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Response of radial growth for five major coniferous tree species to climate warming in China and potential cooperation research areas

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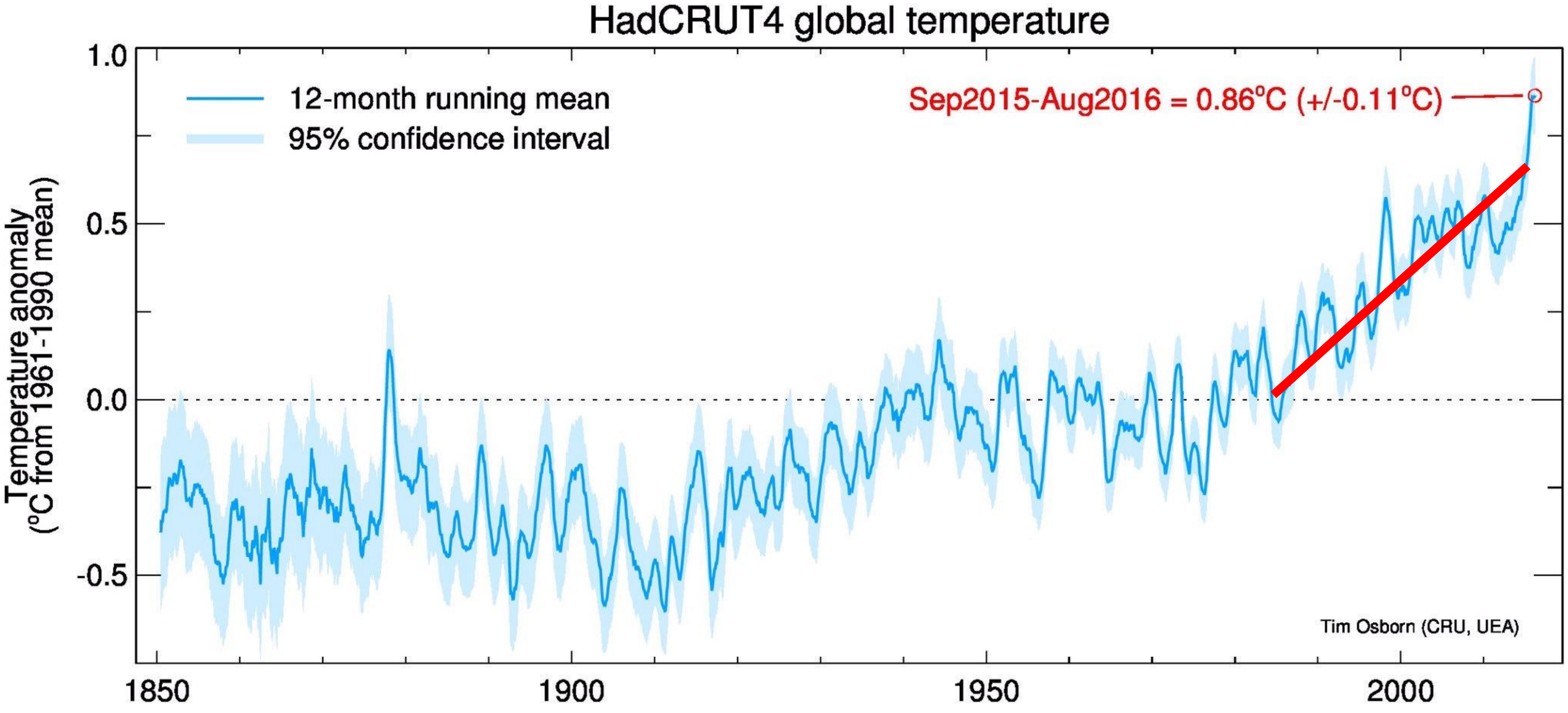
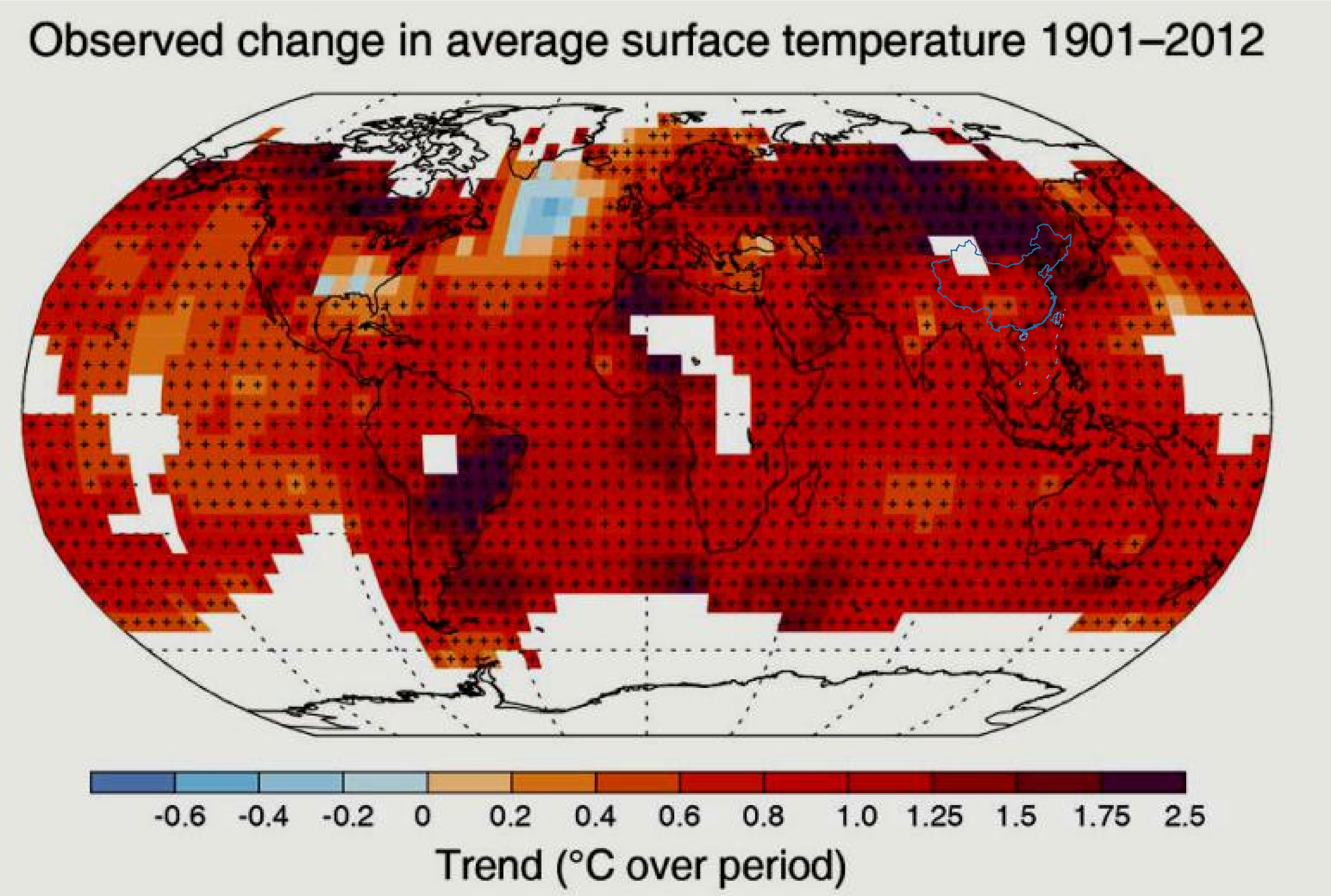
Background

