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Responses of Streamflow and Sediment Discharge to Soil Conservation Measures

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Soil conservation measures

陕西 绥德 韭园沟淤地坝



Sediment trapping dams

- Reduce sediment loads
- Conserve water
- Increase cropping area





Soil conservation measures

Afforestation:

- Control soil erosion
- Improve water quality
- Reduce deep drainage





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Soil conservation measures



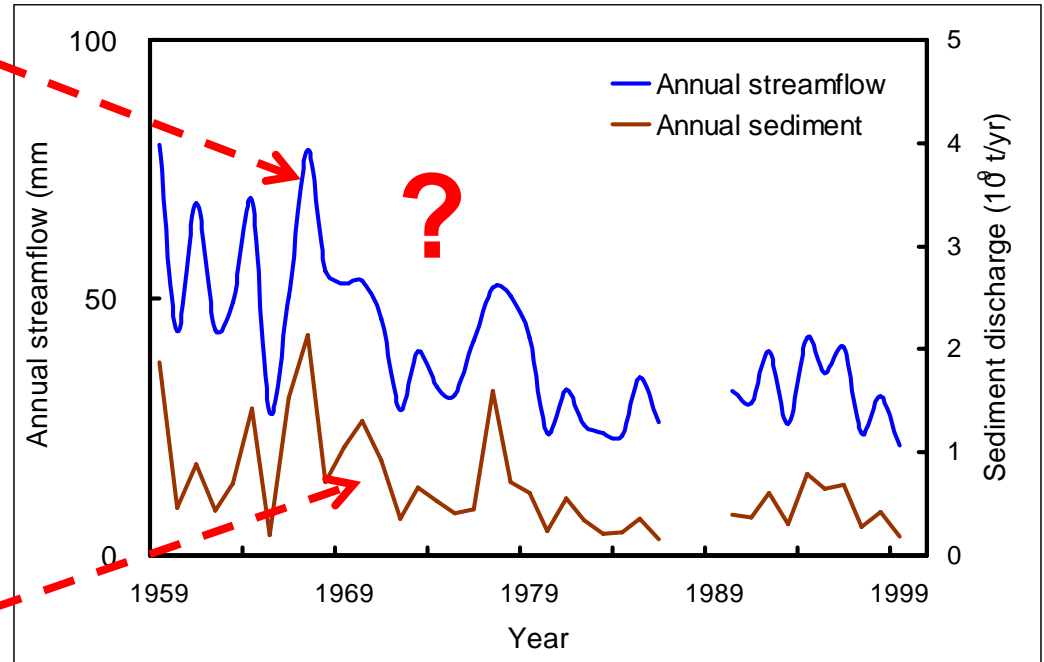
Terraces:

- Control soil erosion
- Conserve soil water





Have they caused any changes?

