Supplement of Hydrol. Earth Syst. Sci., 29, 159–177, 2025
https://doi.org/10.5194/hess-29-159-2025-supplement

Hydrology and Earth System Sciences
Open Access
EGU

Supplement of

Can system dynamics explain long-term hydrological behaviors? The role of endogenous linking structure

Xinyao Zhou et al.

Correspondence to: Xinyao Zhou (zhouxy@sjziam.ac.cn) and Yonghui Yang (yonghui.yang@sjziam.ac.cn)

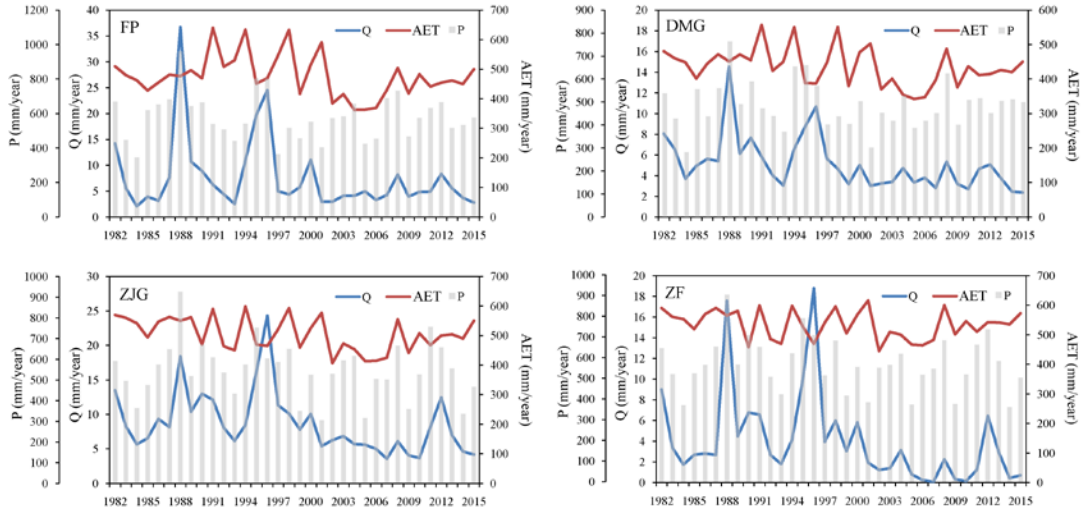

Figure S1 Rainfall, AET, and streamflow in the four catchments of study area.

