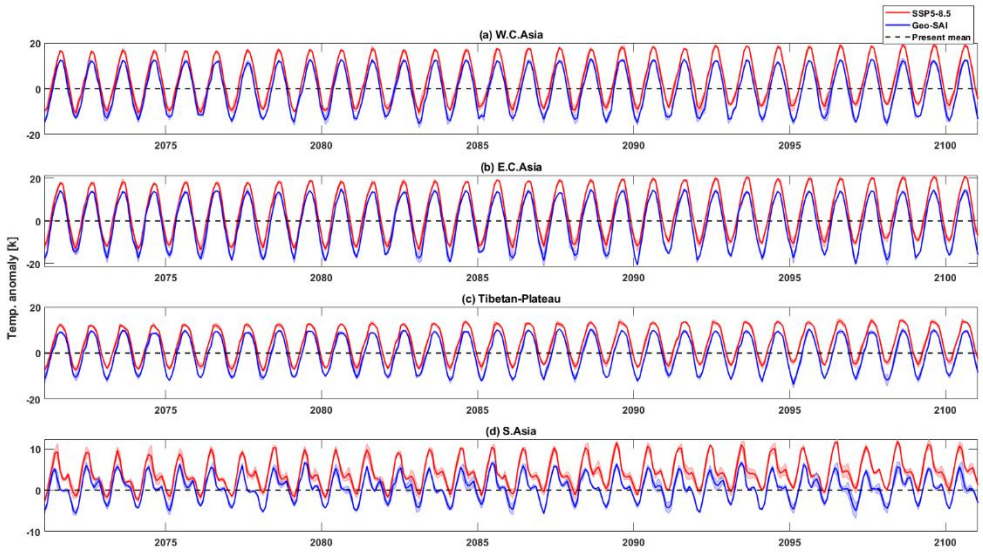


Figure S1. The temperature anomaly relative to the temperature averaged over the present-day conditions (2015-2035) across CSATP under global warming (SSP5-8.5) and with Geo-SAI (SSP5-8.5-SAI). The sub-regions a-d are WCA, ECA, TP and SA, respectively. Shading in each curve shows the across-ensemble range. The dashed line crossing the y-axis at zero in each subplot is the ensemble mean of temperature over the historical period (1985–2014).