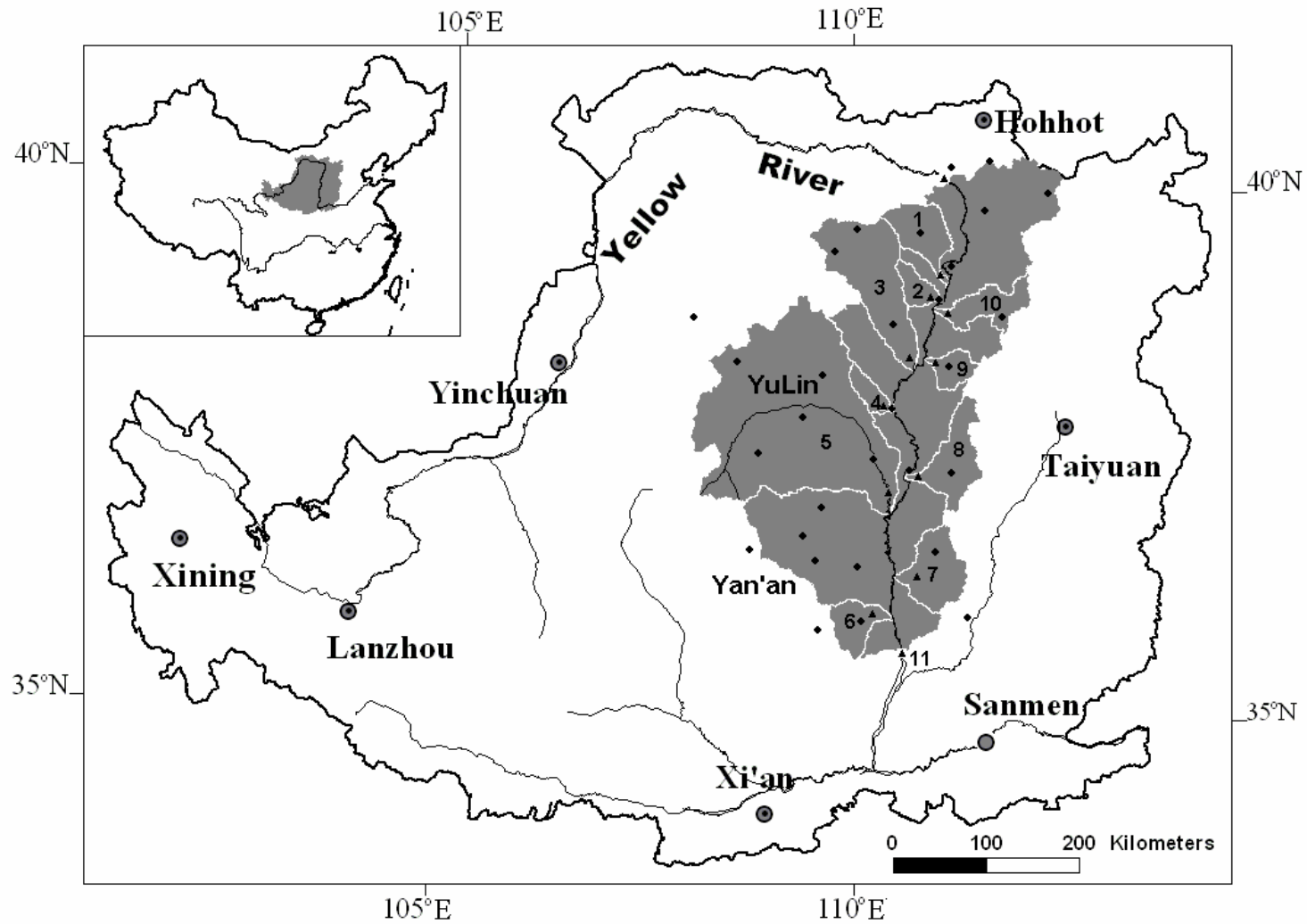




Study area



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Identifying changes

Trend identification:

The Mann-Kendall test statistic is given by

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^n \text{sgn}(x_j - x_k)$$

Change point identification:

The non-parametric approach of Pettitt (1979):