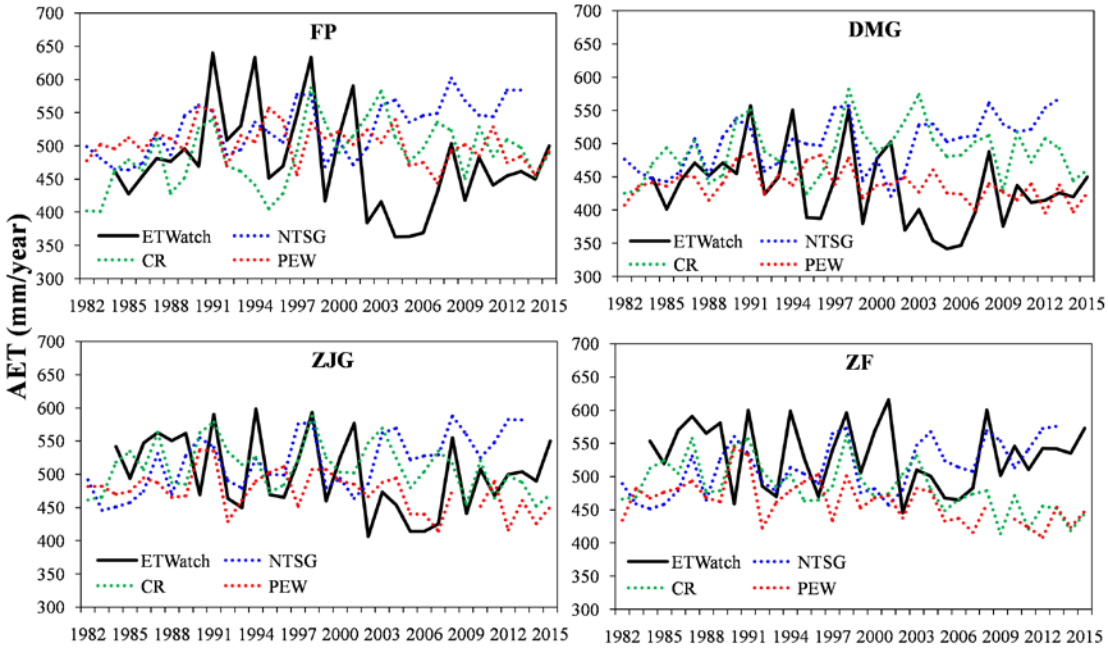

Figure S2 Intercomparison of four actual evapotranspiration products in study area.

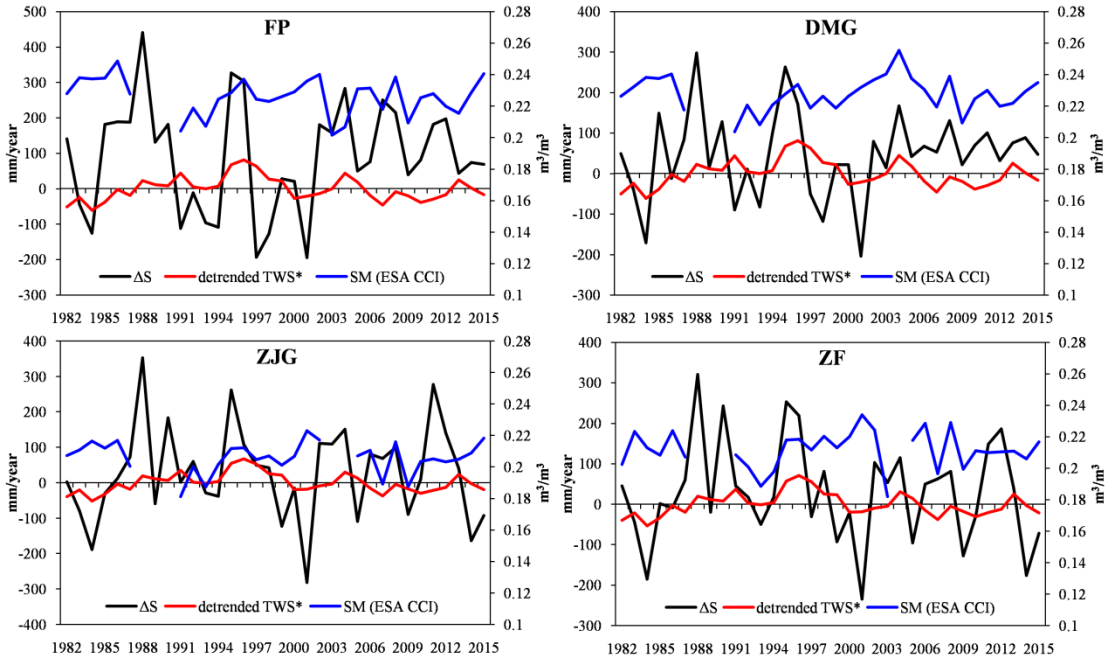

Figure S3 Comparison of water budget (ΔS, unit: mm/year), detrended TWSA (unit: mm/year), and satellite-derived soil moisture (unit: m^3/m^3).

*Details of detrended TWSA data can be obtained from Li et al., 2021.