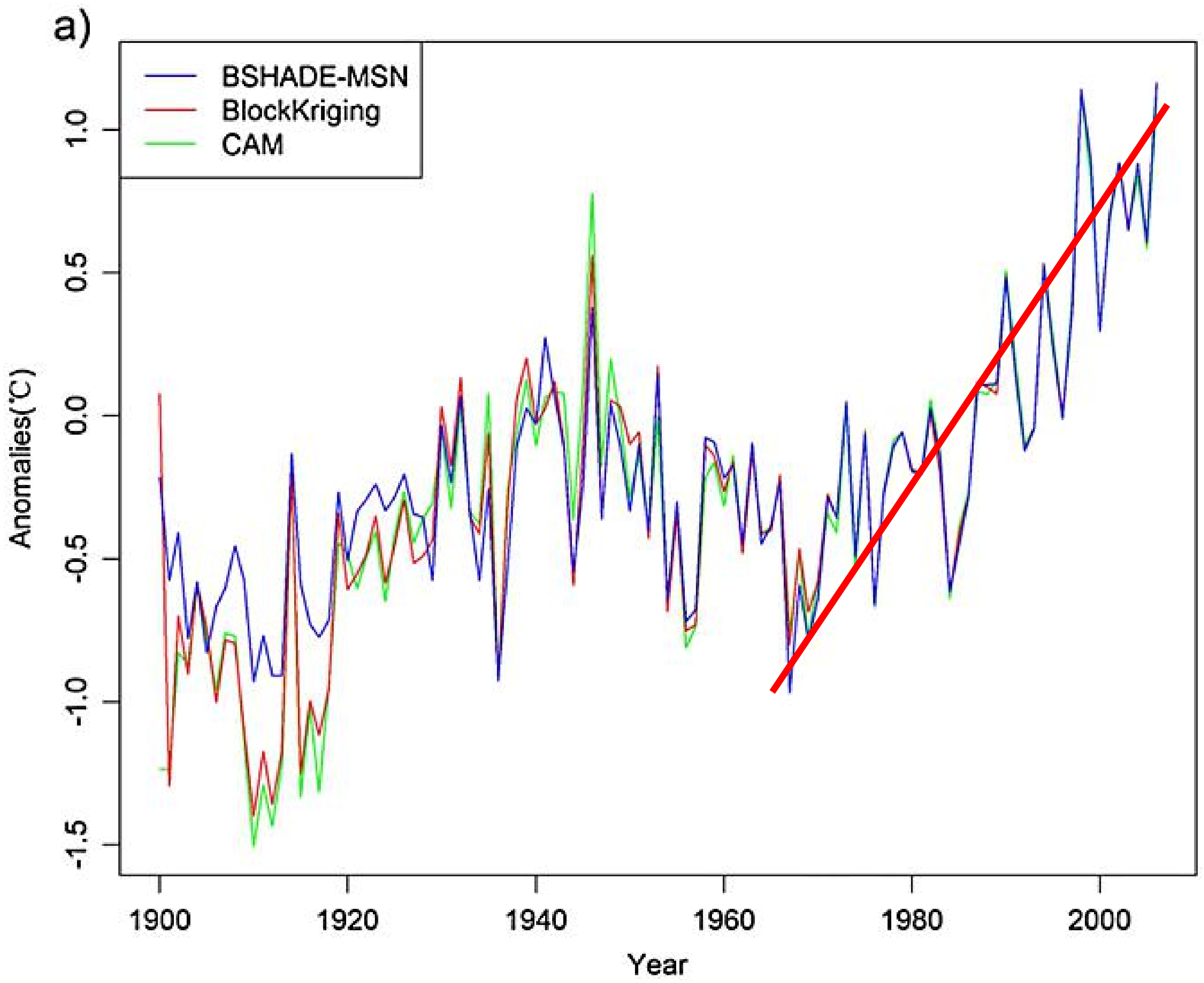


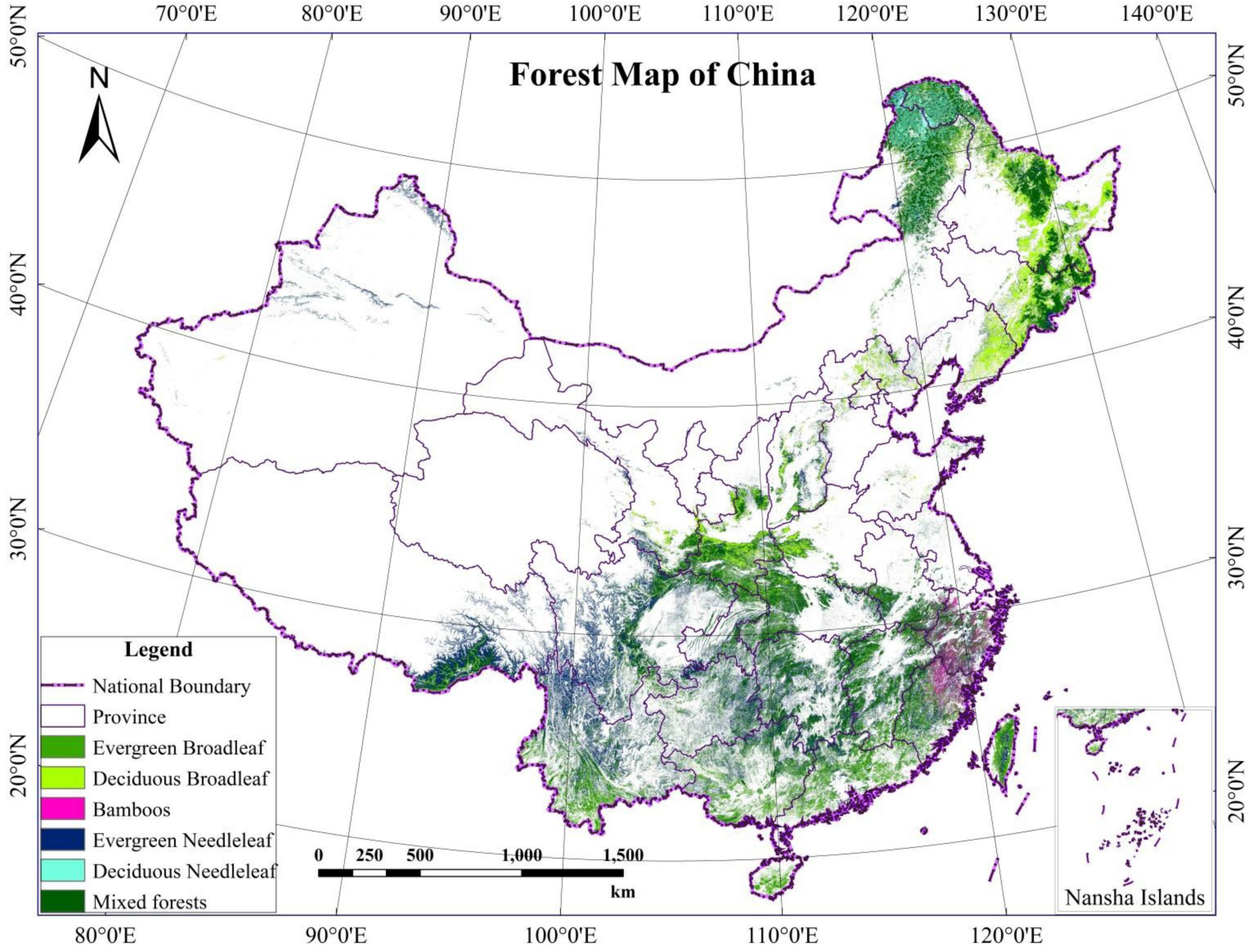
HadCRUT4 global temperature
12-month running mean
95% confidence interval
Sep2015-Aug2016 = 0.86°C (+/-0.11°C)
1.0
0.5
0.0
-0.5
Temperature anomaly
(°C from 1961-1990 mean)
Tim Osborn (CRU, UEA)
1850
1900
1950
2000



Observed change in average surface temperature 1901–2012
-0.6 -0.4 -0.2 0 0.2 0.4 0.6 0.8 1.0 1.25 1.5 1.75 2.5
Trend (°C over period)

Estimated annual temperature anomaly (using a base period of 1971–2000) time series using BSHADE- MSN, CAM, and Block Kriging for 1900–2006 in China (*Wang et al., 2014 JGR*)



