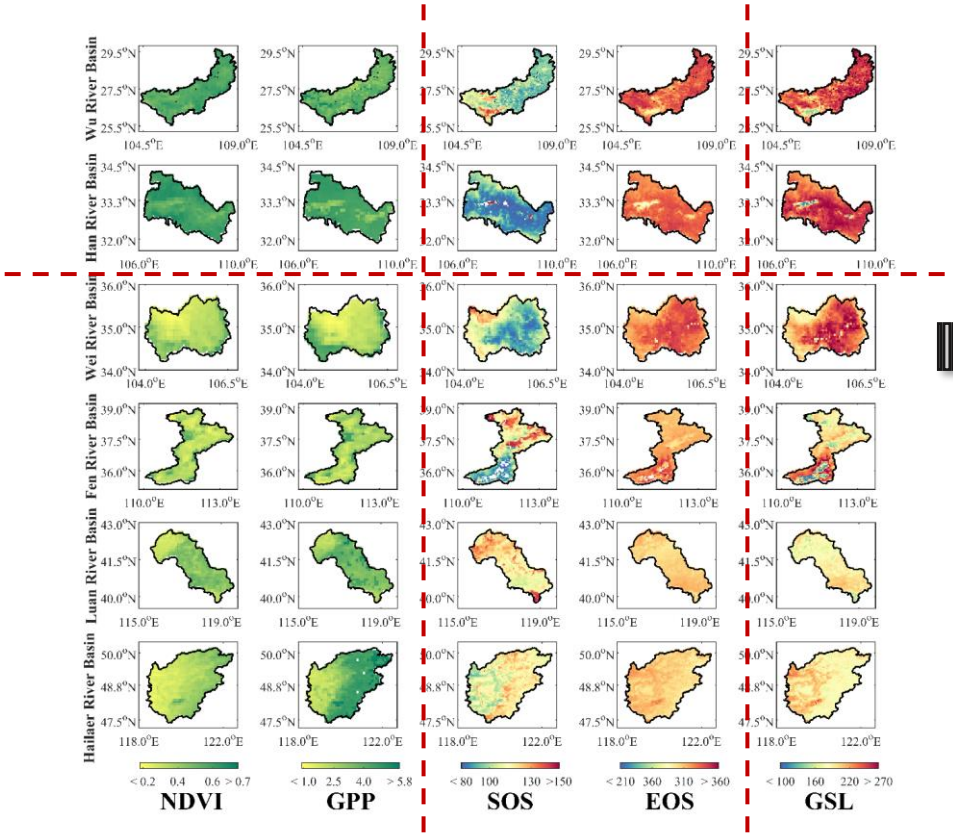
Semi-humid region:
Wei, Fen, Luan, Hailaer;

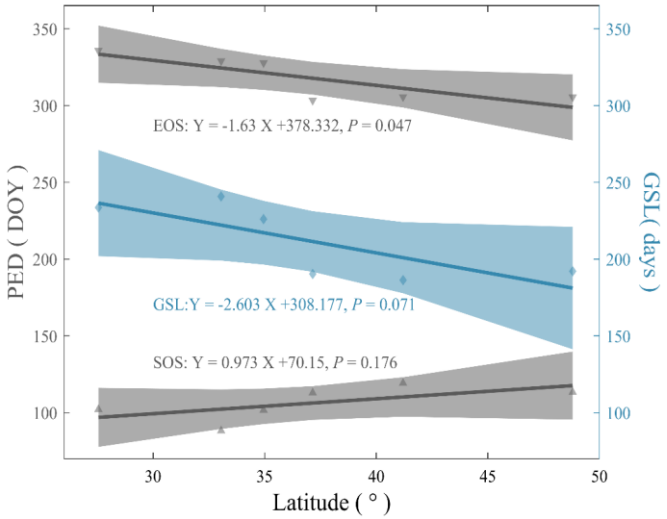


(Chen et al. 2022 Frontiers in plant science)

3. Our researches in China

Vegetation dynamic





Growth condition:

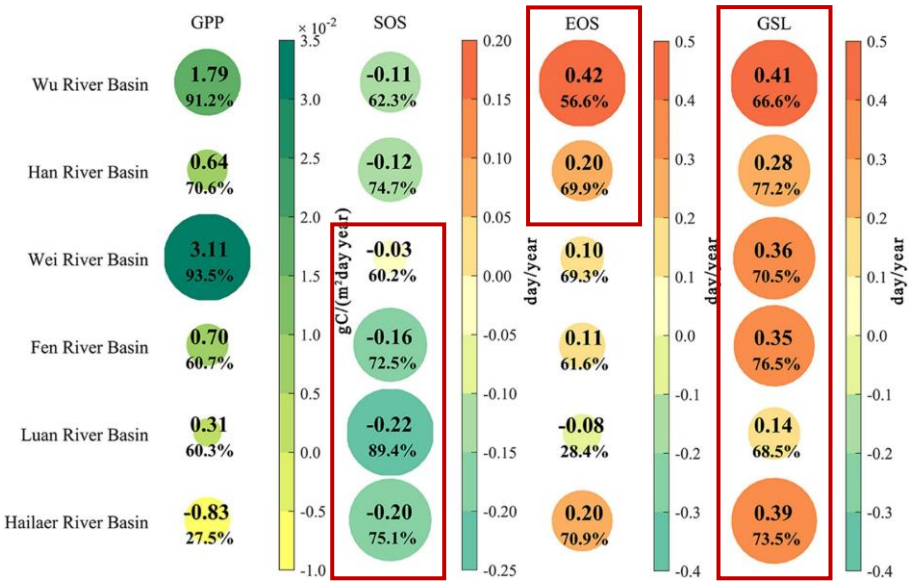
Humid > Semi-humid

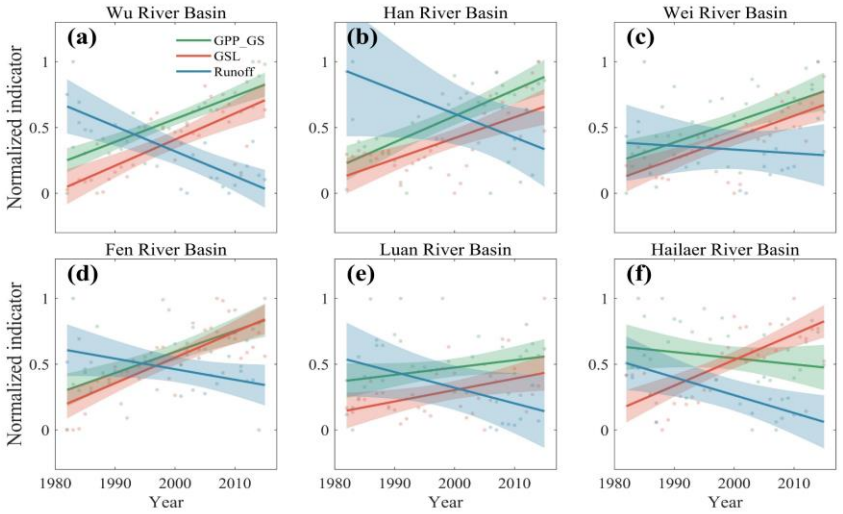
Growing season length:

Humid > Semi-humid

3. Our researches in China

Temporal changes of phenology and runoff





GSL extension:

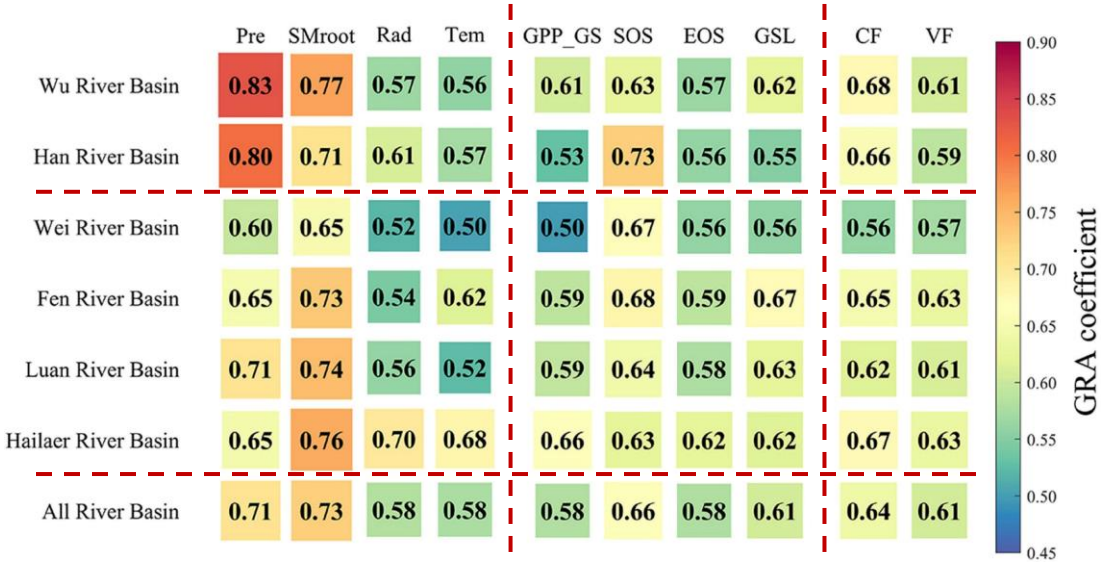
Humid: delayed EOS;

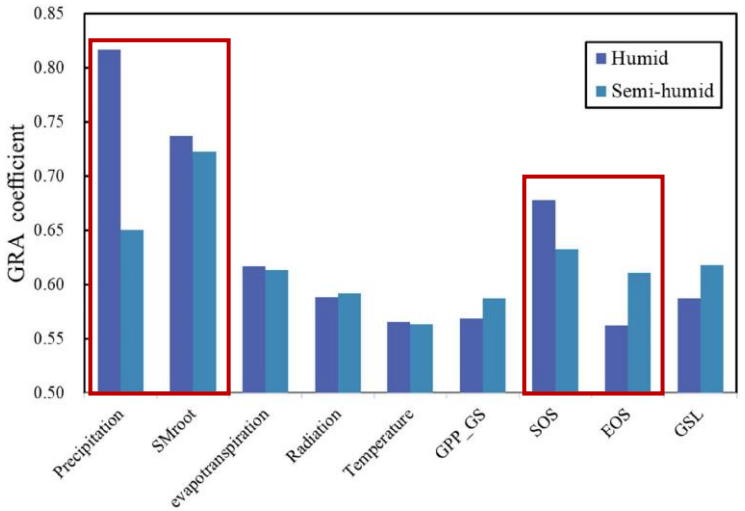
Semi-humid: advanced SOS.

GSL extension ⇨ Runoff decrease

3. Our researches in China

Gray relational analysis





- Precipitation and soil moisture content are the main factors affecting runoff, and vegetation phenology is equally important
- Humid: SOS;
- Semi-humid: SOS and EOS.

Outlines

1. Climate change and phenology

2. Phenology impacts hydrological cycle

3. Our researches in China

4. Summary and prospective

4. Summary and prospective

- The extension of growing season decreased runoff in the watershed, and this effect is stronger in forest than in grassland.
- Precipitation and soil moisture are the main factors affecting runoff in humidity watershed, and the vegetation is a secondary factor, specifically SOS is the main vegetation factor in humid region, and SOS and EOS are both important in semi-humid region.
- The mechanisms of vegetation phenology impacts on river runoffs still need further investigations, and need to be accurately formulated and coupled into hydrological models to better simulate water balance under future climate change.

BEIJING NORMAL UNIVERSITY

College of water science

Thank you for your attention !

Welcome to visit Yongshuo Fu's Group!

Shouzhi Chen (cws_chensz@mail.bnu.edu.cn)
Yongshuo Fu (yfu@mail.bnu.edu.cn)

Group wechat official account