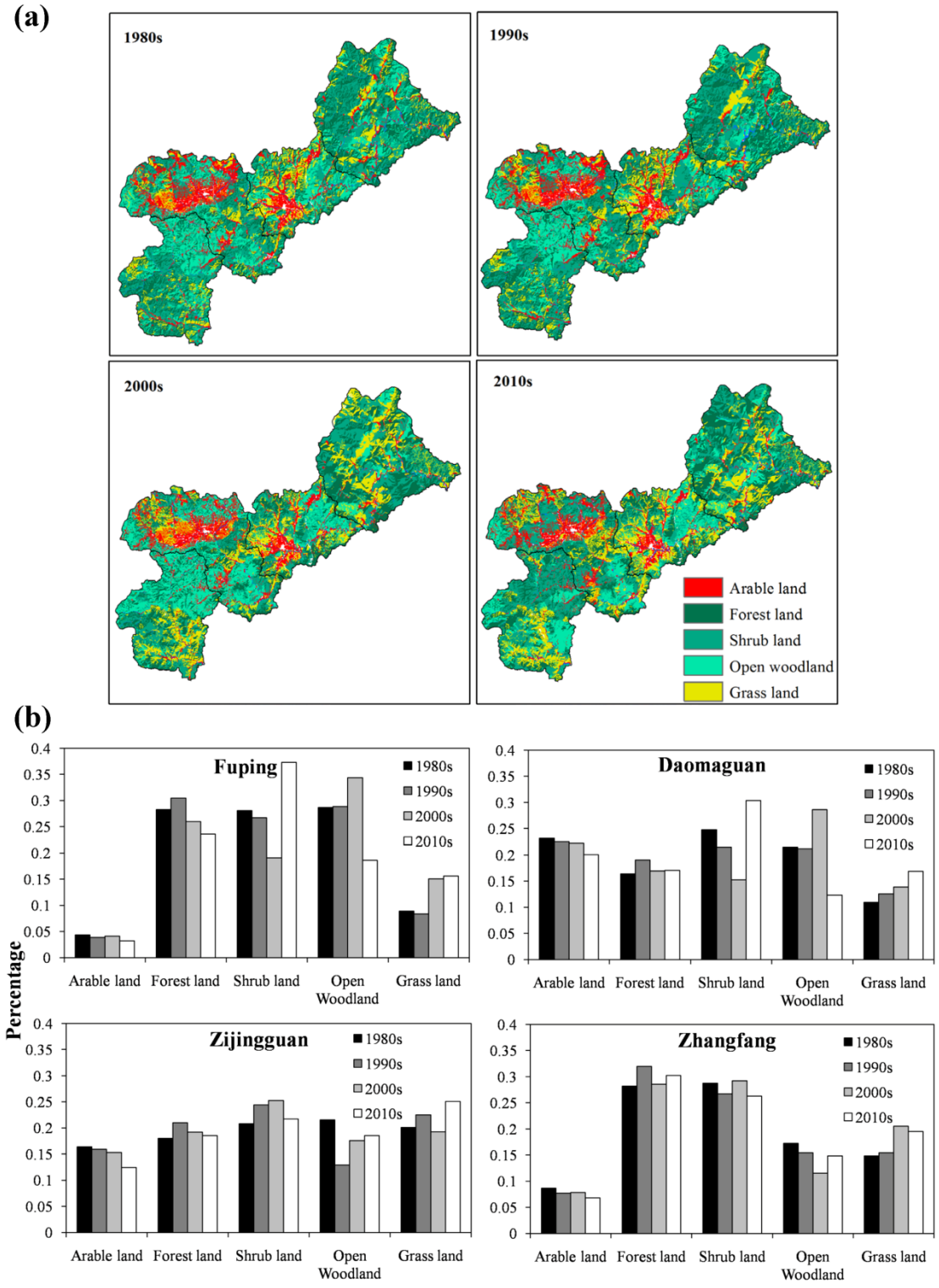

Figure S4 Land use change from 1980s to 2010s

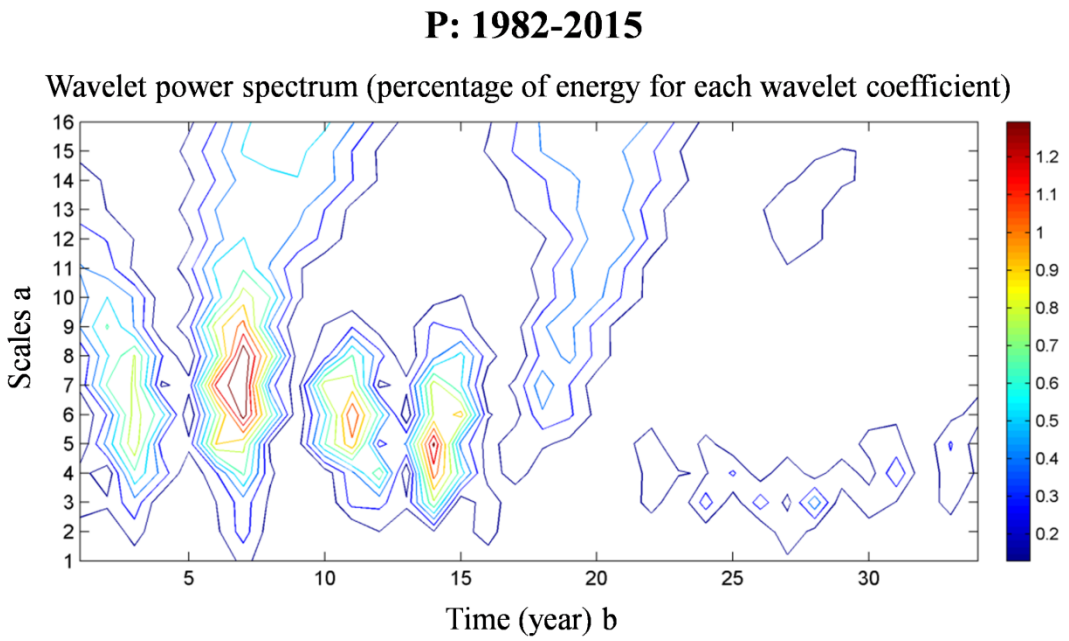

Figure S5 Wavelet analysis of rainfall in the period of 1982-2015. The rainfall