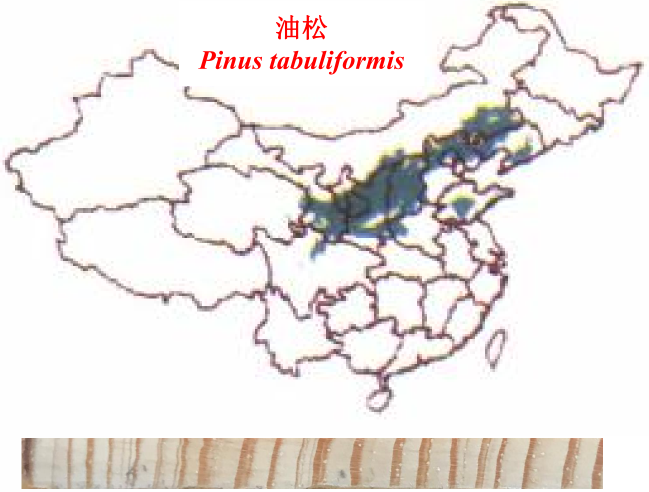

Forest Map of China
N
70°0'E
80°0'E
90°0'E
100°0'E
110°0'E
120°0'E
130°0'E
140°0'E
50°0'N
40°0'N
30°0'N
20°0'N
Legend
National Boundary
Province
Evergreen Broadleaf
Deciduous Broadleaf
Bamboos
Evergreen Needleleaf
Deciduous Needleleaf
Mixed forests
0 250 500 1,000 1,500
km
Nansha Islands

Scientific questions

- How radial growth of major coniferous trees respond to climate warming?
- Are there any other factors that may affect the response of tree radial growth to climate warming?
- Is there a regional difference in the response of tree radial growth to climate warming?

