Forty-Year Data Analysis of Droughts and Drought-Flood Dynamics: Impacts of Cascading Reservoirs

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SWAT Soil & Water Assessment Tool

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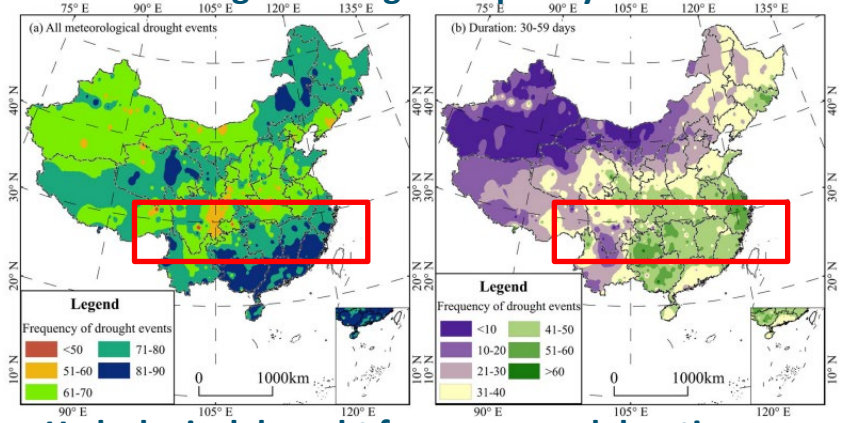
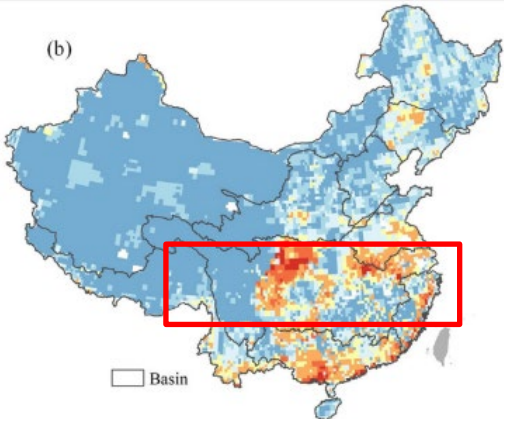
➢ 1. Background

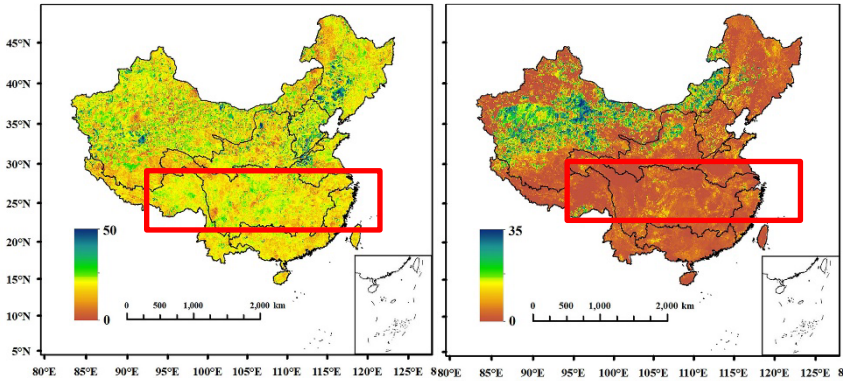
Meteorological drought frequency and duration