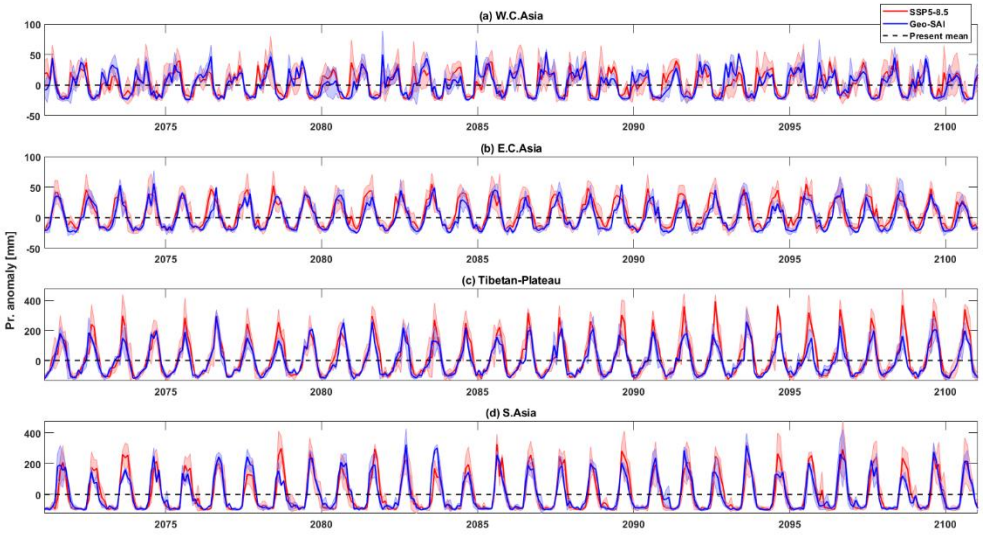
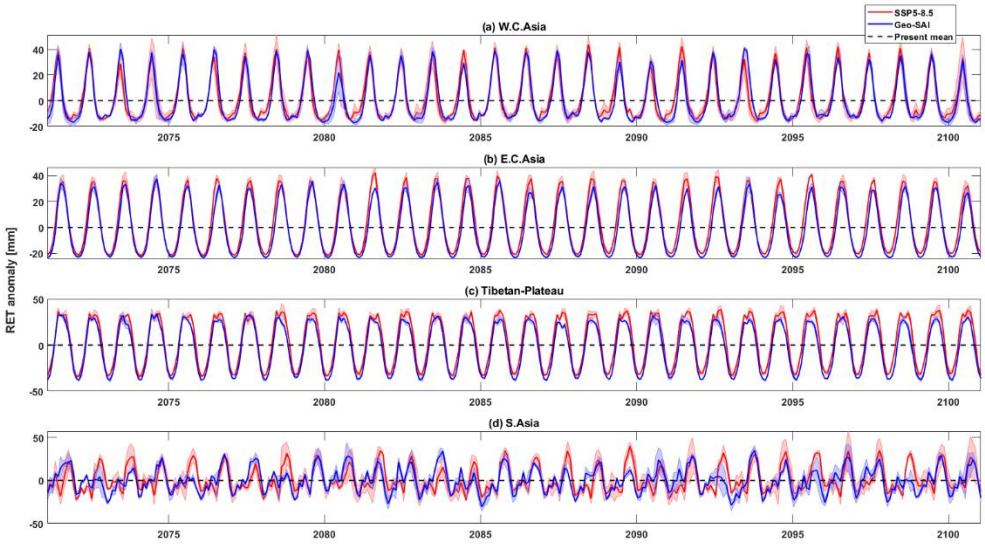
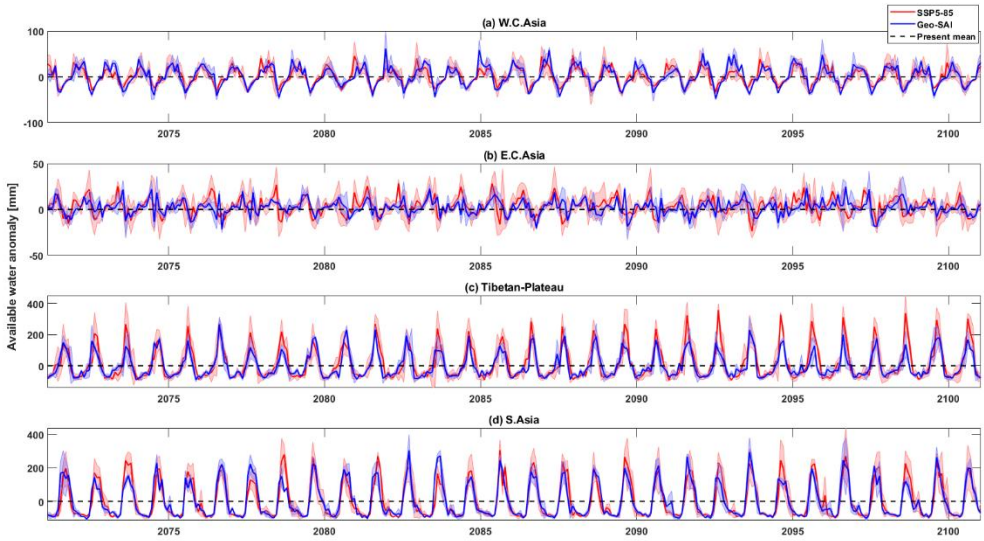


Figure S2. Same as Figure S1, but for precipitation anomaly.



