Supplementary Material

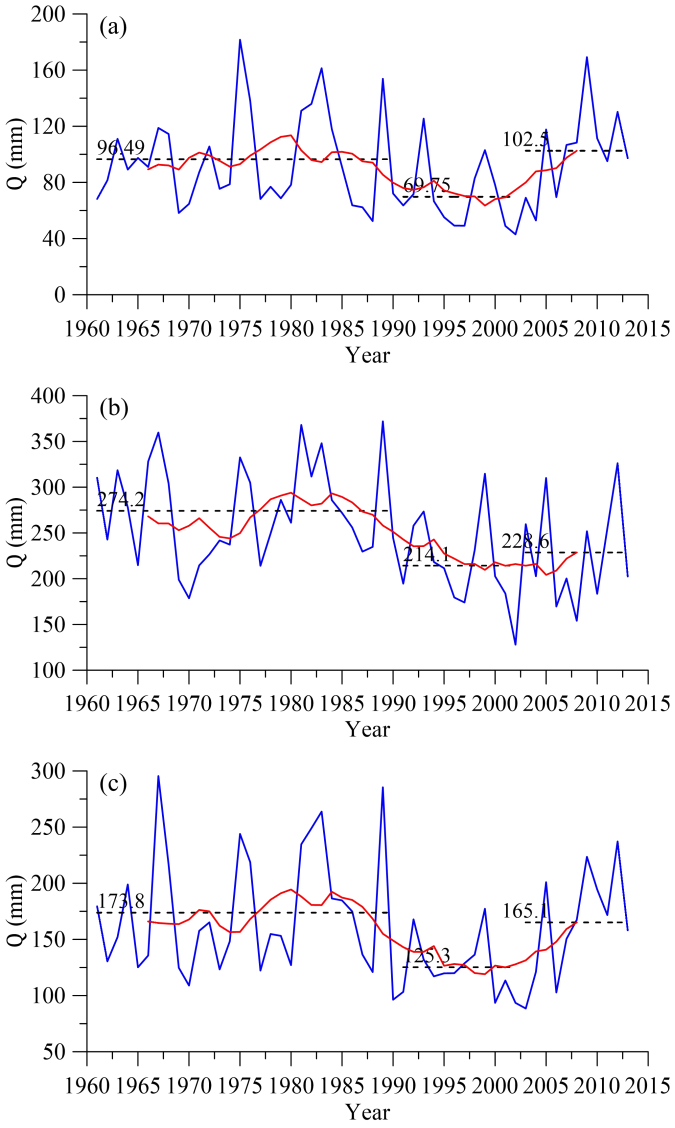

Figure 1 Discharge change in the three sub-basins JM(a), MQ(b) and TNH(c).

As shown in Fig. 1, river discharge changes dramatically between 2003-2013 period so-called return period in this study. Firstly, we test if 11-year average is efficient to remove the ground water storage change in period 2003-2013 in the three sub-basins. Because there are no enough well level observations, we choose GRACE RL 05 Level 03 monthly landmass datasets from GFZ, CRS, JPL to indicate the water storage change, these datasets translate gravity change in centimeters of equivalent water thickness(EWT) and resolution is 1×1 degree.

1×1 km resolution point of three sub-basins were used to extract monthly EWT values from the three datasets and the annual mean values of the three datasets were used to indicate the annual water storage change. And the results are shown as fallowing:

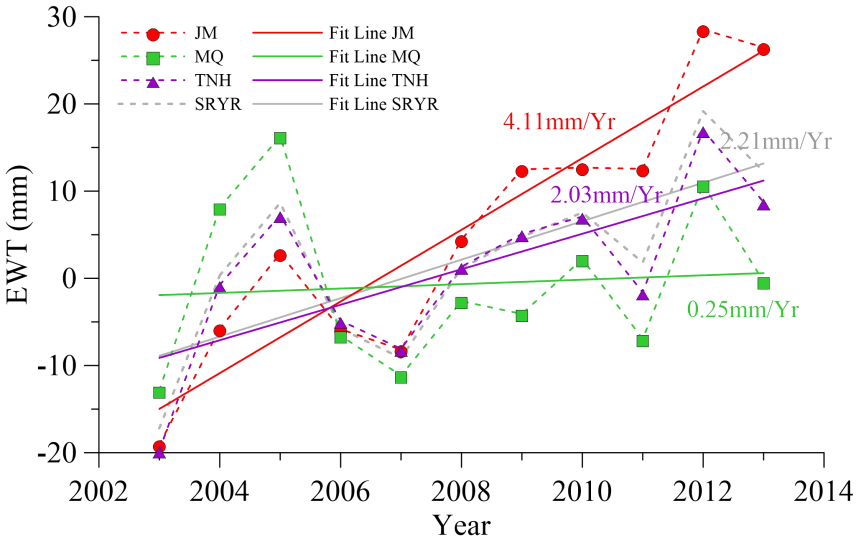

Fig 2 Change in water storage for the 2003-2013 period.

