Potassium Balance and Potassium Fertilization in Chinese Agriculture

Shaojun Qiu and Ping He

Institute of Agricultural Resources and Regional Planning, CAAS

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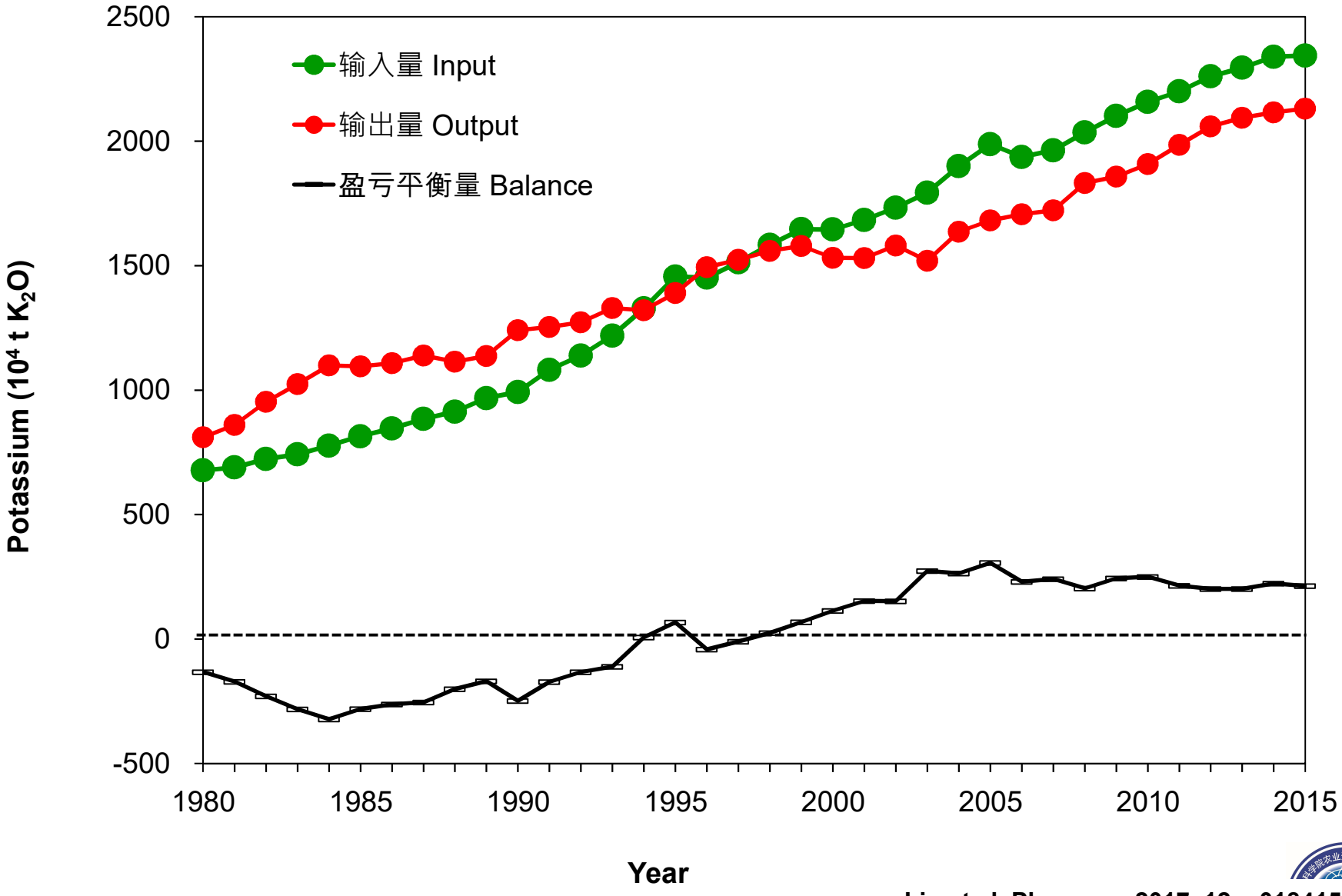
Outlines

- Temporal and spatial variation of potassium
- Yield and K use efficiency
- Soil potassium pool
- Conclusion

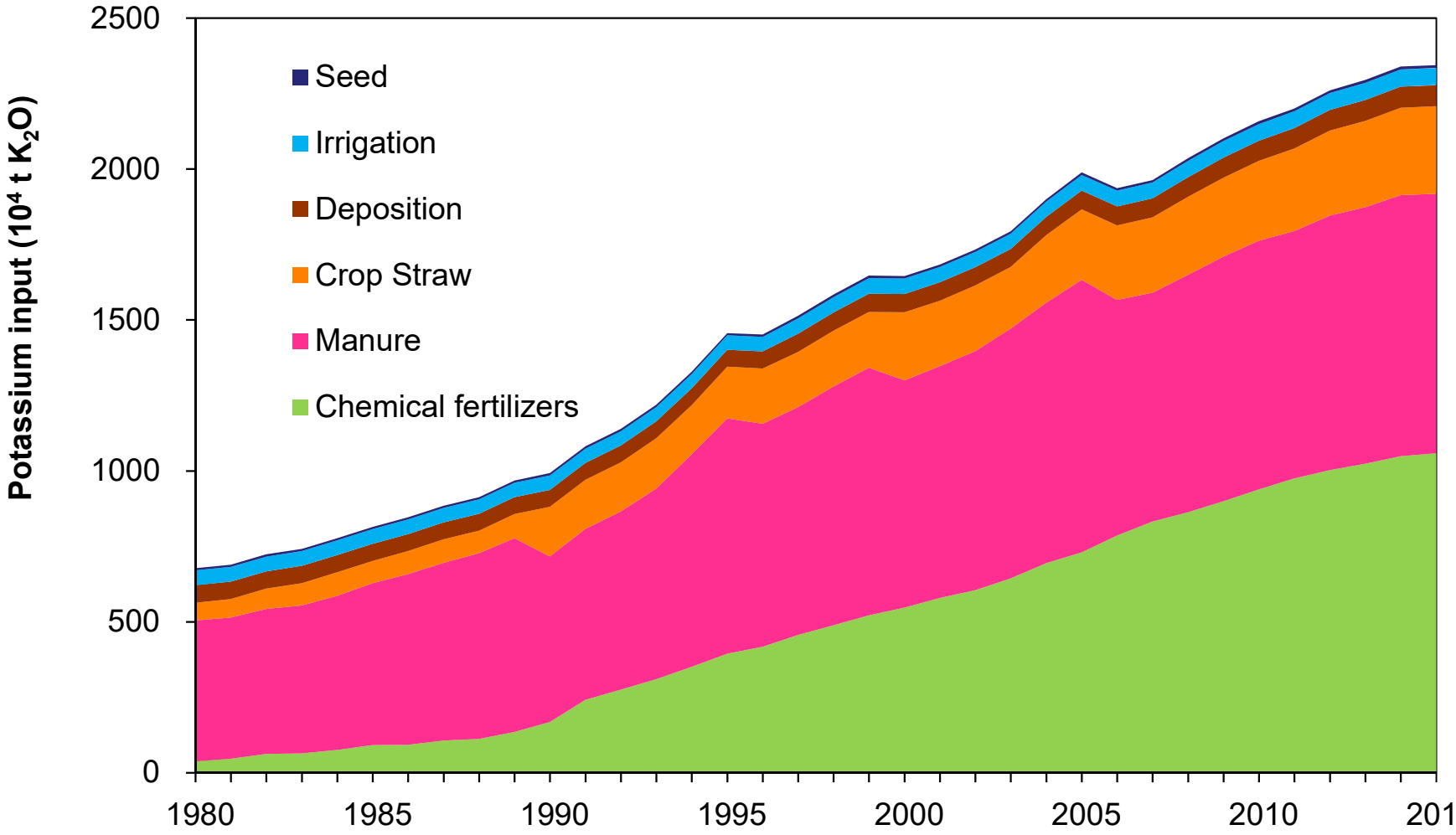
- Potassium input
  - Chemical fertilizers: K from single-chemical and K from compound fertilizers
  - Manure: from human and livestock, cake fertilizer
  - Straw
  - Irrigation, deposition, seed
- Potassium output
  - Crop removal
  - K losses through leaching and runoff
- Potassium balance = K input – K output

China Agricultural Statistical Report



Liu et al. Plos one., 2017, 12: e0184156

Temporal variation of compositions of K input in agricultural land for China



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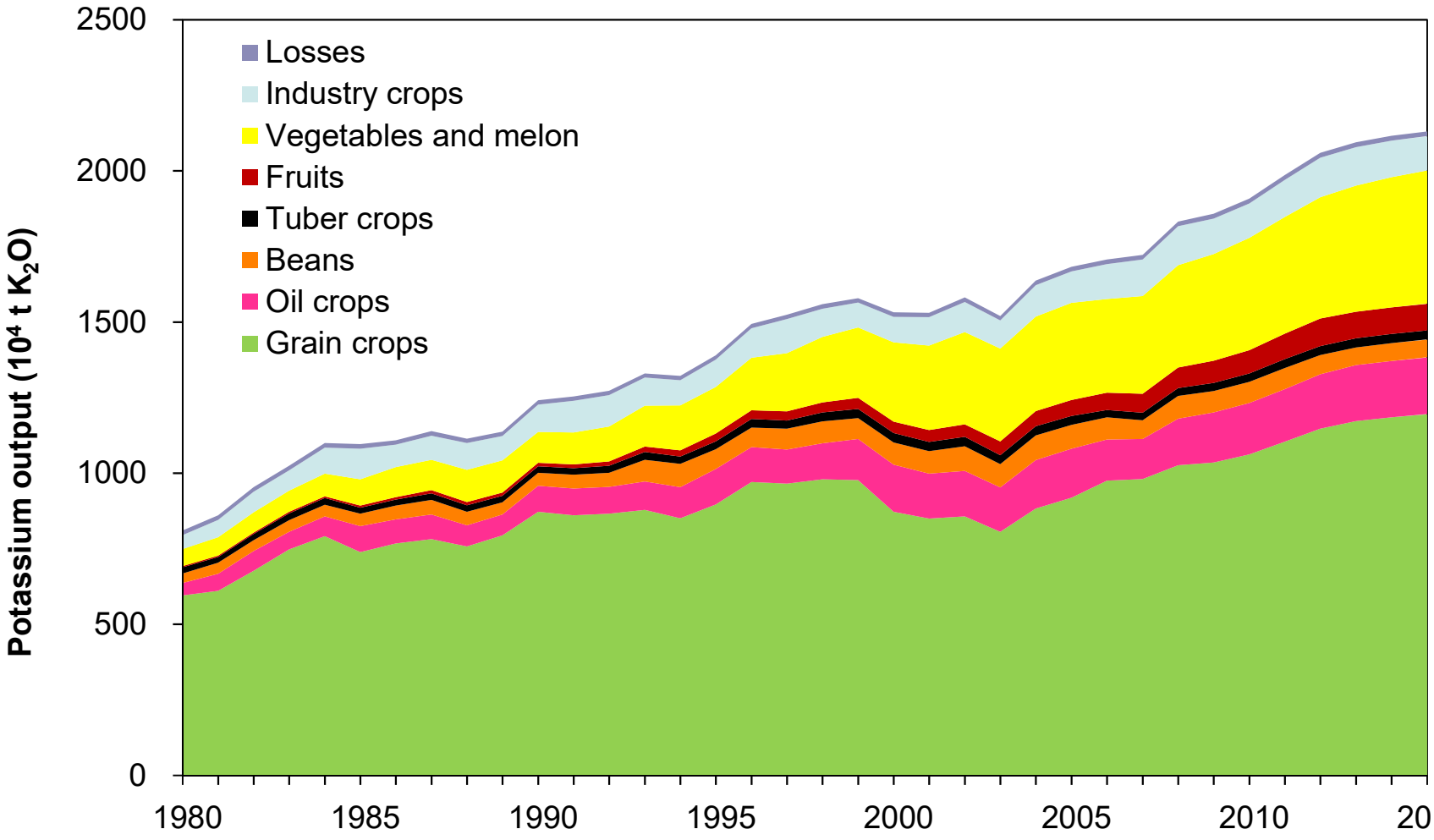