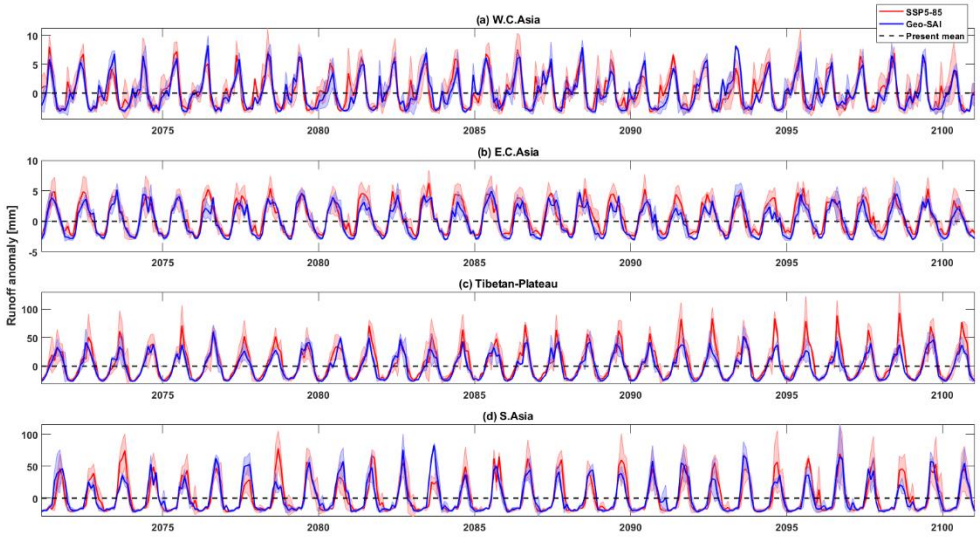
10

11 **Figure S3**. Same as Figure S1, but for Real ET anomaly



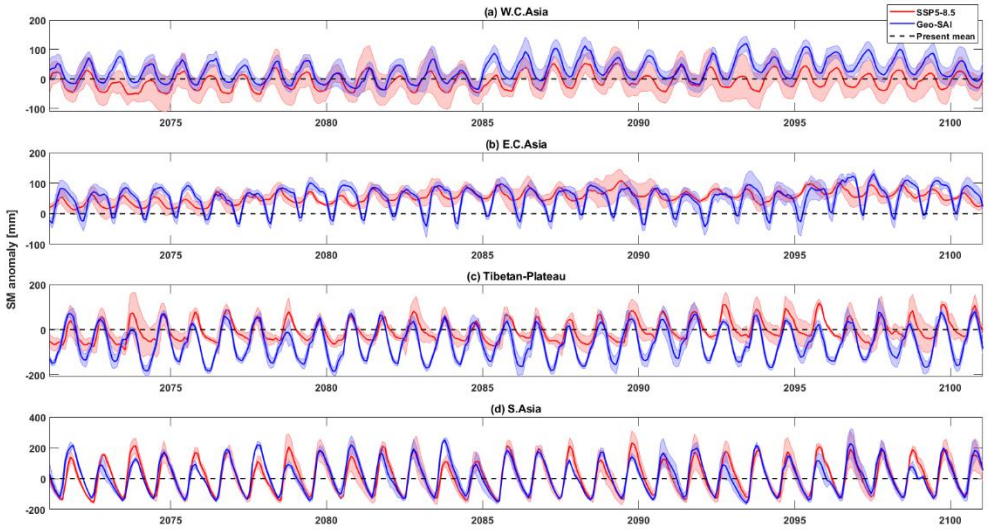
12

13 **Figure S4**. Same as Figure S1, but for available water anomaly.



14

15 **Figure S5**. Same as Figure S1, but for runoff anomaly.



16

17 **Figure S6**. Same as Figure S1, but for soil moisture anomaly.

