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Moving Towards a Sustainable Water and Climate Change Management After COVID-19
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09.00 - 16.30 hrs. (GMT+7 Bangkok)

Assessing recent hydrological changes and groundwater depletion under various policy changes and newly delivered water in the North China Plain

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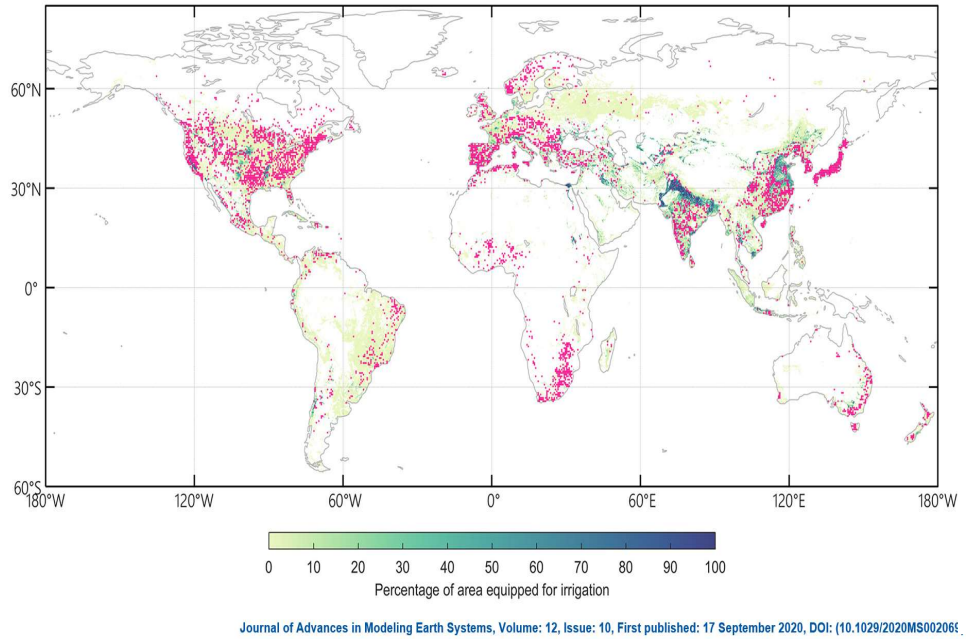
IGDB, Chinese Academy of Sciences

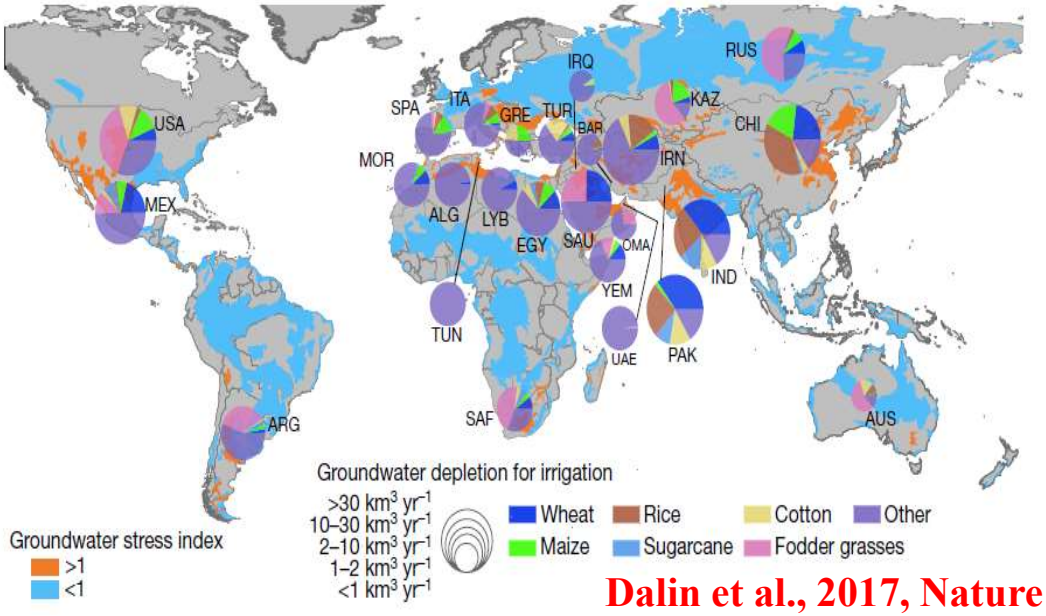
Content

- Problem of groundwater depletion
- Implementing measurements by the government
- What is really happening?
- Will groundwater issues be solved?

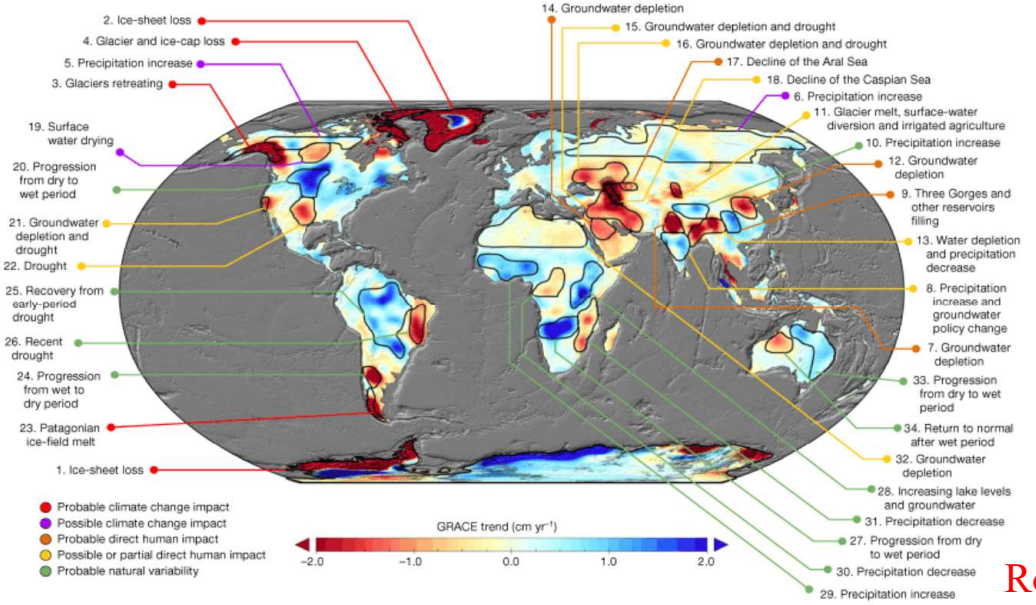
North China Plain is one of the world most concerned region of groundwater depletion



Journal of Advances in Modeling Earth Systems, Volume: 12, Issue: 10, First published: 17 September 2020, DOI: (10.1029/2020MS002069



