

Slight & Heavy Precipitation

Bengang Li, Xinyue Li
Peking University



Outline

1. Data preparations and methods

2. Preliminary results

2.1. Spatial distributions and change trend

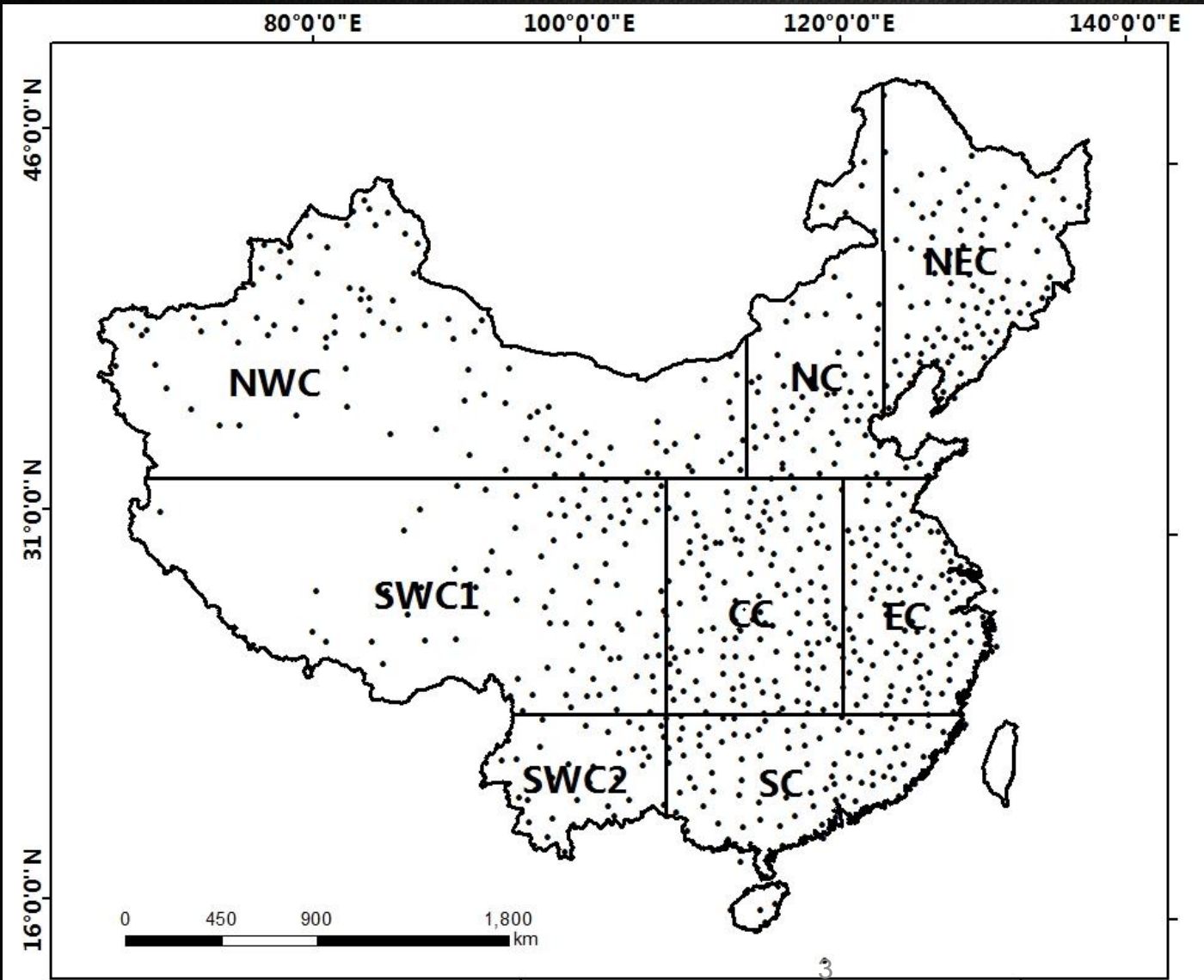
2.2. Relationships between precipitation and climate indices

3. More details about slight precipitation

4. Discussions

1. Preparations

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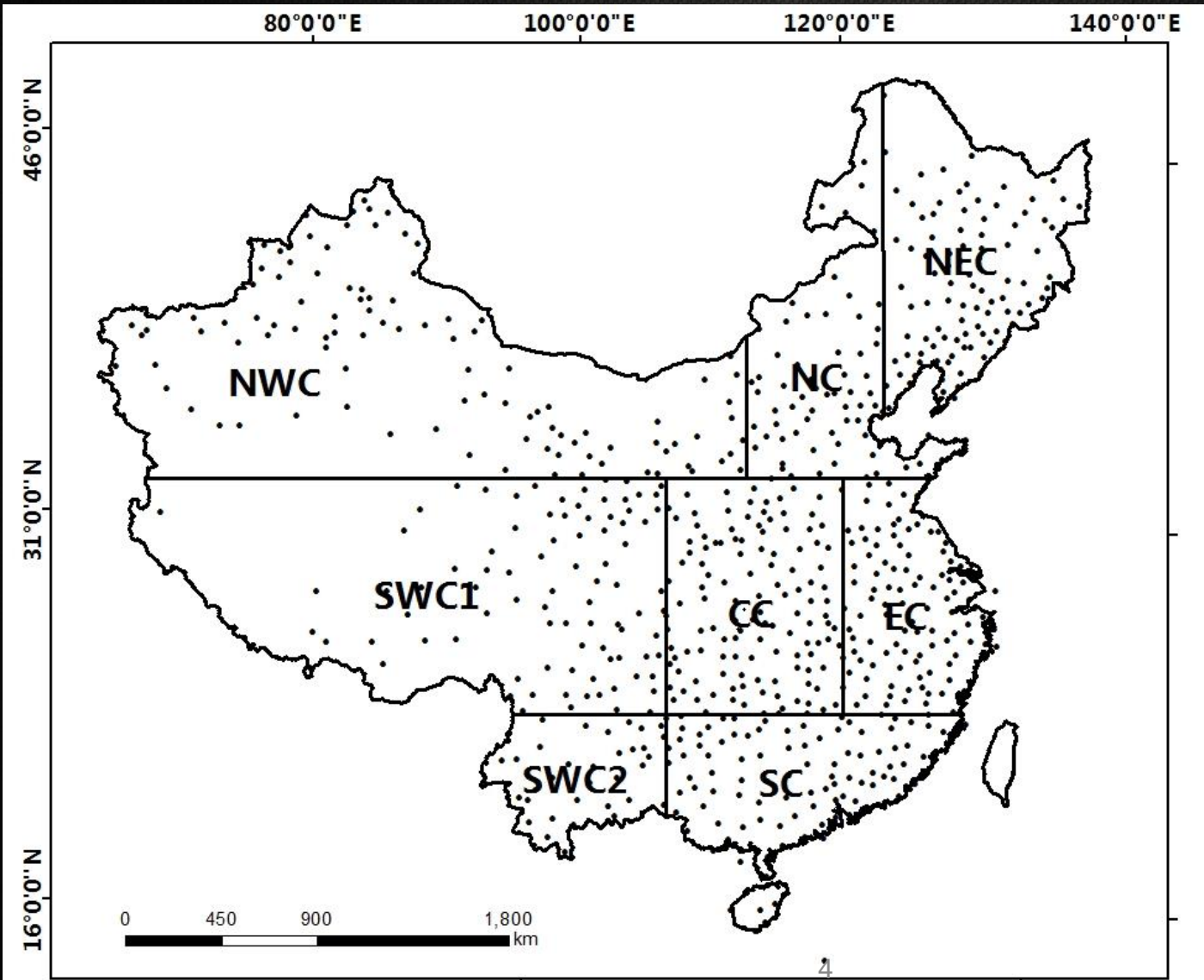
Meteorological data

Heavy: $[50, +\infty)$ mm/day

Slight: $(0, 1]$ mm/day

1. Preparations

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Meteorological data

Heavy: $[50, +\infty)$ mm/day

Slight: $(0, 1]$ mm/day

1. Preparations

Methods

1. Mann - Kendall Trend Analysis Method

$$UF_k = \frac{d_k - E(d_k)}{\sqrt{\text{var}(d_k)}}$$

Formula: $UF_1 = 0$; $\text{Var}(d_k)$ is the variance of the sum of average accumulative d_k , under the circumstance that the x_1, x_2, \dots, x_n are independent of each other, and continuous distributed, they can be calculated by the above formula.

1. Preparations

Methods

2. Pearson correlation

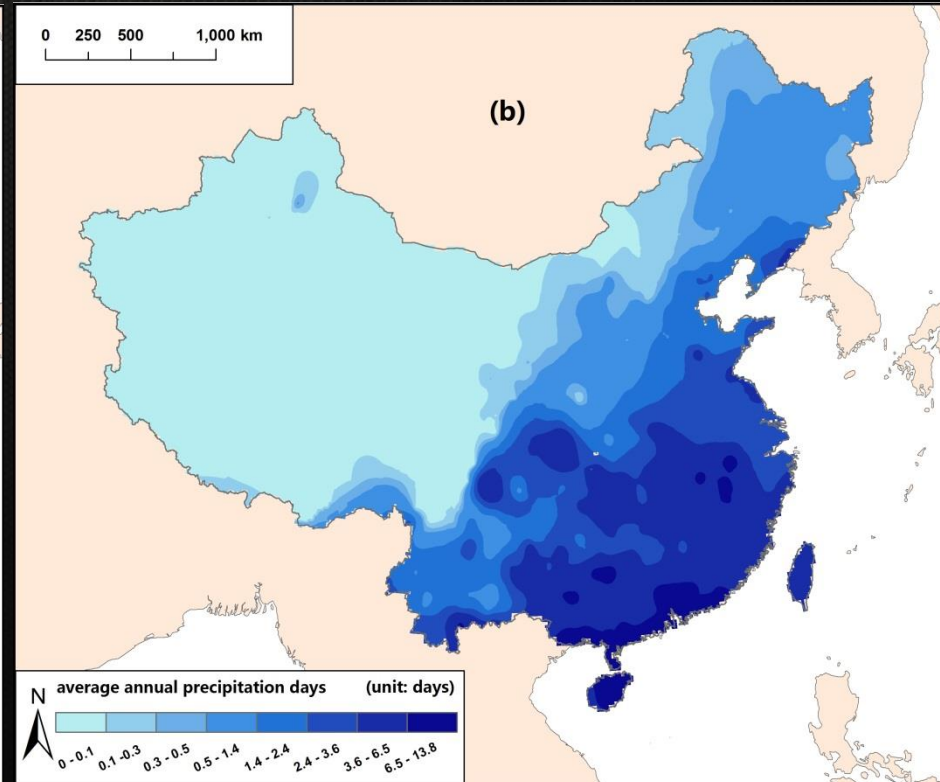
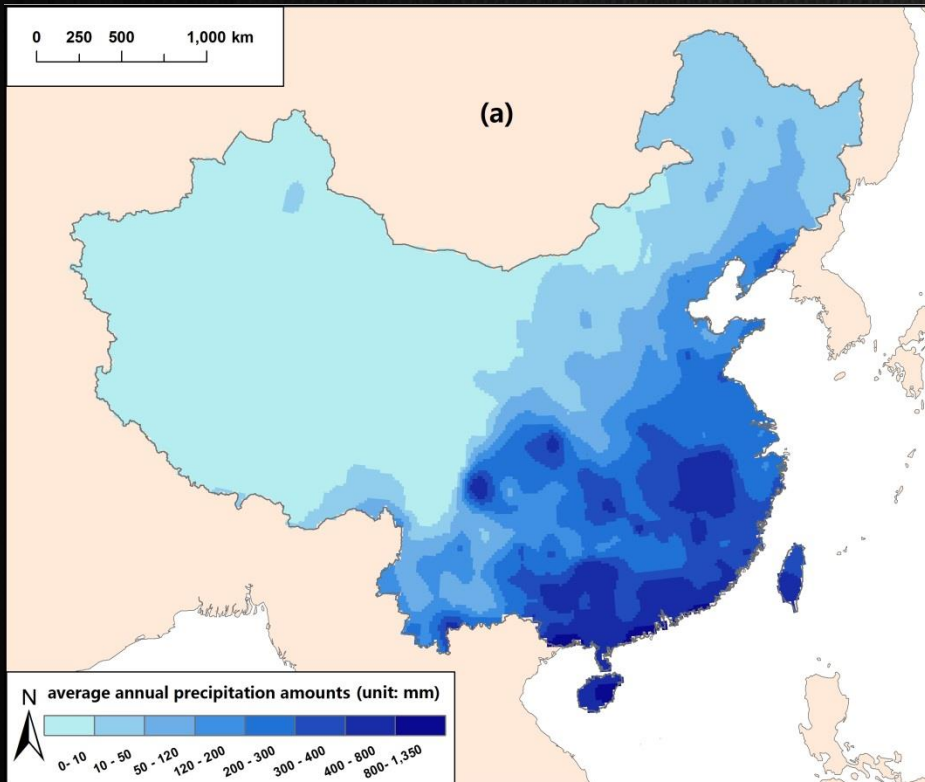
$R = \text{corrcoef}(X)$ returns a matrix R of correlation coefficients calculated from an input matrix X whose rows are observations and whose columns are variables. The matrix $R = \text{corrcoef}(X)$ is related to the covariance matrix $C = \text{cov}(X)$ by