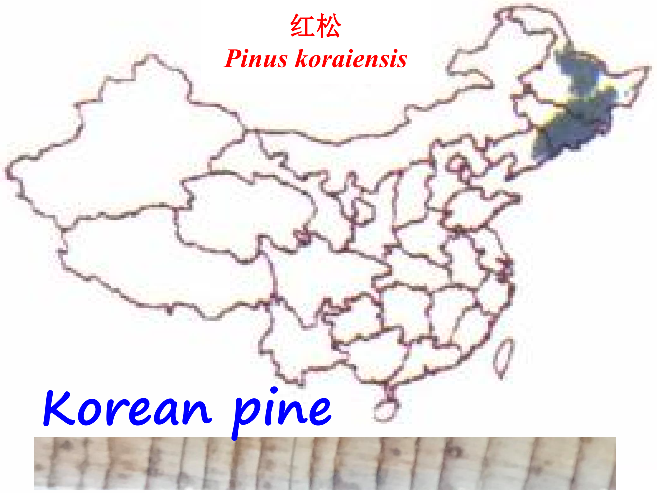
Materials and methods

Dahurian larch



Korean red pine

Masson pine

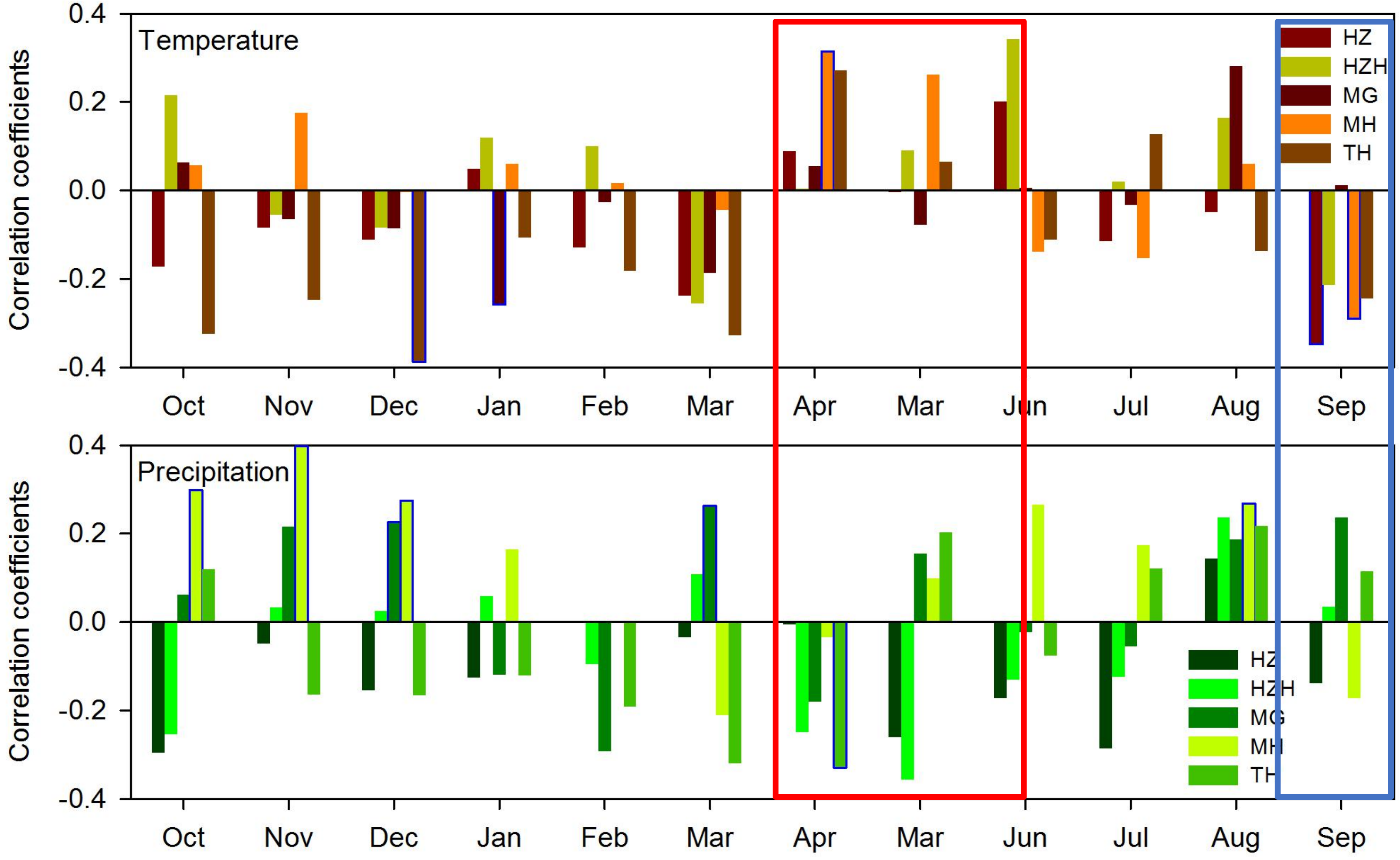


Korean pine

China fir

Results

- Growth-climate relationships of *Larix gmelini* in northeast China



Wang et al., 2009. Trees

Table 8 Correlation analyses between monthly mean temperature and the five age-class chronologies