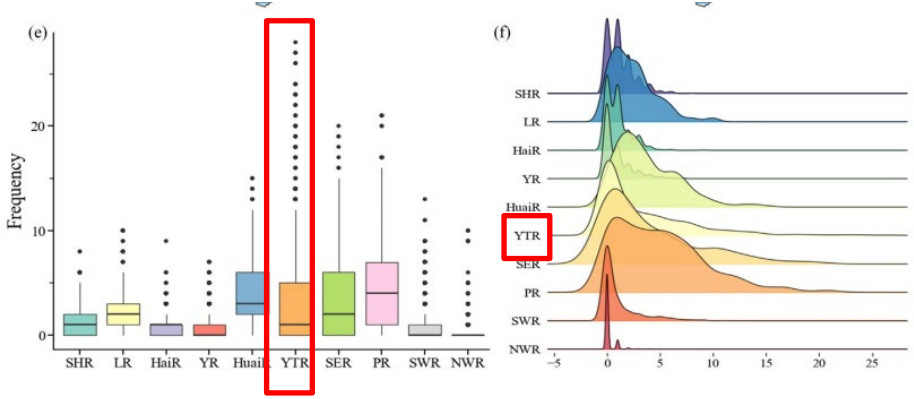


Drought–flood abrupt alternation intensity and frequency



Hydrological drought frequency and duration





(Ma et al. 2020;Bi et al. 2023; Yang et al. 2024)

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➢ 1. Background

Cascading reservoirs in the YRB

➢ 2. Research question

How these cascading reservoirs influence extreme events in this region?