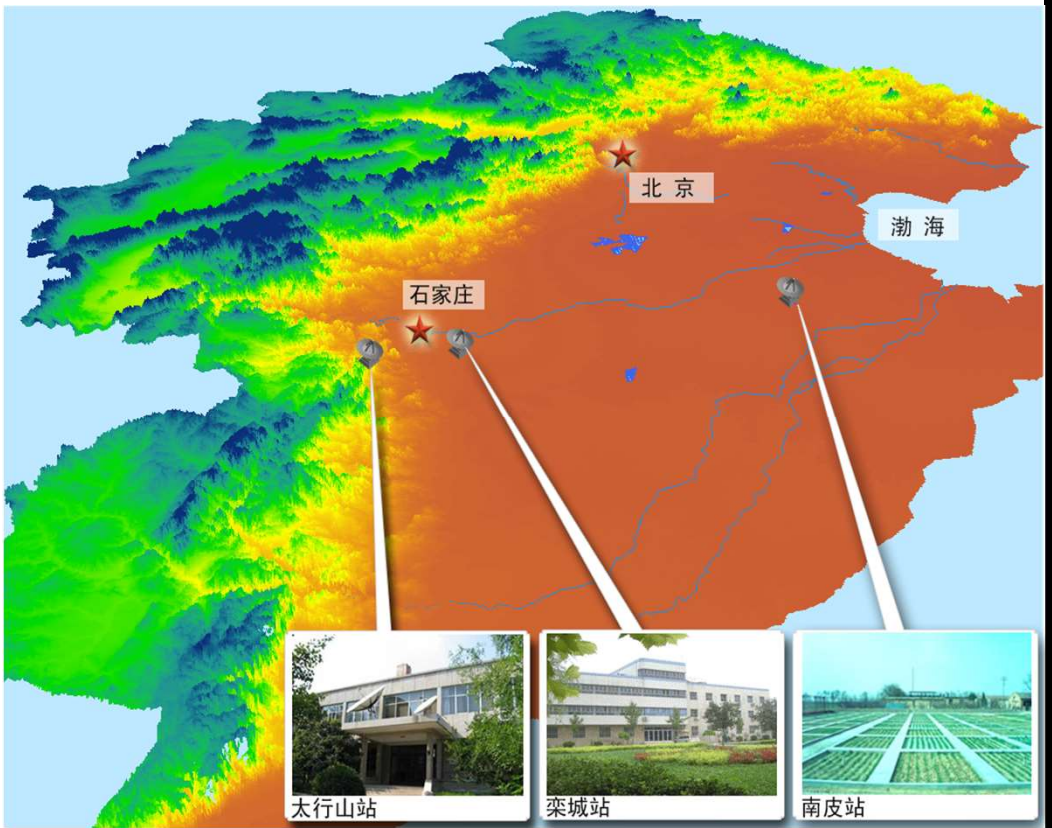
Dalin et al., 2017, Nature

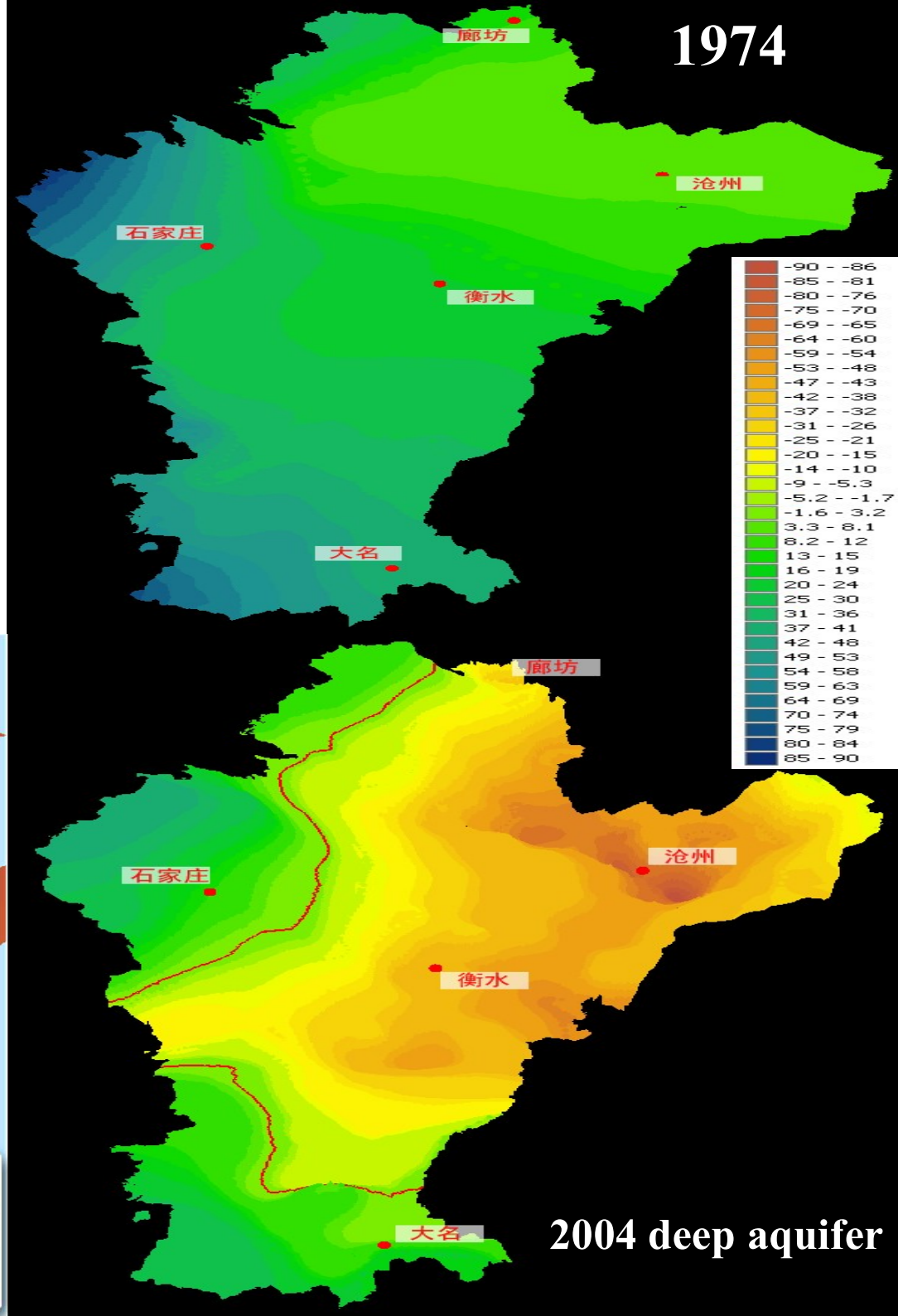


Rodell et al, 2018, Nature 557

Groundwater depletion

Groundwater overuse: 180-200 km^3





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Limiting groundwater abstraction

- Largely reduce groundwater use for city and rural domestic purpose.
- Cutting the plantation of high water consumptive winter wheat by 50,000-15,000 ha annual with governmental subsidy.
- Increasing water use from Yangtze River

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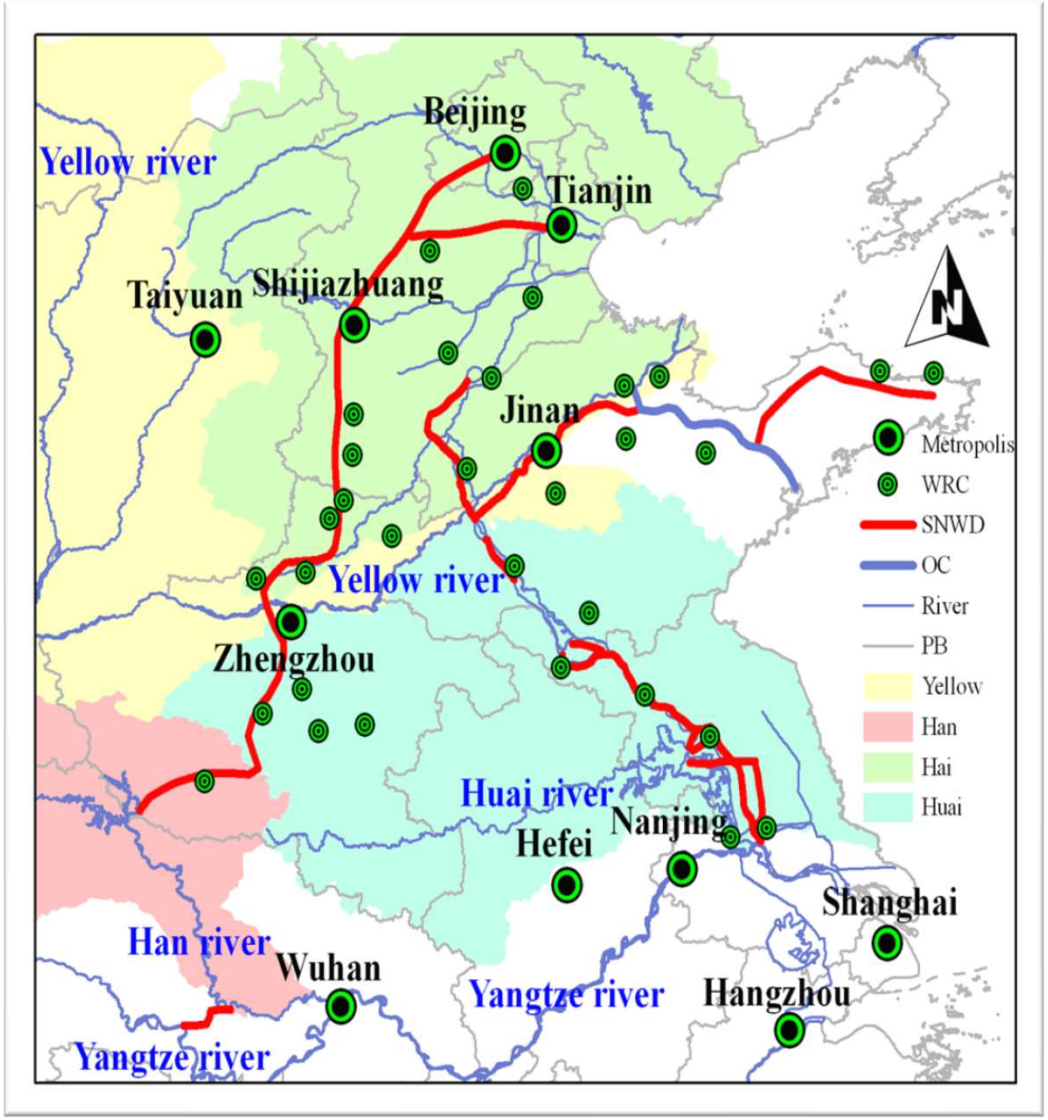
1. South to North Water Transfer Projects