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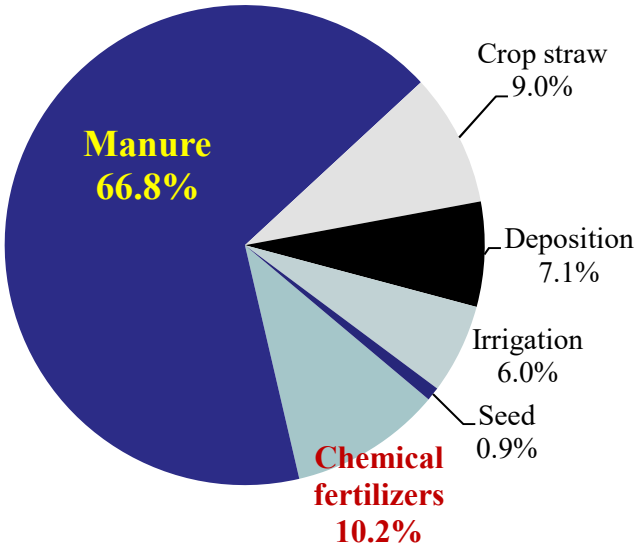
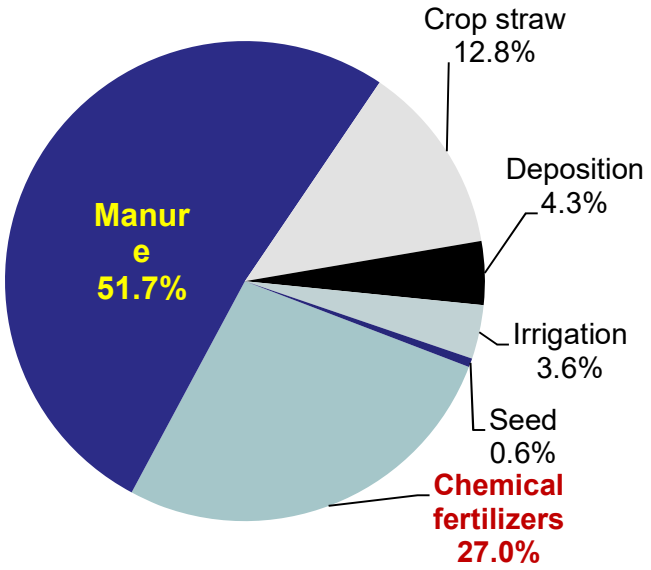
Potassium input

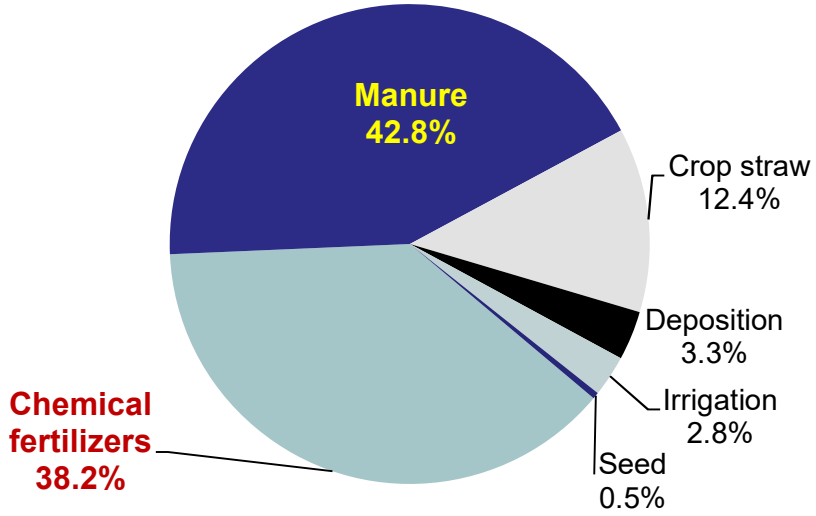
(a) 1980s



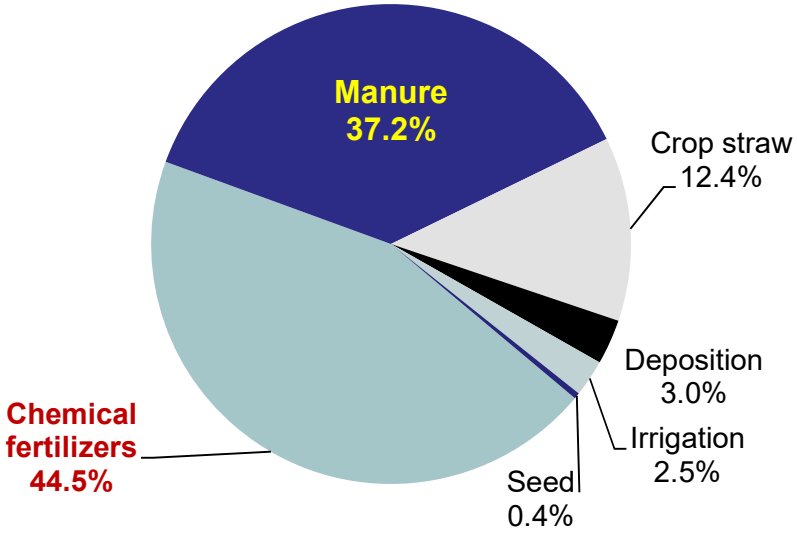
(b) 1990s



(c) 2000s



(d) 2010s



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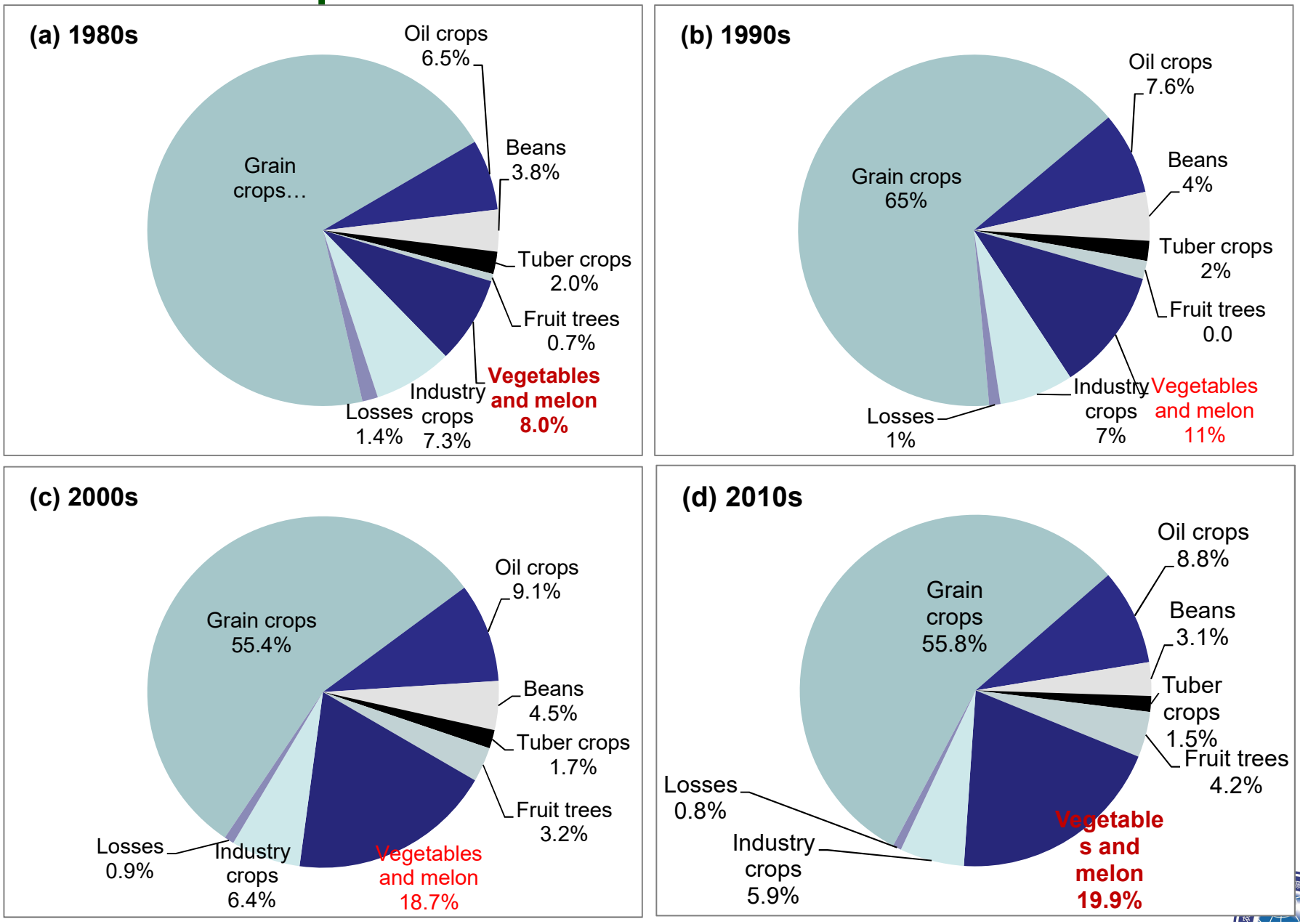
Potassium output