$$R(i, j) = \frac{C(i, j)}{\sqrt{C(i, i)C(j, j)}}$$

2. Results

Distribution

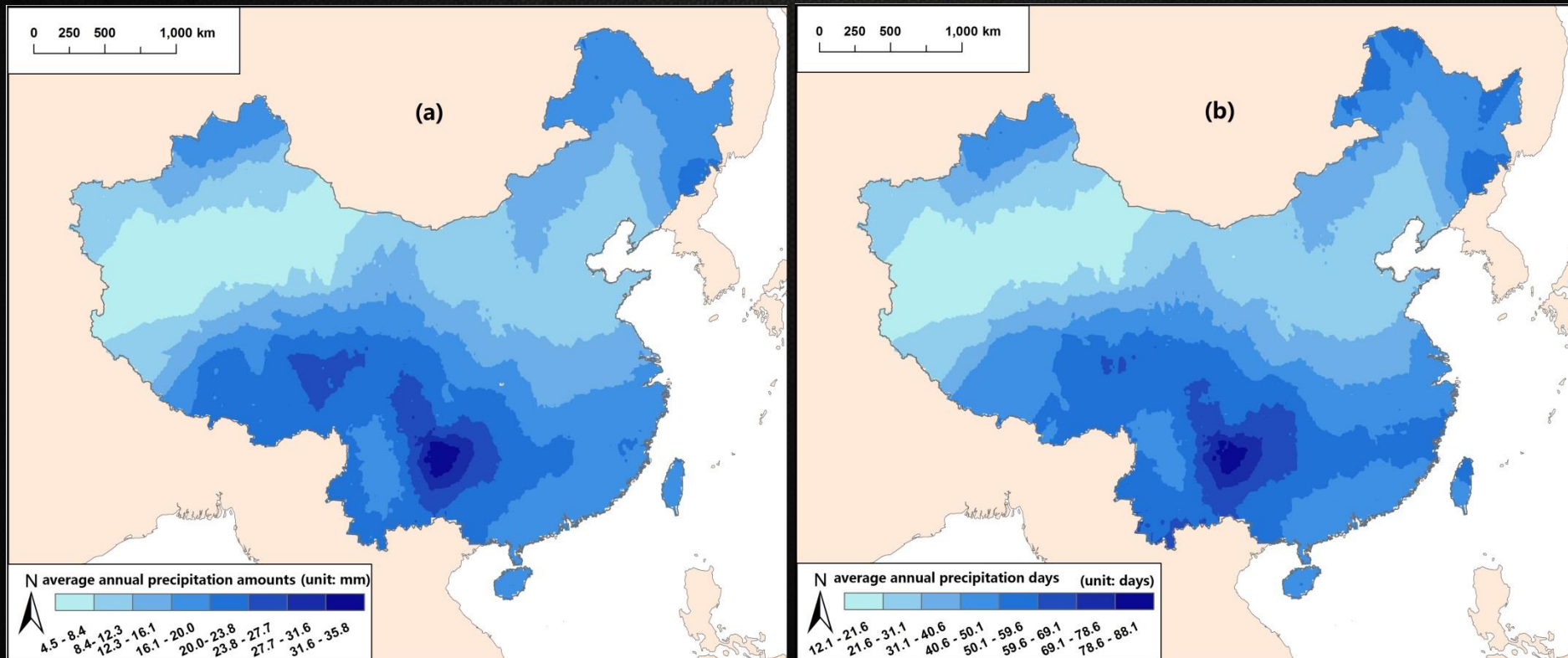
Distribution of heavy precipitation amounts (a) and days (b) from 1961 to 2013



2. Results

Distribution

Distribution of slight precipitation amounts (a) and days (b) from 1961 to 2013



Hypothesis

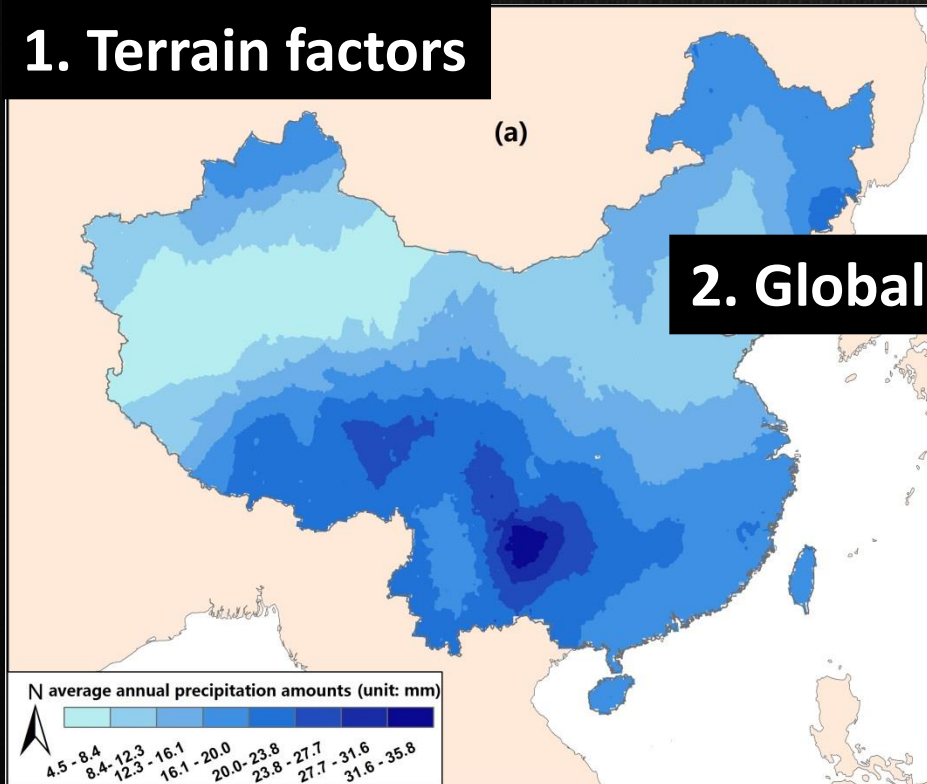
3. Results

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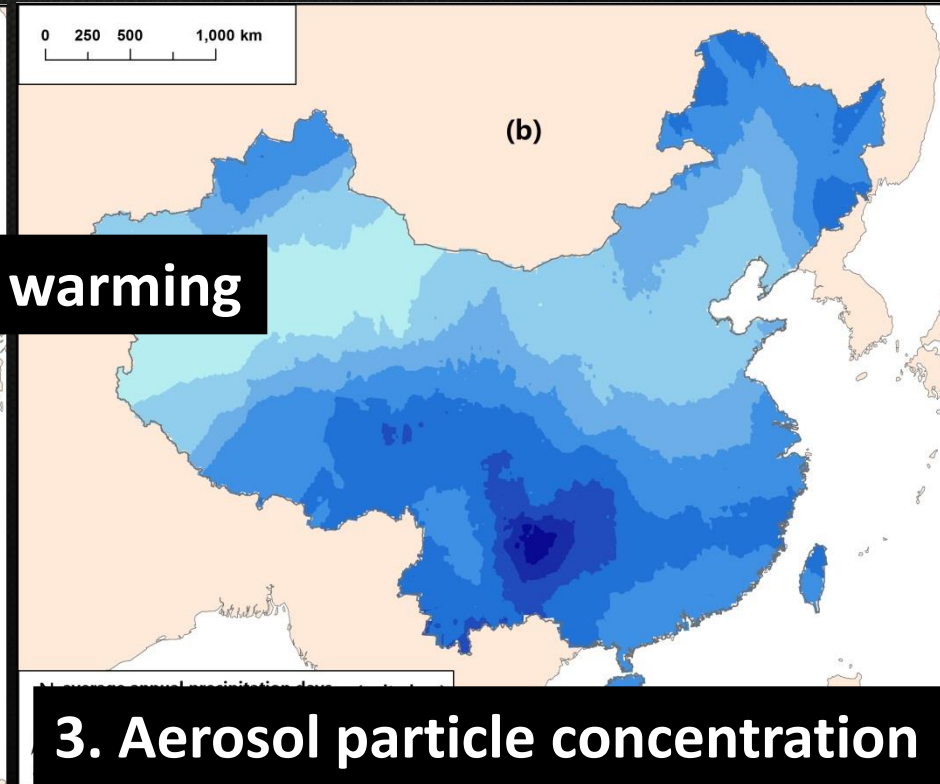
Distribution