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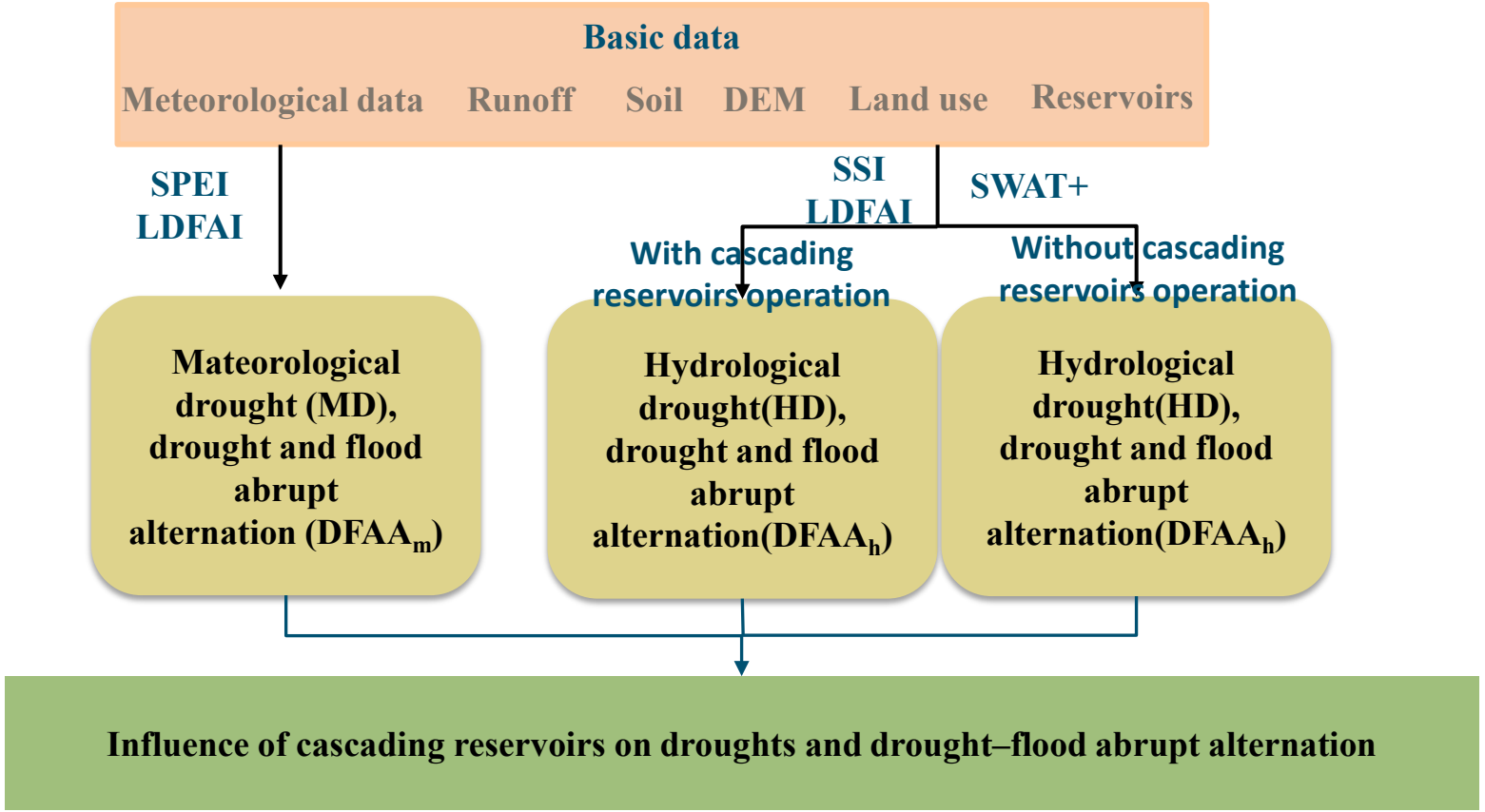
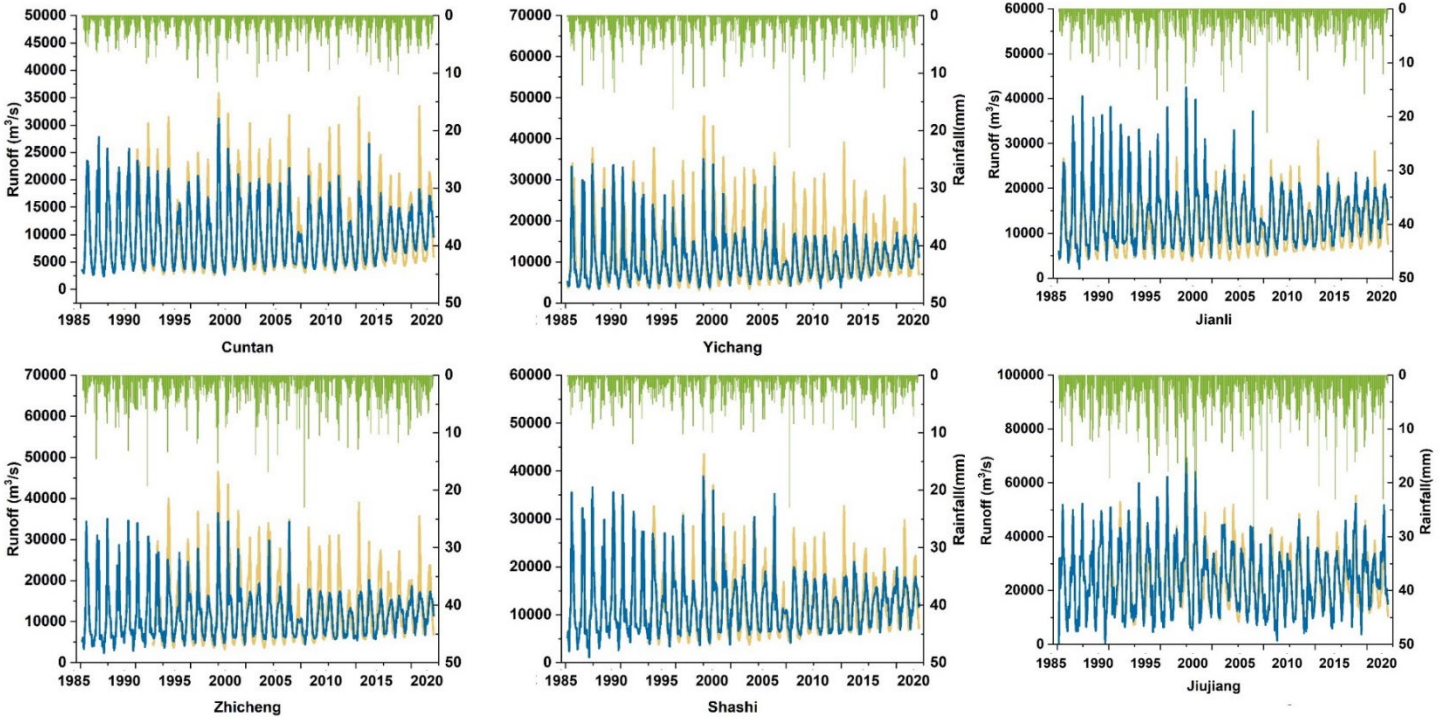
➢ 3.Framework