$$U_{t,N} = U_{t-1,N} + \sum_{j=1}^N \text{sgn}(x_t - x_j)$$

$$k(t) = \text{Max}_{1 \leq t \leq N} |U_{t,N}|$$



Assessing climatic and LUCC impacts



Total change in Q:

$$\Delta Q^{tot} = \overline{Q}_2^{obs} - \overline{Q}_1^{obs}$$



Assume:

$$\Delta Q^{tot} = \Delta \overline{Q}^{clim} + \Delta \overline{Q}^{LUCC}$$



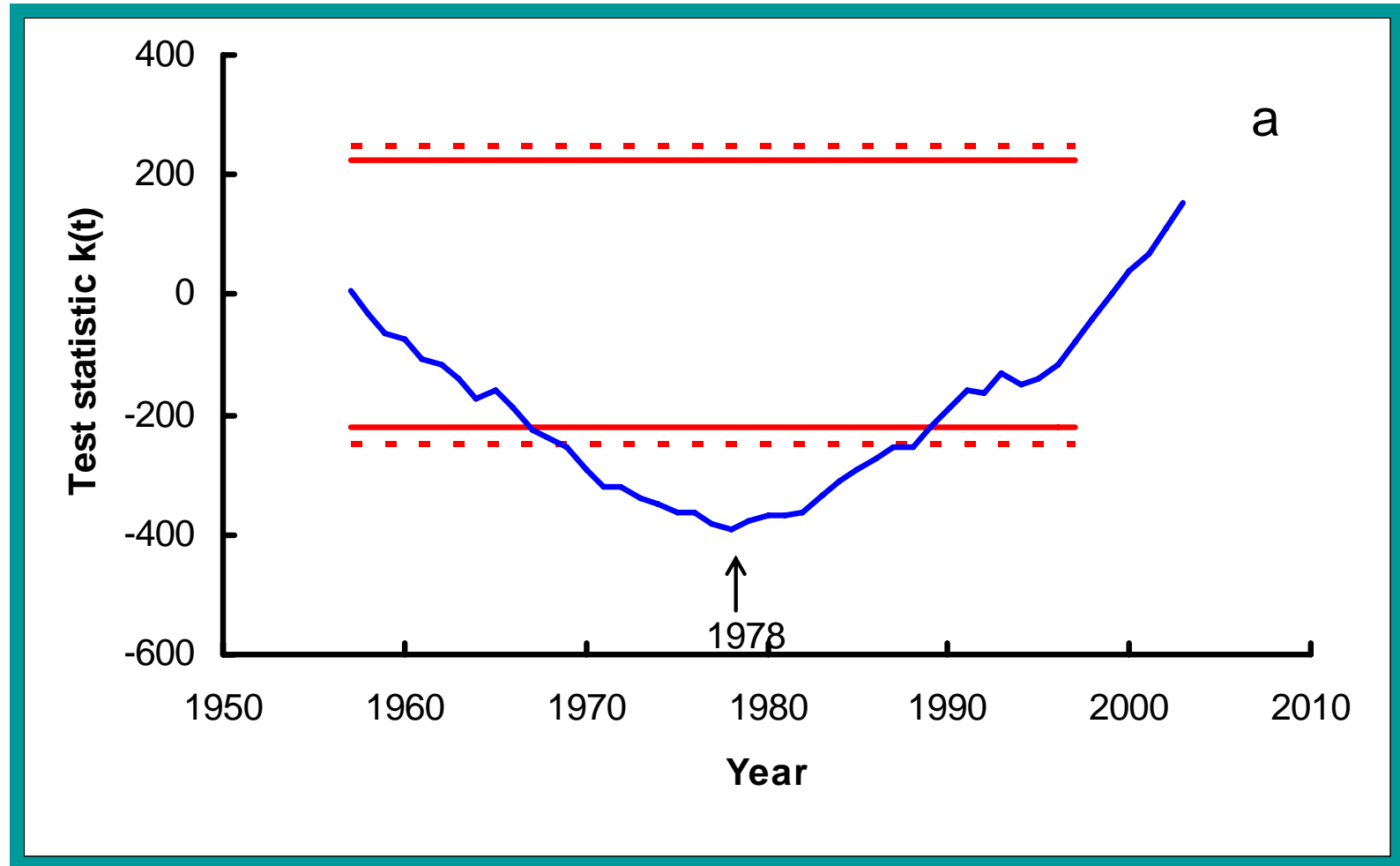
Impact of climate on Q:

$$\Delta \overline{Q}^{clim} = \beta \Delta P + \gamma \Delta E_0$$



Identifying change point in annual streamflow

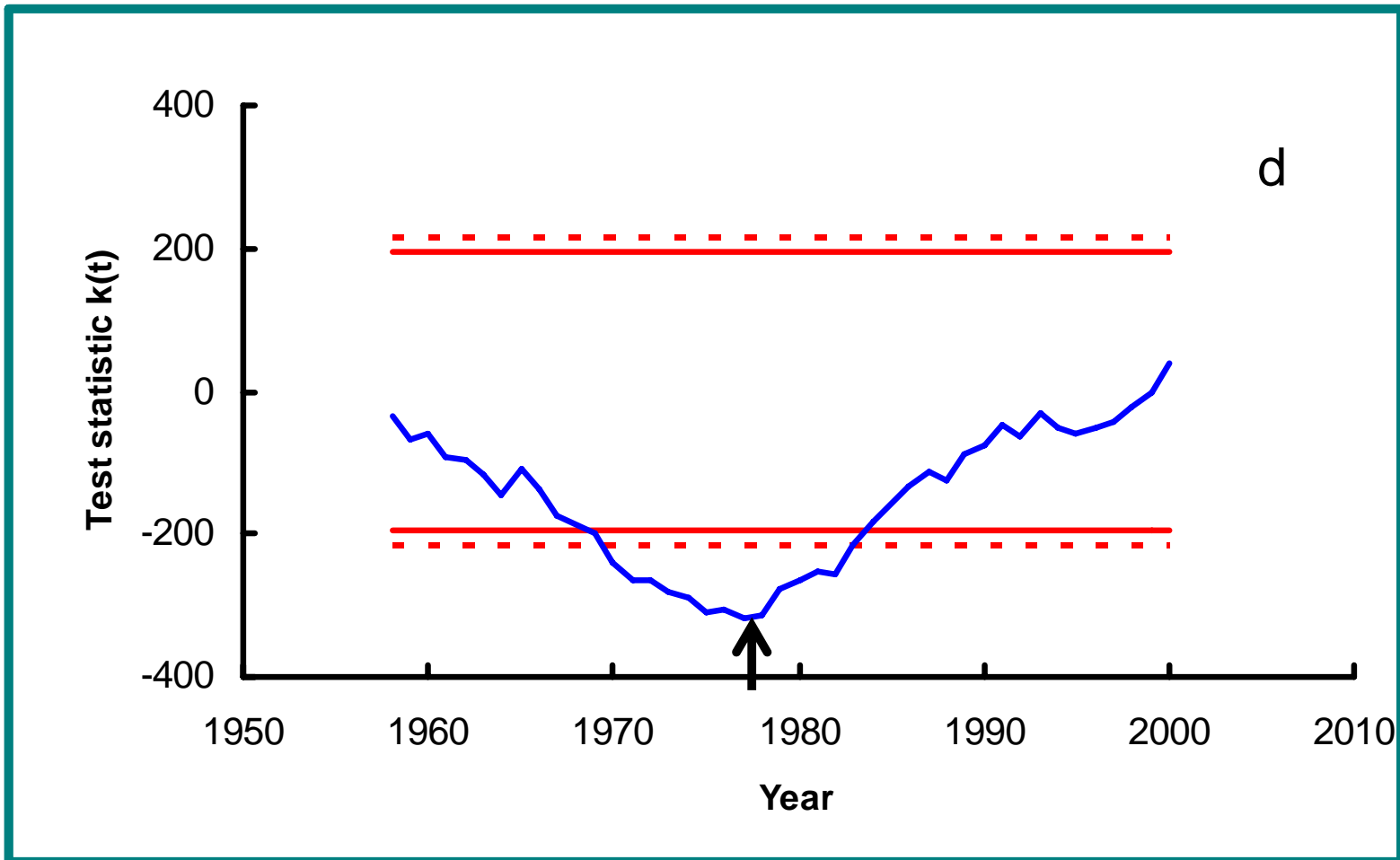