	A100	A150	A200	A250	A300
Oct_P	0.14	0.14	−0.16	**−0.27**	**−0.30**
Nov_P	0.19	0.09	−0.01	−0.05	−0.11
Dec_P	0.11	−0.17	0.08	−0.01	−0.07
Jan	0.24	0.12	0.16	0.03	0.02
Feb	−0.20	0.03	−0.18	−0.32	−0.27
Mar	−0.12	−0.16	**−0.38**	**−0.38**	**−0.47**
Apr	**0.53**	**0.46**	0.20	0.05	0.04
May	**0.34**	0.32	0.01	0.03	−0.05
Jun	−0.17	−0.10	0.14	0.15	0.08
Jul	−0.17	−0.03	−0.23	−0.23	−0.20
Aug	−0.02	−0.08	**−0.44**	**−0.46**	**−0.39**
Sep	**−0.42**	−0.31	−0.25	−0.26	**−0.30**

The postfix "P" means "in the previous year". Bolded values for significance at the 0.05 level as tested by bootstrap method

Wang et al., 2009. Trees

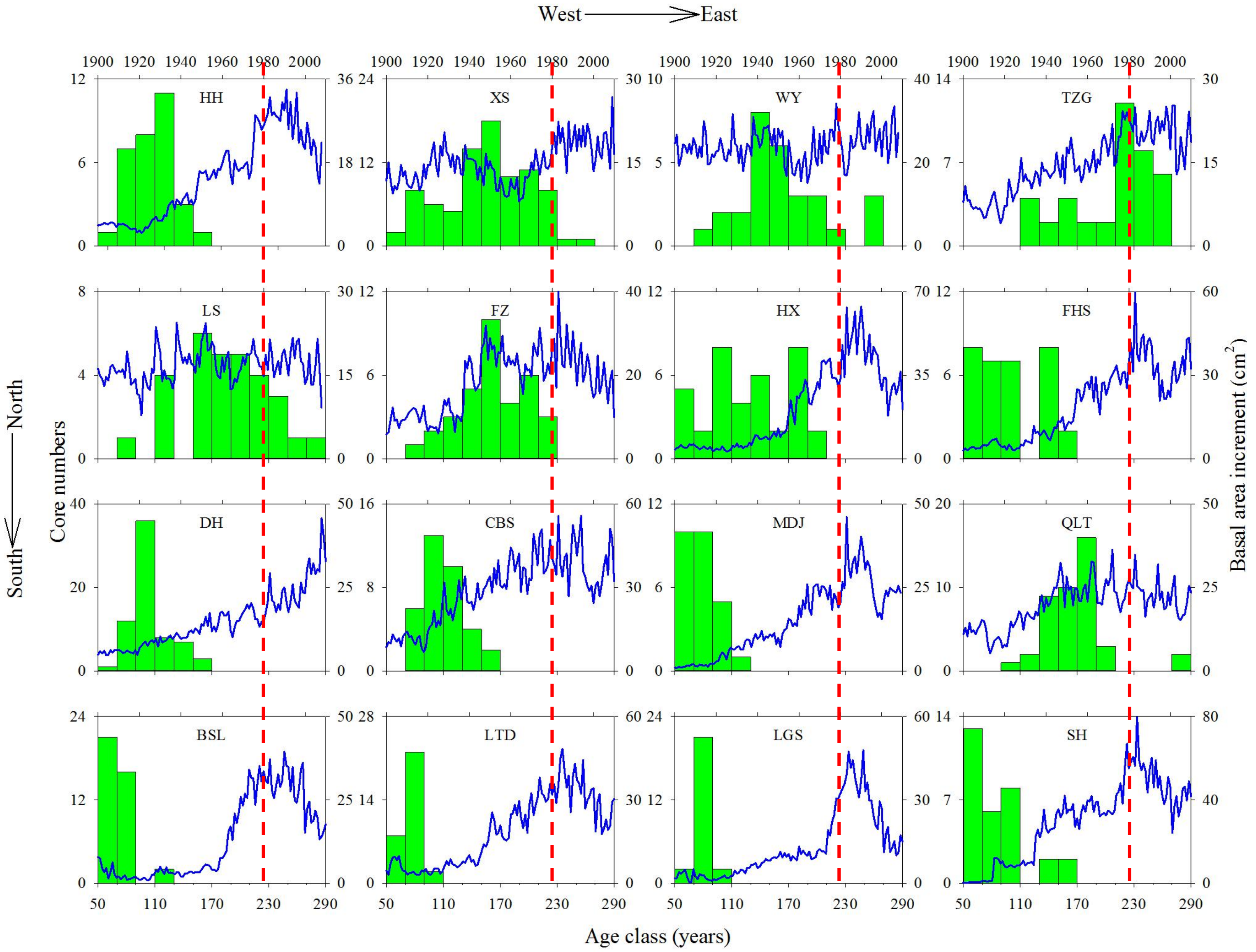
Table 9 Correlation analyses between monthly total precipitation and the five age-class chronologies

	A100	A150	A200	A250	A300
Oct_P	0.23	0.18	−0.07	−0.06	−0.10
Nov_P	−0.10	−0.14	−0.23	−0.22	−0.24
Dec_P	0.02	0.15	**−0.35**	**−0.41**	−0.27
Jan	0.15	0.14	−0.28	**−0.46**	−0.26
Feb	−0.14	0.02	−0.23	−0.19	−0.27
Mar	−0.16	**−0.32**	−0.13	−0.04	−0.09
Apr	−0.11	−0.35	−0.02	−0.14	−0.15
May	−0.16	−0.01	−0.27	**−0.41**	−0.21
Jun	0.21	0.15	**−0.45**	**−0.47**	**−0.47**
Jul	**0.37**	0.30	0.15	0.18	0.13
Aug	0.29	0.24	**0.49**	**0.40**	**0.49**
Sep	−0.17	−0.15	0.00	−0.12	0.05