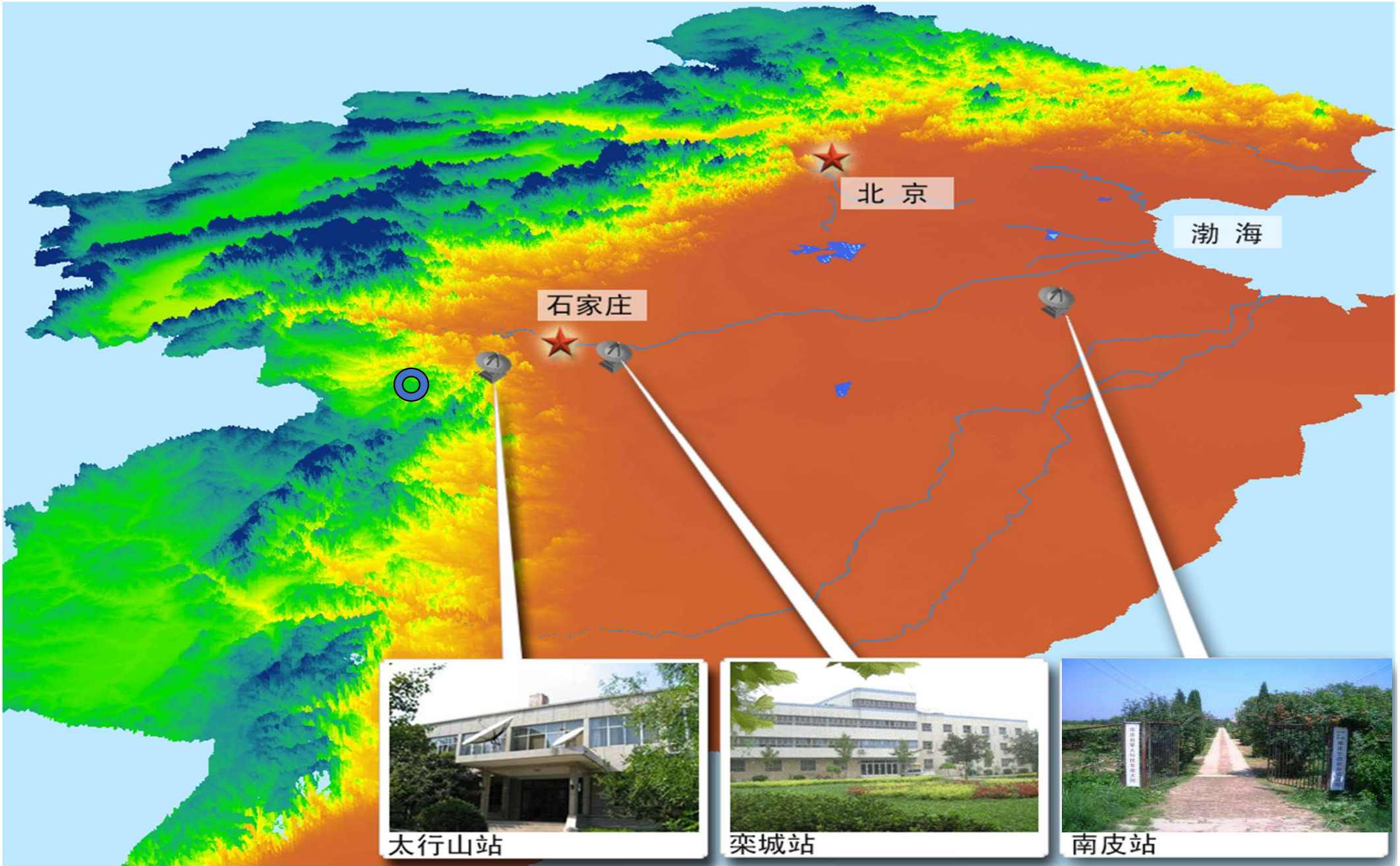


Middle route: total investment: 208 billion RMB Yuan.

Water delivery: 9.5 billion per year.

Total water delivered : 23 km^3 to Beijing-Tianjin-Hebei area since 2015.

Haihe Catchment：



As the biggest water user, effect of reducing wheat plantation

The paradox of irrigation efficiency

Higher efficiency rarely reduces water consumption

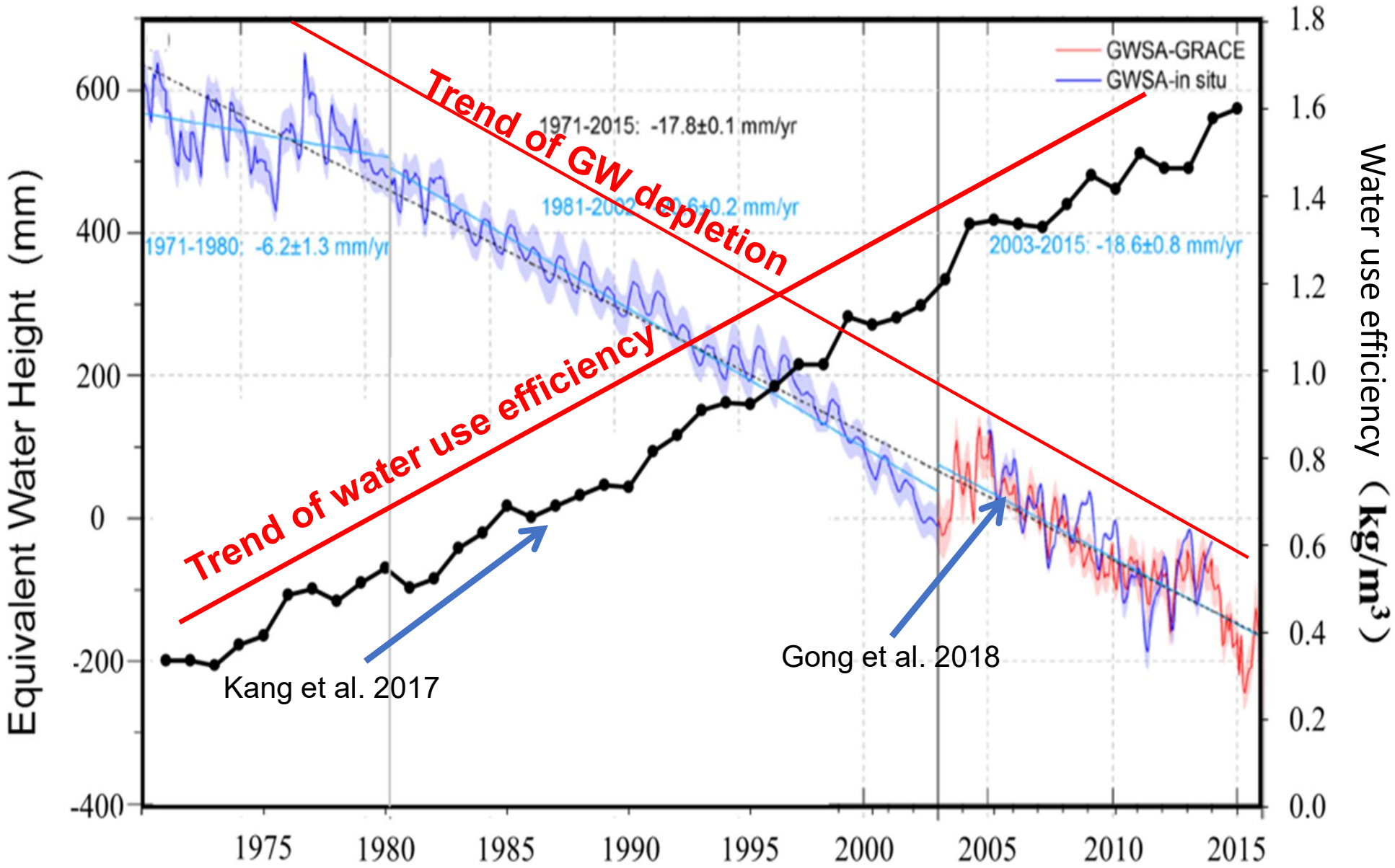
By **R. Q. Grafton[1,2], J. Williams[1], C. J. Perry[3], F. Molle[4], C. Ringler[5], P. Steduto[6], B. Udall[7], S. A. Wheeler[8], Y. Wang[9], D. Garrick[10], R. G. Allen[11]**

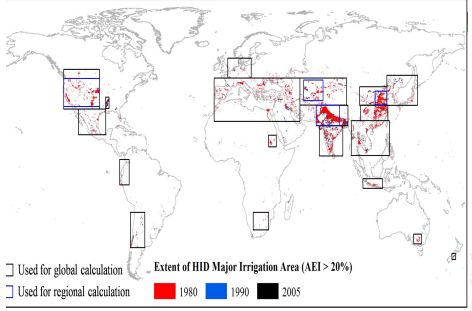
increased IE rarely delivers the presumed public-good benefits of increased water availability. Decision-makers typically have not known or understood the importance of

stored for irrigation in the soil) (*2*). Annually, governments spend billions of dollars subsidizing advanced irrigation technologies, such as sprinklers or drip systems (*3*). Sometimes

Science 24 Aug 2018: Vol. 361, Issue 6404, pp. 748-750
DOI: 10.1126/science.aat9314