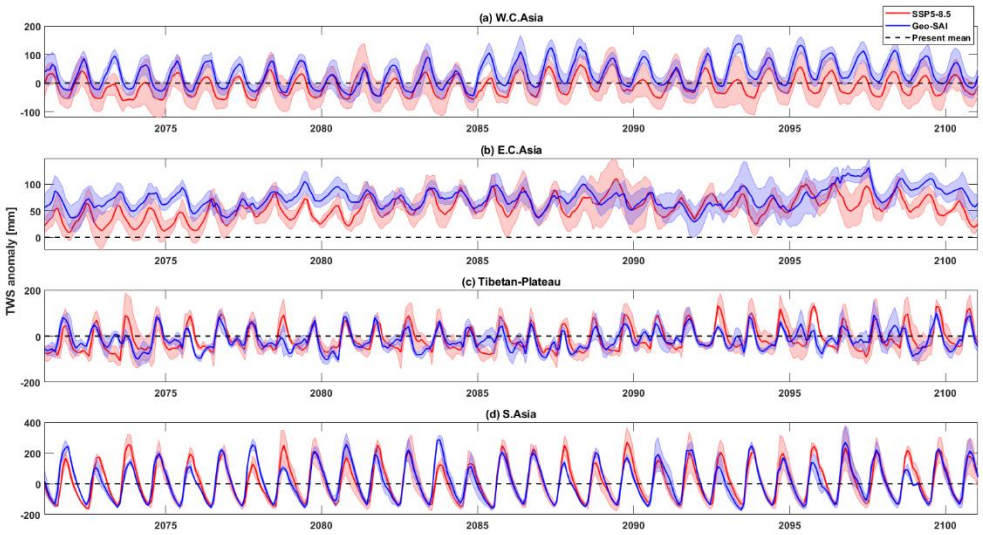


Figure S7. Same as Figure S1, but for TWS anomaly

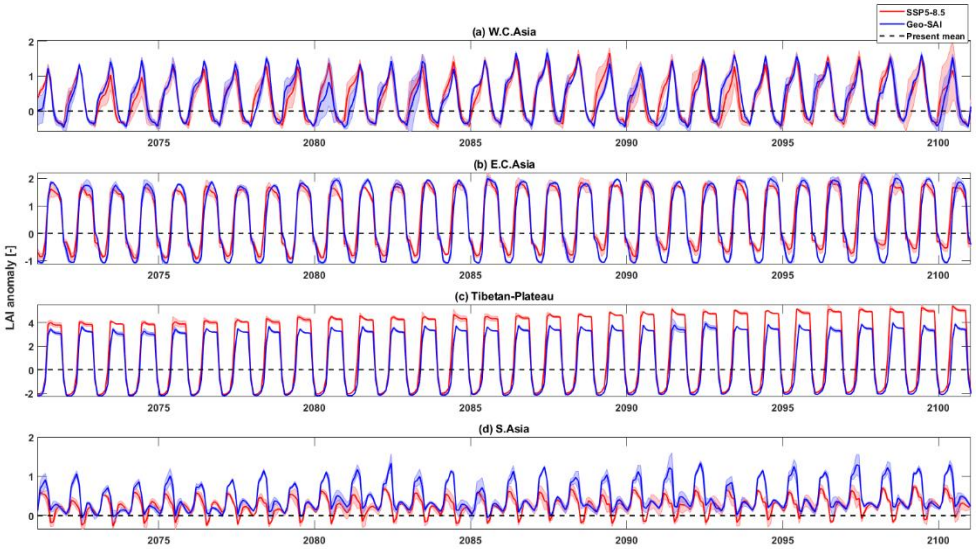


Figure S8. Same as Figure S1, but for Leaf Area Index anomaly.

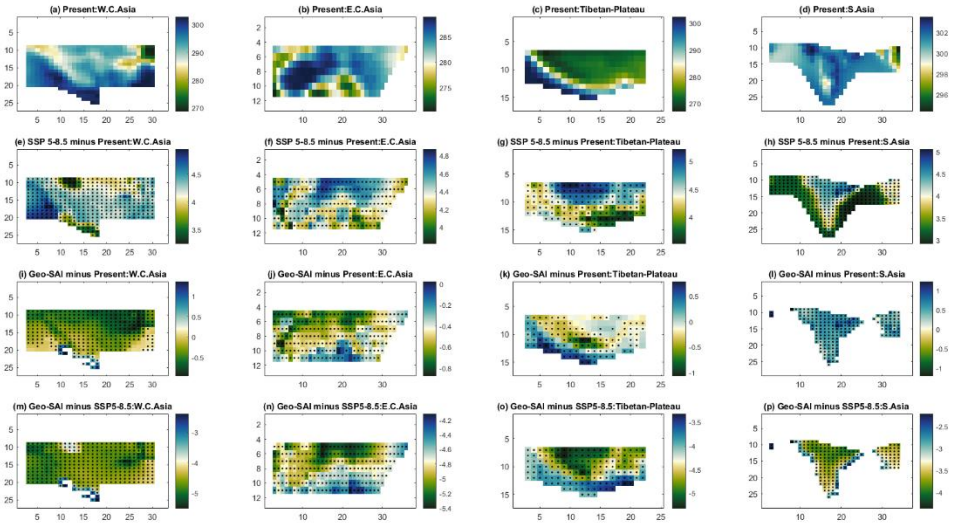


Figure S9. Ensemble mean maps of temperature over W.C. Asia (first column), E. C. Asia (second column), Tibetan Plateau (third column), and S. Asia (fourth column) in the present-day conditions (2015–2035), SSP minus baseline, SAI minus baseline and SAI minus SSP5-8.5 during 2071–2100. Dotted regions indicate the significant change in ensemble members.