Jialu River





Identifying change point in sediment discharge

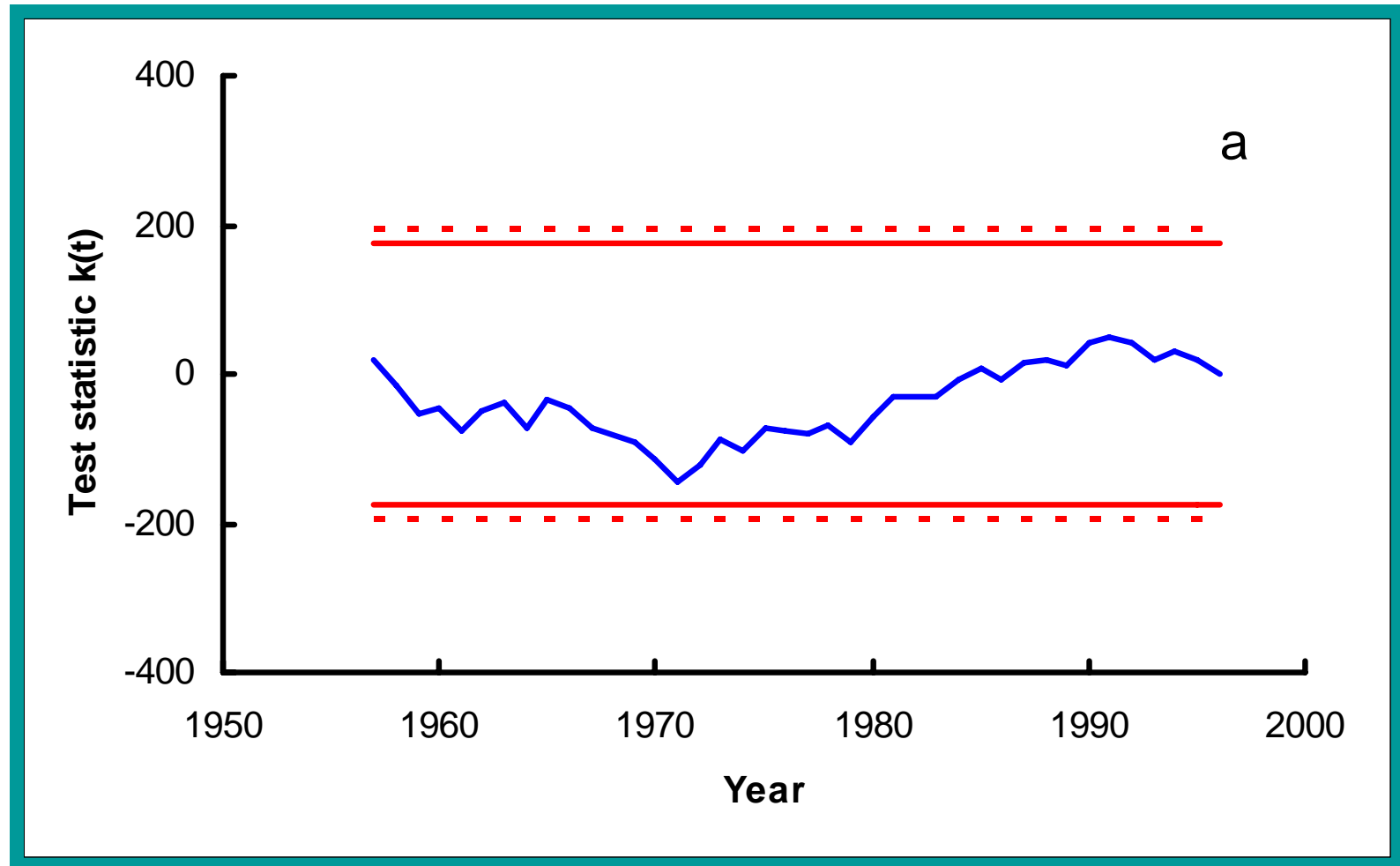
Jialu River





Identifying change point in annual rainfall