2. Agricultural Water saving





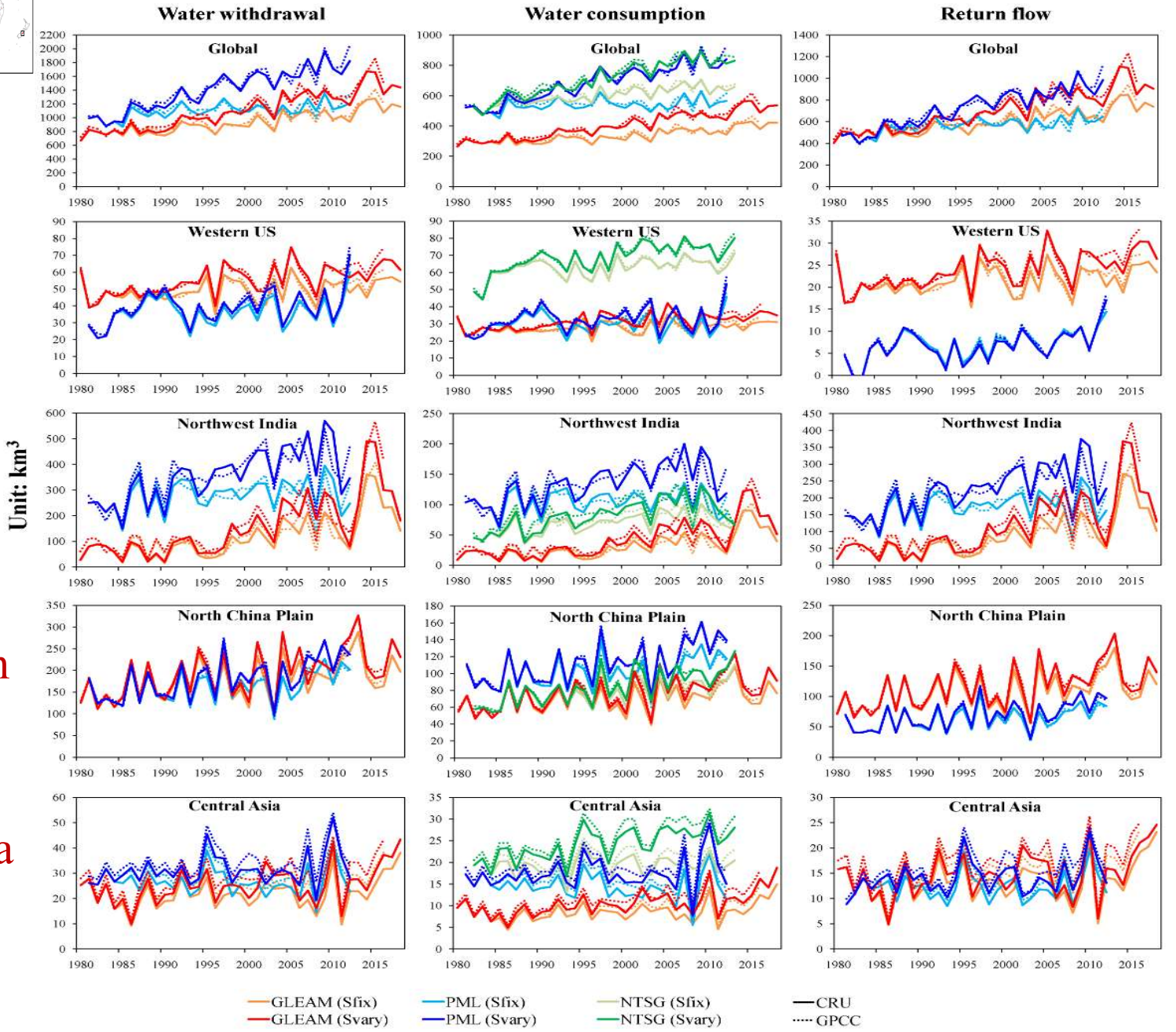
Global

Western US

Northwest India

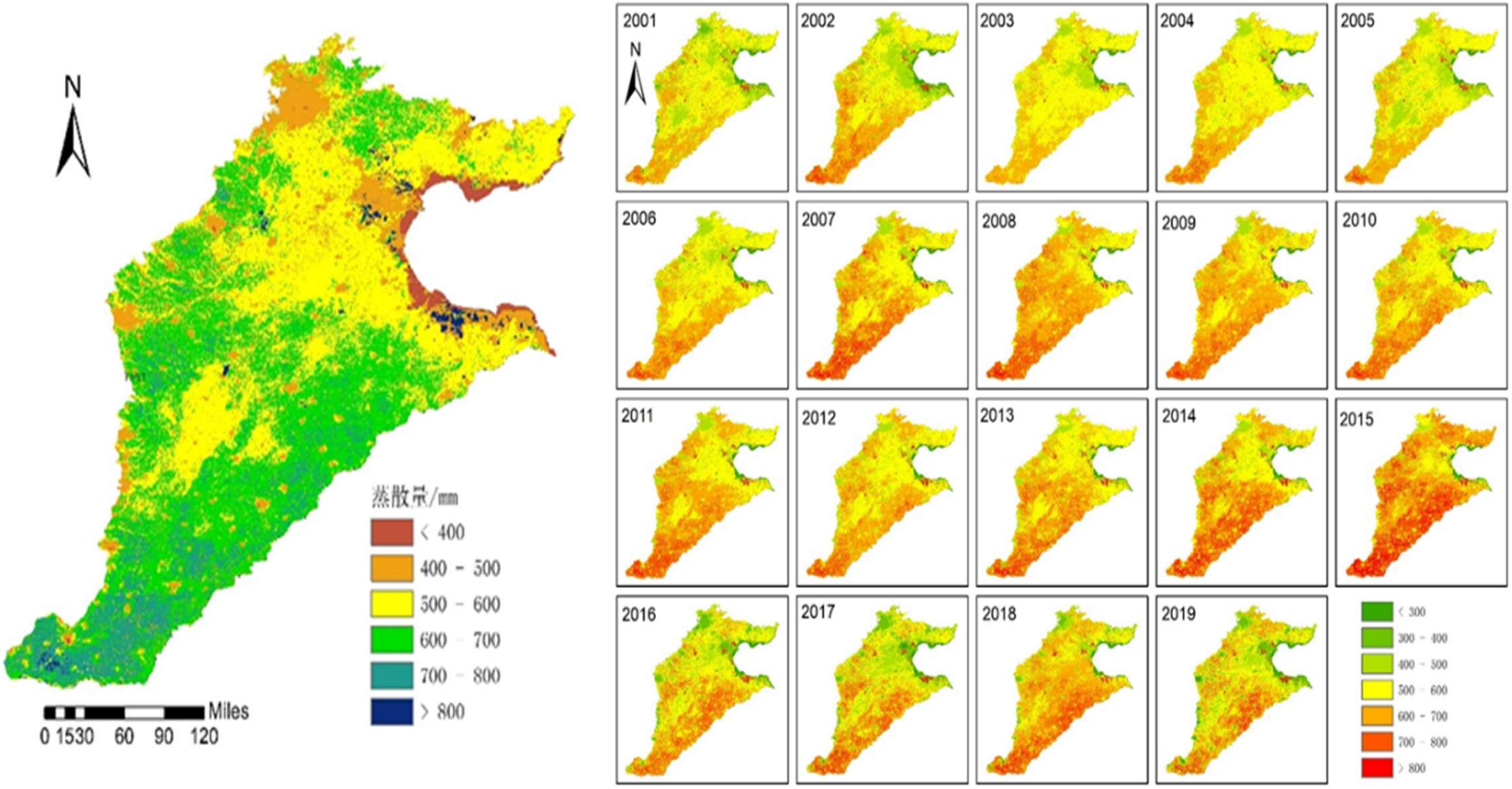
North China Plain