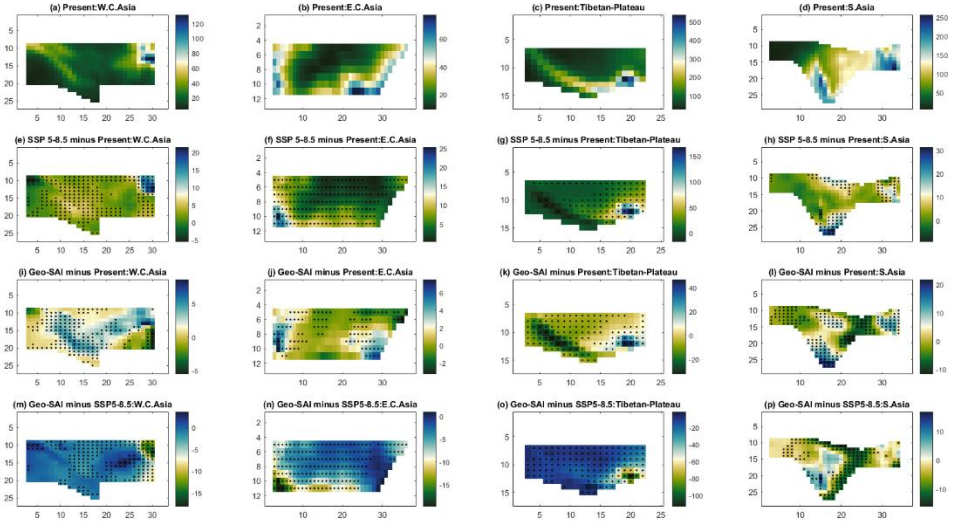


Figure S10. Same as Figure S9, but for precipitation.

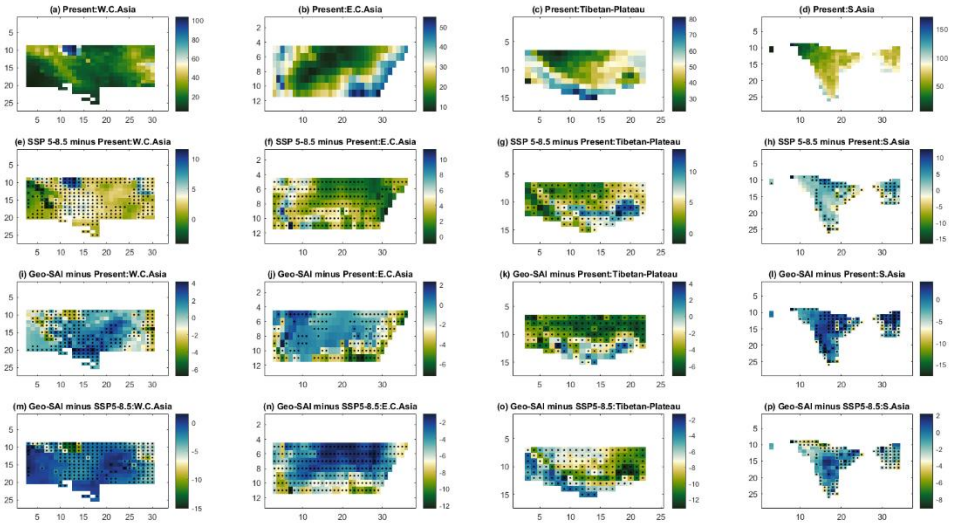


Figure S11. Same as Figure S9, but for RET.