is the average of four catchments.

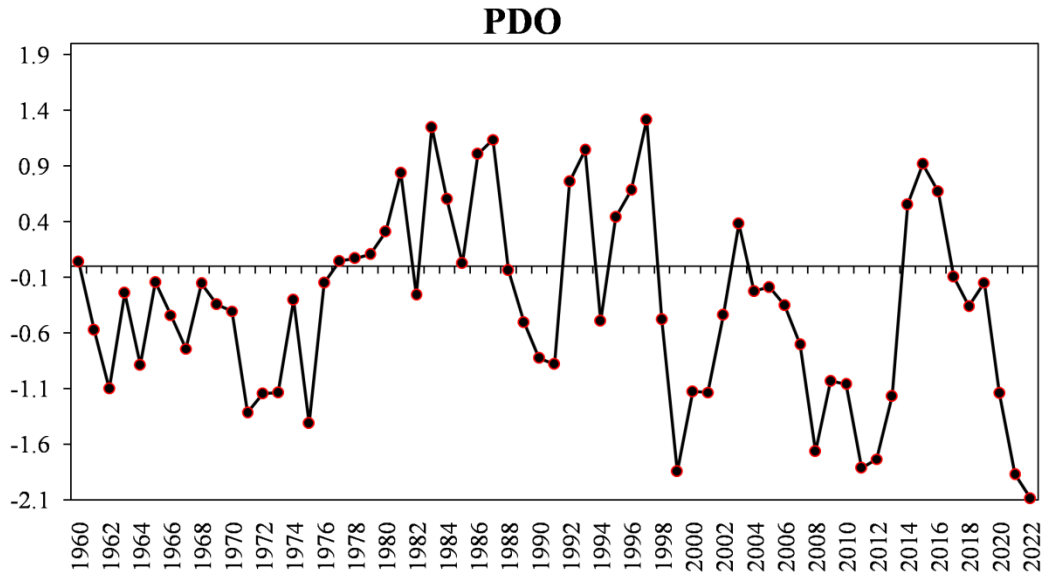

Figure S6 The PDO Index from 1960 to 2022. The index was downloaded from website of https://www.ncdc.noaa.gov/teleconnections/pdo/