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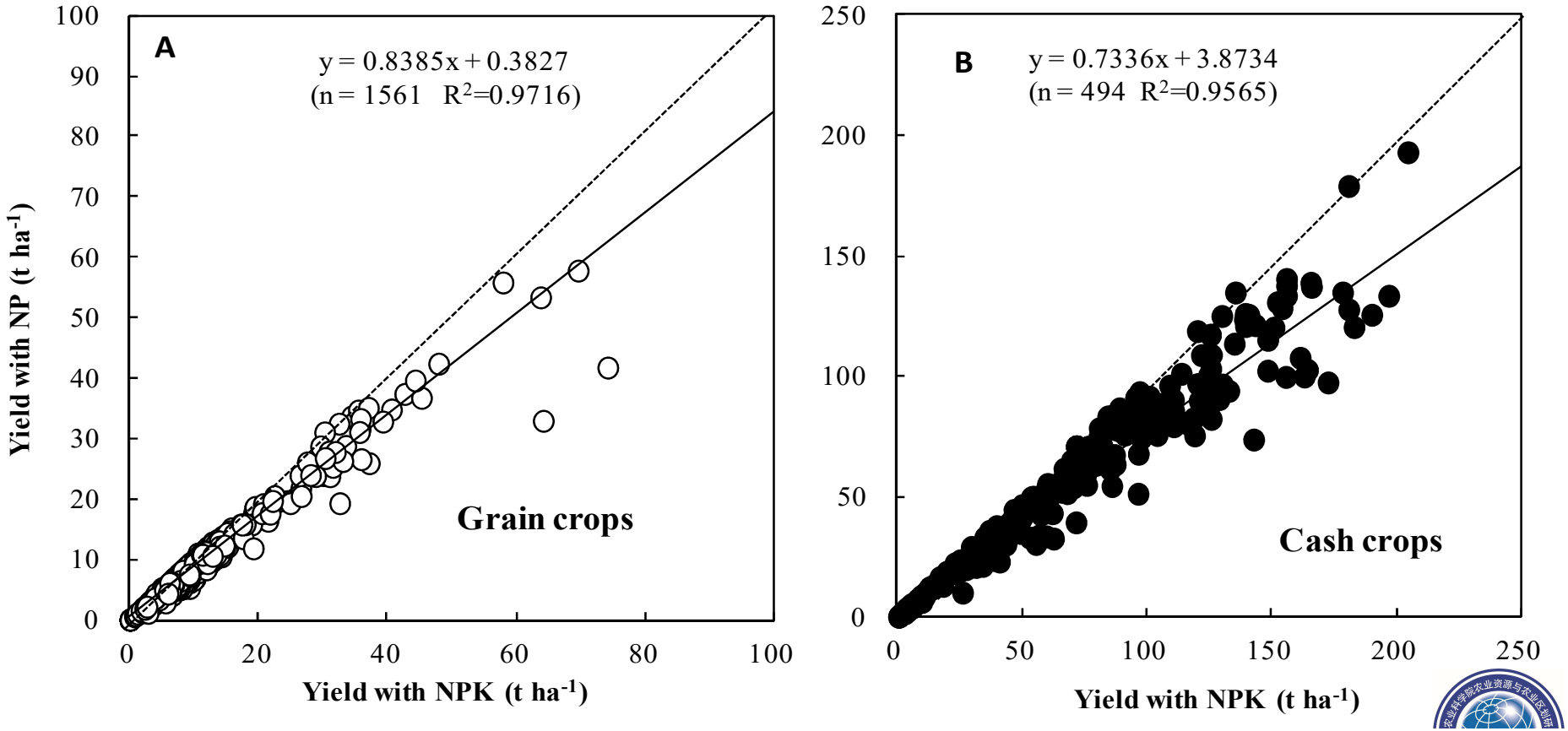
Crop yield response: cash crops>grain crops

- Cash crops are more sensitive to K application than grain crops



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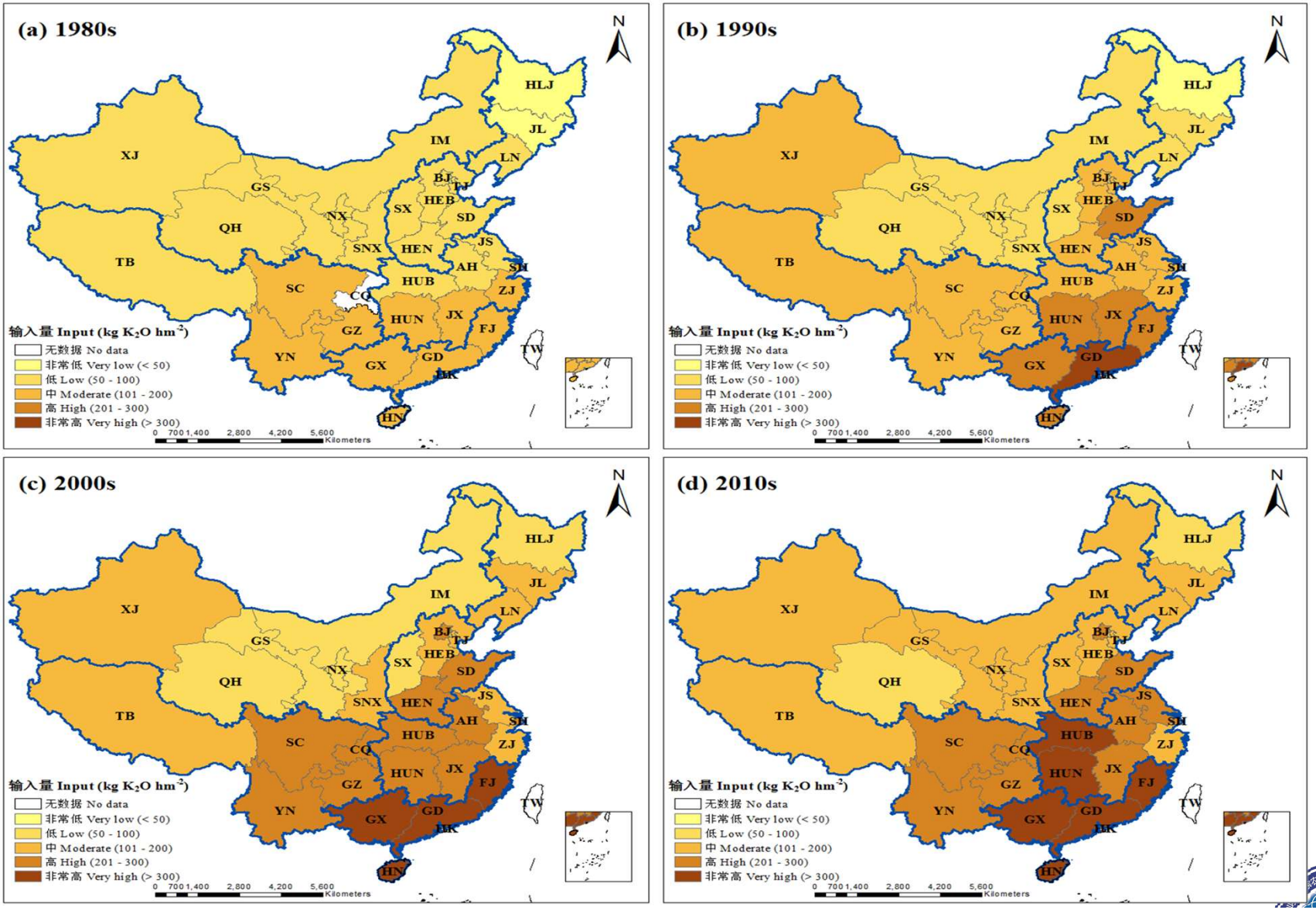
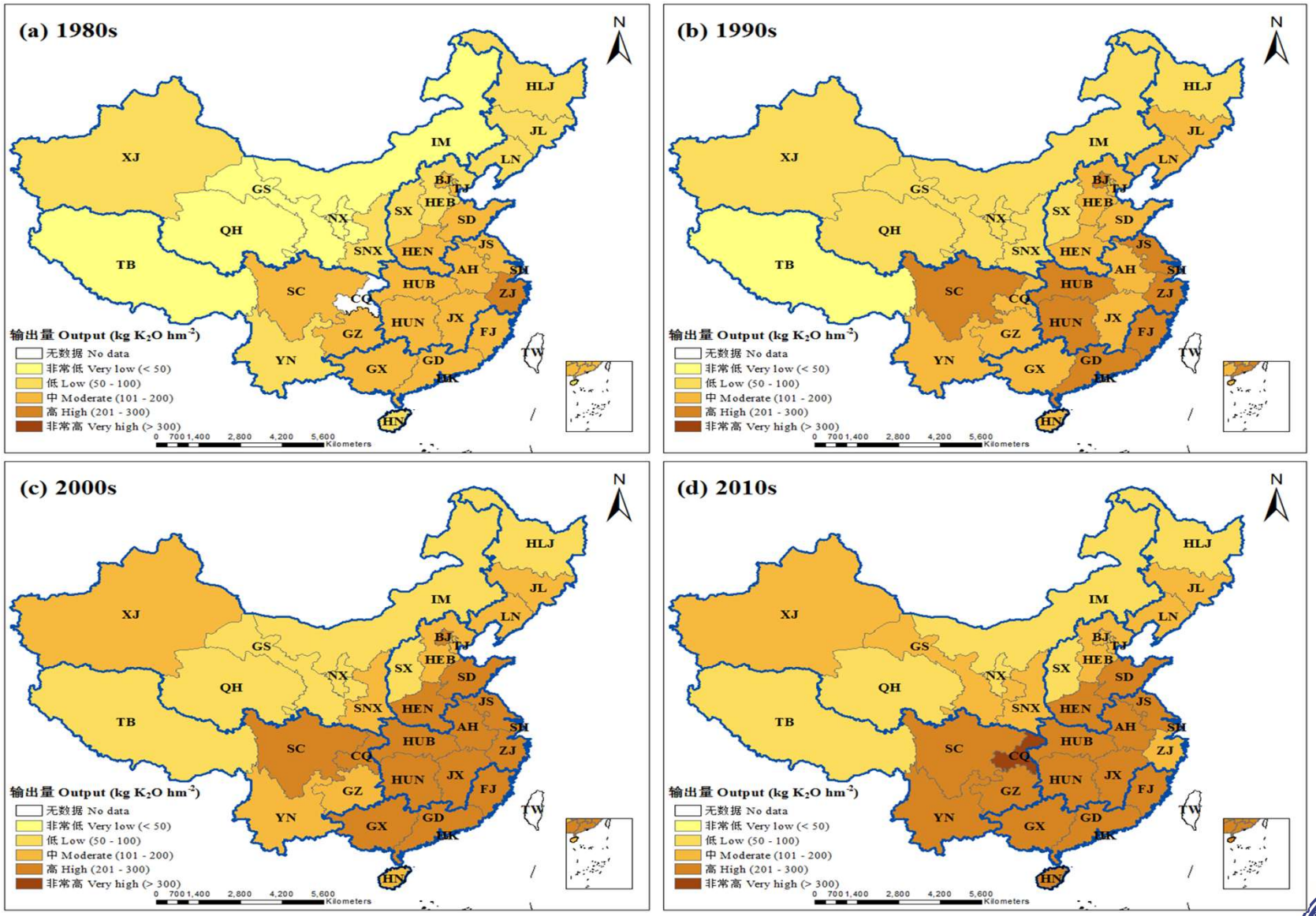
Temporal variation of K input in each province