3.2 Distribution of slight precipitation amounts (a) and days (b) from 1961 to 2013

1. Terrain factors



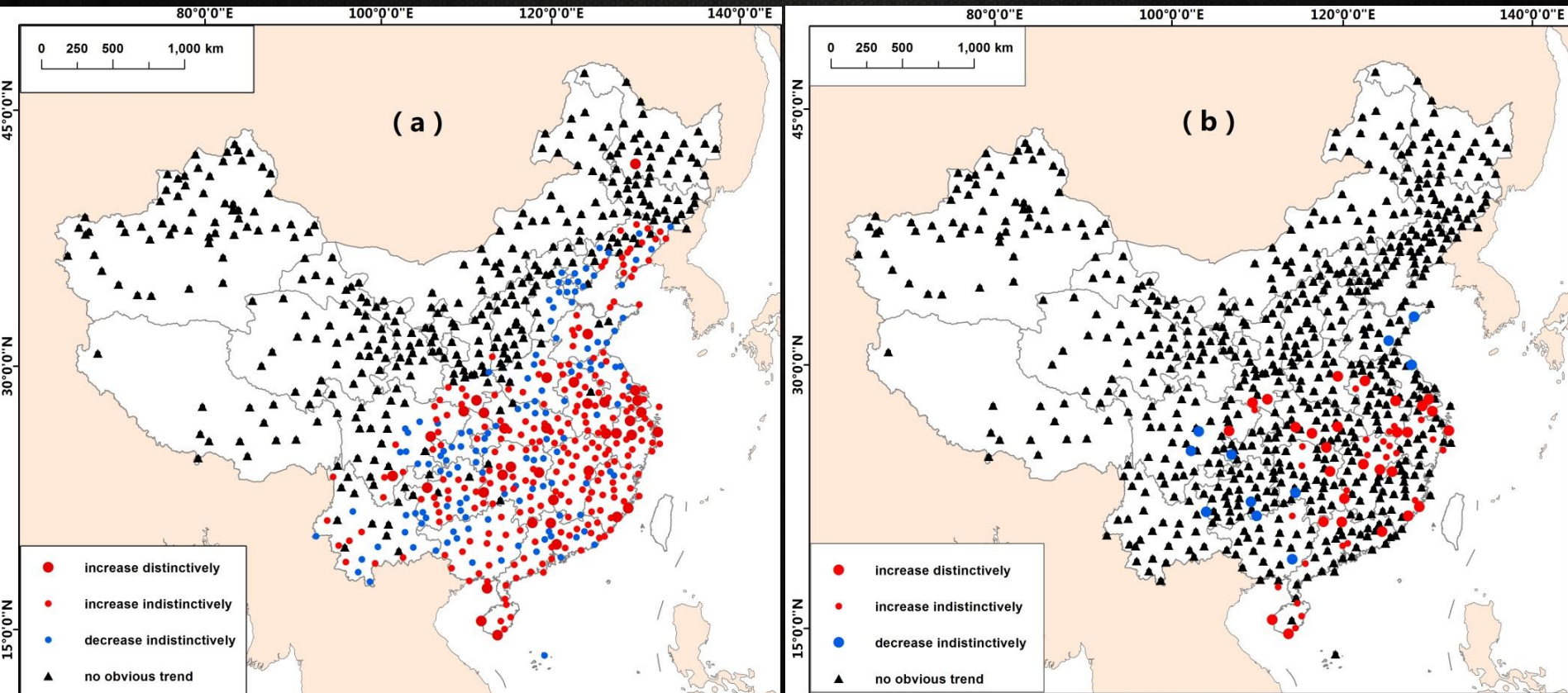
2. Global warming



2. Results

Trends

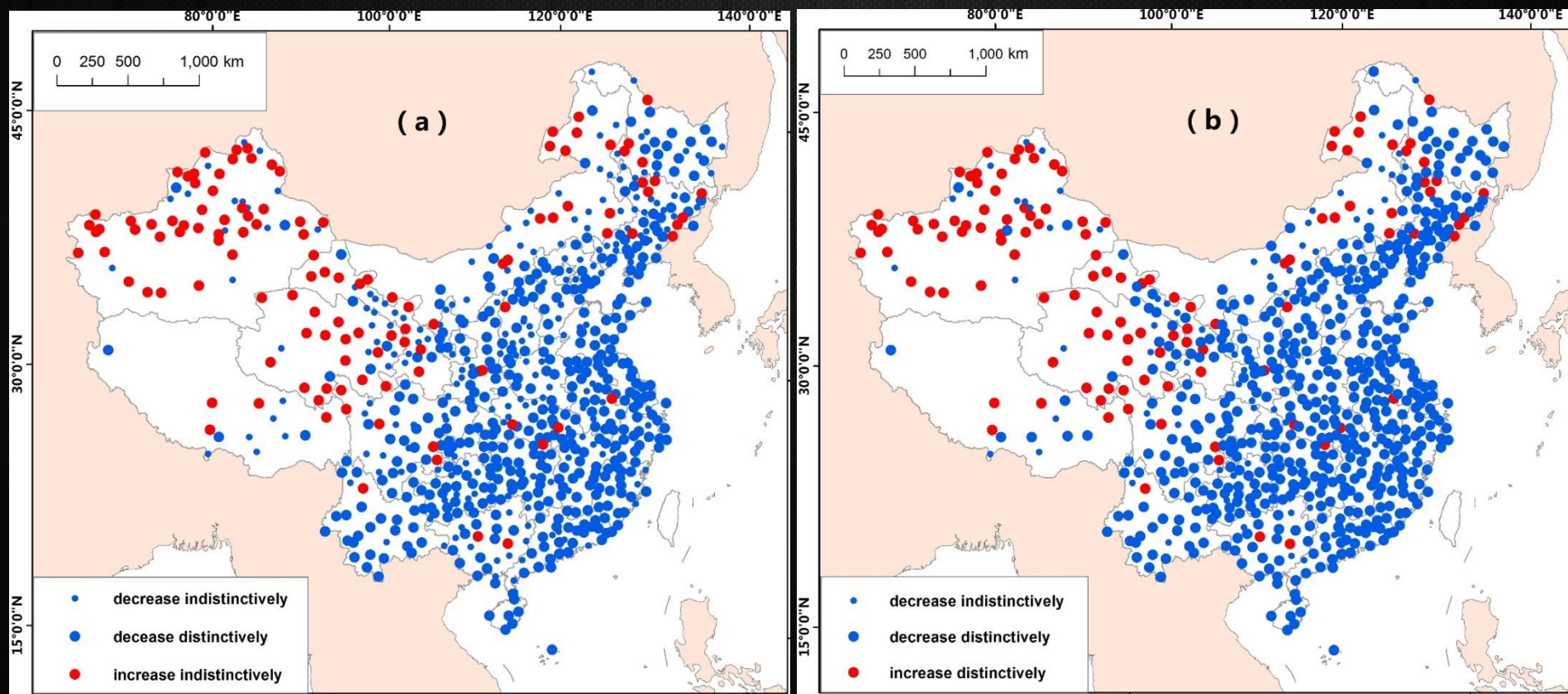
Spatial distribution of trend for annual heavy precipitation (a) and precipitation days (b) during the period of 1961-2013.



2. Results

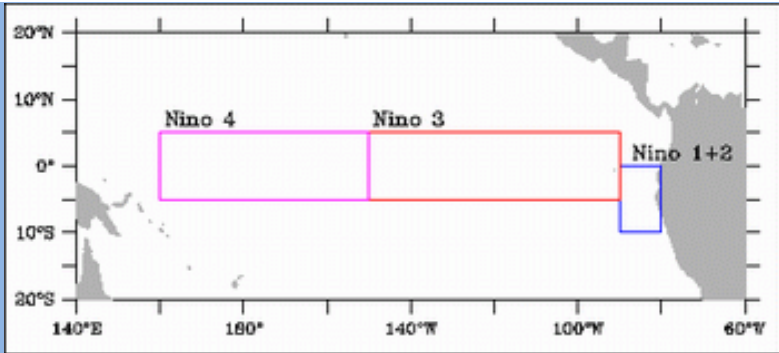
Trends

Spatial distribution of trend for annual slight precipitation (a) and precipitation days (b) during the period of 1961-2013.



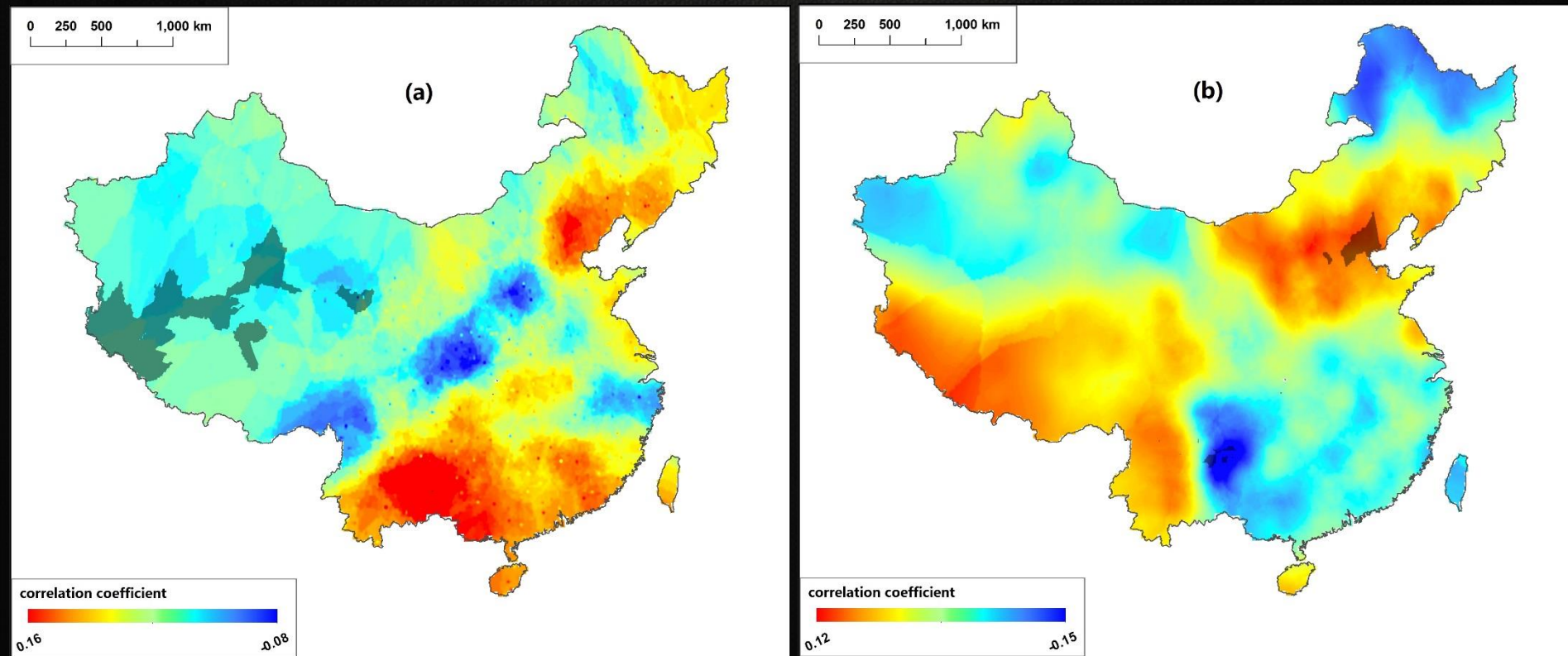
2. Results

Climate indexes

EAWR	Eastern Pacific/North Pacific Oscillation
ONI	Oceanic Nino Index
NINO1+2	
NINO3	
NINO4	
NINO3.4	
PDO	Pacific Decadal Oscillation
GMT	Global Mean Land/Ocean Temperature