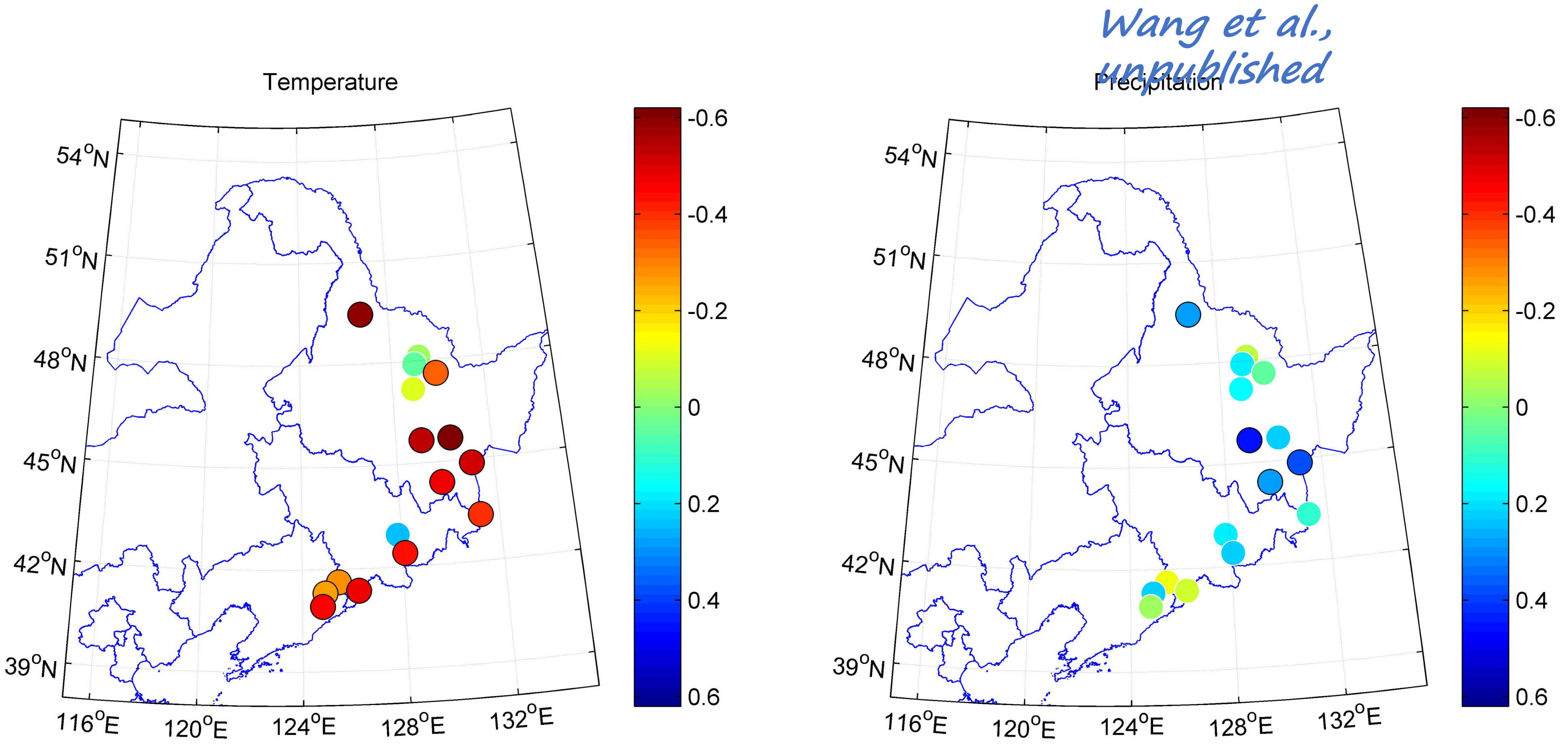
The postfix "P" means "in the previous year". Bolded values for significance at the 0.05 level as tested by bootstrap method

● Response of Korean pine (*Pinus koraiensis*) to recent climate warming

Basal area increment of Korean pine decreased at most sites since 1980, and which is more serious in younger trees.