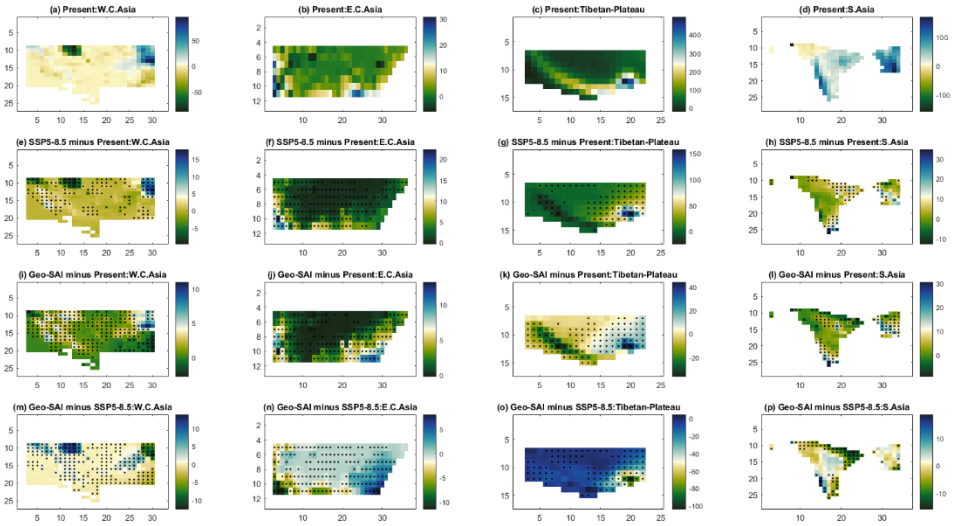
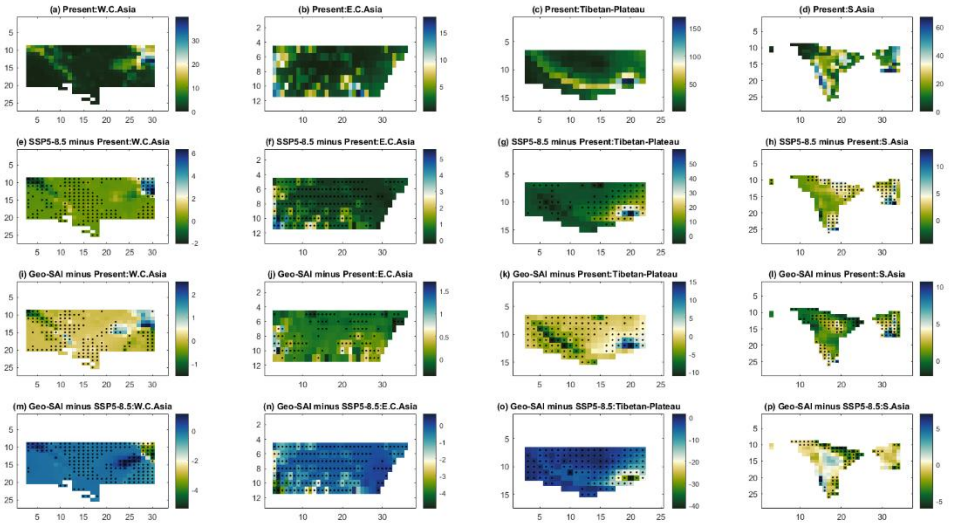
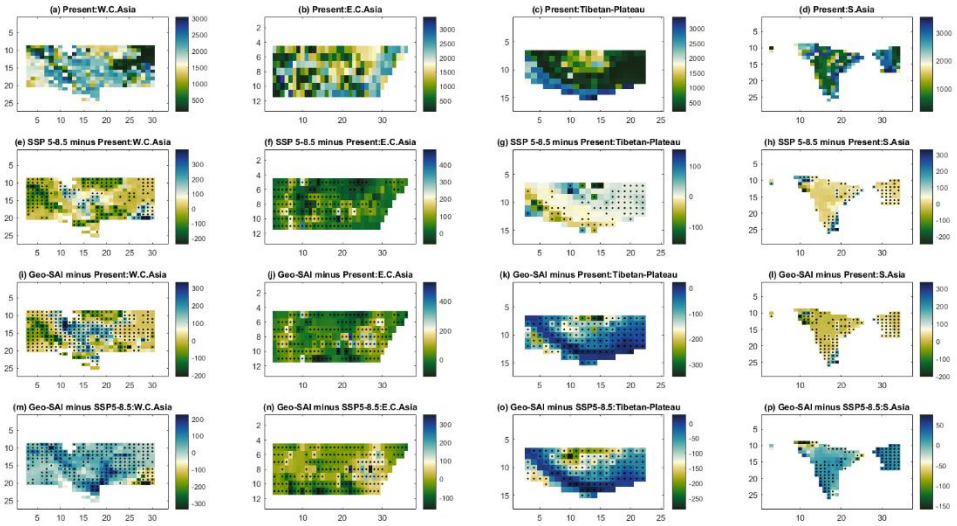


Figure S12. Same as Figure S9, but for Available water.