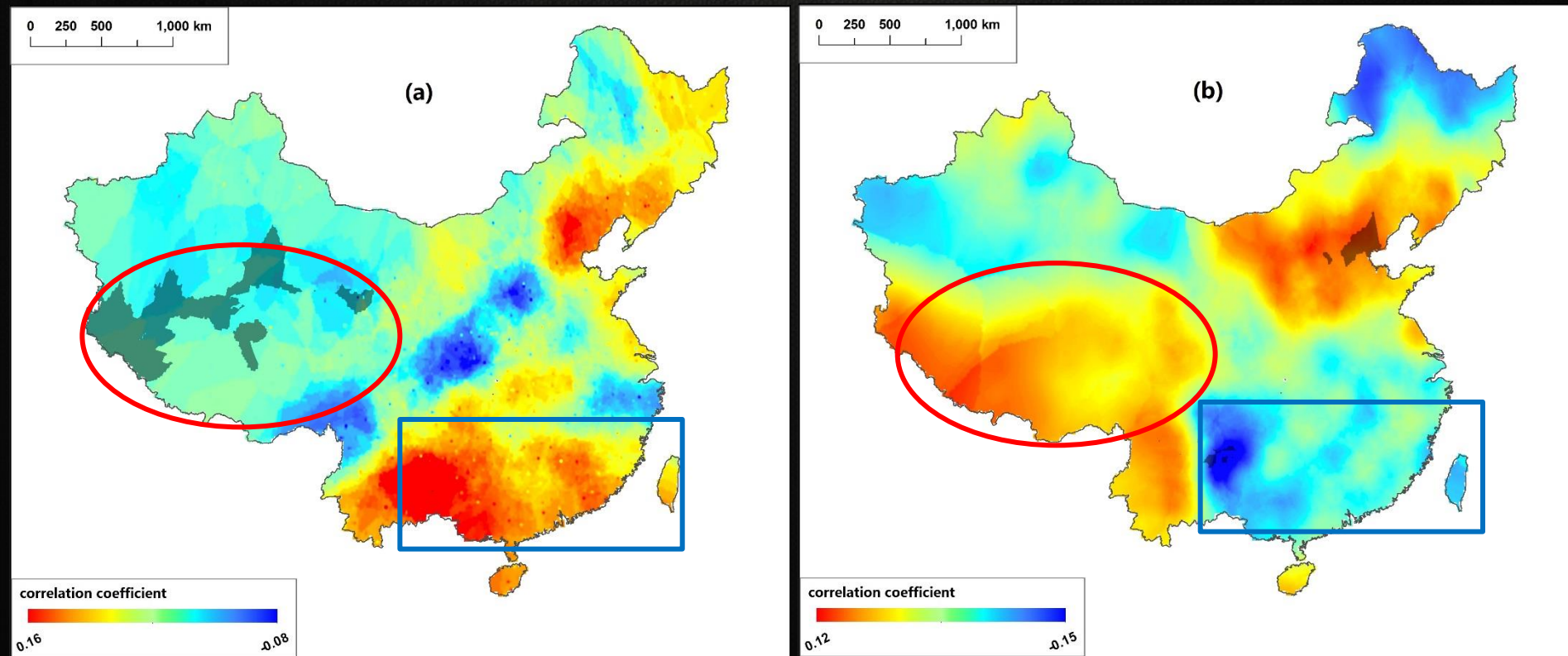
2. Results

1. The correlation coefficient between heavy rain(a) and EA/WR, the correlation coefficient between slight rain(a) and EA/WR.



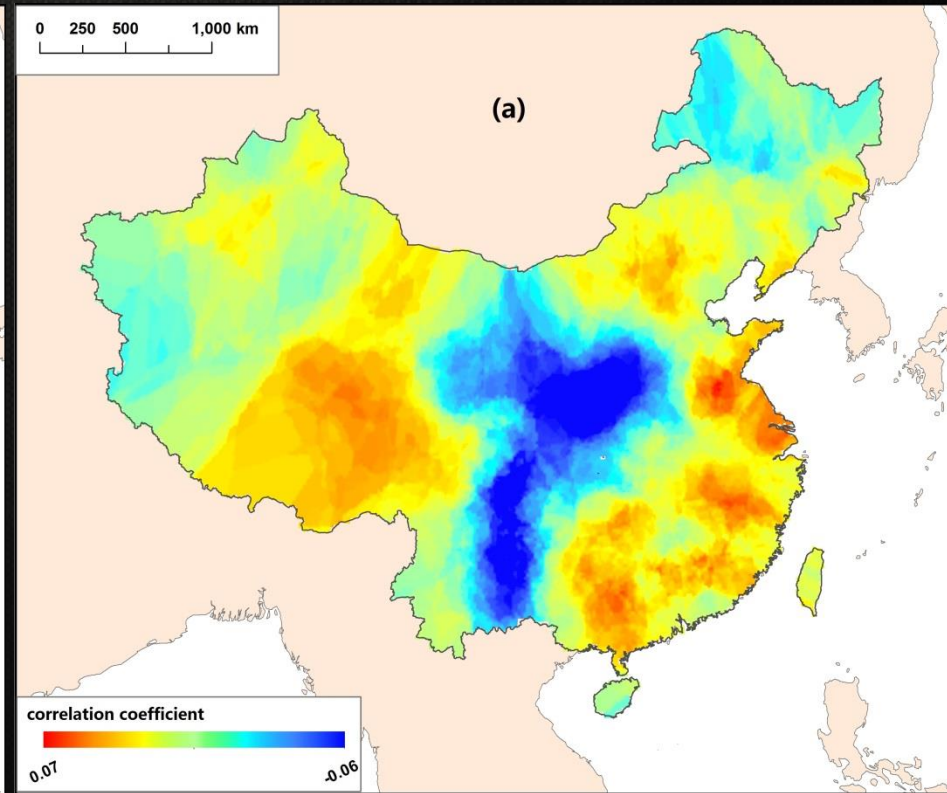
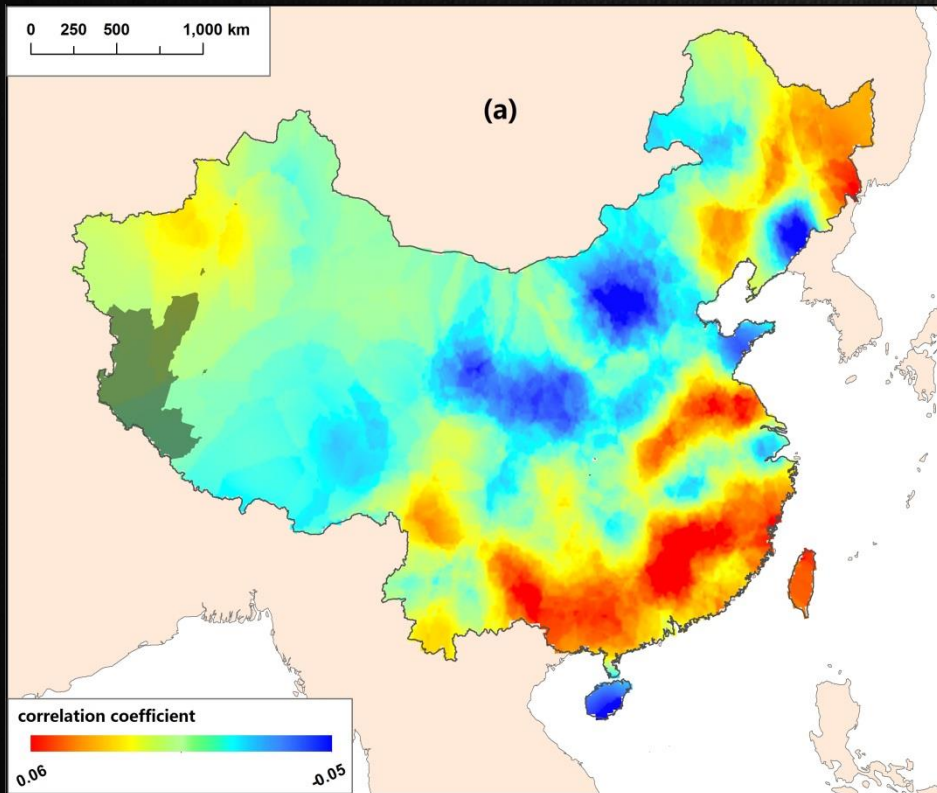
2. Results

1. The correlation coefficient between heavy rain(a) and EA/WR, the correlation coefficient between slight rain(b) and EA/WR.