Basic data
Meteorological data
Runoff
Soil
DEM
Land use
Reservoirs
SPEI
LDFAI
SSI
LDFAI
SWAT+
With cascading reservoirs operation
Without cascading reservoirs operation
Mateorological drought (MD), drought and flood abrupt alternation ($DFAA_m$)
Hydrological drought(HD), drought and flood abrupt alternation($DFAA_h$)
Hydrological drought(HD), drought and flood abrupt alternation($DFAA_h$)
Influence of cascading reservoirs on droughts and drought–flood abrupt alternation

➢ 4.Results

4. 1 Calibration and validation results of the SWAT+ model



Comparison of simulated and observed monthly streamflow for 7 stations

PCC>0.8, NSE>0.6

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➢ 4.Results

4.2 The influence of cascading reservoirs on drought events

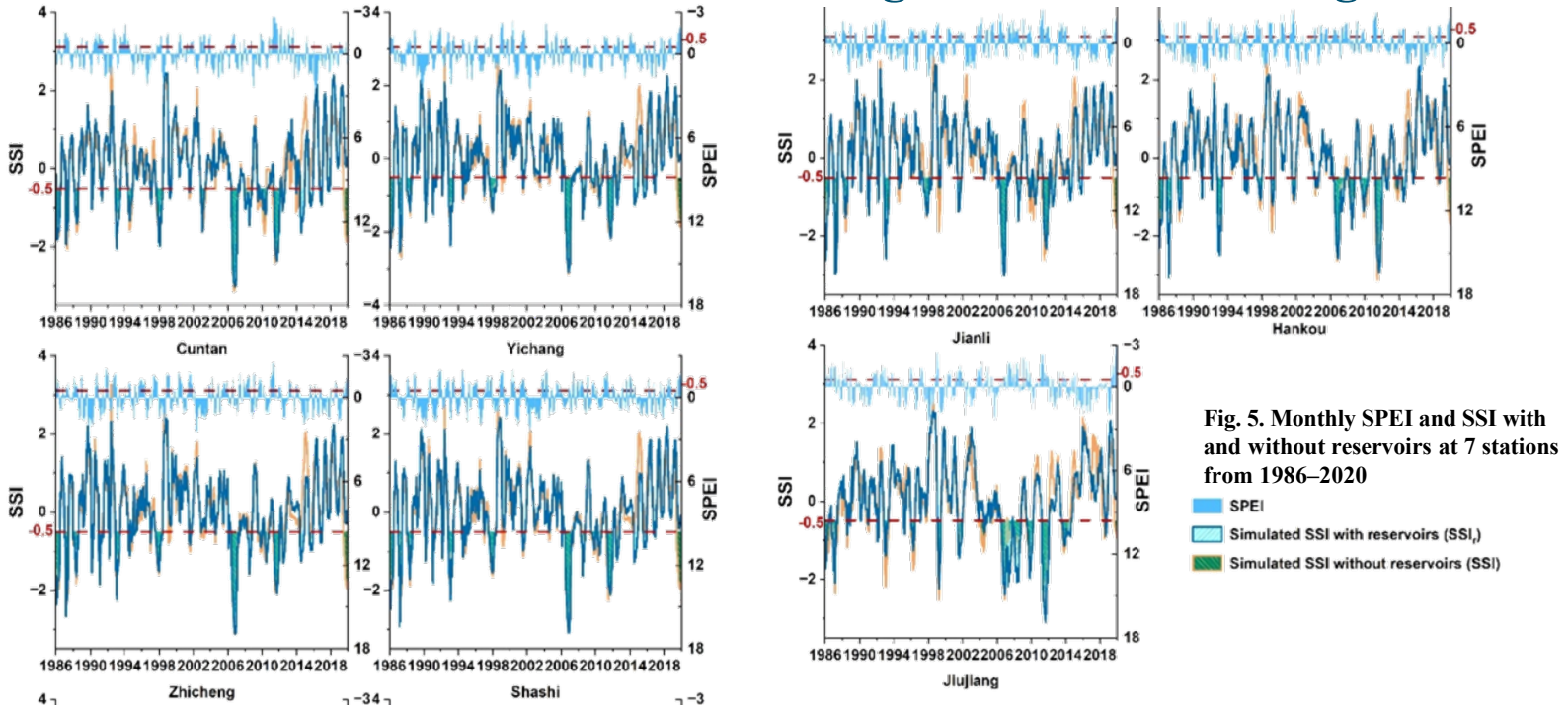
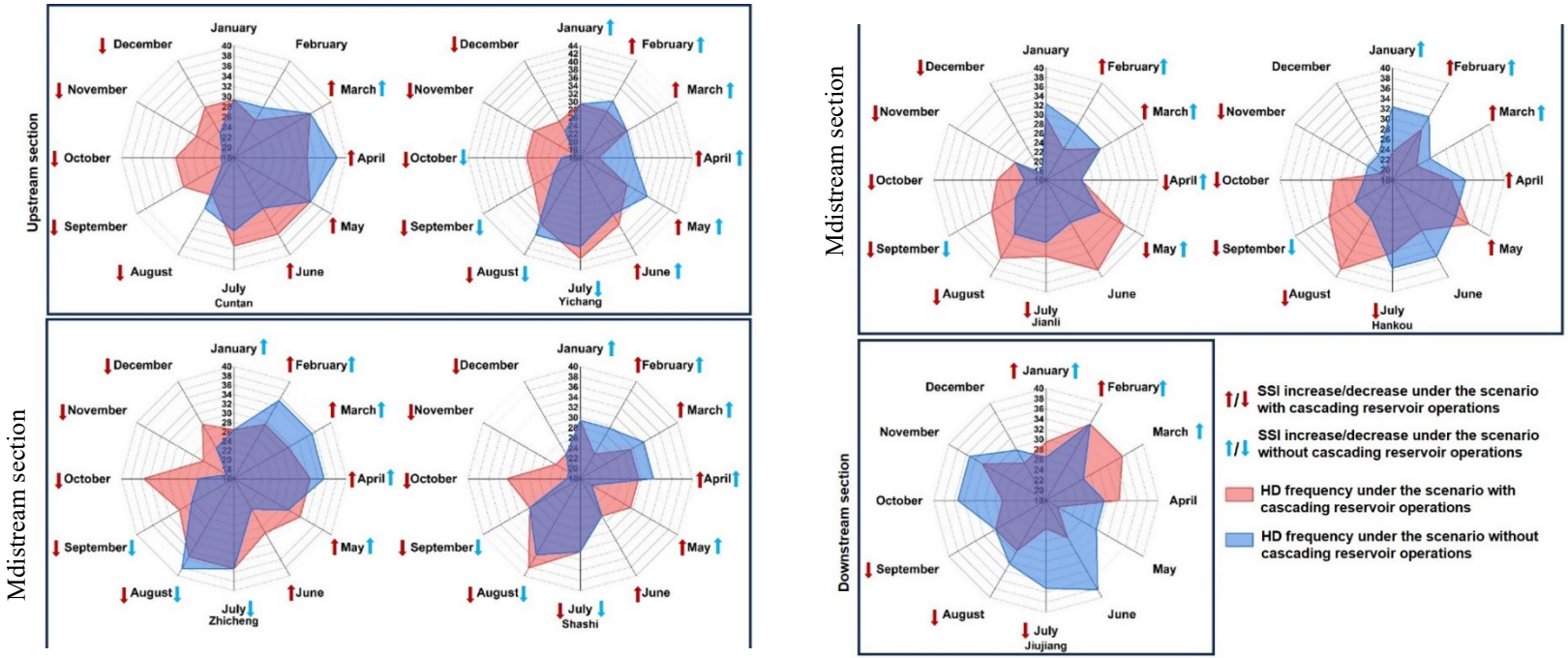


Fig. 5. Monthly SPEI and SSI with and without reservoirs at 7 stations from 1986–2020

MD prevailed in the autumn (August to November), while HD concentrated in the summer (May to August). Cascading reservoirs increased the frequency and duration of HD events while decreased their intensity.