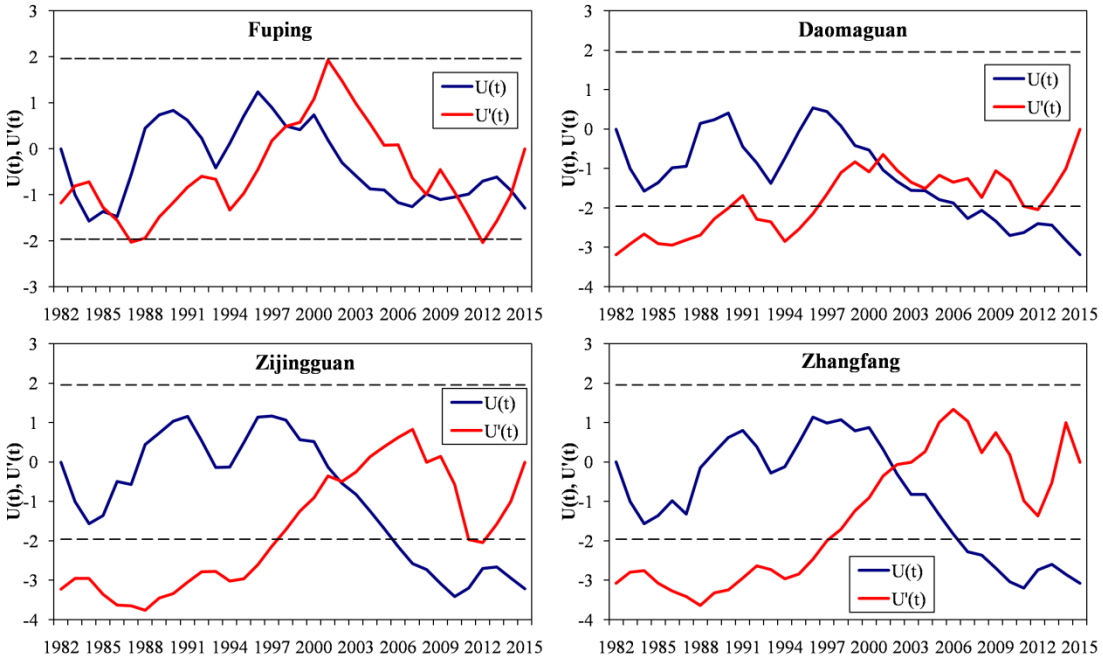

Figure S7 Significant decrease in streamflow with tipping point around 2000 in four catchments using Mann-Kendall analysis

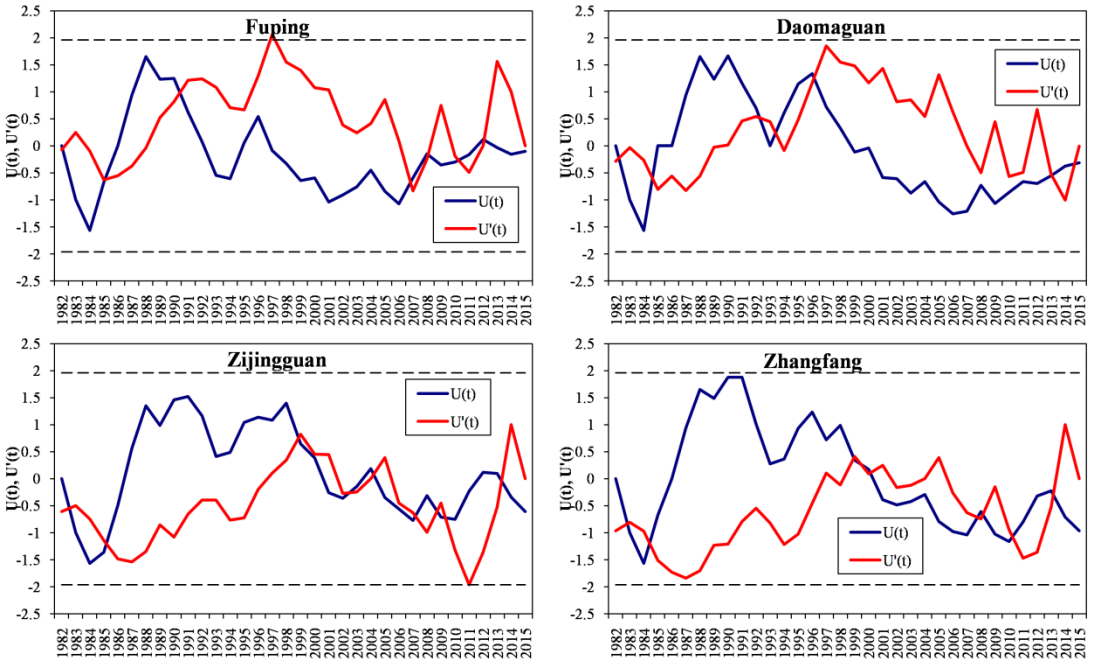

Figure S8 Insignificant decrease in precipitation in four catchments using Mann-Kendall analysis