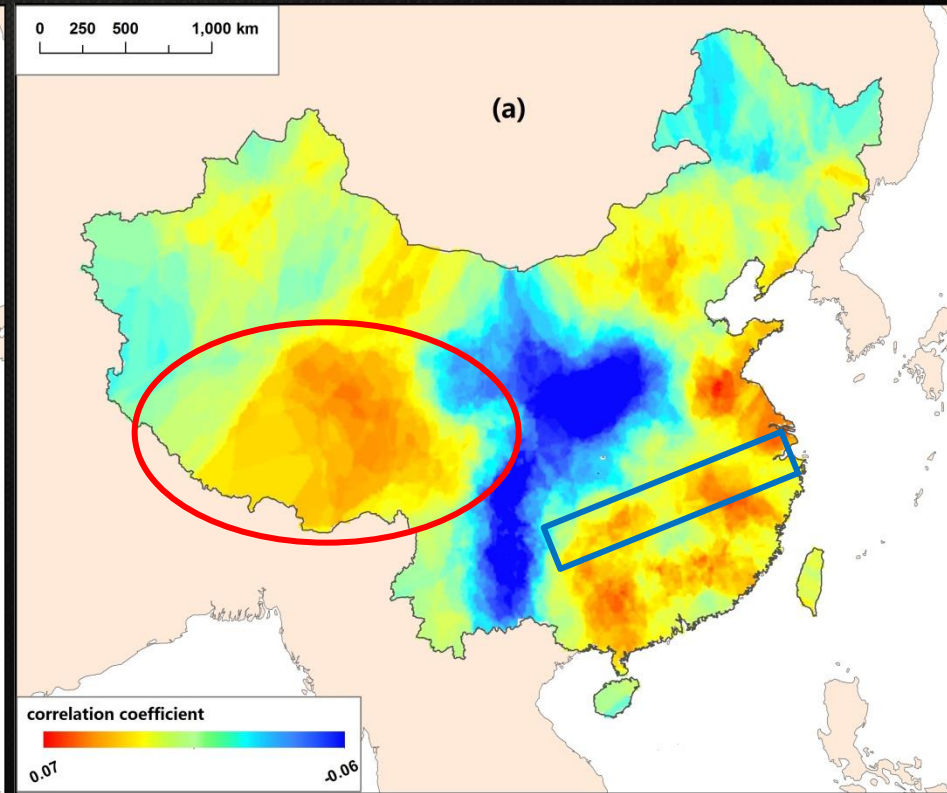
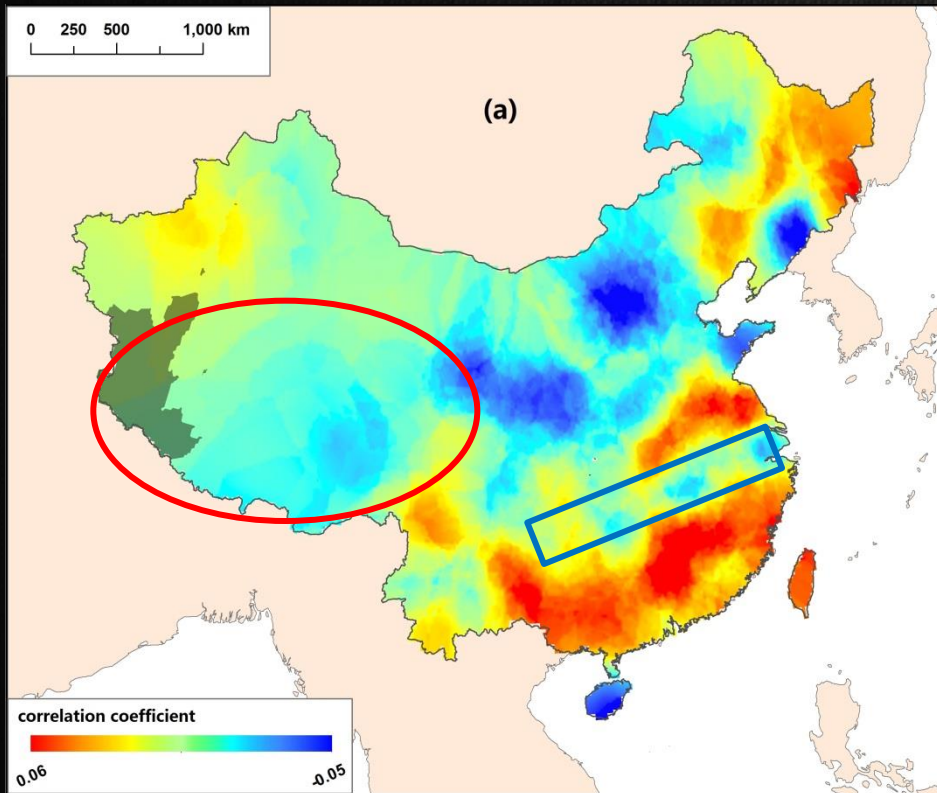
2. Results

2. The correlation coefficient between heavy rain(a) and ONI, the correlation coefficient between slight rain(a) and ONI.



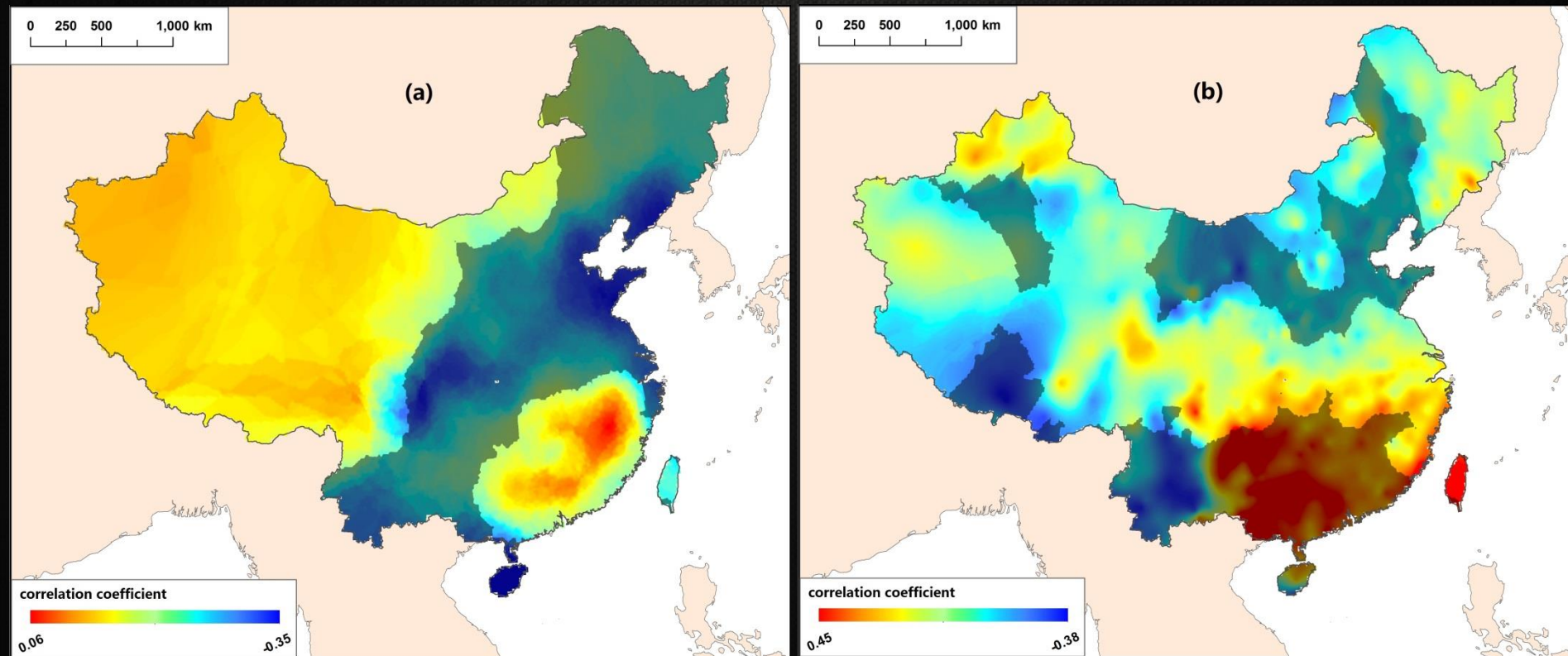
2. Results

2. The correlation coefficient between heavy rain(a) and ONI, the correlation coefficient between slight rain(a) and ONI.



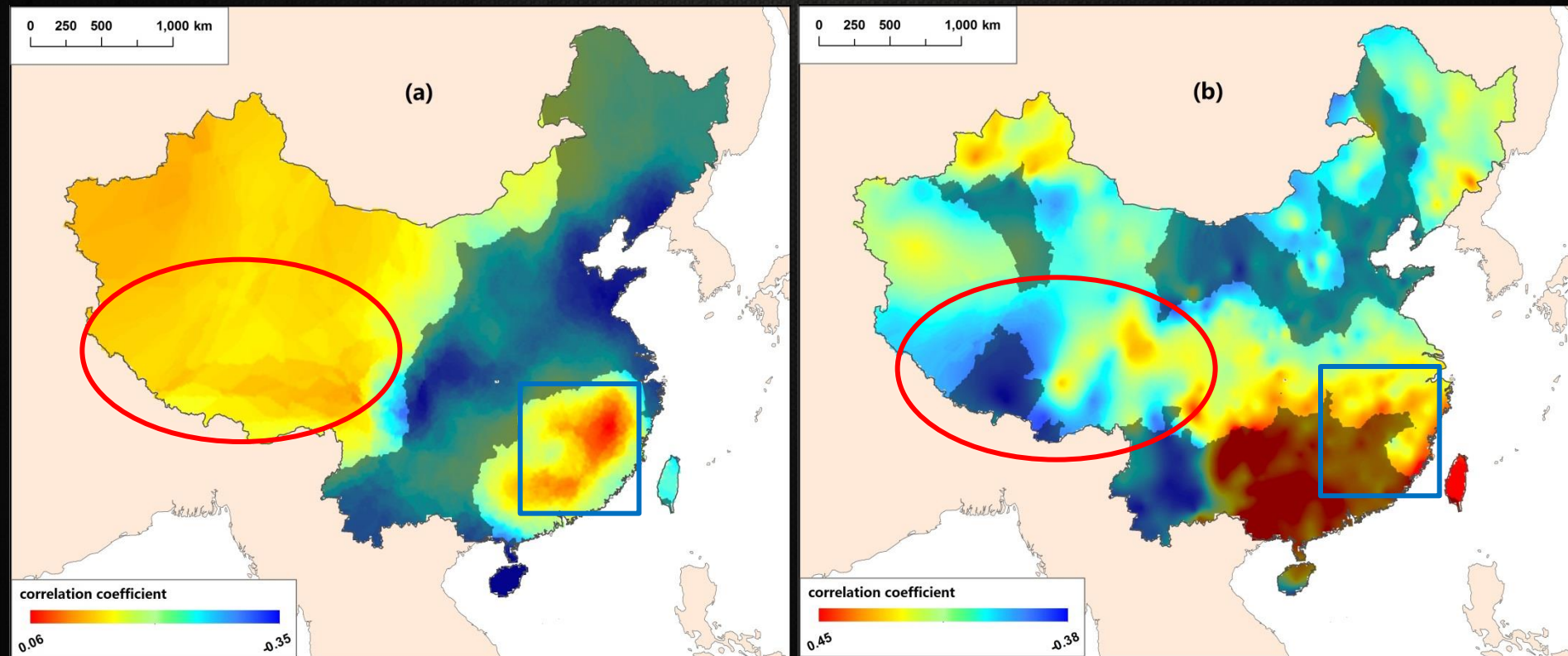
2. Results

3. The correlation coefficient between heavy rain(a) and NINO1+2, the correlation coefficient between slight rain(a) and NINO1+2.