Central Asia

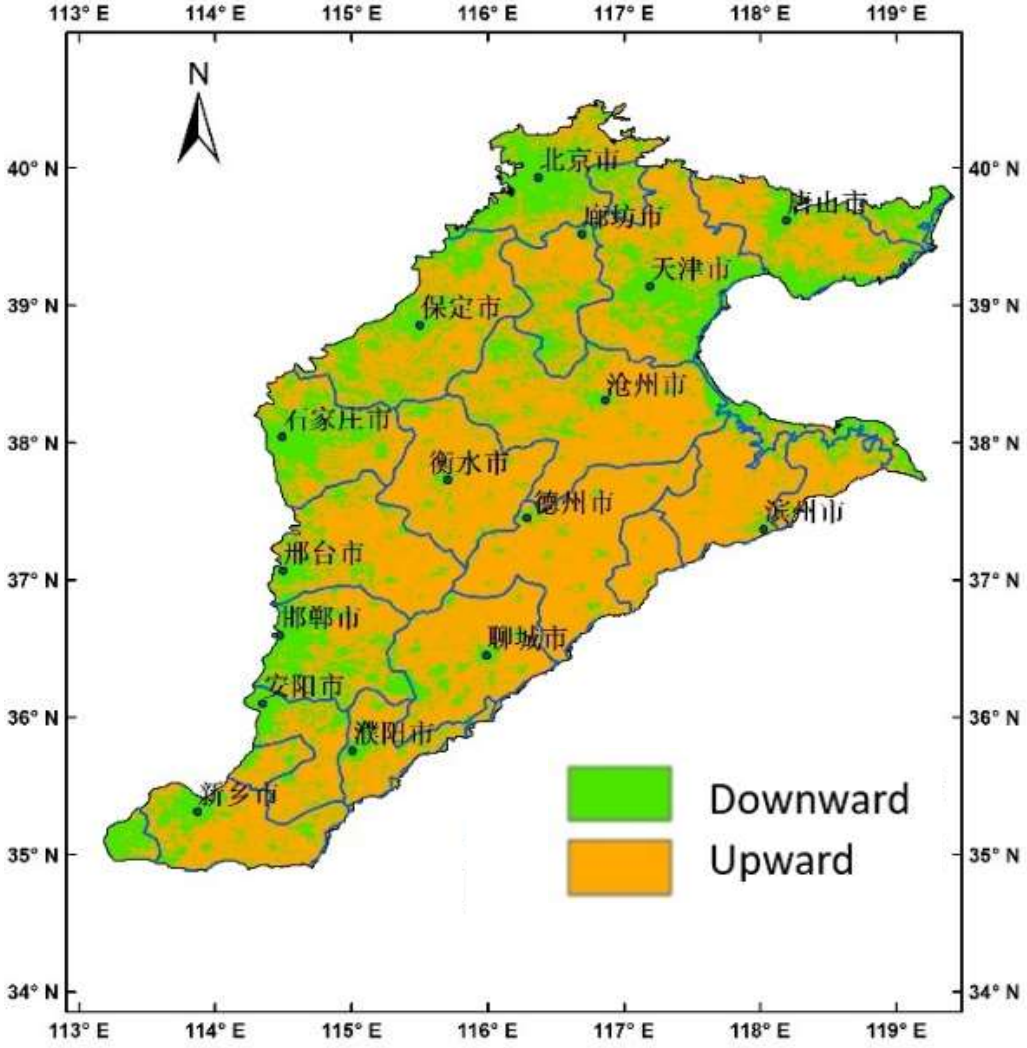


Zhou et al. 2021, Agri Water Manage

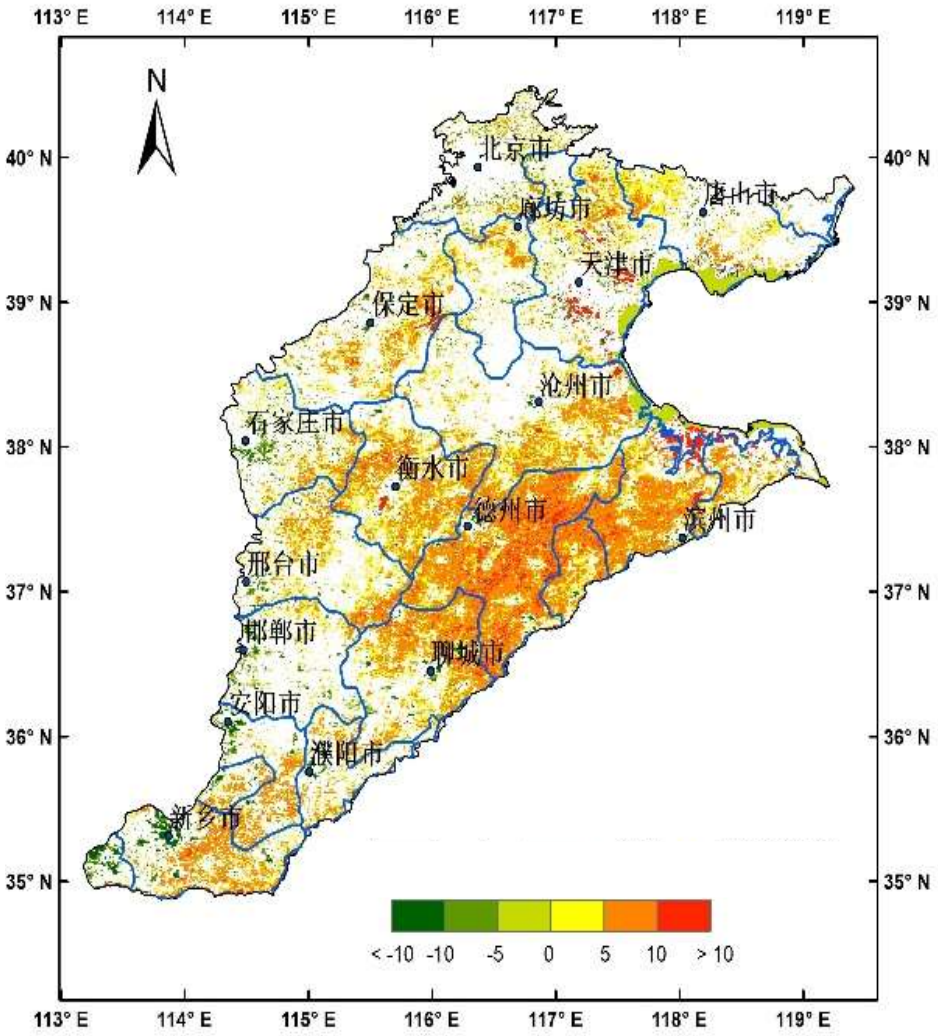
Evapotranspiration changes:



Is ET increasing ?