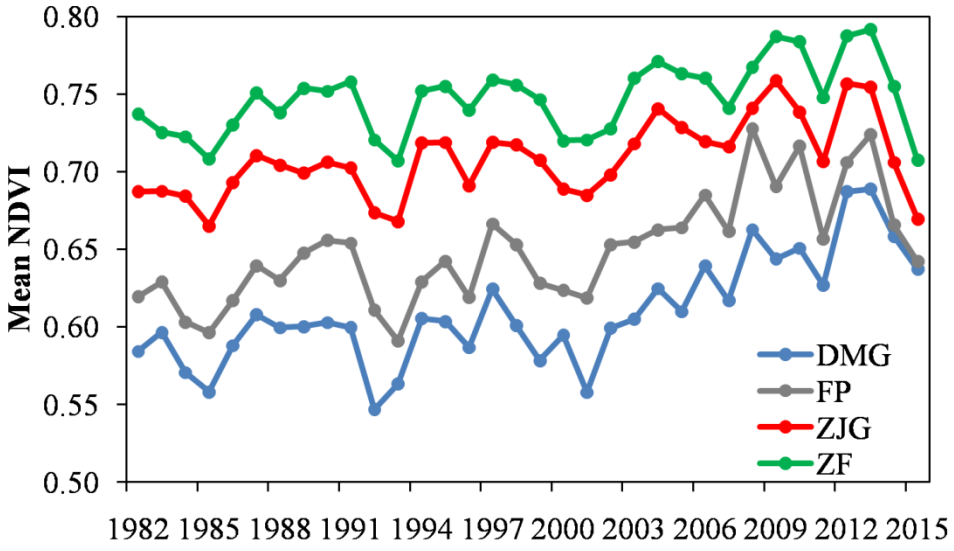

Figure S9 NDVI data in study area

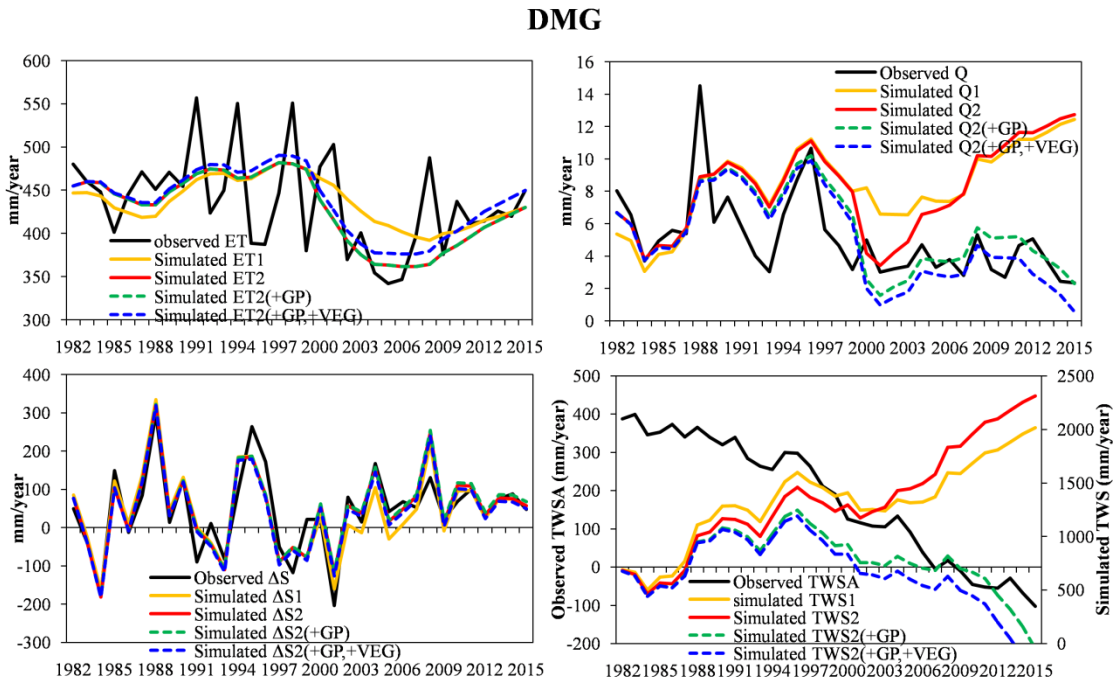

Figure S10 Observed and simulated evapotranspiration (ET), streamflow (Q), water budget (ΔS) and total water storage (TWS) using system dynamics approach for the DMG catchment. Yellow and red lines indicate the simulation without human intervention (GP=0 and VEG=0), with respectively fixed and varying desired soil moisture (ESMS). Green dashed line indicates simulation with groundwater pumpage

(GP), which increased at an exponential rate. Blue dash line is the simulation with GP and vegetation change (VEG) which is increasing at a linear rate.