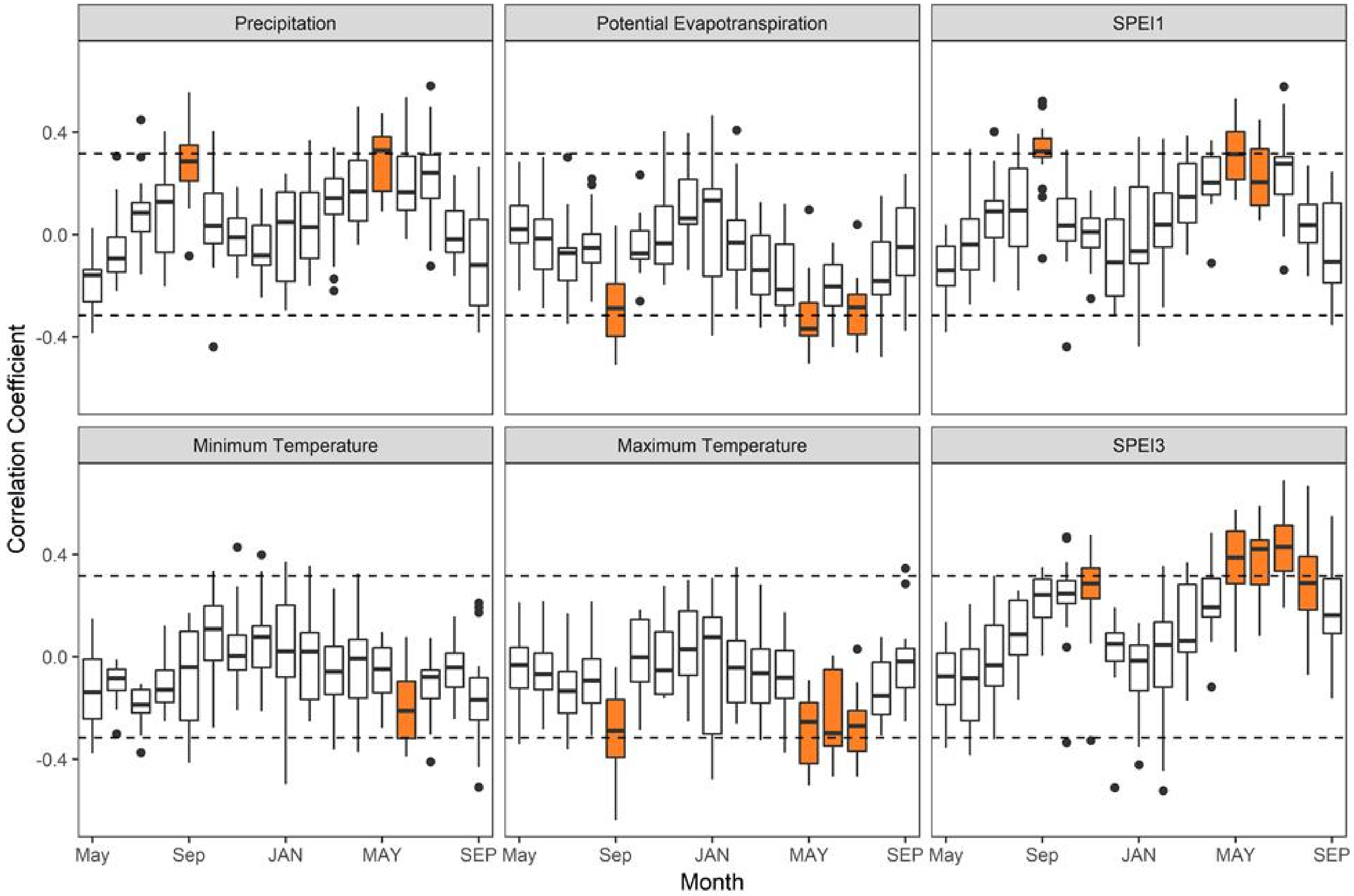


Wang et al., unpublished



Tree-ring index of Korean pine negatively correlated with temperature, while positively correlated with precipitation during the growing season.