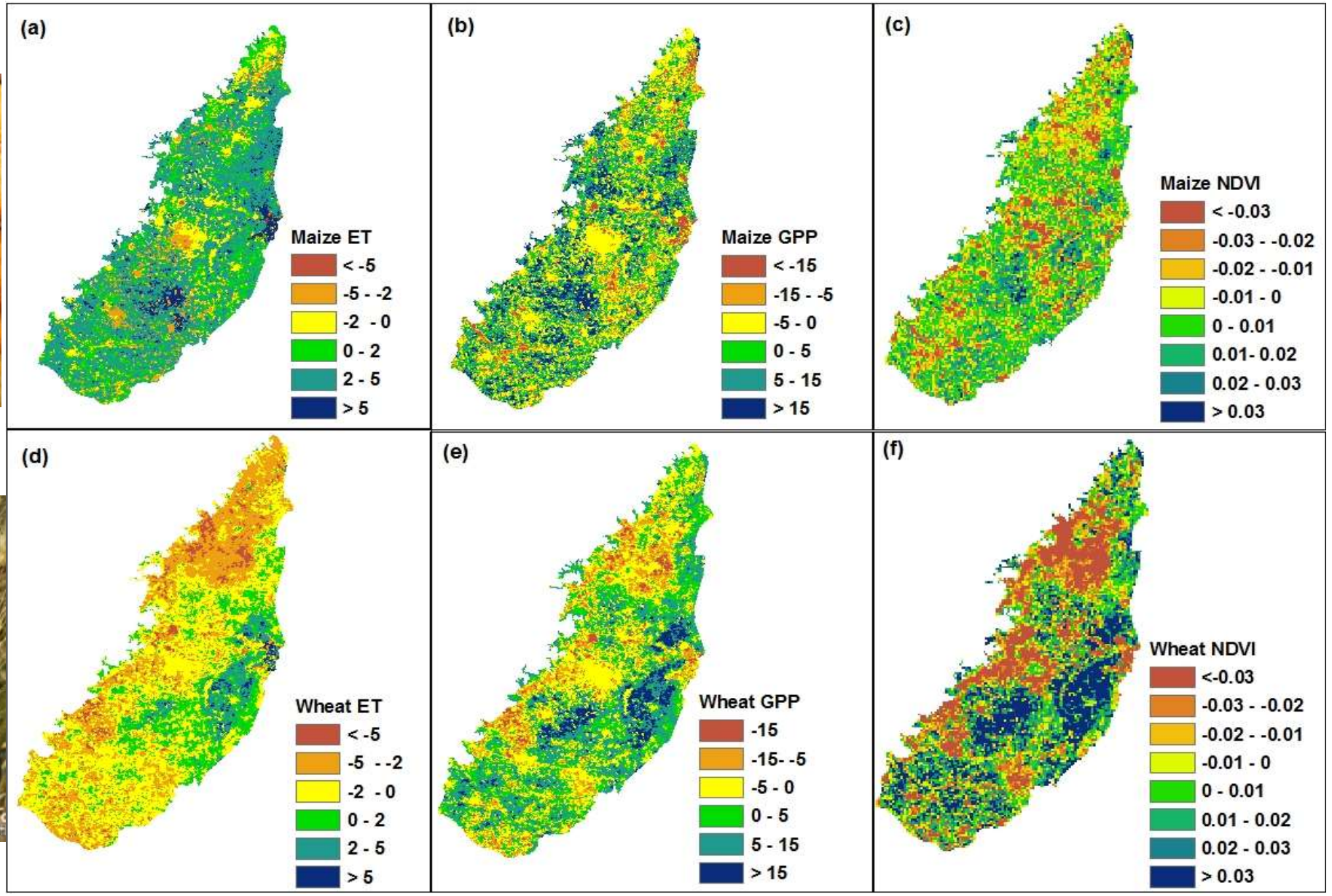


ET trend in 2001-2019

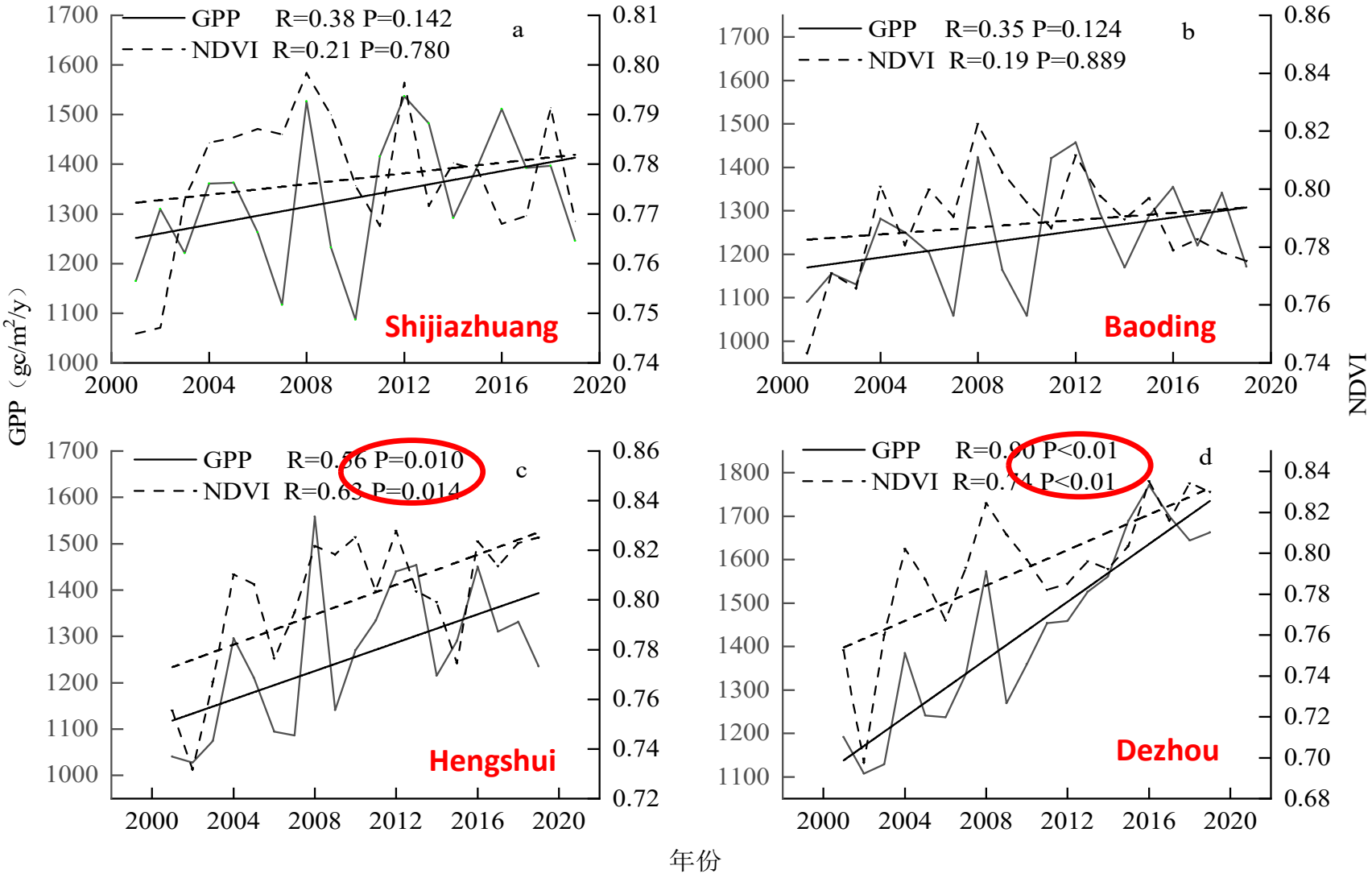


ET Significance（P<0.05）

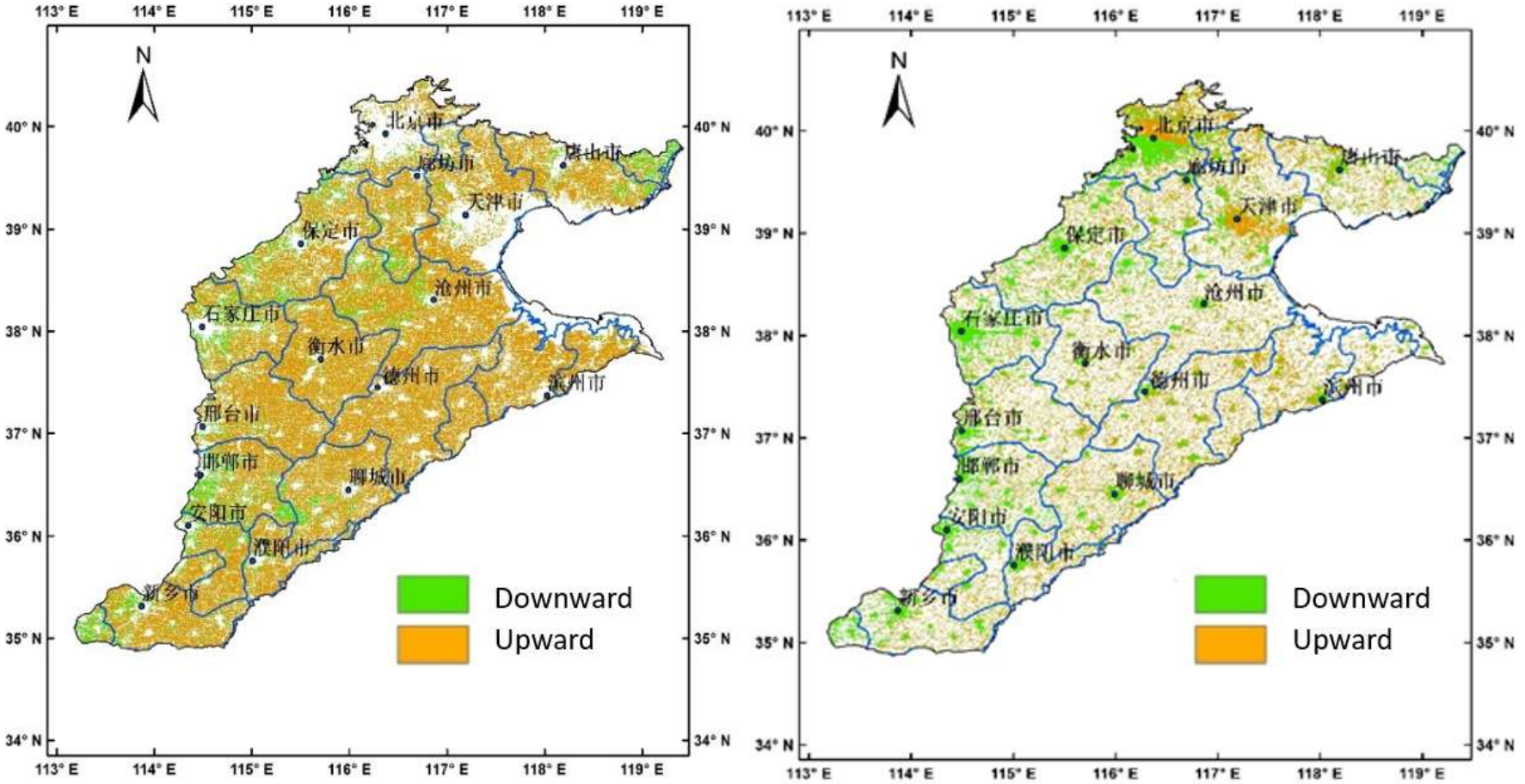
Wheat ET is decreasing.



NDVI & GPP changes in four typical regions



ET trend in irrigated field and non-irrigated fields.



- ET in agricultural regions is still increasing.
- ET in central part of the city is increasing but decrease in the outside along urbanization.