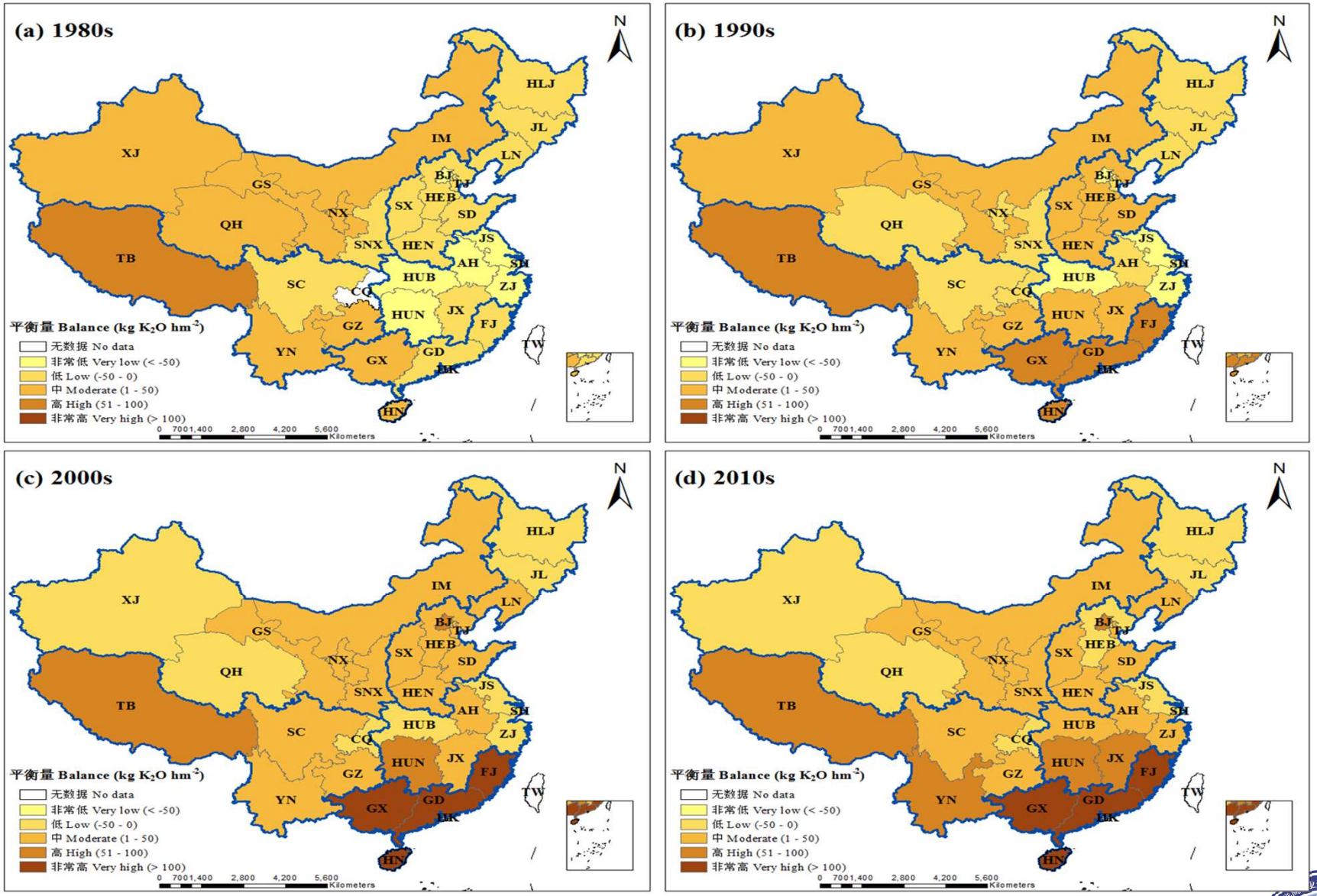
Liu et al.Nutr. Cyc. Agr., 2017, 107: 247-264

Temporal variation of K output in each province



Liu et al.Nutr. Cyc. Agr., 2017, 107: 247-264

Temporal variation of K balance in each province



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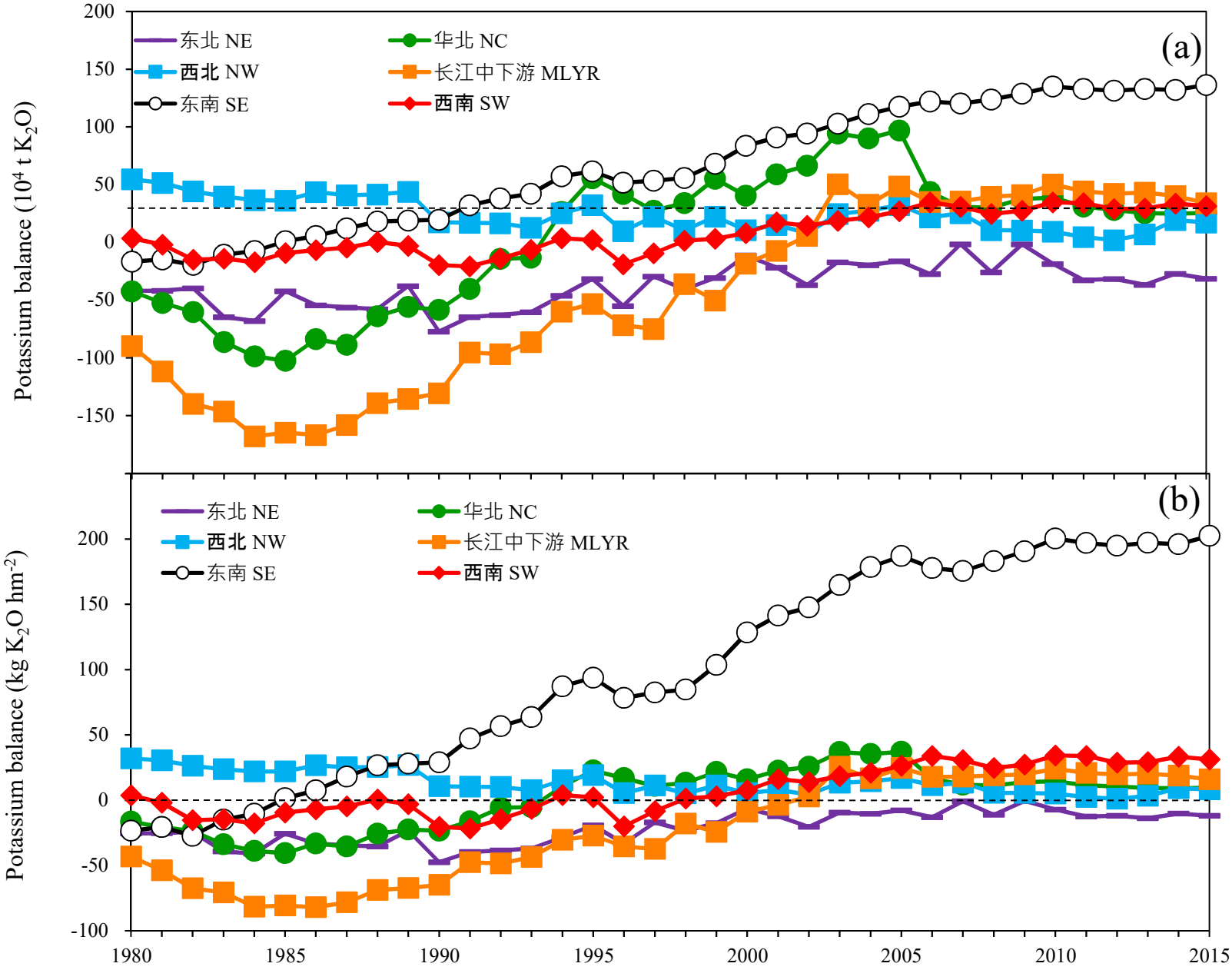

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- Temporal and spatial variation of potassium
- **Yield and K use efficiency- Example of northeast China**
- Soil potassium pool
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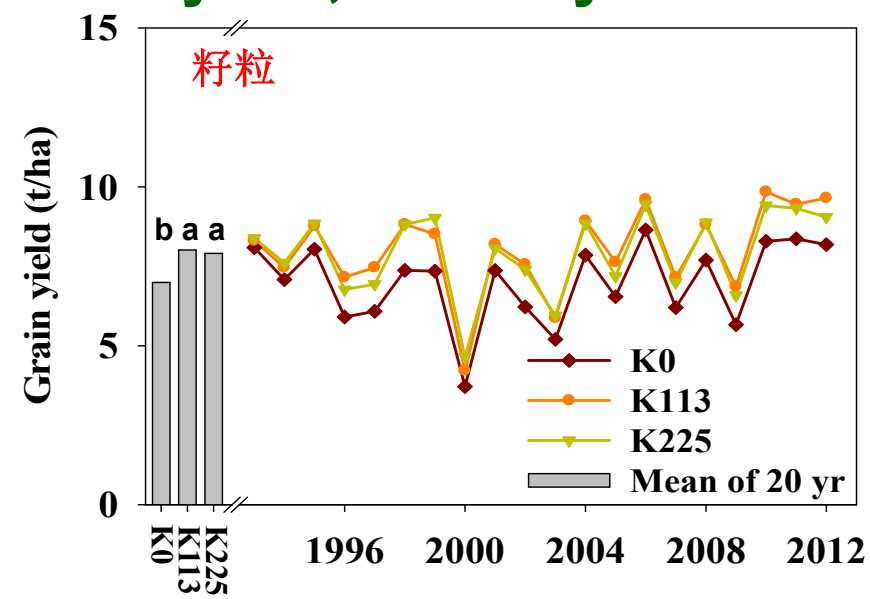
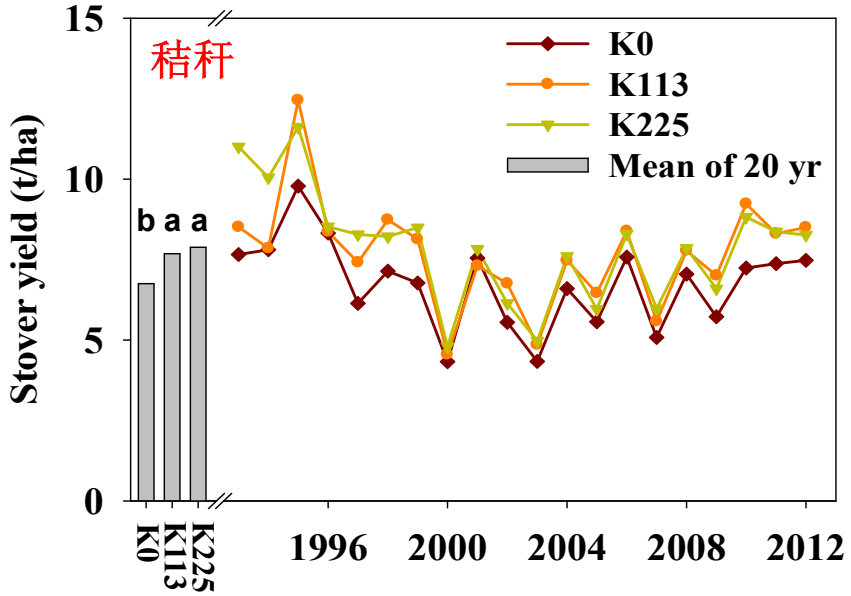
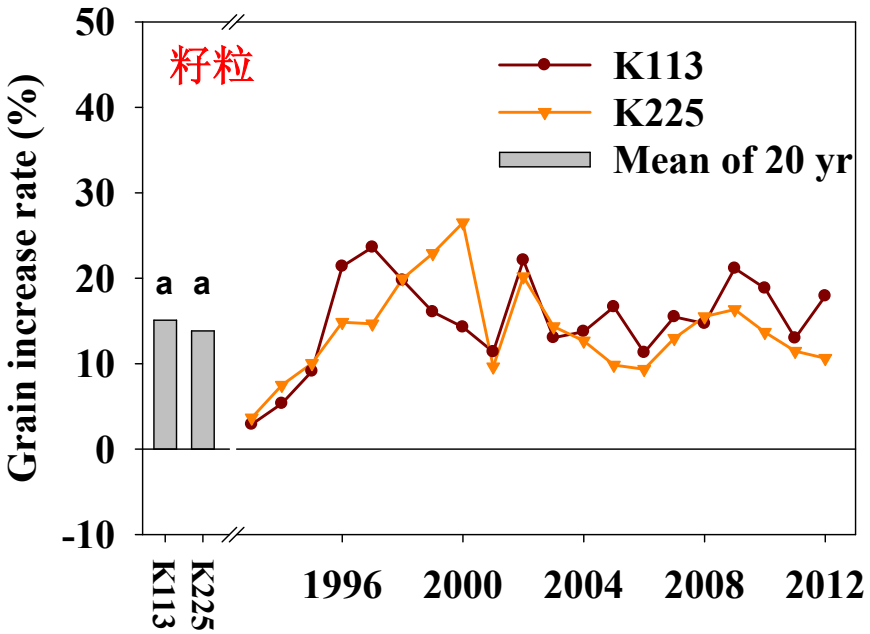
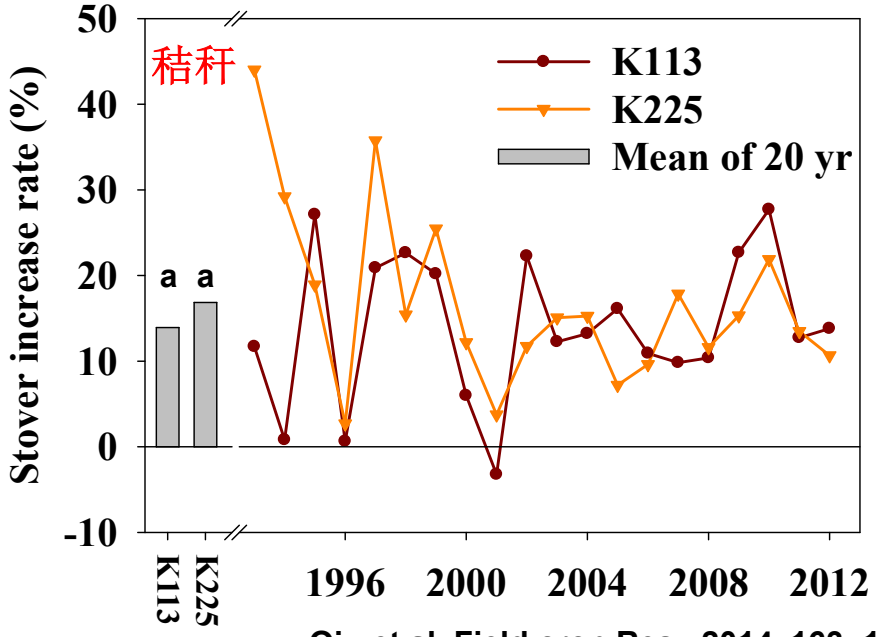
Grain yield, stover yield and their increase rate