As shown in this fig 2, EWT increase rate are 4.11 mm/a, 0.25 mm/a and 2.03 mm/a in JM, MQ and TNH, respectively. The 11-year mean grounder water change value of these three sub-basins are 4.11 mm, 0.25 mm and 2.03 mm, respectively. And for the SRYR is 2.21 mm as indicated in this figure. These value is negligible in this study.

Because GRACE Dataset records begin in April 2002, so only 2003-2013 water storage change can be estimated from GRACE Dataset. As shown in Fig. 1, discharge change value of period 2003—2013 is more considerable in JM and TNH than MQ, and EWT change shown similar results in Fig 2. For absent of Grace Data of other periods. We assume water storage change is positive correlated with discharge change. We use following equation to calculate the other period water storage change:

$$\Delta S = \Delta S_r * \frac{\Delta Q}{\Delta Q_r}$$

Period 2003-2013 is used as a reference period. ΔS,ΔQ are water storage change rate and discharge change rate in 11-year period, respectively. ΔS_r, ΔQ_r are respective values of 2003-2013.

Then water storage change is calculated in 11-year water balance:

$$E = P - Q - \Delta S$$

Finally, recalculated E, P are used to obtain recalculated w based on Fu's equation, results shown in following fig. 3, Dash line in the figure indicates recalculated w values of the three sub-basins considered water storage change. As shown in the figure, the results changed lightly after consider water storage change in 11-year period water balance.

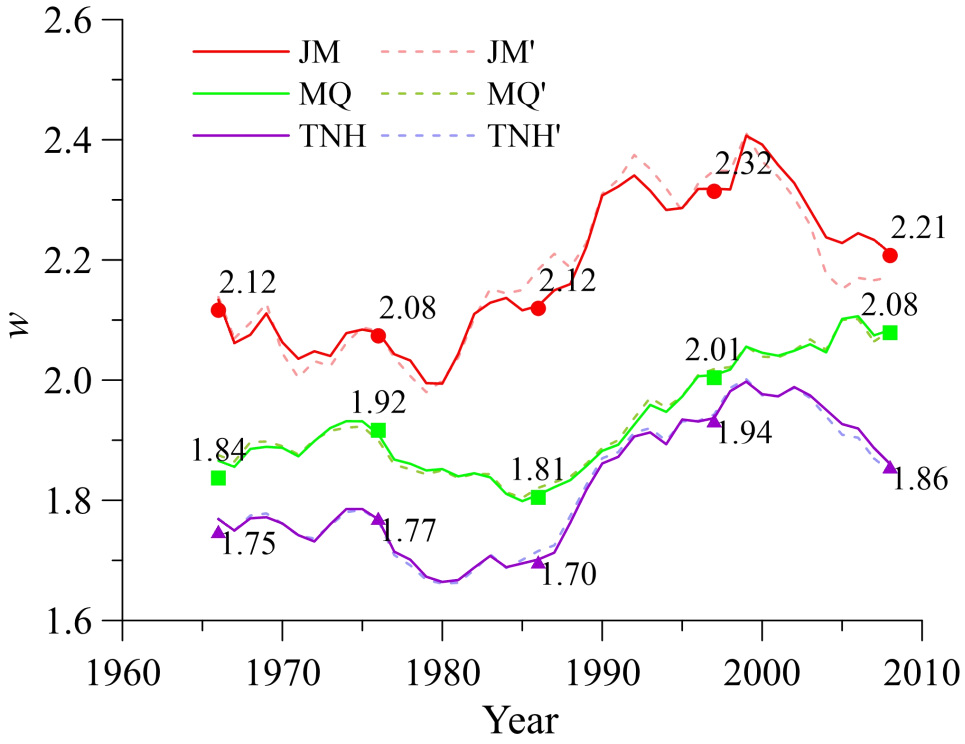

Figure 3 Water storage change impacts on the *w* value. The dashed lines indicate recalculated results in considering water storage change.