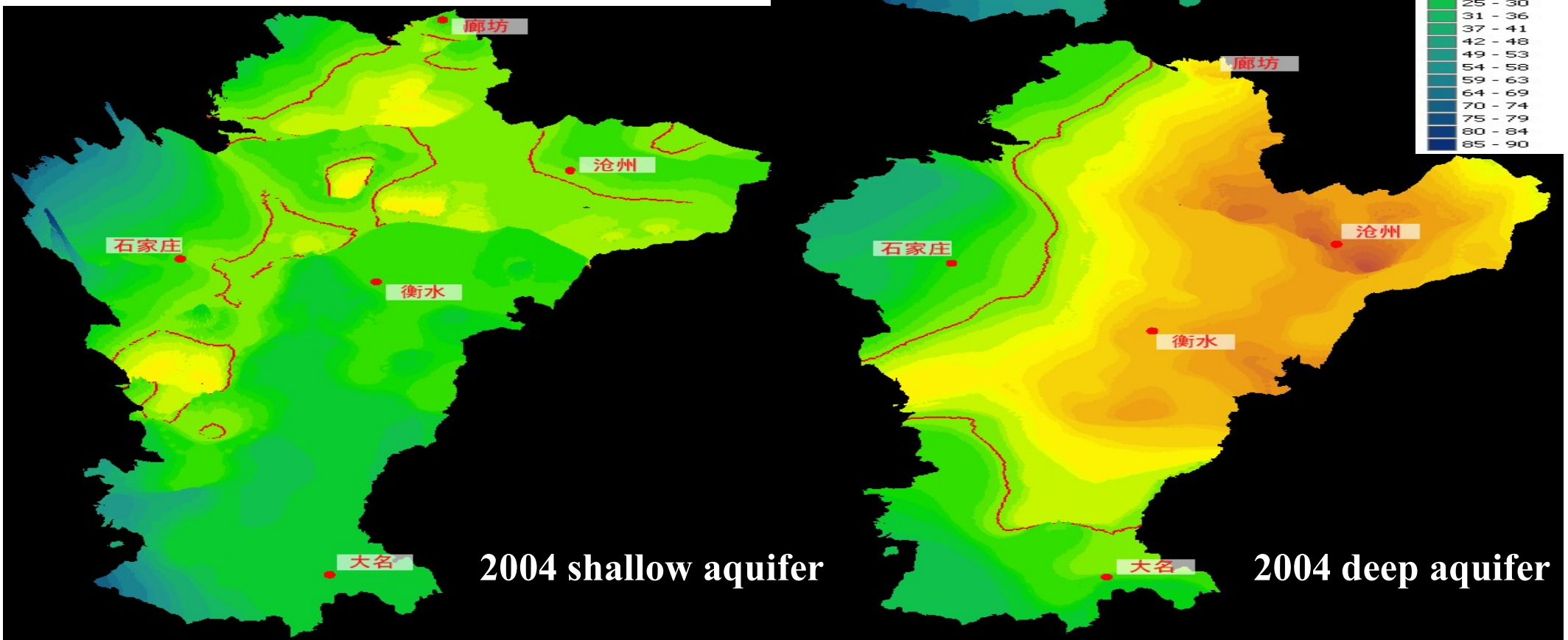
城市水体

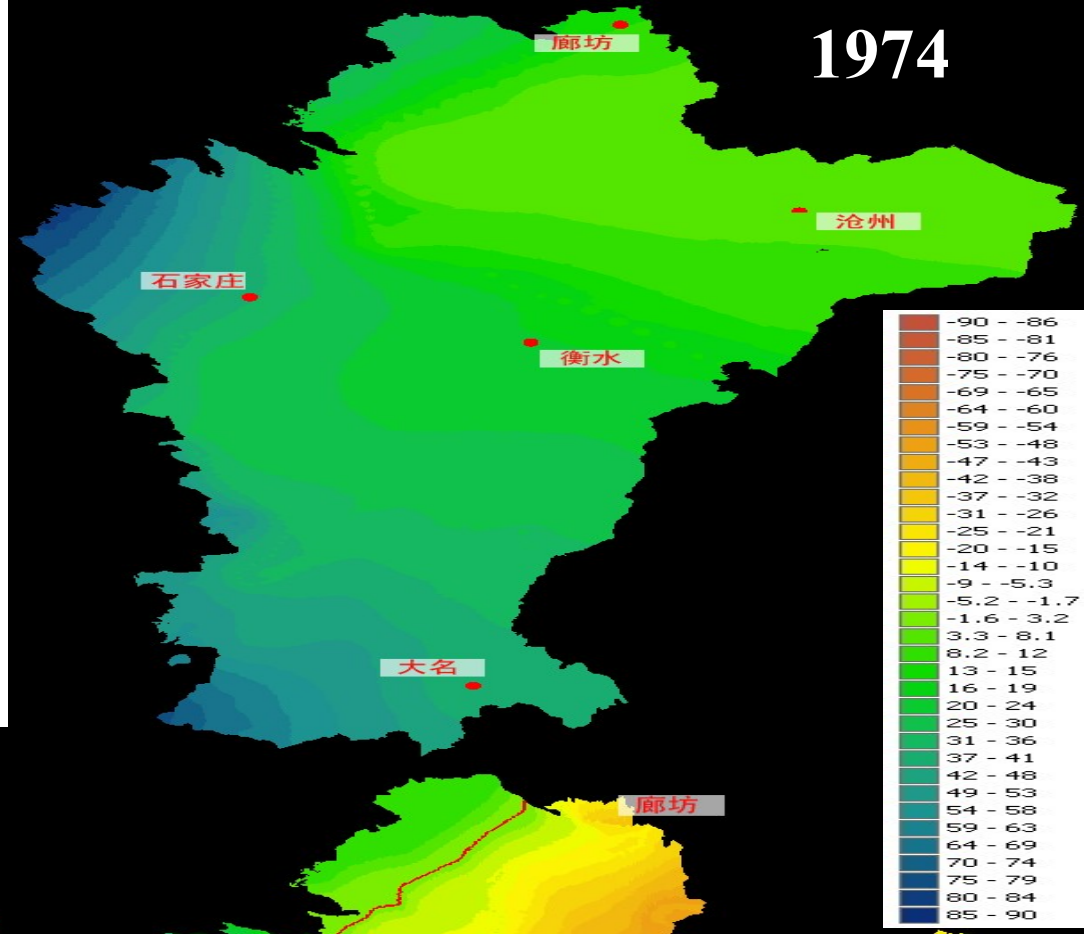
永定河

城市水体

滹沱河

3. Groundwater ?





Simple crop pattern needs large efforts to remain a sustainable groundwater use.

Table 1 Cropping adjustment solutions according to the three groundwater sustainability targets

	Irrigation water requirement (mm)	Water saving compared with cropping pattern S_{base} (mm)	Target 1: IWR is less than or equal to 187 mm (%)	Target 2: IWR is less than or equal to 226 mm (%)	Target 3: IWR is less than or equal to 284 mm (%)
S_{base}	330				
S_W	174	156	92	67	31
S_M	72	258	55	41	18
S_{MWMF}	180	150	95	70	31
S_{MWFW}	253	77	–	–	61
S_F	− 85	415	34	25	11

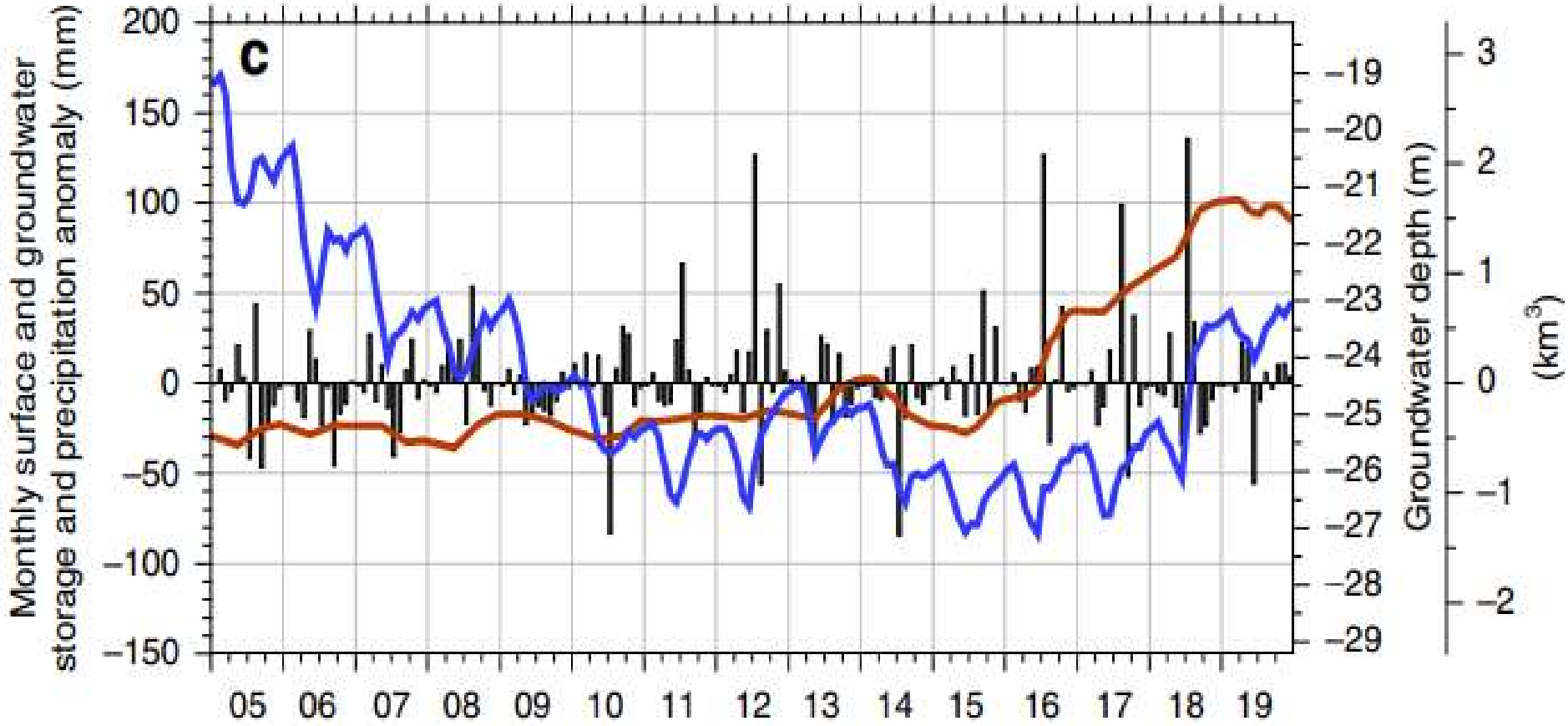
Target 1: Sustainable groundwater use according to the correlation between groundwater and IWR established in this study (annual irrigation of less than 187 mm); Target 2: Sustainable groundwater use based on 0.2 billion m^3 (39 mm) of extra water supply. In this case, the upper limit for irrigation can increase to 226 mm; Target 3: Sustainable use of groundwater based on 0.5 billion m^3 (97 mm) of additional water supply. The upper limit for irrigation can increase to 284 mm

Ren et al, 2021, SERRA

Present wheat plantation decrease, ranging from 50,000 ha to 150,000 ha will not likely solve the groundwater depletion problem.

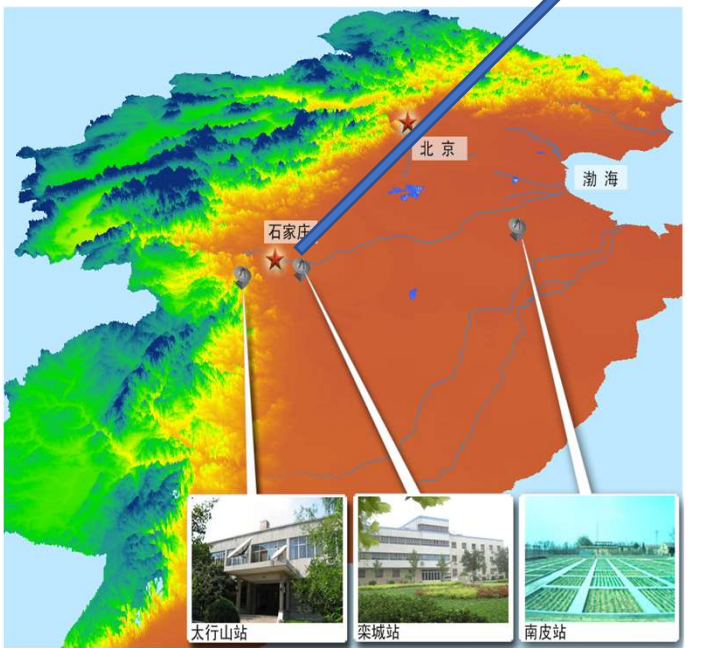
South-to-North Water Diversion stabilizing Beijing's groundwater levels