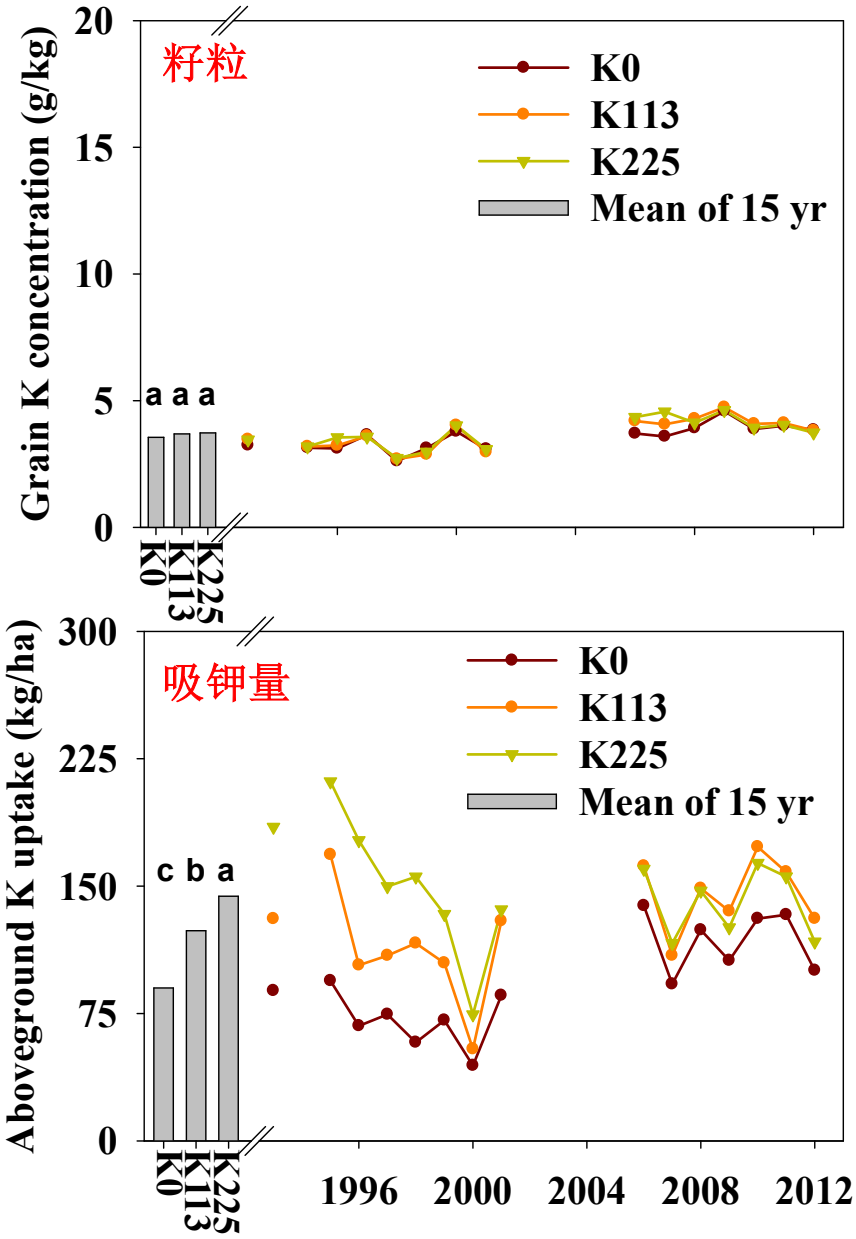


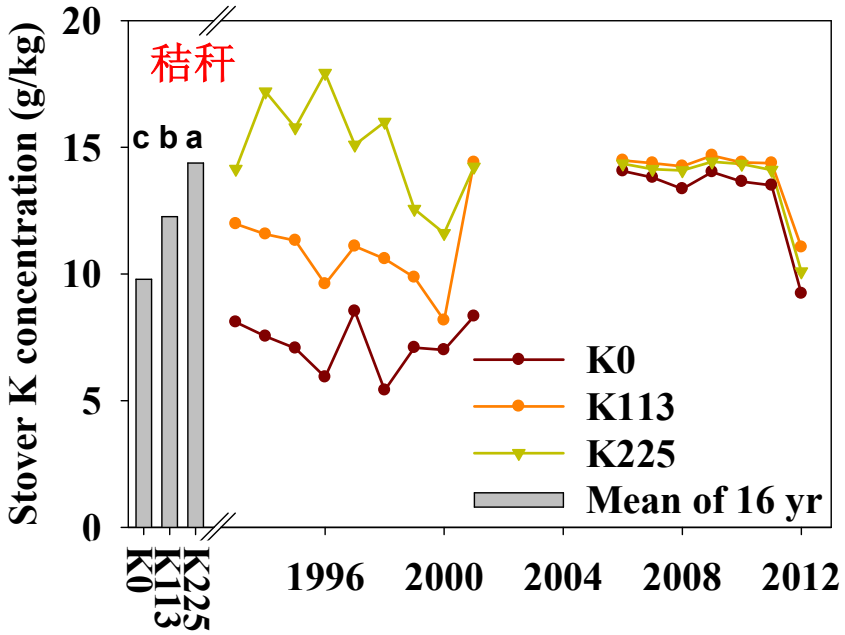




Qiu et al. Field crop Res., 2014, 163: 1-9

K concentration and aboveground K uptake





Grain K concentration, stover K concentration, aboveground K uptake, in the K0, K113, and K225 treatments

Qiu et al. Field crop Res., 2014, 163: 1-9

Analysis of variance for the effects of the K_2O application rate, cultivar, density, precipitation, and the interactions between K_2O rate and the other variables.

	Grain yield	Stover yield	Grain K concentration	Stover K concentration	Aboveground K uptake
Rate (R)	**	**	**	**	**
Cultivar (C)	**	**	**	**	**
Density (D)	*	ns	**	**	ns
Precipitation (P)	**	**	**	**	**
C × R	ns	**	ns	**	**
D × R	ns	**	ns	**	ns
P × R	ns	*	ns	**	**

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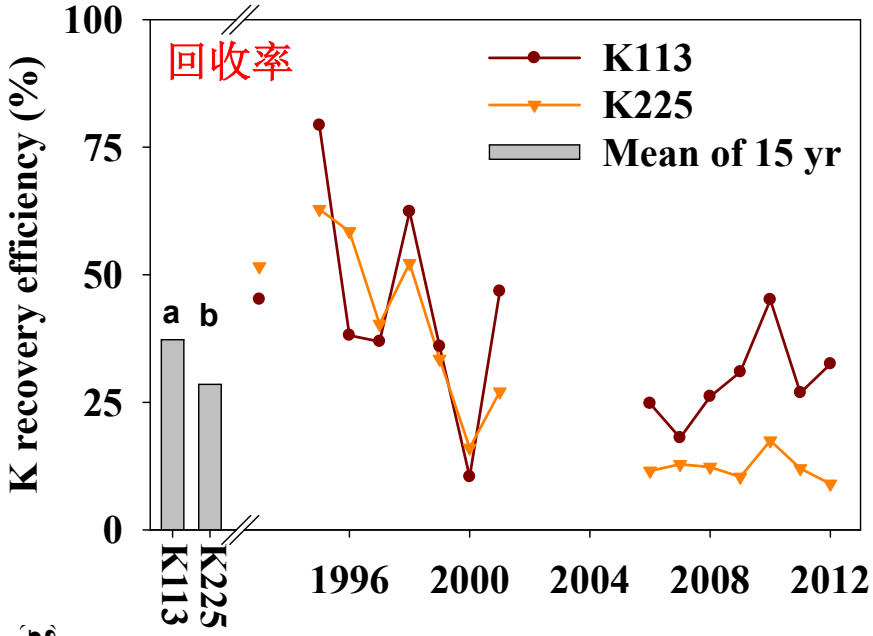
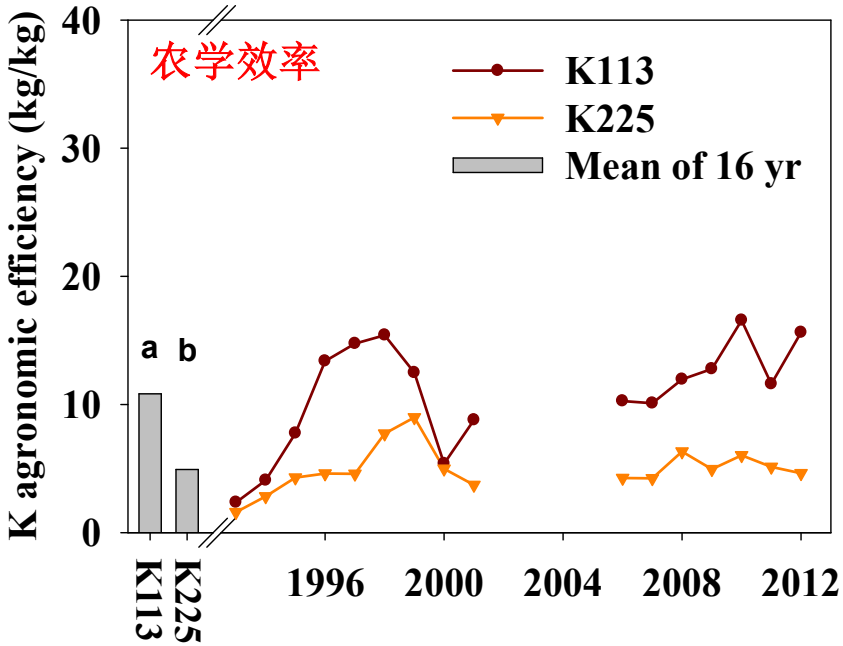
Correction between monthly precipitation from May to September and grain or stover yield.