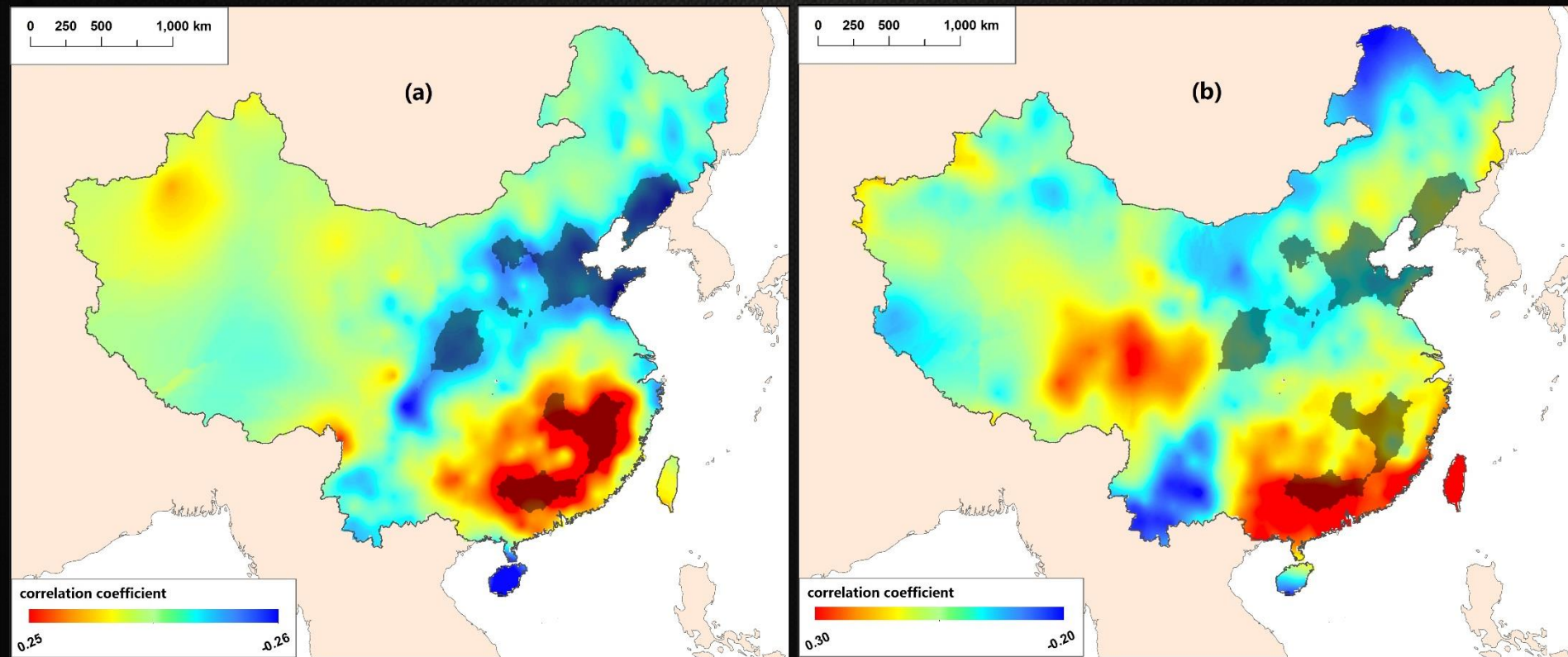
2. Results

3. The correlation coefficient between heavy rain(a) and NINO1+2, the correlation coefficient between slight rain(a) and NINO1+2.



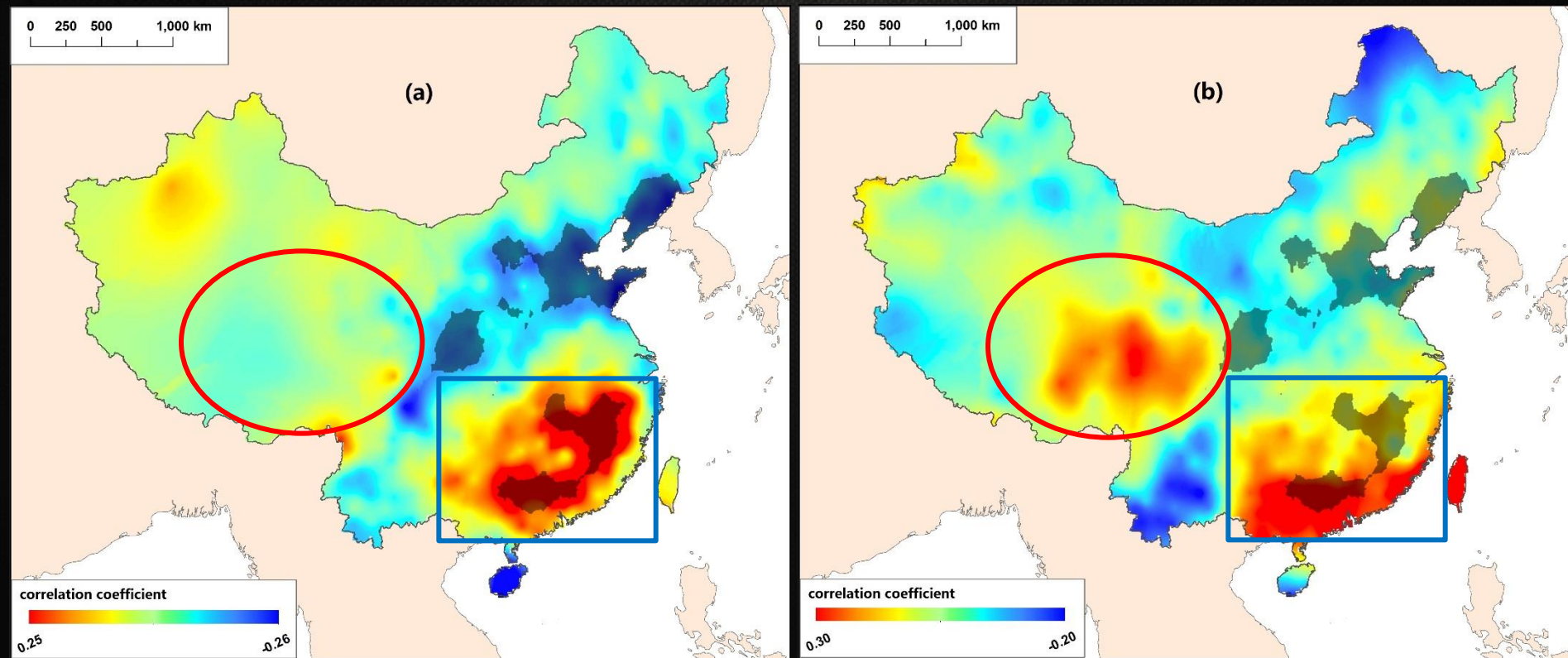
2. Results

4. The correlation coefficient between heavy rain(a) and NINO3, the correlation coefficient between slight rain(a) and NINO3.



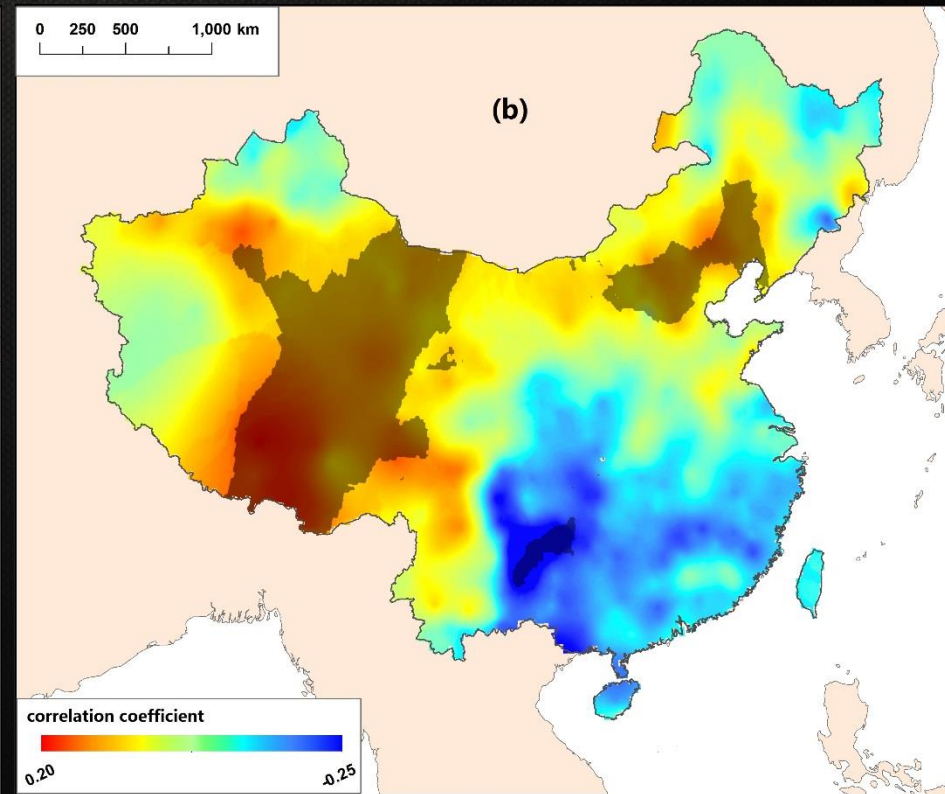
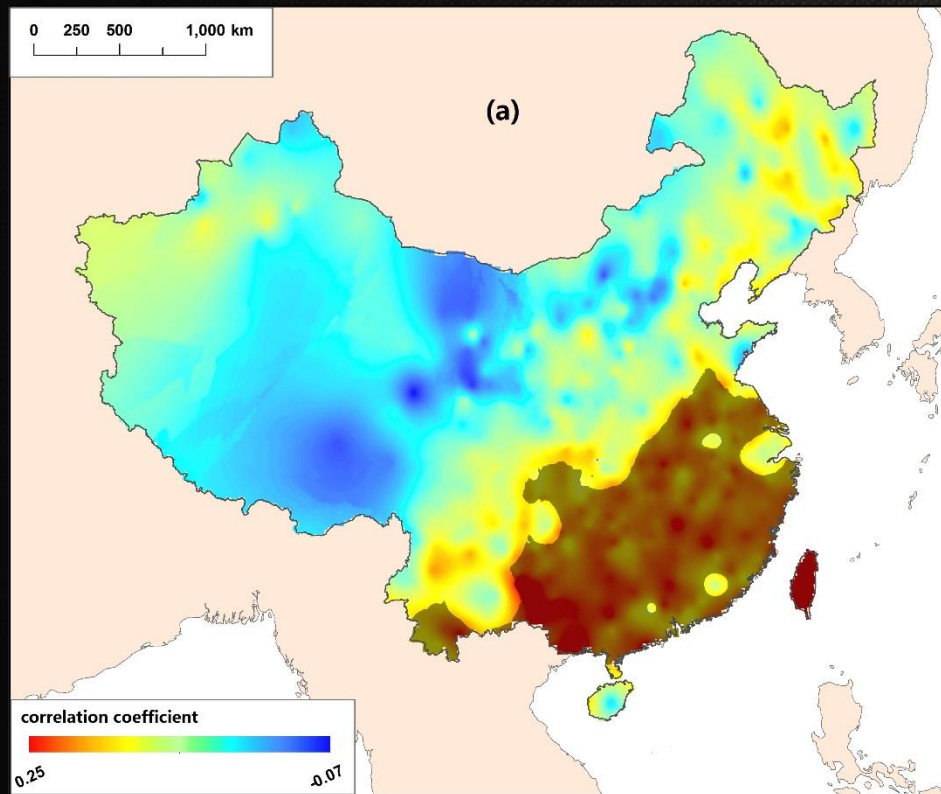
2. Results

4. The correlation coefficient between heavy rain(a) and NINO3, the correlation coefficient between slight rain(a) and NINO3.