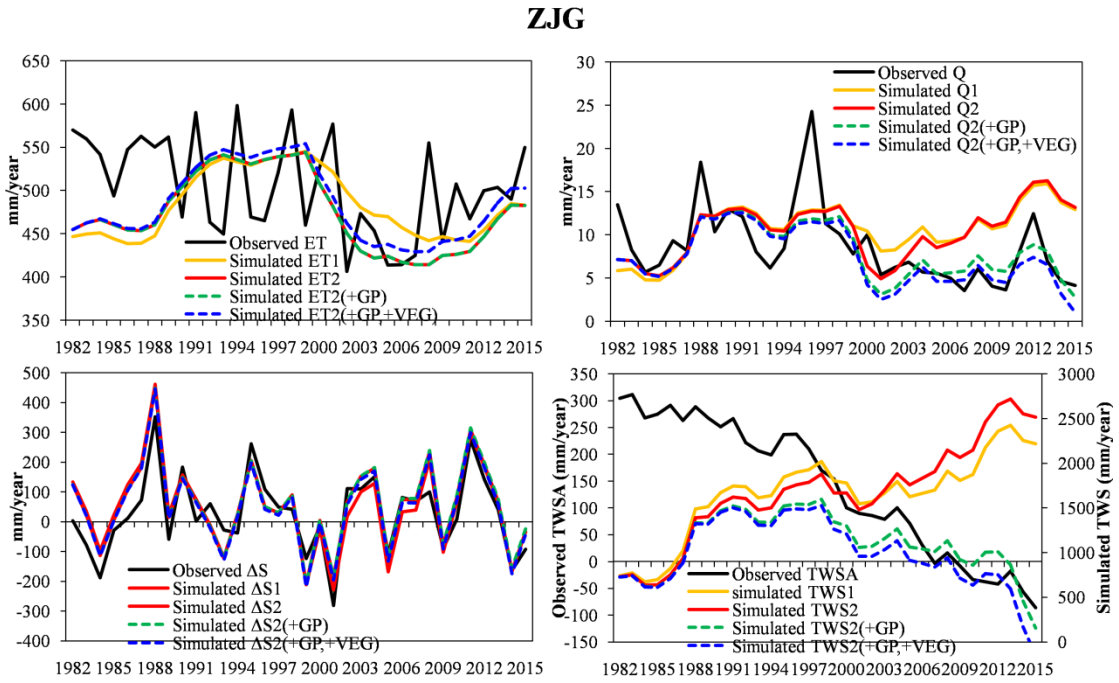

Figure S11 Same as above but for ZJG catchment

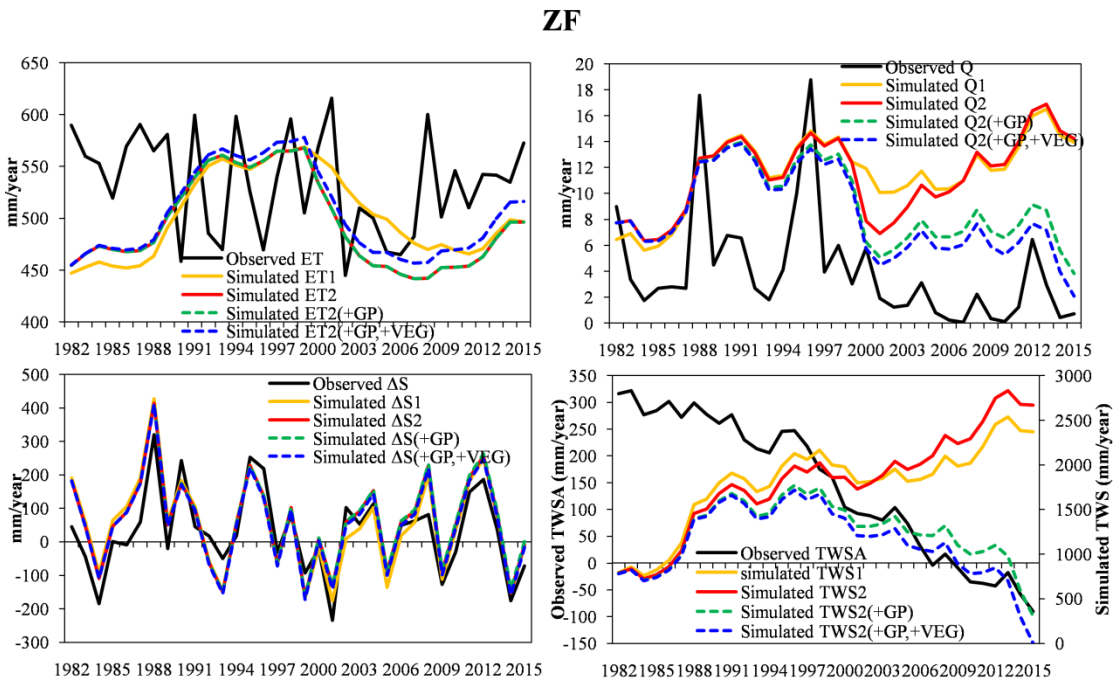

Figure S12 Same as above but for ZF catchment

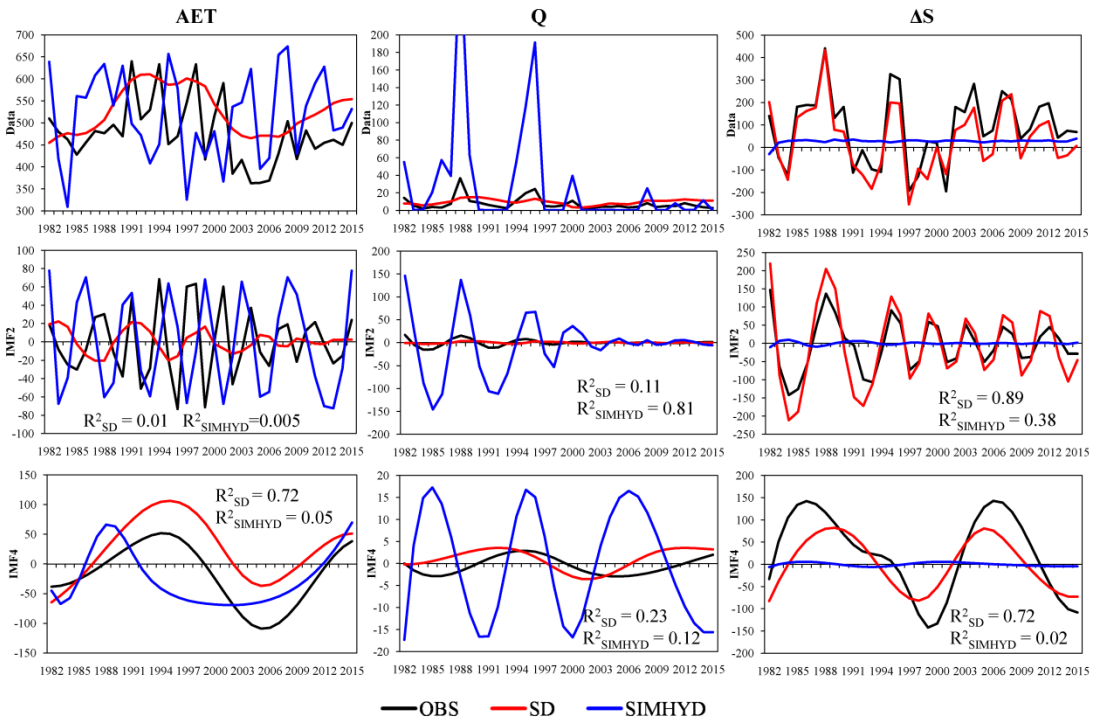

Figure S13 Comparison between the proposed system dynamics model and traditional rainfall-runoff model SIMHYD on simulating short- and long-term hydrological dynamics in Fuping catchment in China as example. The comparison is conducted by the empirical model decomposition method. OBS is observations, SD is system dynamics model. Here the results of SD model were obtained with varied ESMS (expected soil moisture stock, see eq. 6 in the main text), without VEG and GP which mimic human activity parameters for, respectively, vegetation-related activities such as reforestation, and groundwater pumpage. IMF is the intrinsic mode functions which can be used to extract different resolutions from the data without the use of fixed functions or filters.