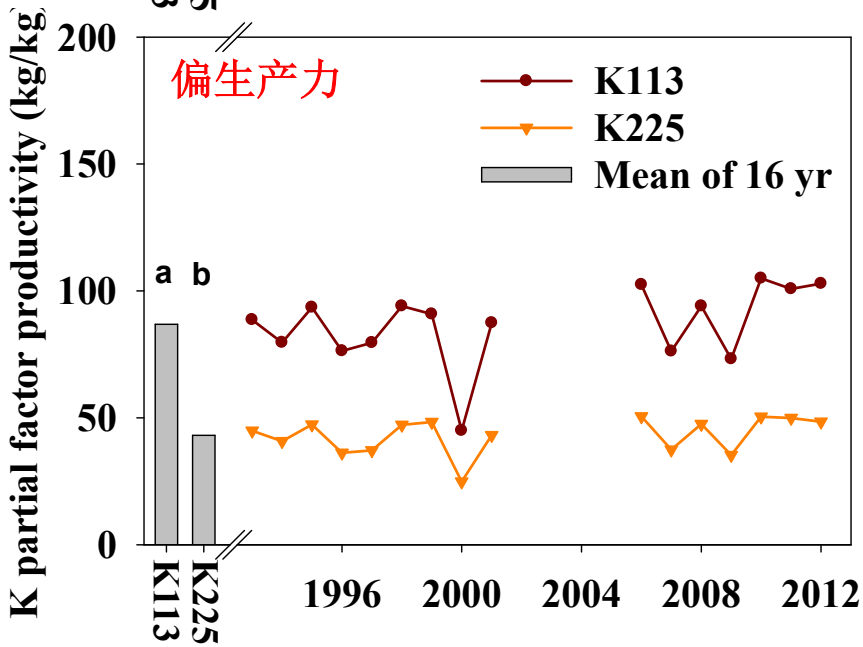
	May	June	July	August	September
Grain yield	0.12	0.16	0.51**	0.05	-0.02
Stover yield	0.25	0.09	0.29*	-0.00	-0.01

Qiu et al. Field crop Res., 2014, 163: 1-9

K use efficiencies



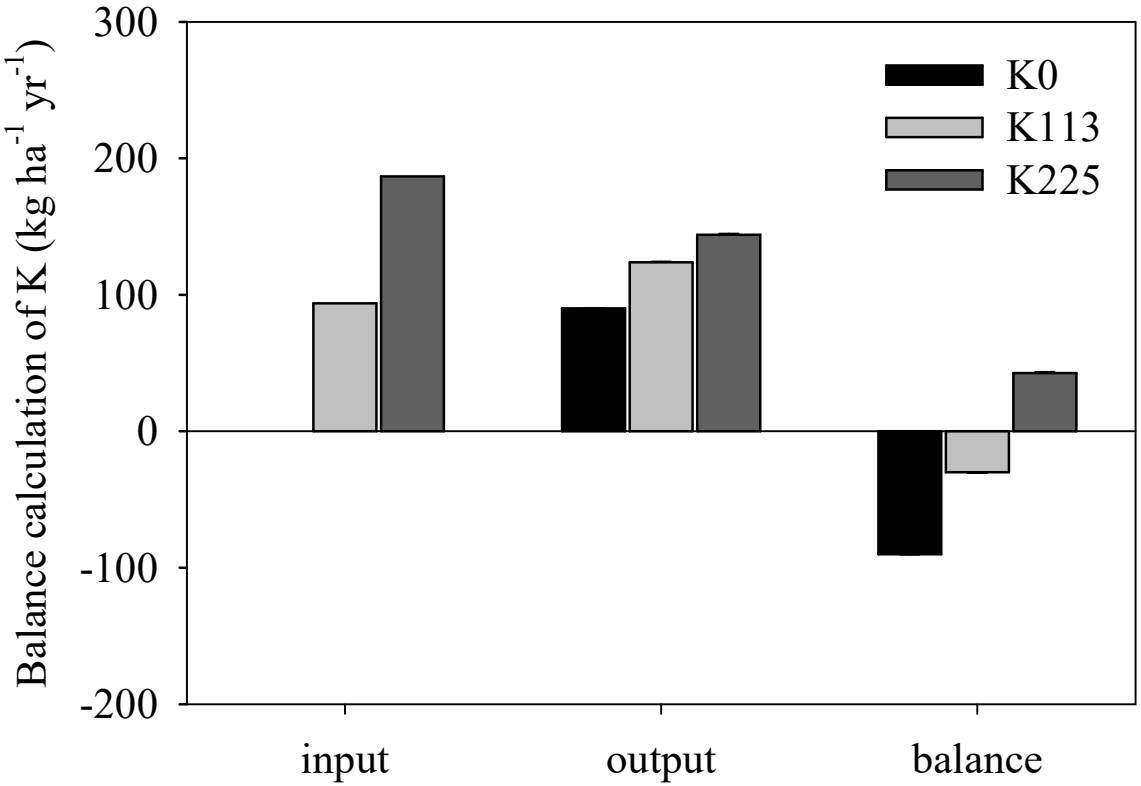




Potassium recovery efficiency, K agronomic efficiency, and K partial factor productivity in the K0, K113, and K225 treatments.

Qiu et al. Field crop Res., 2014, 163: 1-9

K Balance



Average K input and output in the K0, K113, and K225 treatments over the 20-year experimental period.

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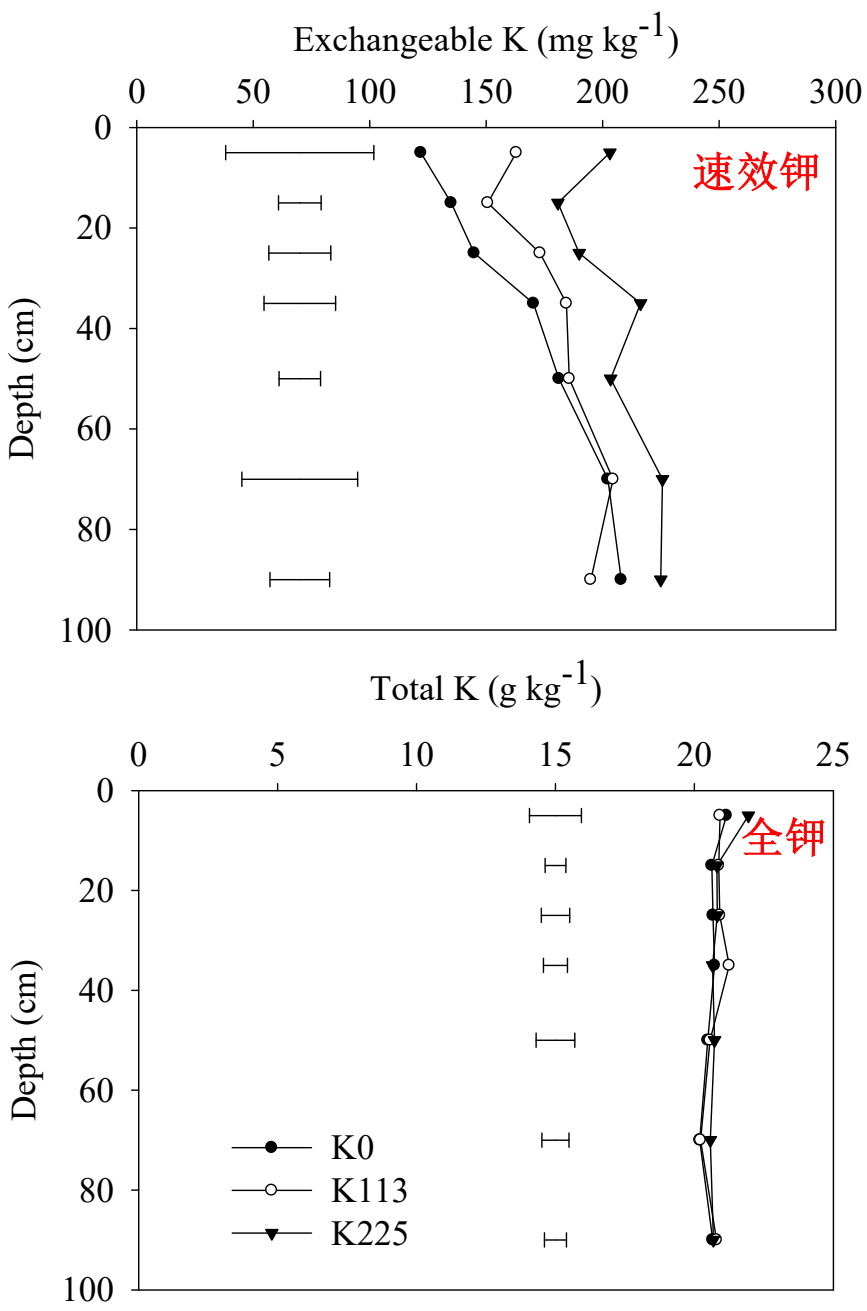
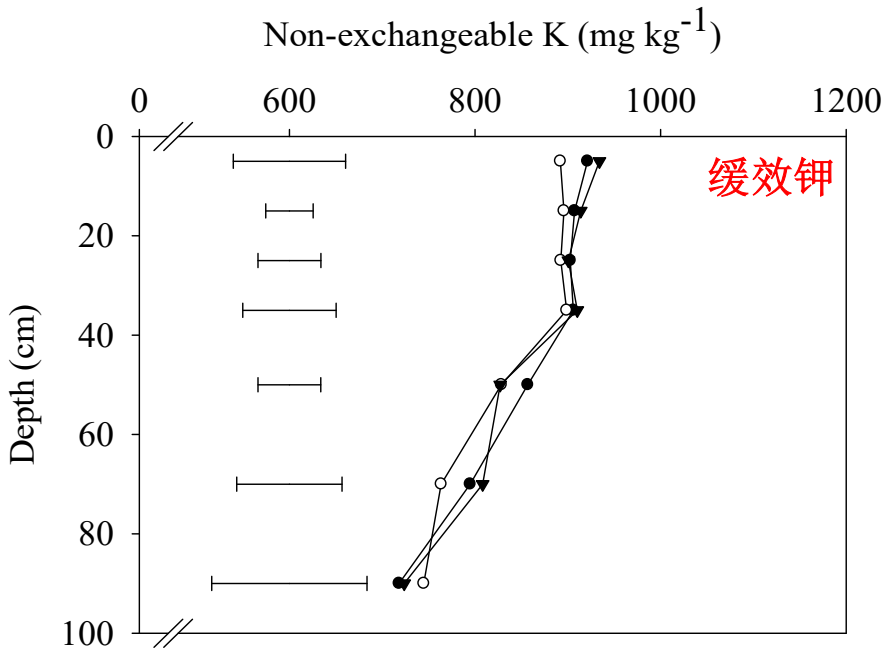
Soil K in northeast China





Concentrations of exchangeable K, non-exchangeable K, and total K at different soil depths in K0, K113, and K225 treatments in 2012.