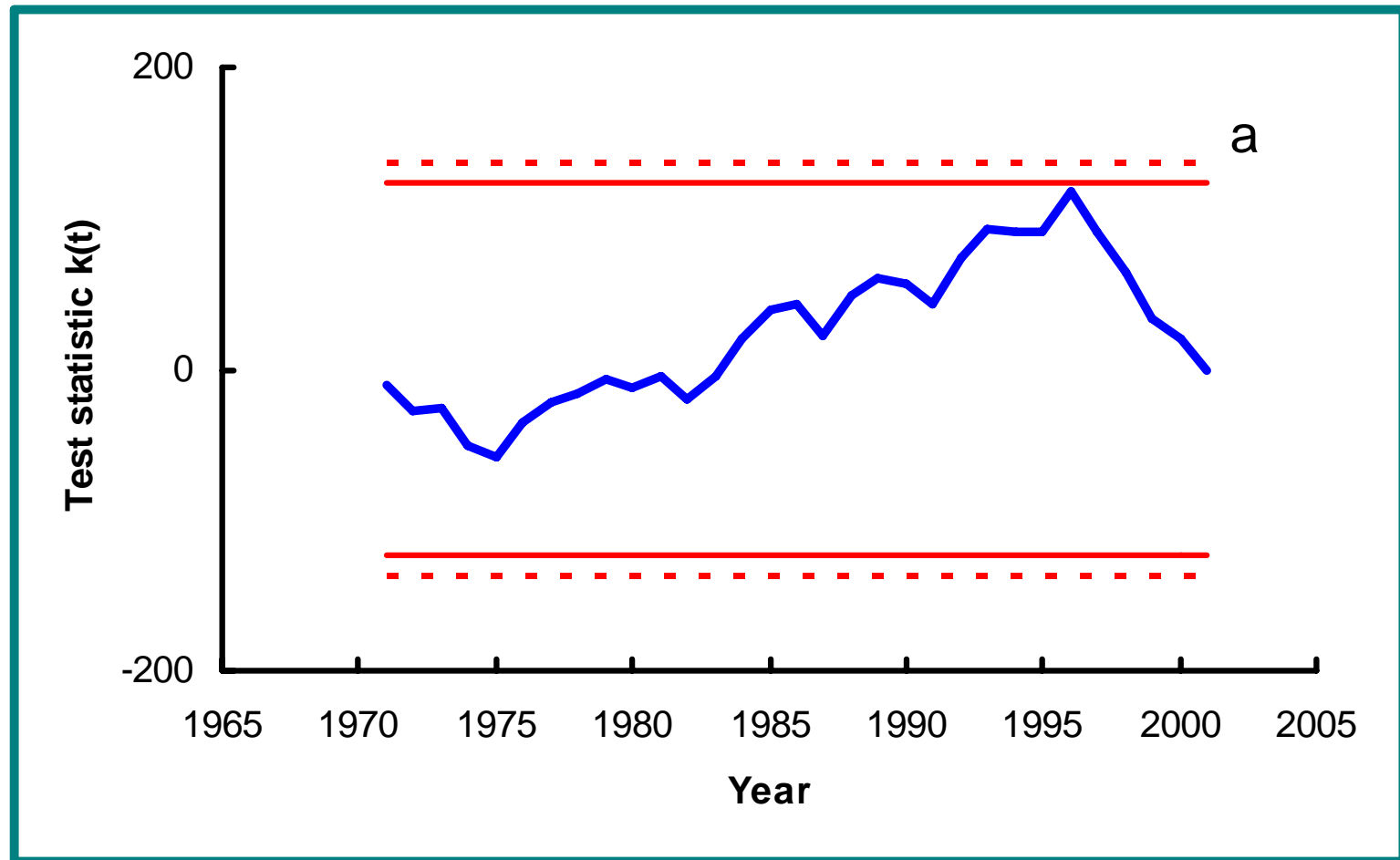
Jialu River





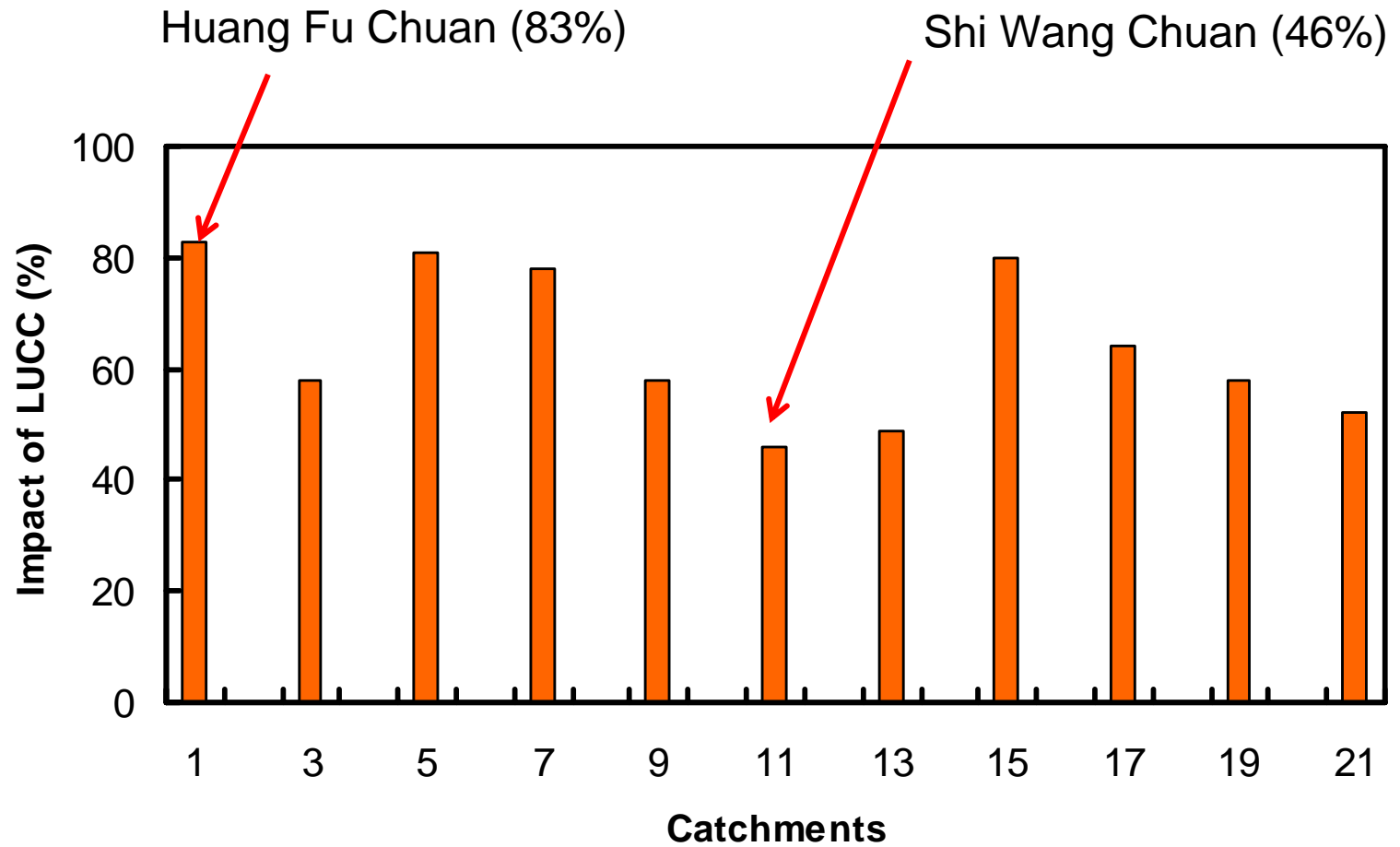
Identifying change point in annual PET

Jialu River