➢ 4.Results

4.3 Seasonal influence of cascading reservoirs on drought events



Percentage radar map of HD events with and without cascading reservoirs operation

Cascading reservoirs exacerbate HD in summer and autumn, while alleviate it in winter and spring.

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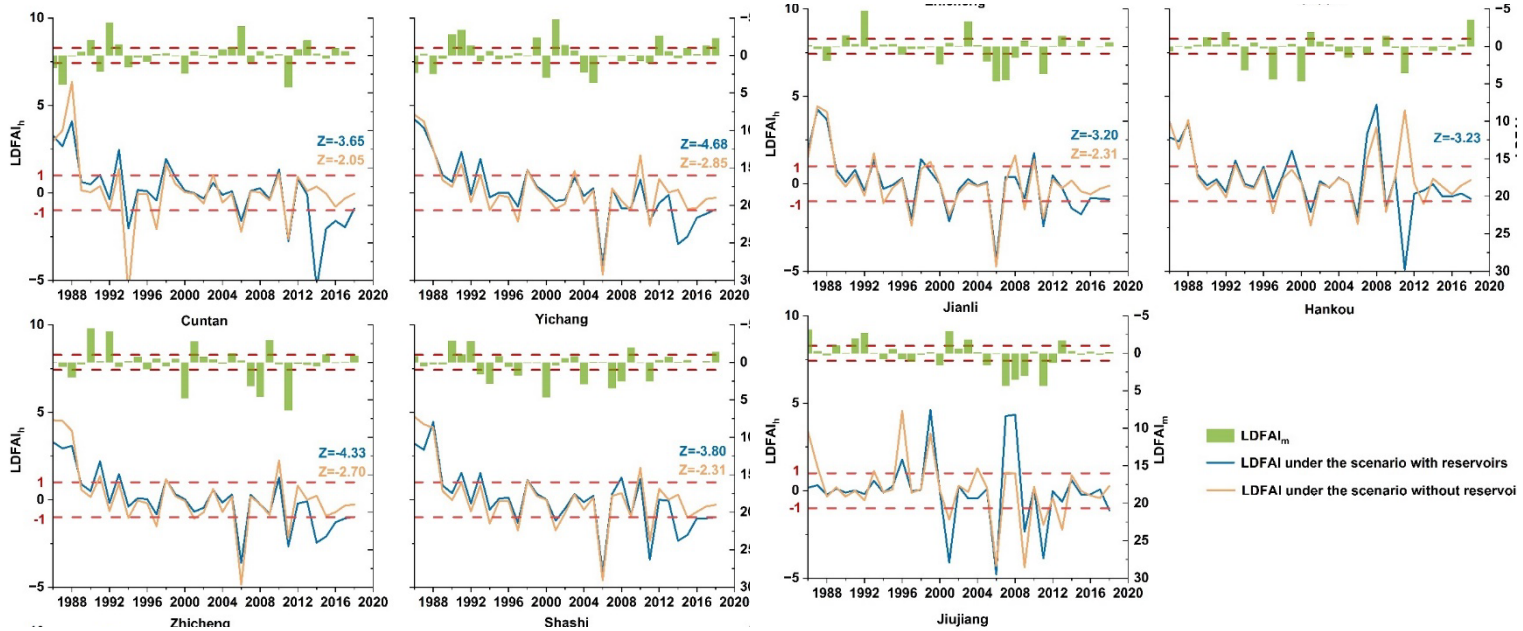
➢ 4.Results 4.4 Influence of cascading reservoirs on DFAA



Comparison of $LDFAI_m$, $LDFAI_{hr}$, and $LDFAI_h$ for 7 stations

The operation of cascading reservoirs has a significant mitigation effect on DTF events in the downstream section but aggravates the occurrence of FTD events in this region.