Qiu et al. Field crop Res., 2014, 163: 1-9

Soil K in northeast China

Contents of exchangeable K, non-exchangeable K, and total K at 0–1 m depth among treatments in 2012 (after 20yrs). Unit: t K ha^{-1}.

Treatment	Exchangeable K	Non-exchangeable K	Total K
K0	2.4 b	11.5 a	285.6 a
K113	2.5 b	11.6 a	287.4 a
K225	2.9 a	11.6 a	288.8 a

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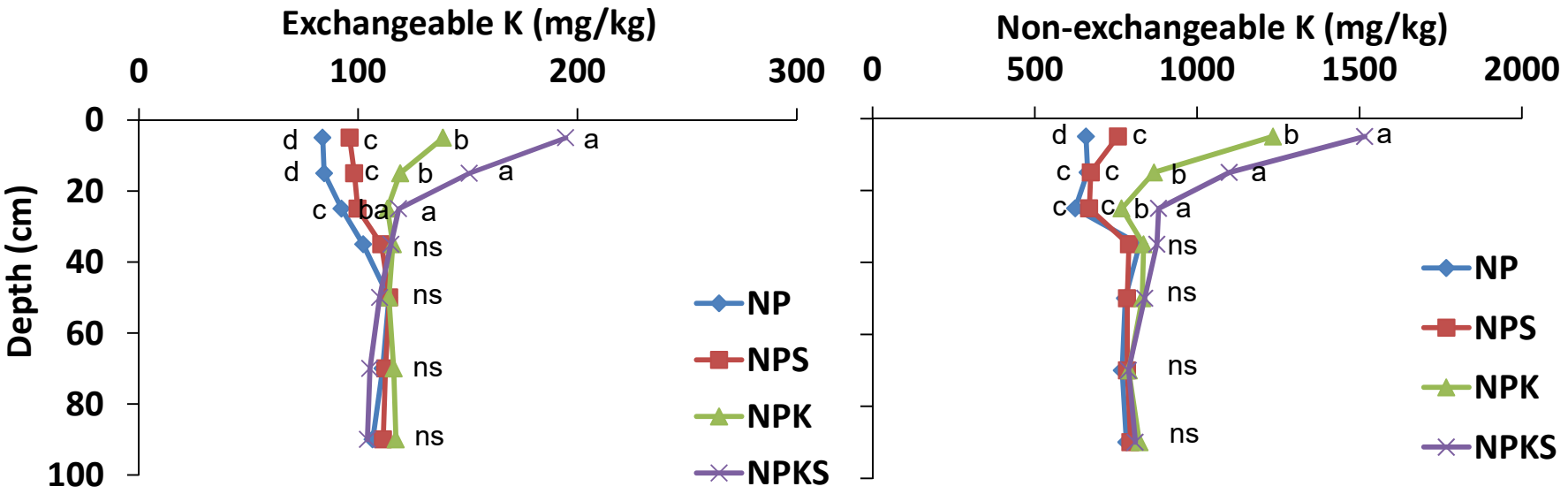
Straw returned to Soil in north China plain (NCP)

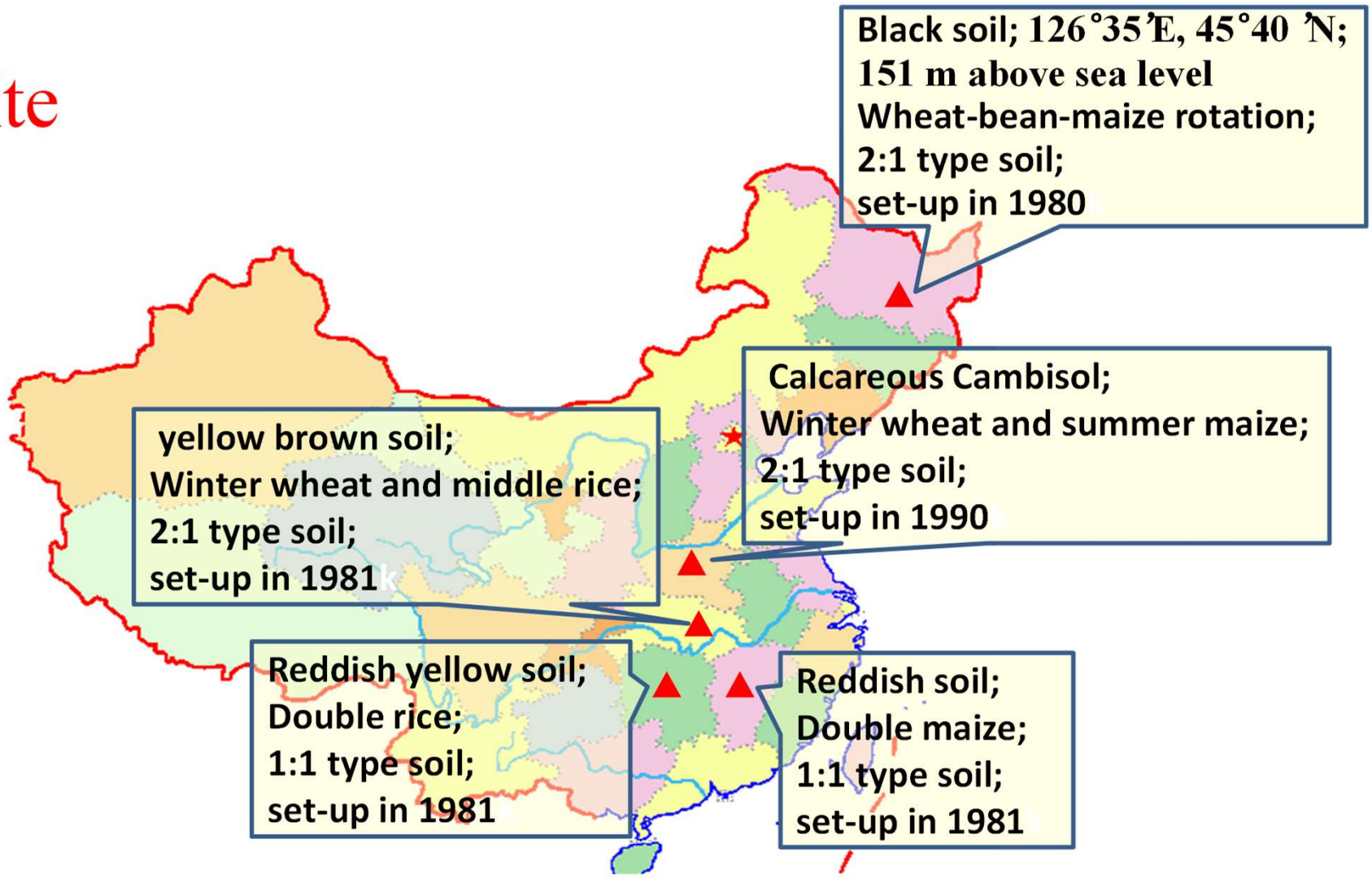


Soil exchangeable K and non-exchangeable K in different soil layers(cm) under different fertilization treatments after 20 yr winter wheat and summer maize cropping system in NCP.

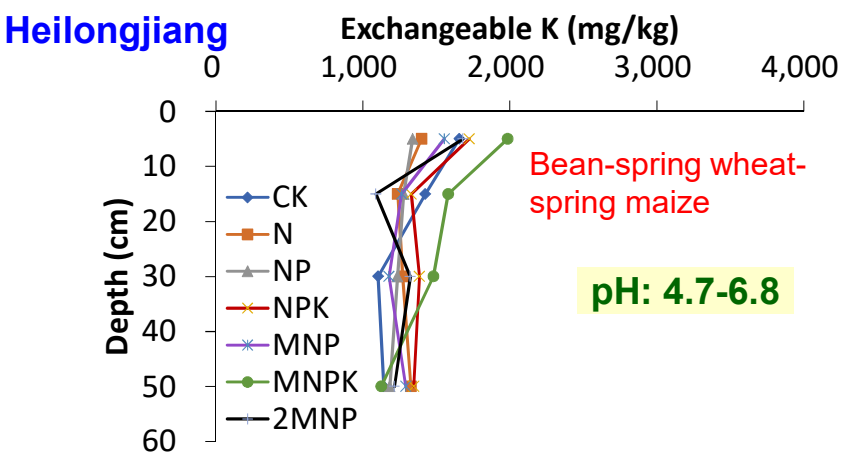
Each crop: N : P_2O_5 : K_2O = 225 : 90 : 150; S, straw

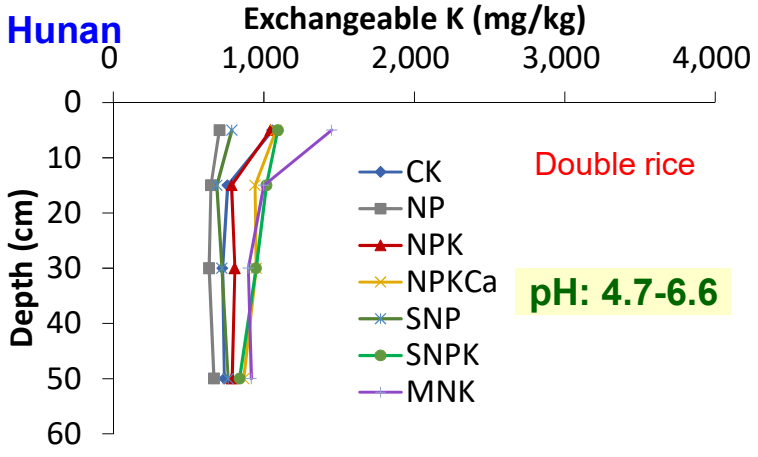
Zhao et al. Field crop Res., 2014, 163: 116-122