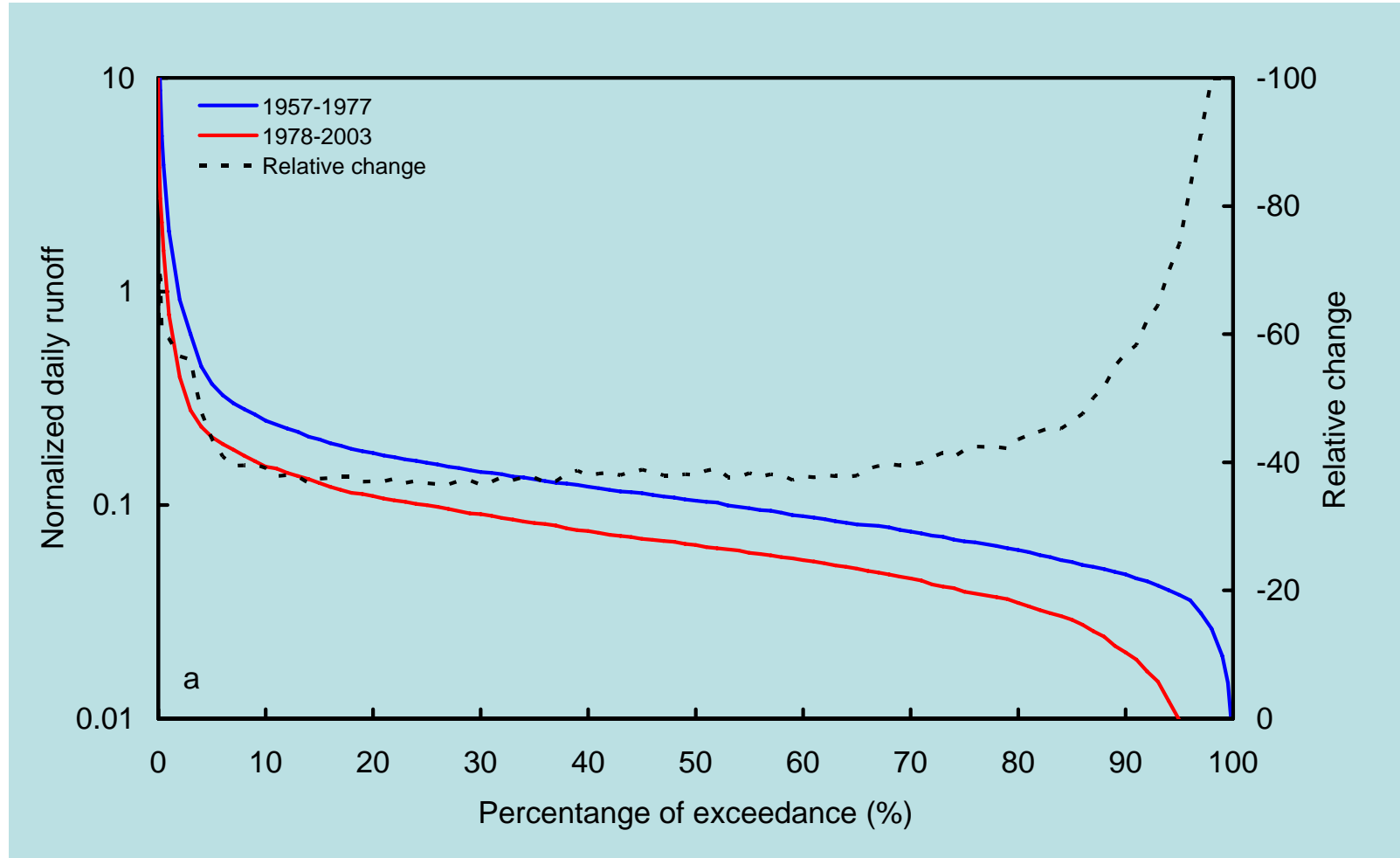
Impact of LUCC on annual streamflow





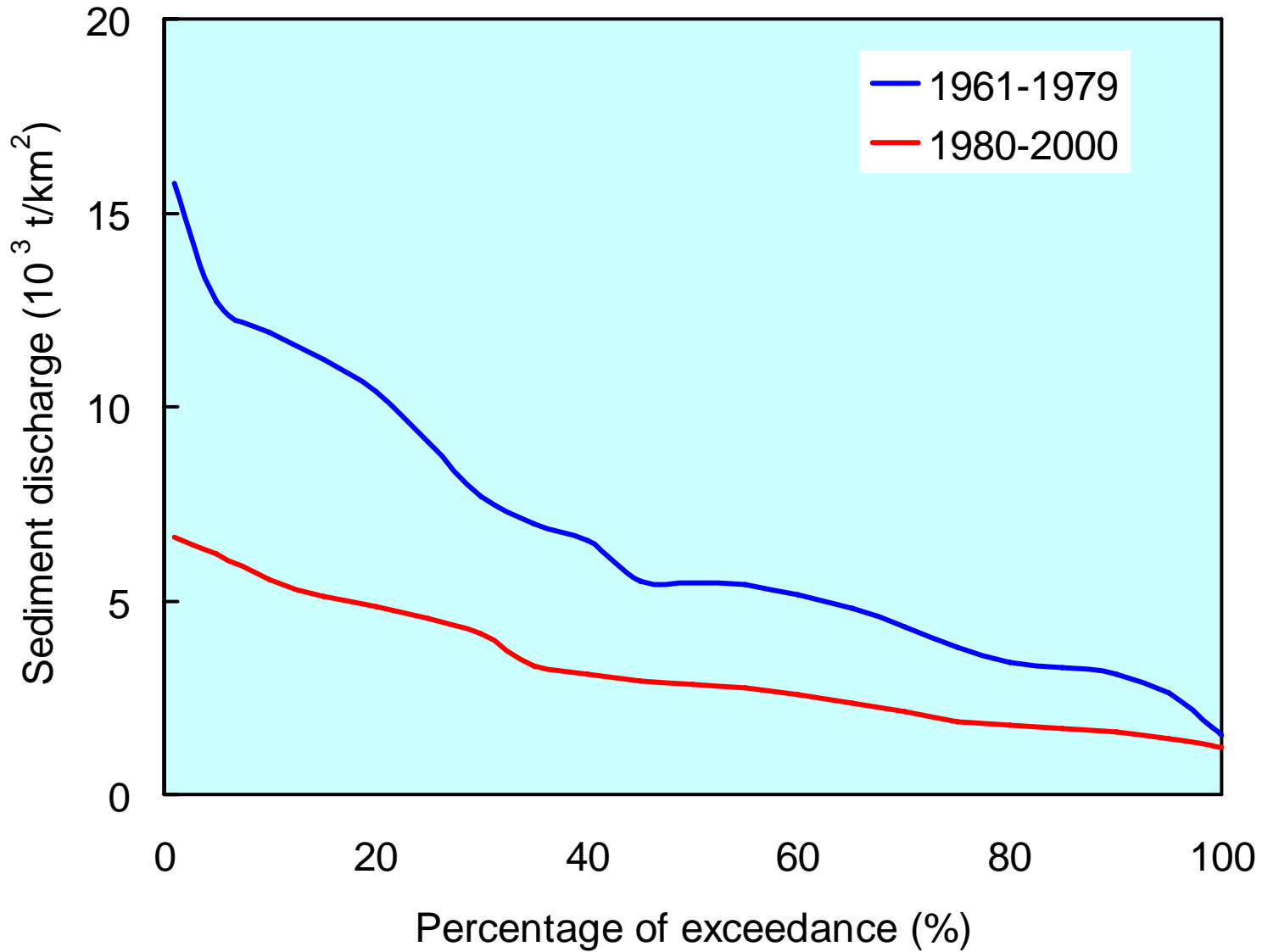
Changes in flow duration curves (FDCs)

