# Supplement:

Table S1. The differences in annual mean temperature and precipitation based on WFD and OBS during 1961-2001 for the four river basins.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| River | Annual precipitation | | | Annual mean temperature | | |
| OBS(mm) | WFD (mm) | Difference (%) | OBS(℃) | WFD(℃) | Difference (℃) |
| SYR | 246.1 | 282.1 | 14.6 | 5.2 | 2.7 | -2.5 |
| CBR | 570.7 | 476.5 | -20.0 | 9.2 | 5.1 | -4.1 |
| HHR | 917.6 | 898.7 | -2.1 | 14.9 | 14.8 | -0.1 |
| FJR | 906.0 | 894.6 | -1.3 | 16.5 | 15.6 | -0.9 |

Table S2. The agreements in annual mean, maximum and minimum temperature, and mean annual precipitation based on WFD and downscaling climate data from five GCMs during 1961-2001 for the four river basins.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| River | GFDL-ESM2M | HadGEM2-ES | IPSL-CM5A-LR | MIROC-ESM-CHEM | NorESM1-M |
| Difference in mean annual temperature (℃) | | | | |
| SYR | -0.01 | -0.03 | 0.02 | -0.00 | -0.03 |
| CBR | -0.01 | -0.02 | 0.08 | -0.03 | -0.01 |
| HHR | -0.01 | 0.01 | 0.07 | -0.03 | -0.05 |
| FJR | 0.31 | 0.31 | 0.36 | 0.33 | 0.29 |
| River | Difference in mean annual maximum temperature (℃) | | | | |
| SYR | 0.00 | 0.07 | 0.04 | 0.02 | 0.04 |
| CBR | 0.02 | 0.10 | -0.02 | 0.00 | 0.02 |
| HHR | 0.07 | 0.13 | 0.03 | 0.01 | 0.06 |
| FJR | 0.24 | 0.29 | 0.25 | 0.23 | 0.27 |
|  | Difference in mean annual minimum temperature (℃) | | | | |
| SYR | -0.01 | 0.03 | 0.01 | -0.01 | 0.01 |
| CBR | -0.03 | 0.08 | -0.02 | -0.01 | 0.00 |
| HHR | 0.00 | 0.05 | -0.05 | -0.07 | -0.04 |
| FJR | 0.37 | 0.41 | 0.39 | 0.34 | 0.35 |
| River | Difference in mean annual precipitation (%) | | | | |
| SYR | 14.8 | 7.8 | 13.3 | 6.3 | 5.2 |
| CBR | 9.7 | 8.2 | 9.1 | 8.0 | 6.3 |
| HHR | 4.9 | 5.4 | 5.3 | 3.9 | 4.8 |
| FJR | 11.0 | 5.6 | 8.7 | 10.4 | 7.2 |

Table S3. Sensitivity results for pre-define parameters by SWAT for the four river basins

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Rank | SYR | CBR | HHR | FJR |
| 1 | ALPHA\_BF | CN2 | CN2 | CN2 |
| 2 | GWQMN | ALPHA\_BF | GWQMN | ESCO |
| 3 | TIMP | GW\_DELAY | RCHRG\_DP | SOL\_AWC |
| 4 | CN2 | ESCO | ESCO | CANMX |
| 5 | SMTMP | GWQMN | SOL\_AWC | GWQMN |
| 6 | SOL\_AWC | CH\_N | GW\_REVAP | RCHRG\_DP |

Table S4. Definition of identified sensitive parameters in SWAT hydrological model for the four river basins

|  |  |  |
| --- | --- | --- |
| Parameters | Definition | Processes |
| ALPHA\_BF | Baseflow recession constant (days) | Groundwater |
| CANMX | Maximum canopy storage (mm H2O) | Runoff |
| CH\_N | Manning coefficient value | Channel |
| CN2 | SCS runoff curve number for moisture condition II | Runoff |
| ESCO | Soil evaporation compensation factor | Evaporation |
| GW\_DELAY | Delay time for aquifer recharge (days) | Groundwater |
| GW\_REVAP | Groundwater “Revap” coefficient (days) | Groundwater |
| GWQMN | Threshold water level in shallow aquifer for base flow (mm) | Soil |
| RCHRG\_DP | Deep aquifer percolation coefficient (fraction) | Groundwater |
| SMTMP | Threshold temperature for snow melt (°C) | Snow |
| SOL\_AWC | Soil available water capacity (mm/mm soil) | Soil |
| TIMP | Snow temperature lag factor | Snow |

Table S5.The mean of middle-year of the 30-year samples for all GCMs under RCPs and under 1.5℃ or 2℃ global warming scenarios.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| threshold | RCP2.6 | RCP4.5 | RCP6.0 | RCP8.5 |
| 1.5℃ | 2029 | 2030 | 2032 | 2025 |
| 2.0℃ | × | 2049 | 2053 | 2038 |

Table S6. The agreements in simulated mean annual runoff and evapotranspiration based on WFD and downscaling climate data from 5 GCMs during 1961-2001 for the four river basins.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| River | GFDL-ESM2M | HadGEM2-ES | IPSL-CM5A-LR | MIROC-ESM-CHEM | NorESM1-M |
| Difference in mean annual runoff (%) | | | | |
| SYR | 16.2 | 25.3 | 16.6 | 14.4 | 12.7 |
| CBR | -19.3 | 21.5 | 0.5 | -9.1 | -2.3 |
| HHR | -7.2 | 23.7 | 9.3 | 6.3 | 3.8 |
| FJR | -6.2 | -16.7 | 6.3 | 0.0 | -4.3 |
| River | Difference in mean annual evapotranspiration (%) | | | | |
| SYR | -3.3 | -37.7 | -4.7 | -19.8 | -17.6 |
| CBR | 12.4 | -0.5 | 6.6 | 7.5 | 3.2 |
| HHR | -1.8 | -8.1 | 0.8 | 3.2 | 4.8 |
| FJR | 15.5 | 13.4 | 4.7 | 11.7 | 12.7 |

# Figure Captions：

Figure S1. The differences in monthly mean temperature and monthly precipitation based on WFD and OBS in (a) SYR, (b) CBR, (c) HHR, and (d) FJR during 1961-2001.

Figure S2. The agreements in monthly mean temperature and mean precipitation based on WFD and downscaling climate data from five GCMs in (a) SYR, (b) CBR, (c) HHR, and (d) FJR during 1961-2001.

Figure S3. Observed and simulated monthly discharge during calibration period (1961-1990) and validation period (1991-2001) for (a) SYR, (b) Chaohe River, (c) Baihe River, (d) HHR, and (e) FJR.

Figure S4. Observed and simulated flow duration curve based on monthly discharge during 1961-2001 for (a) SYR, (b) Chaohe River, (c) Baihe River, (d) HHR, and (e) FJR.

Figure S5. The agreements in simulated mean monthly runoff and mean monthly evapotranspiration based on WFD and downscaling climate data from 5 GCMs during 1961-2001 for (a) SYR, (b) CBR, (c) HHR, and (d) FJR.