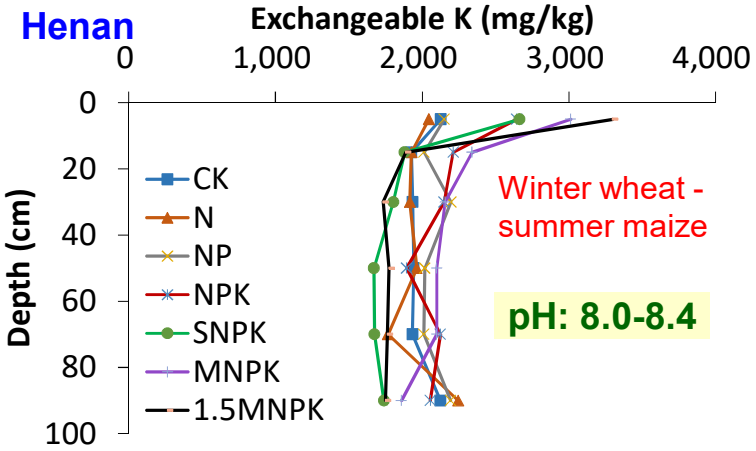
Site

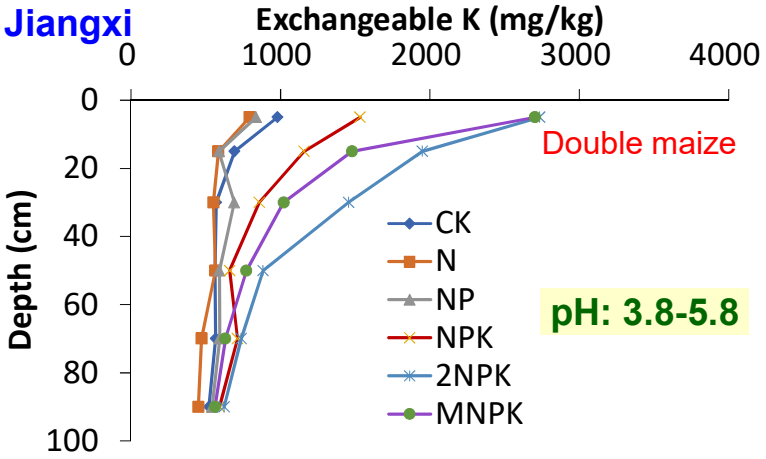


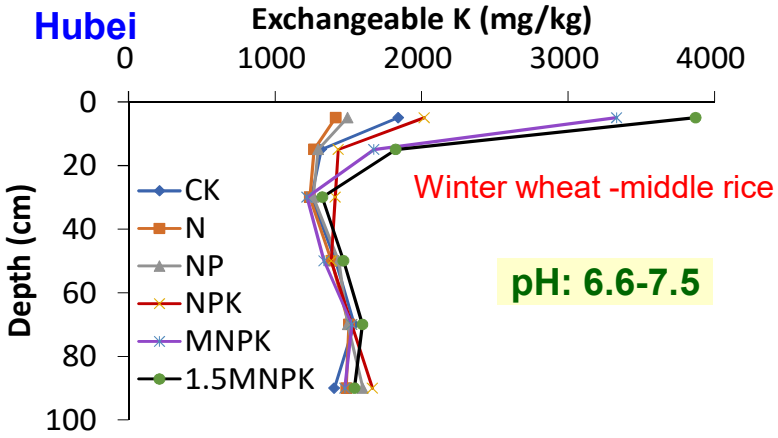
▲ Site of Five long term location experiments， more than 20-30 years





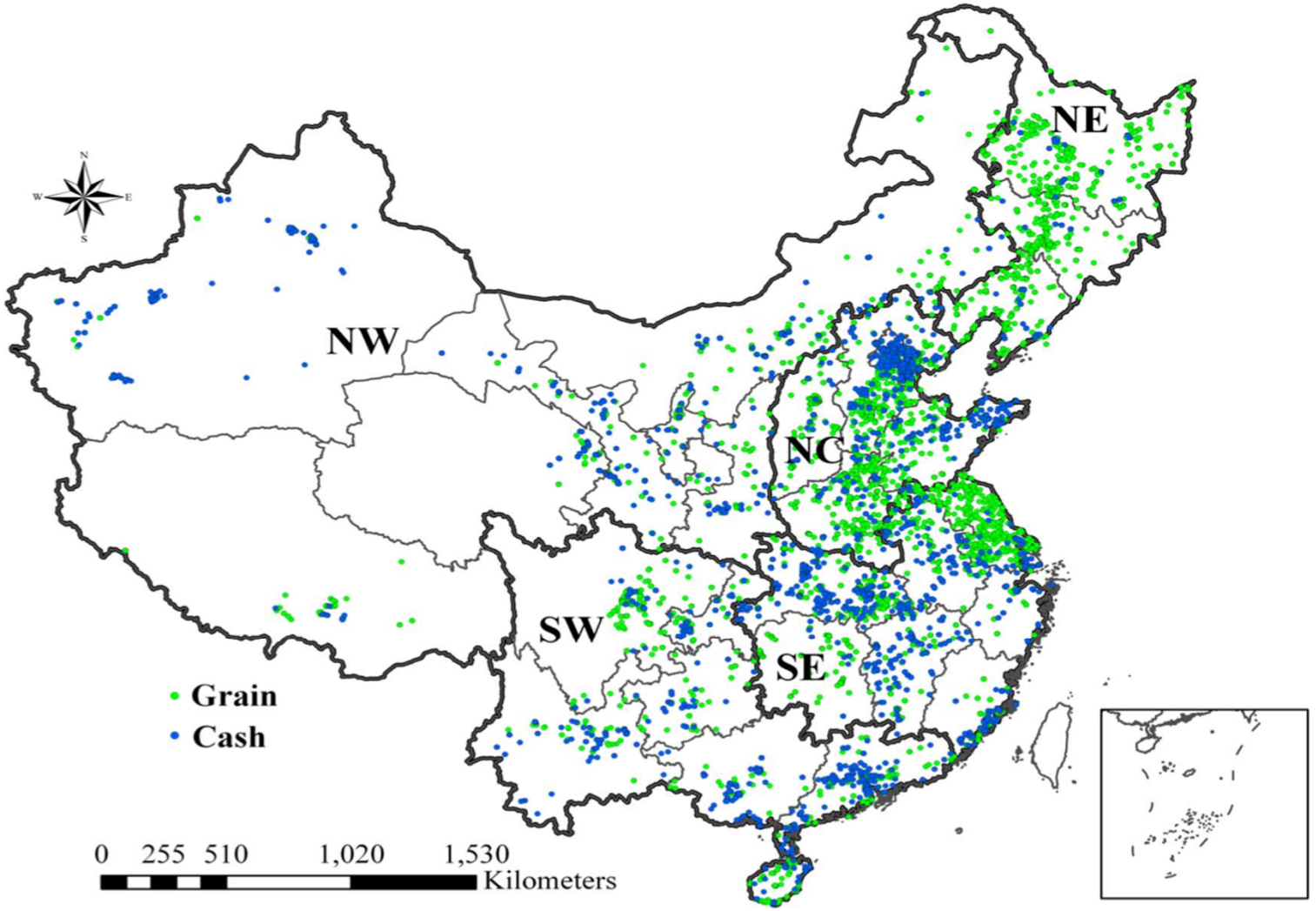


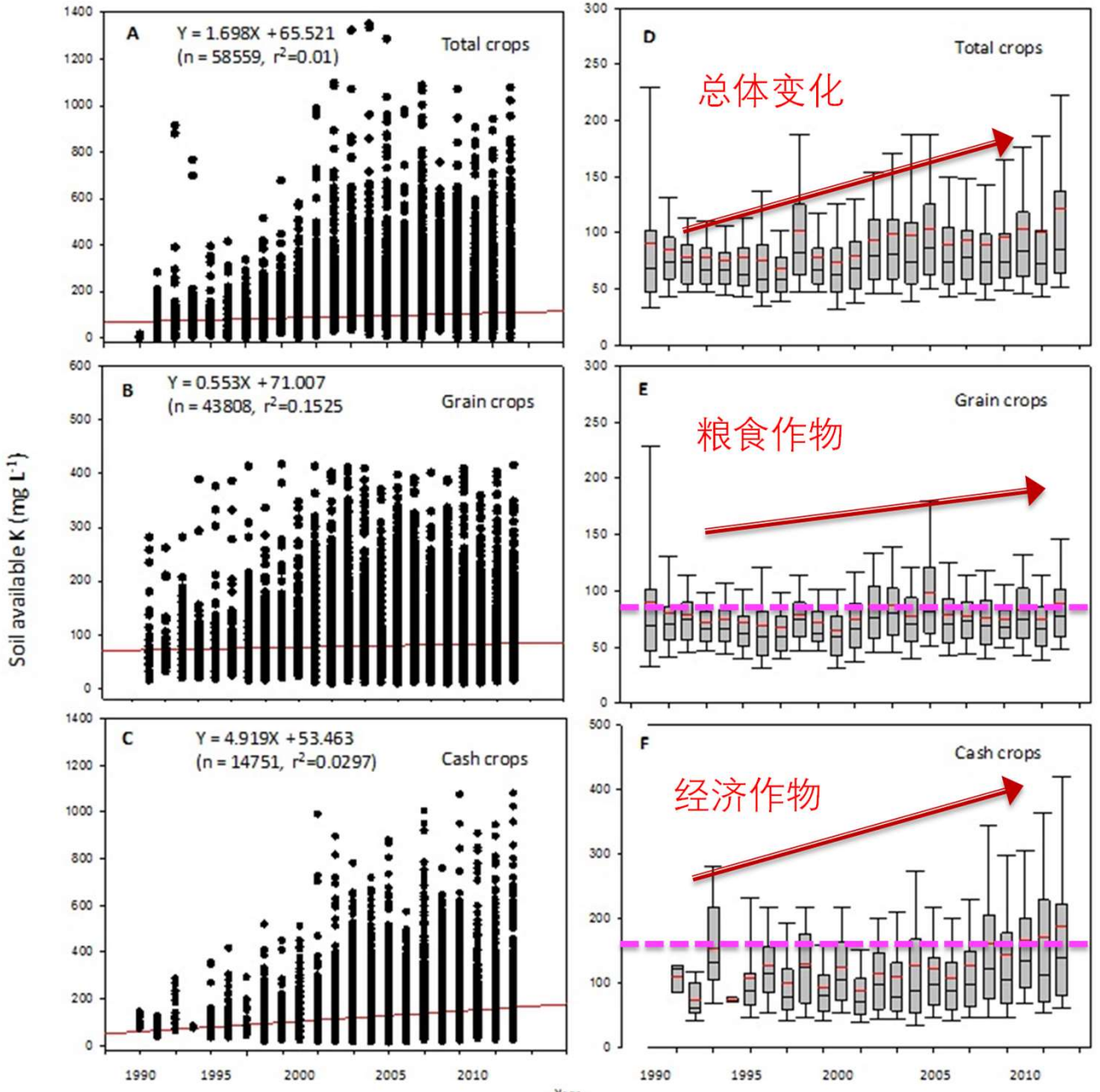




Unpublished data

59, 956 surface soil samples throughout China since 1990s





Exchangeable K change with years

He et al. Field crop Res., 2015, 173: 49-56

Conclusion

- K nutrient management should be site specific and cropping system specific;
- Optimal K rate increase the averaged grain yield about 15%, excessive K rate cannot continue increase grain yield and decrease K use efficiency;
- Great attention needs to be paid on optimal K rate and the replacement of chemical fertilizer with the organic fertilizers, e.g. straw and manure.

Thank you for your attention!