Jialu River



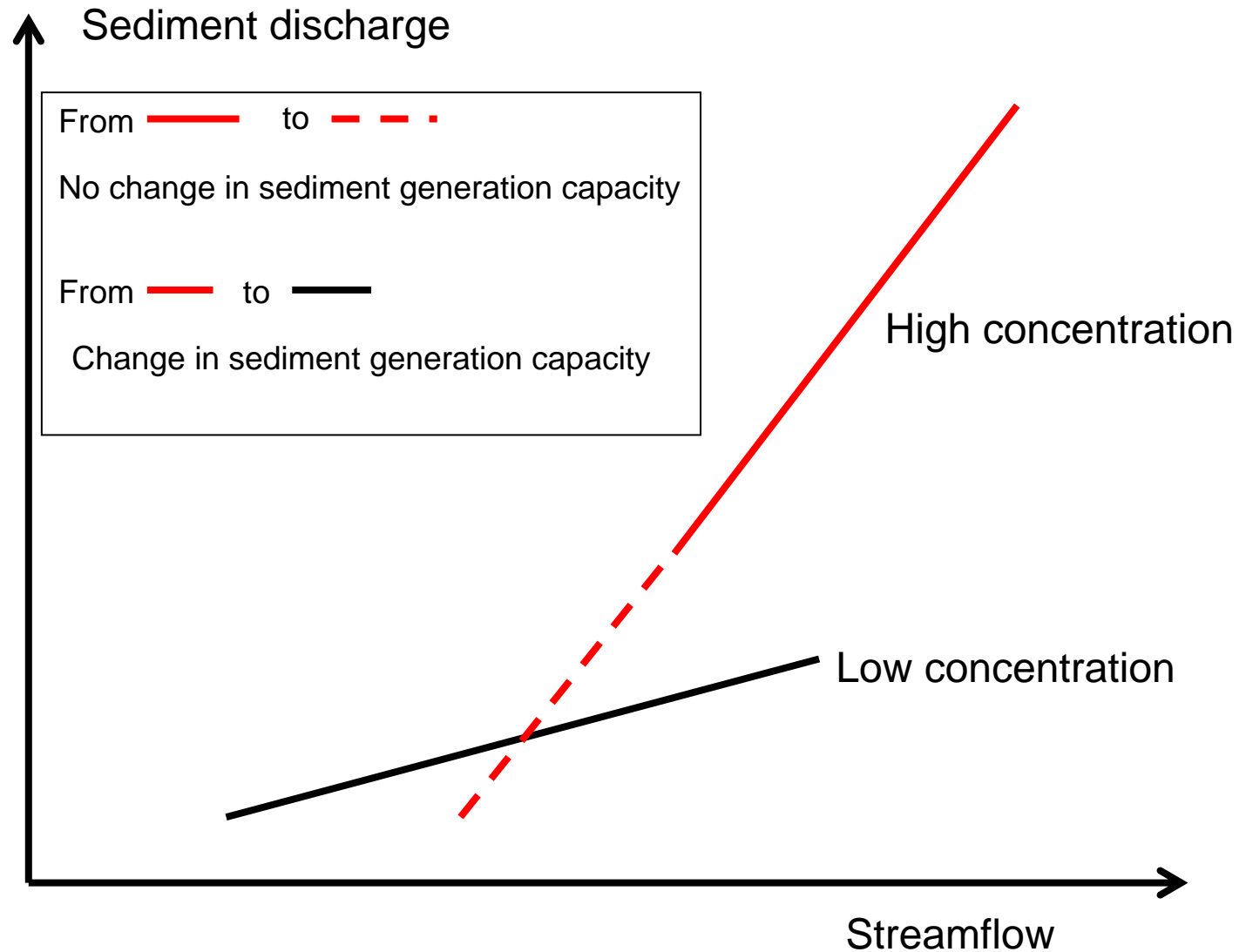


Changes in sediment duration curves (SDC)



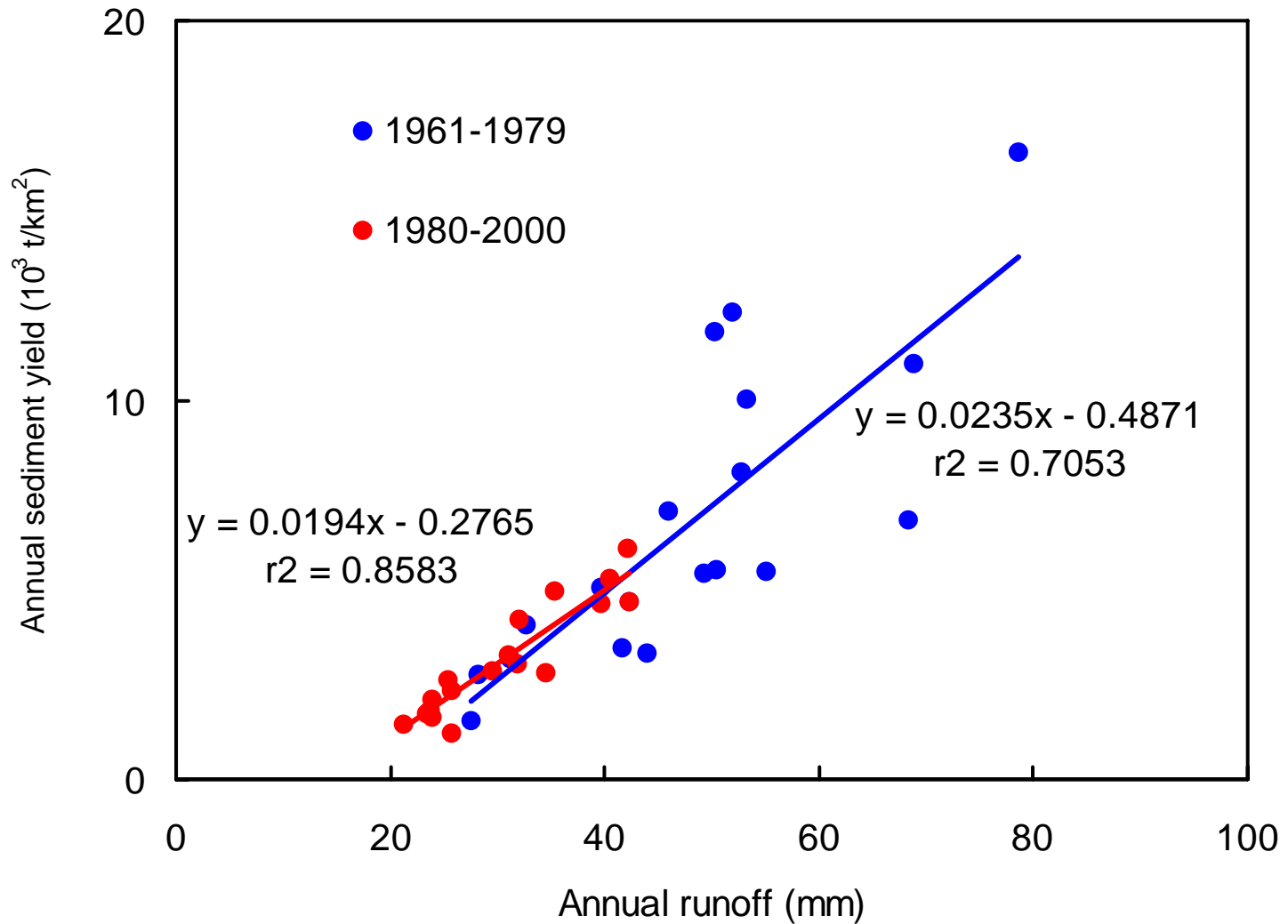


What have changed?





Changes in sediment generation capacity





Conclusions



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- The soil conservation measures in the Loess Plateau have significantly modified the stream-flow and sediment discharge in the last 50 years.
- The soil conservation measures have had greater impacts on annual streamflow than climatic variability.
- Annual sediment discharge reduced by over 58% for the region with average sediment generation capacity decreased by 18%.





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Conclusions

- Past soil conservation practices have achieved the purpose of reducing sediment discharge in the Loess Plateau.
- Future conservation plans need to acknowledge the impact on streamflow while trying to achieve reduction in sediment discharge.



谢谢

Thank You