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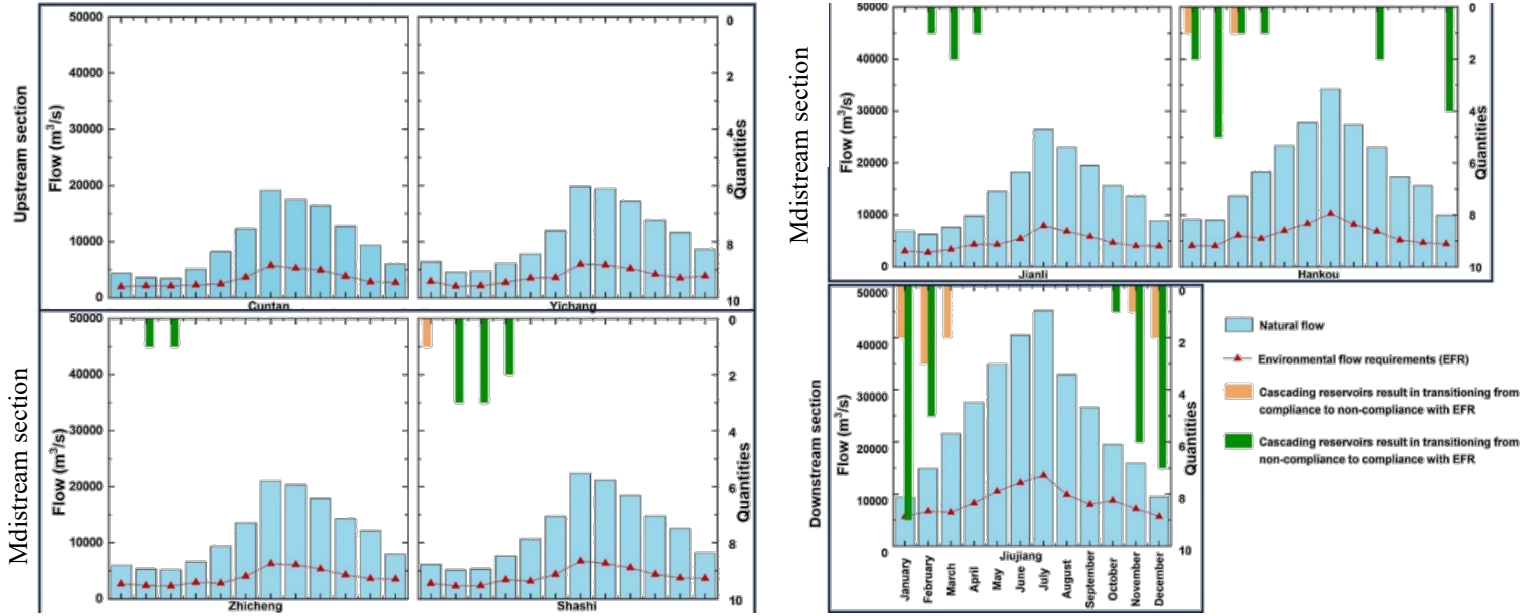
➢ 5.Disscussion

Influence of cascading reservoirs on environmental flow



Environmental flow requirements (EFR) in each month at 7 stations; Cascading reservoirs result in transitioning from non-compliance to compliance with EFR and from compliance to non-compliance with EFR.

Cascading reservoirs result in an average 7-time transition from non-compliance to compliance with EFR at stations in the midstream section between December and May. For stations in the downstream section, there are 28 times of transitioning from non-compliance to compliance with EFR between October and March and 10 times of transitioning from compliance to non-compliance with EFR.

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➢ 6. Take home message

- MD events prevalent in autumn (August to November), while HD events concentrate in s ummer (May to August).

- Cascading reservoirs significantly aggravated HD and FTD in summer and autumn, but their positive impacts on environmental flow requirements in some months compensate for the negative impacts in other months.

Thank you!