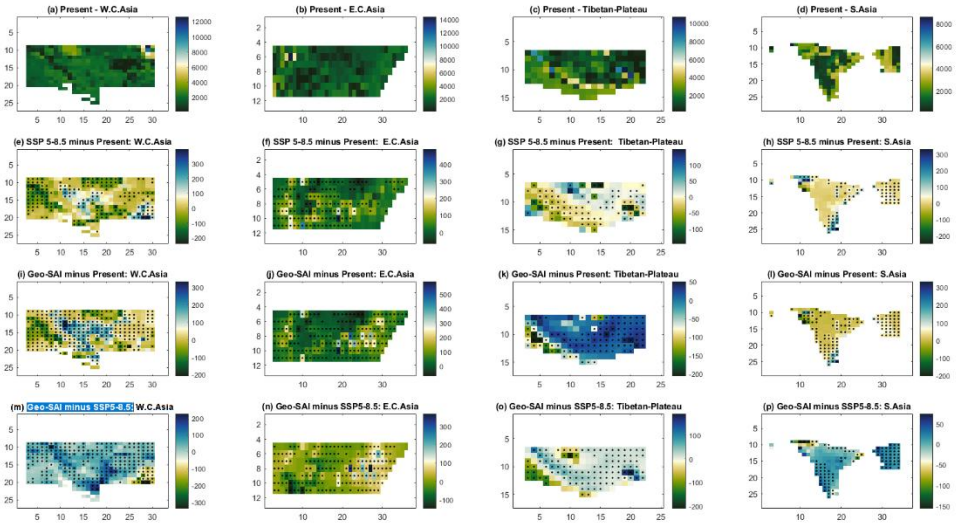
35

36 **Figure S13**. Same as Figure S9, but for runoff.



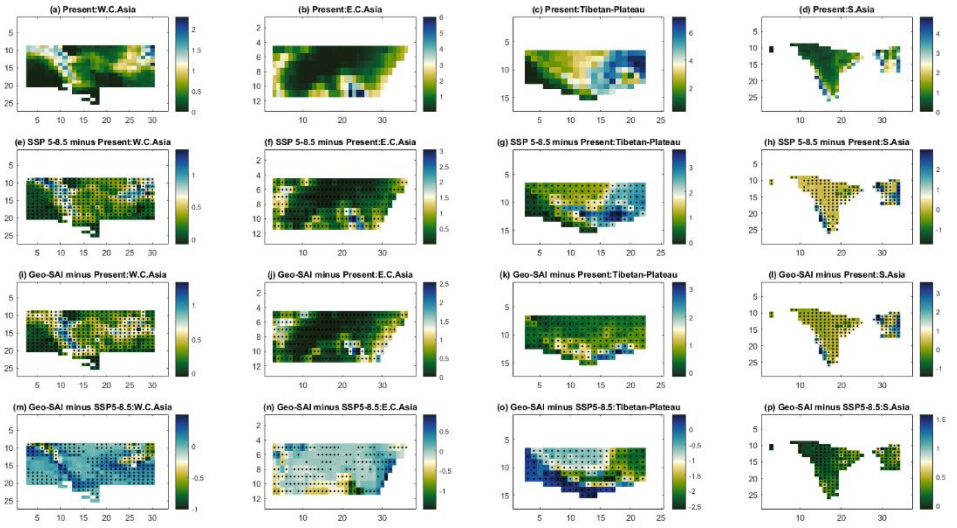
37

38 **Figure S14**. Same as Figure S9, but for soil moisture.



39

40 **Figure S15.** Same as Figure S9, but for TWS.



41

42 **Figure S16**. Same as Figure S9, but for LAI.

43