● Growth-climate relationships of *Pinus tabuliformis* in central China

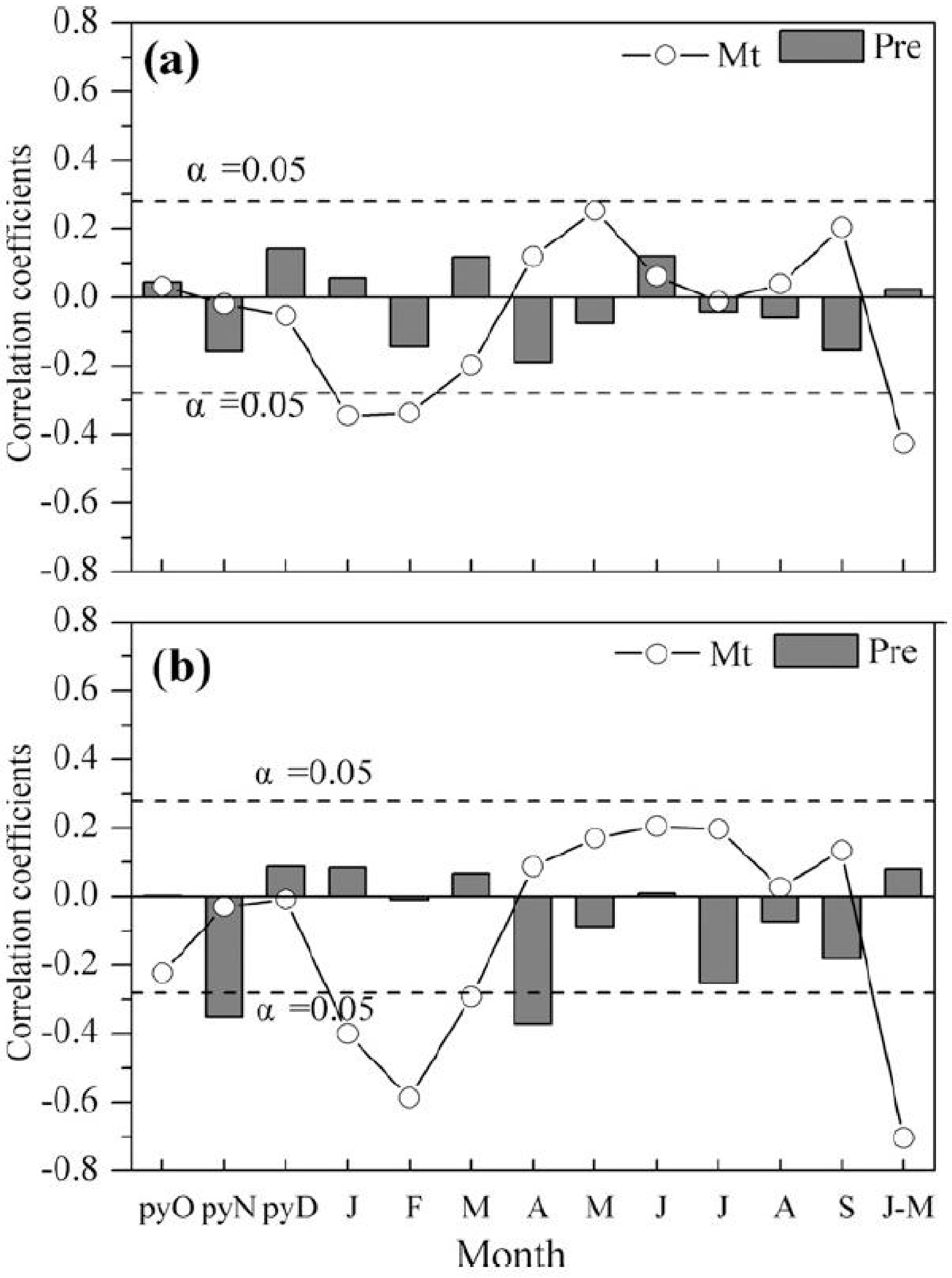


SPEI-Standardized Precipitation Evapotranspiration Index

Zhao et al., unpublished

● Growth-climate relationships of *Pinus massoniana* in southeast China

The percentage of ring-width growth decrease (PRGD) series was significantly correlated with regional temperature (PC1) in January, February, and January–March, but no significant correlation was found between PRGD and precipitation (Fig. 3a). Further examination showed that the PRGD series had a stronger correlation with the interannual difference of January–March mean temperature (Fig. 3b).



Duan et al. 2013. J Clim.

Zhu et al., 2017. Forest Research

● Growth-climate relationships of *Cunninghamia lanceolate* in southeast China

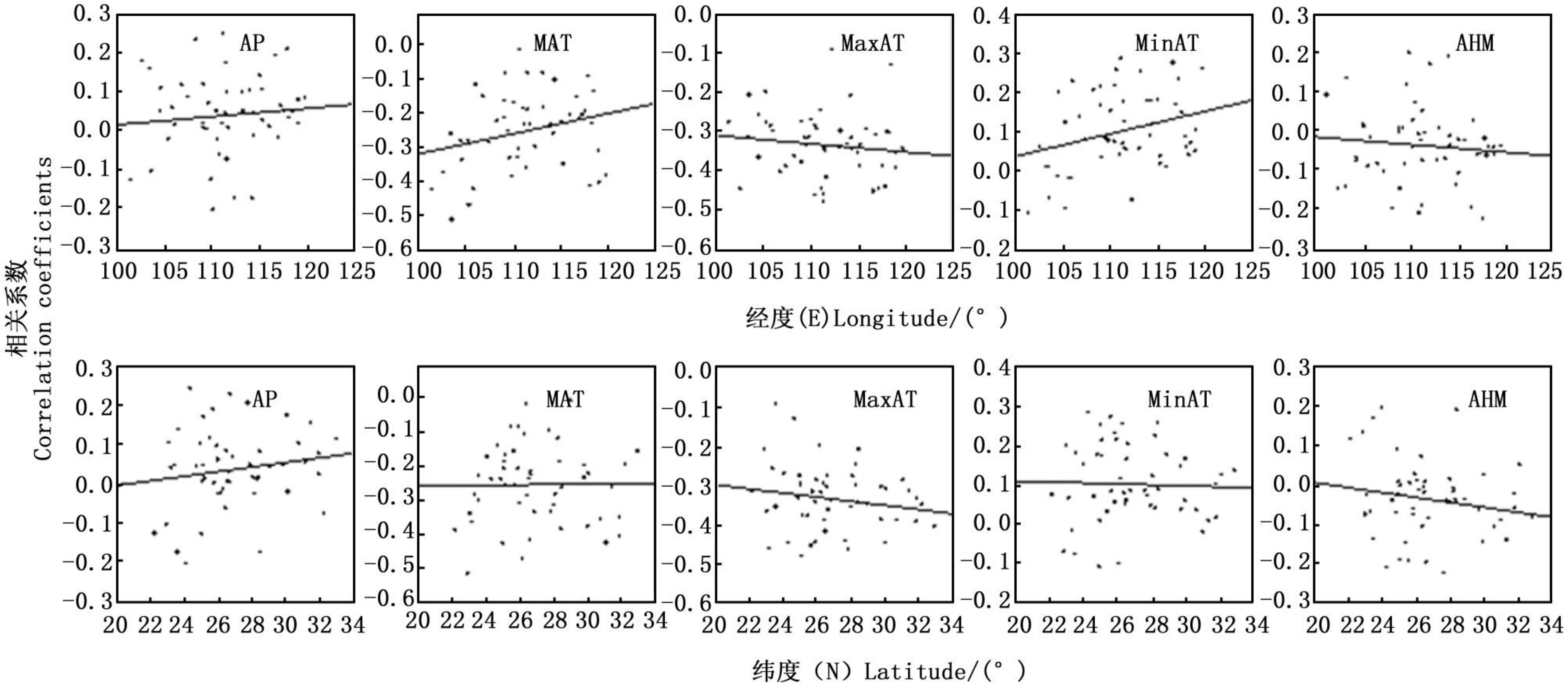


Fig. 3 Scatter diagram of correlation coefficients between the whole tree ring width and interannual climatic factors along with longitude and latitude of provenances

Summary

- Radial growth of the five coniferous tree species could decrease with climate warming.
- The extent of growth change is also affected by other conditions, especially precipitation, tree age, etc.
- The regional difference in the response of tree radial growth to climate warming is depend on the ratio of temperature/precipitation.

Potential areas of cooperation

- Effects of climate warming on radial growth of temperate trees
- Effects of disturbance (extreme climate events and human activities) on the structure of temperate forest ecosystem and growth of major tree species.
- Comparison of growth responses of gymnosperms (tree) and angiosperms (tree) to climate warming.
- Response of woody anatomical characteristics of temperate trees to climate warming.

Ways of cooperation

- Exchange visits, including the exchange of graduate students.
- Joint application project, such as NSFC.
- Joint writing papers.
- Other possible ways

Thank you for your attention!