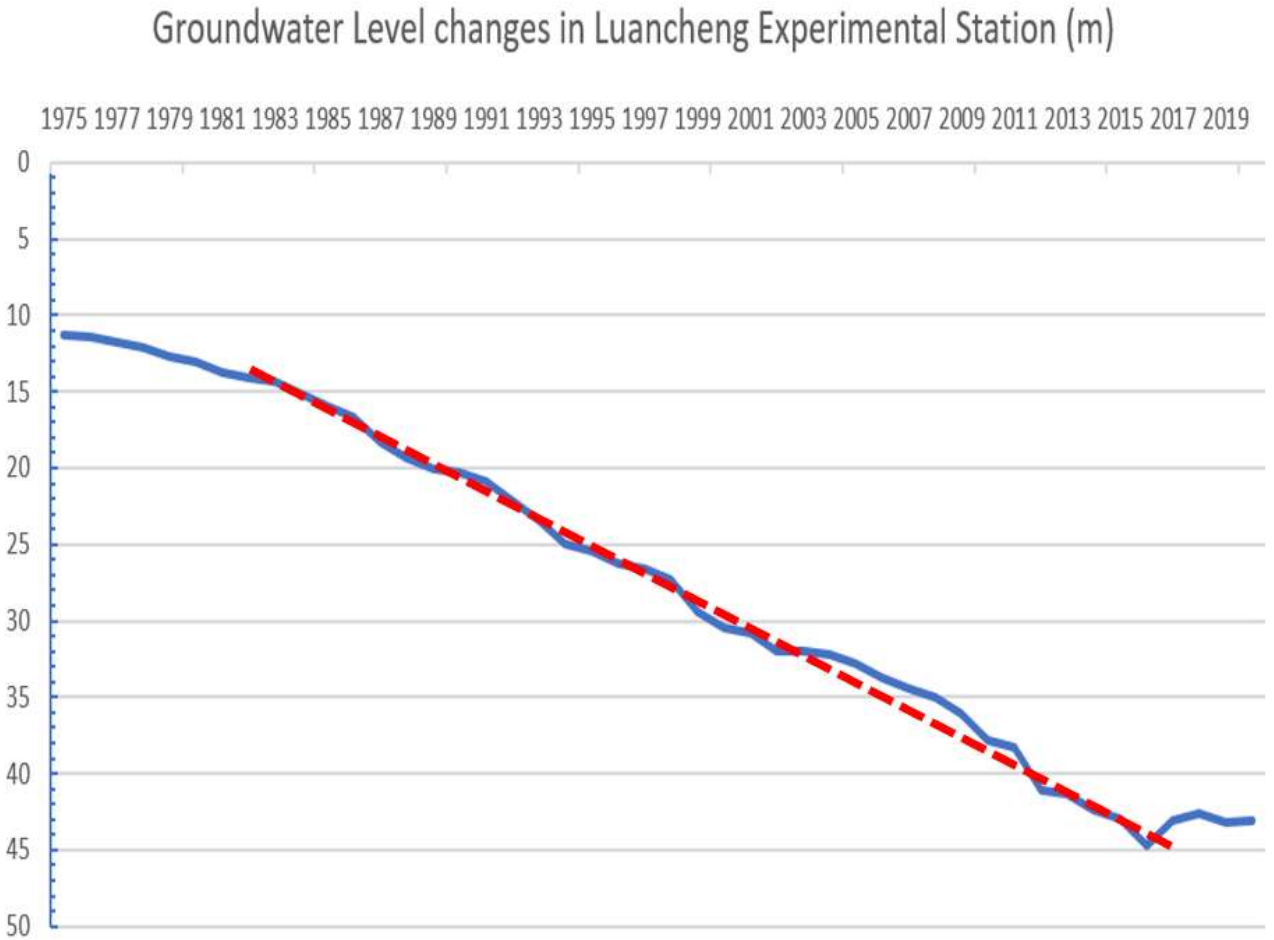
Di Long [1✉], Wenting Yang [1], Bridget R. Scanlon [2], Jianshi Zhao[1], Dagen Liu[3], Peter Burek [4], Yun Pan[5],



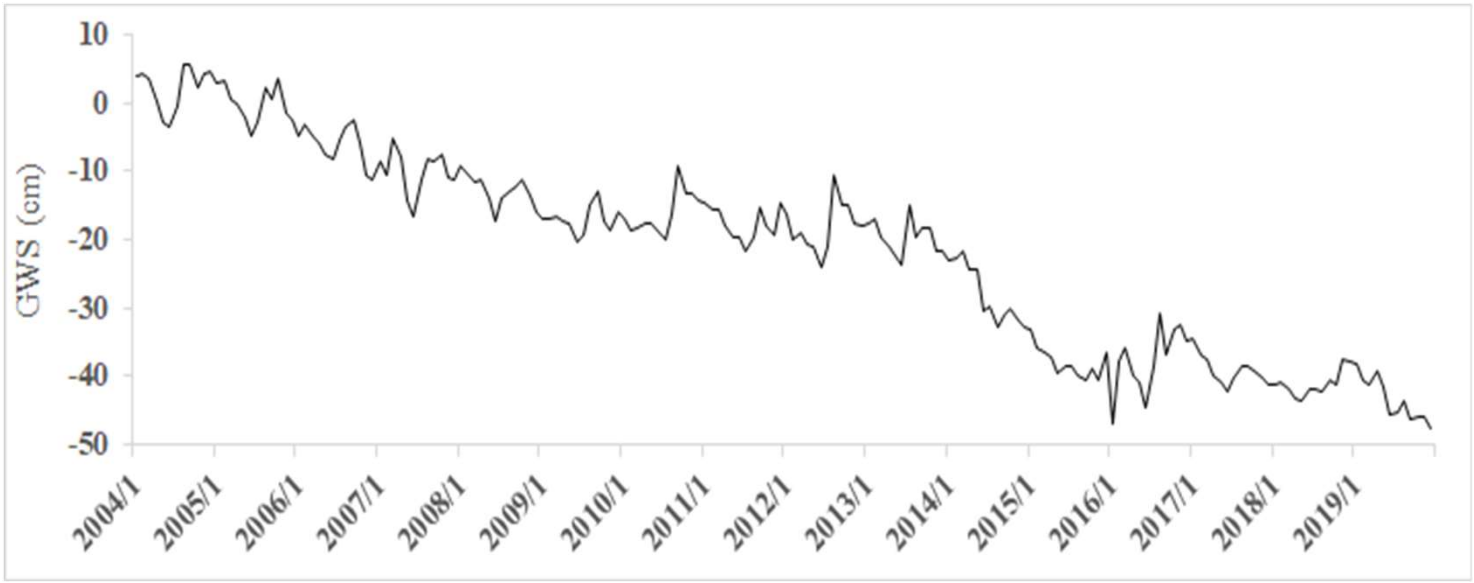
But Beijing's area is only 6300 km^2, while Hebei Plain is 81,459 km^2.
13 times of Beijing's area, water is only 3 times.

Observed groundwater level decline (1975-2020) in Luancheng Experimental Station.

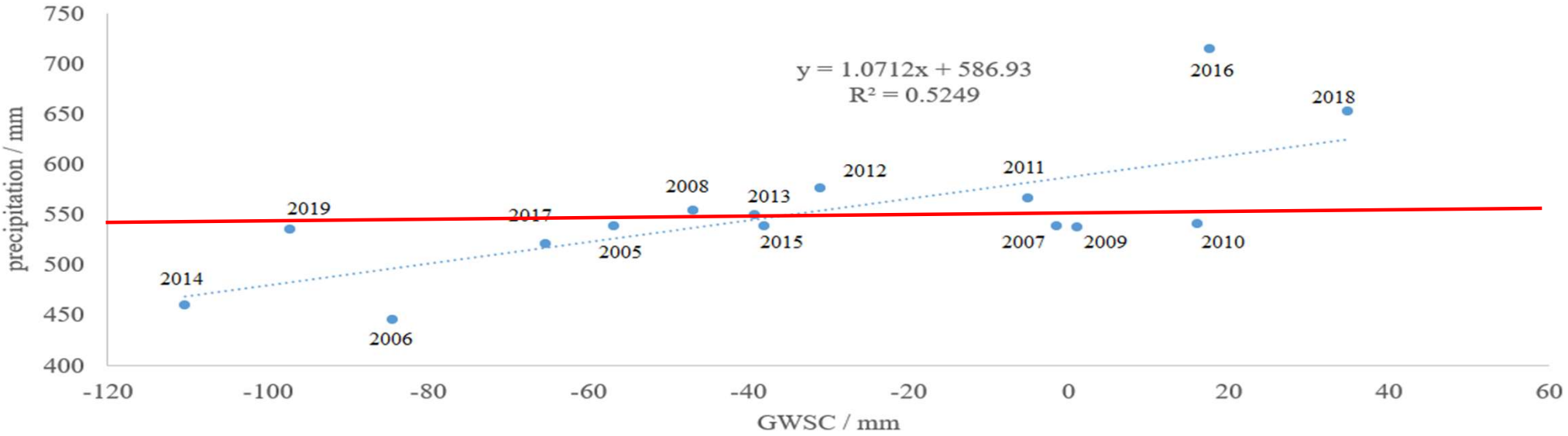




Groundwater storage in the North China Plain



Groundwater Storage Changes from GRACE data for the Hebei Plain



Precipitation & GWSC

Ma et al., Draft paper.

Conclusions

- Crop adjustment, replacing groundwater by Yangtze River water for domestic and industrial use, less vegetation water use driven by urbanization, and relatively high rainfall is beneficial for regional groundwater.
- However in the whole NCP, ET is still increasing slightly.
- In general, groundwater decline has been greatly slowed down, but stabilization looks not yet confirmed.

Thanks for your attentions.