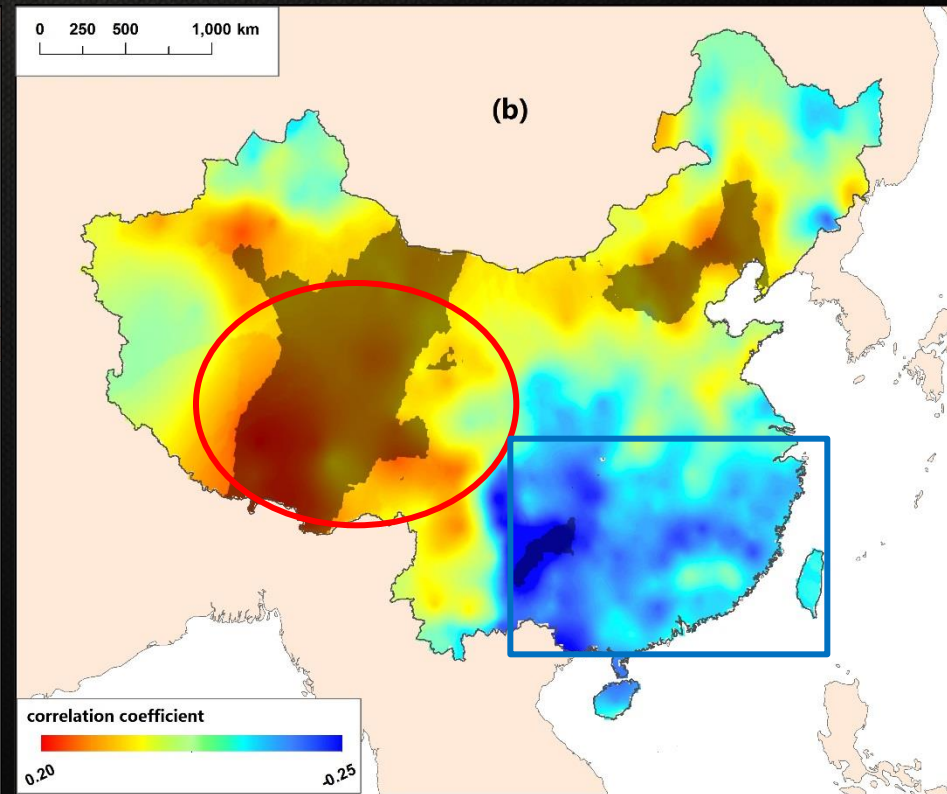
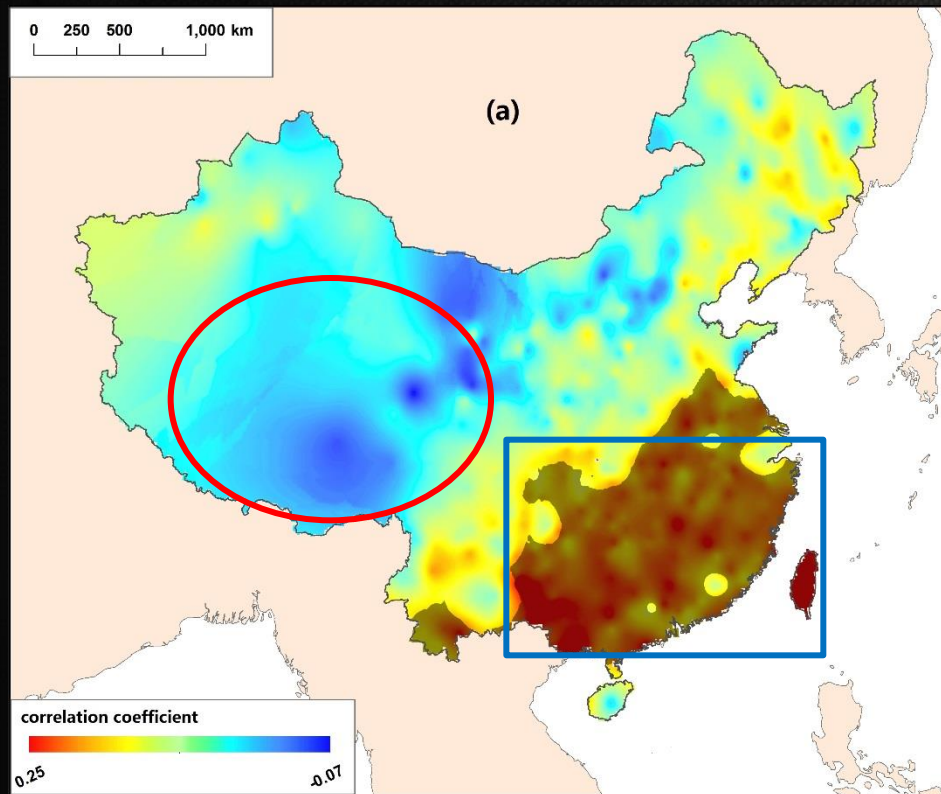
2. Results

5. The correlation coefficient between heavy rain(a) and NINO4, the correlation coefficient between slight rain(a) and NINO4.



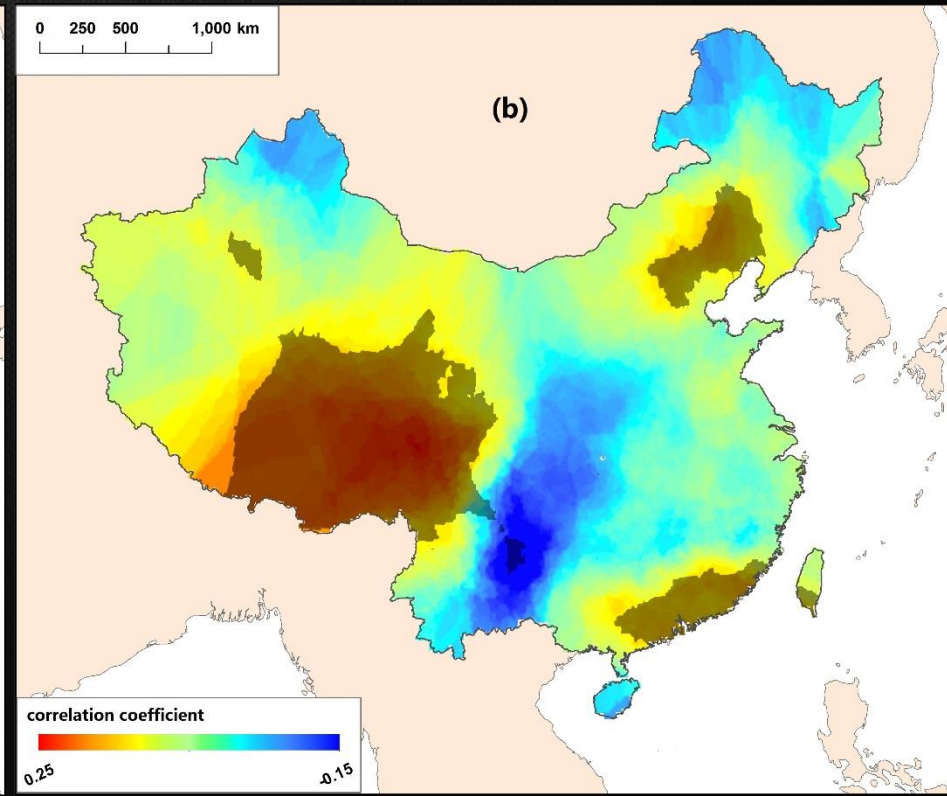
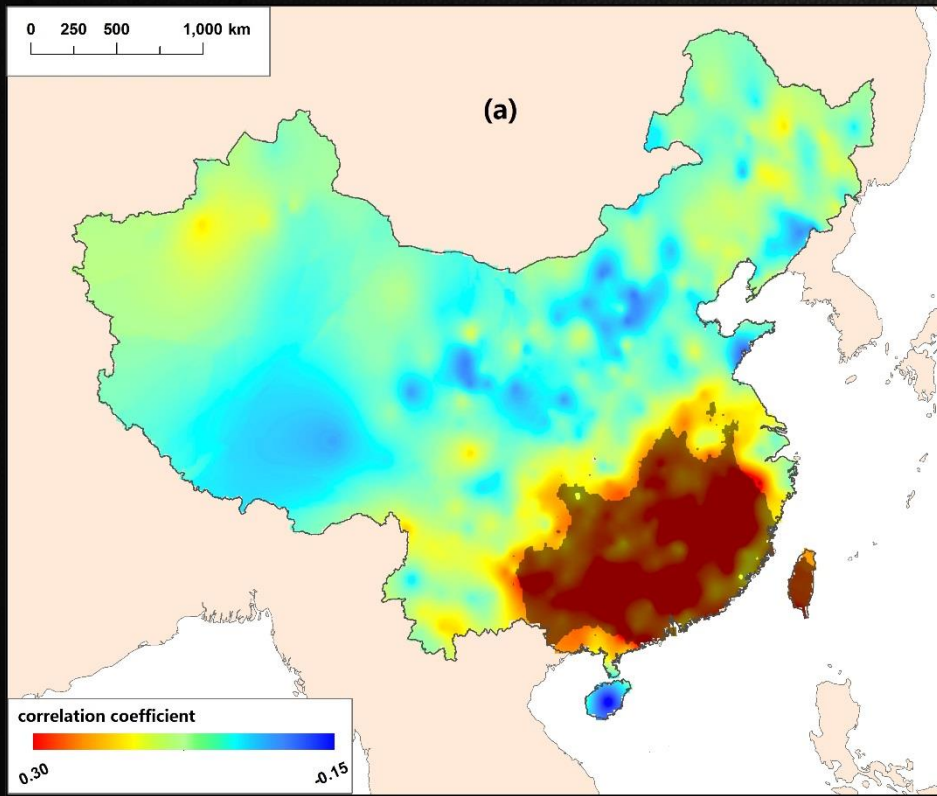
2. Results

5. The correlation coefficient between heavy rain(a) and NINO4, the correlation coefficient between slight rain(a) and NINO4.



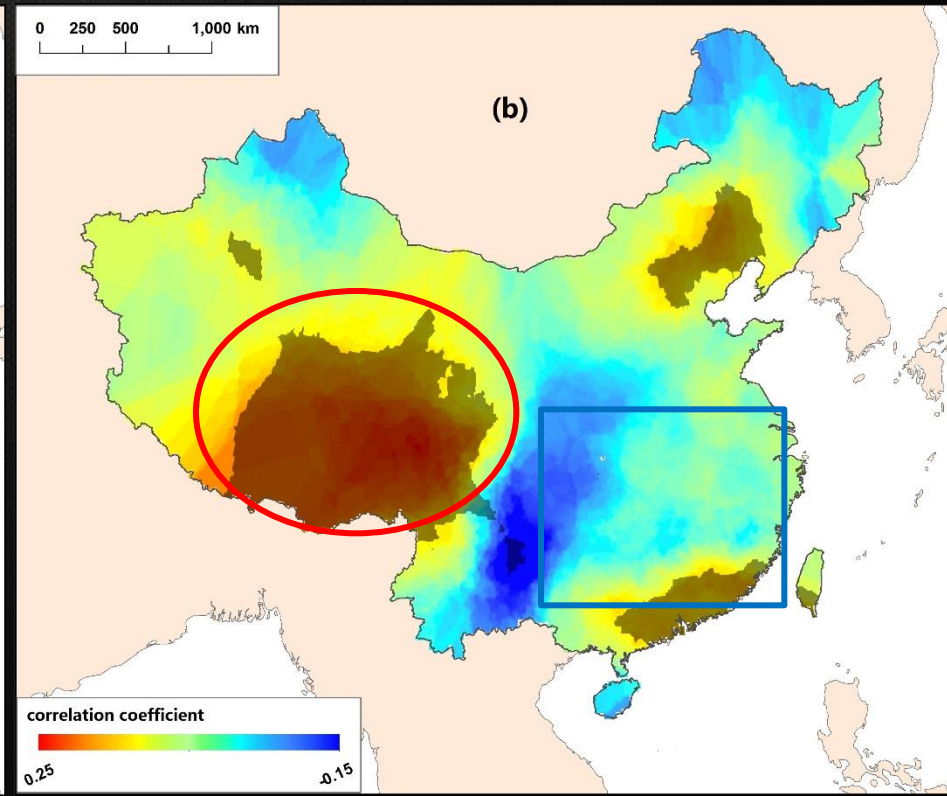
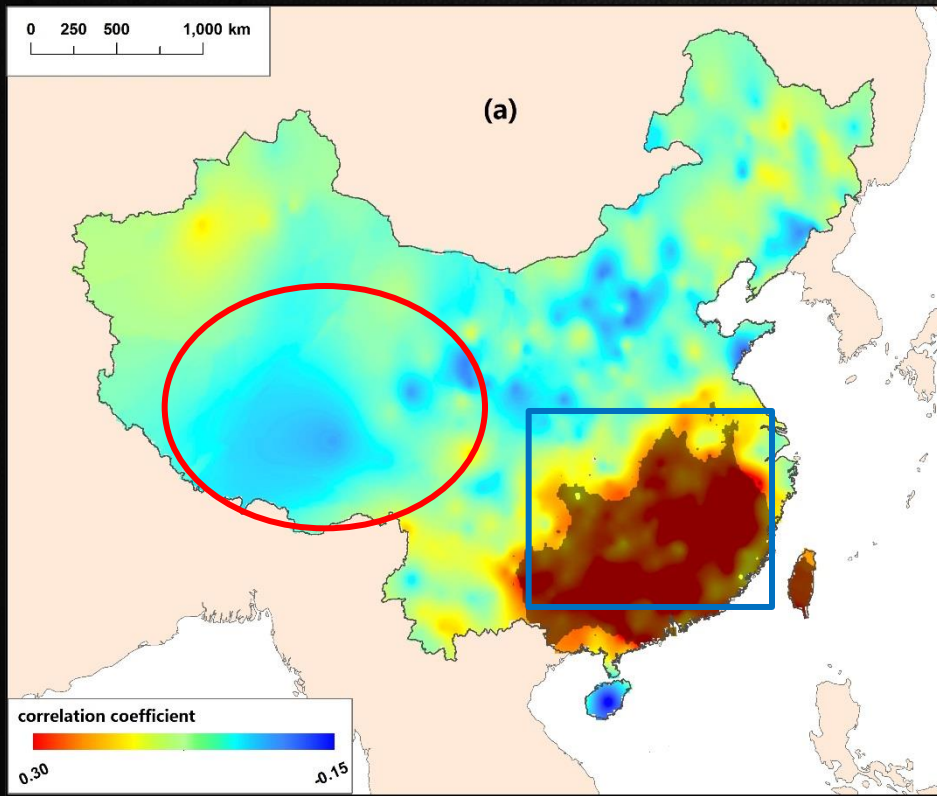
2. Results

6. The correlation coefficient between heavy rain(a) and NINO3.4, The correlation coefficient between slight rain(a) and NINO3.4.



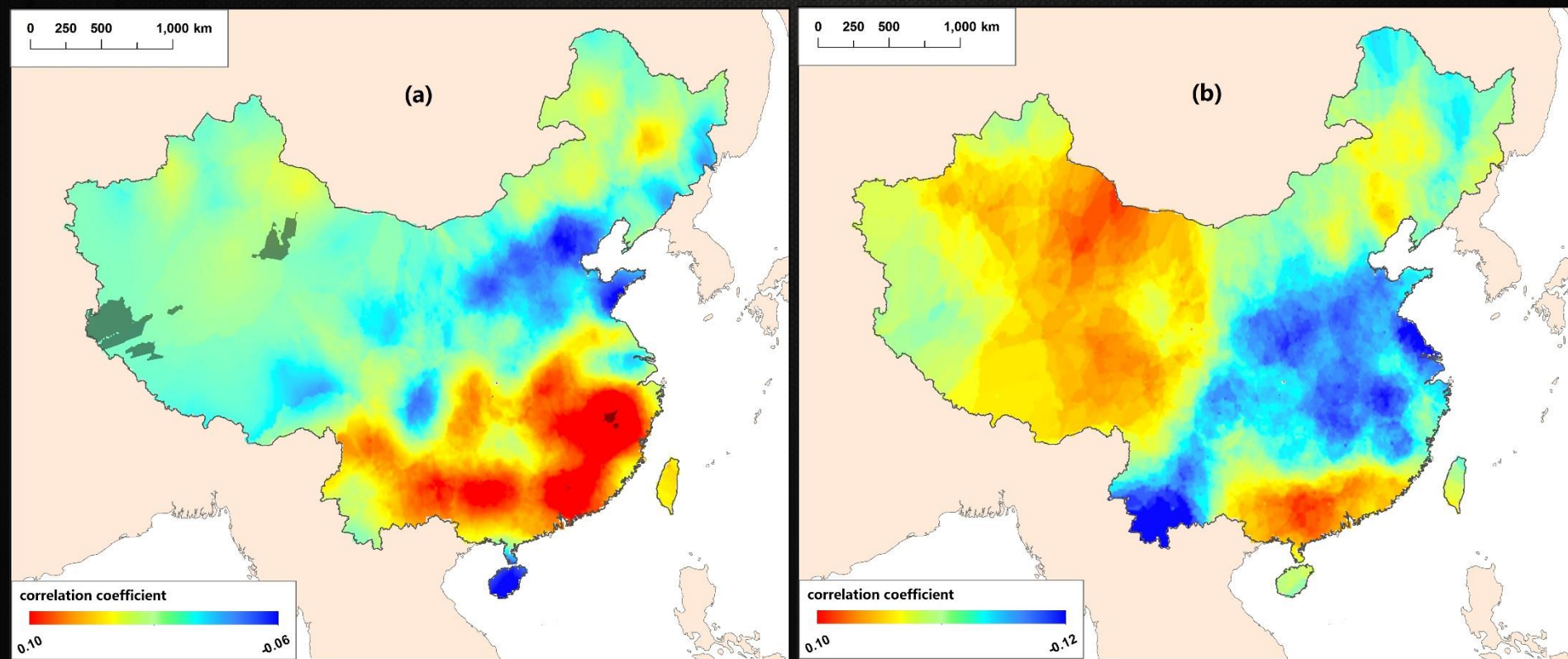
2. Results

6. The correlation coefficient between heavy rain(a) and NINO3.4, The correlation coefficient between slight rain(a) and NINO3.4.



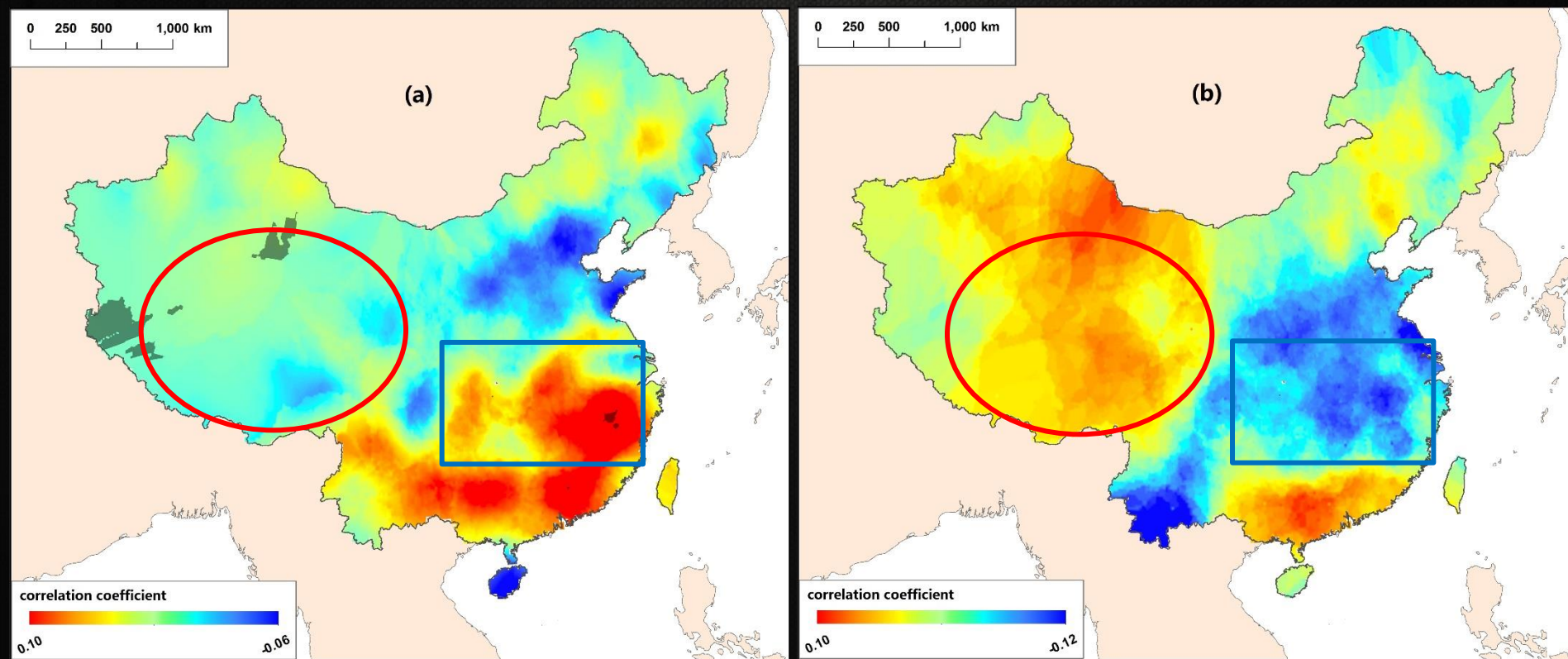
2. Results

7. The correlation coefficient between heavy rain(a) and PDO, the correlation coefficient between slight rain(a) and PDO.



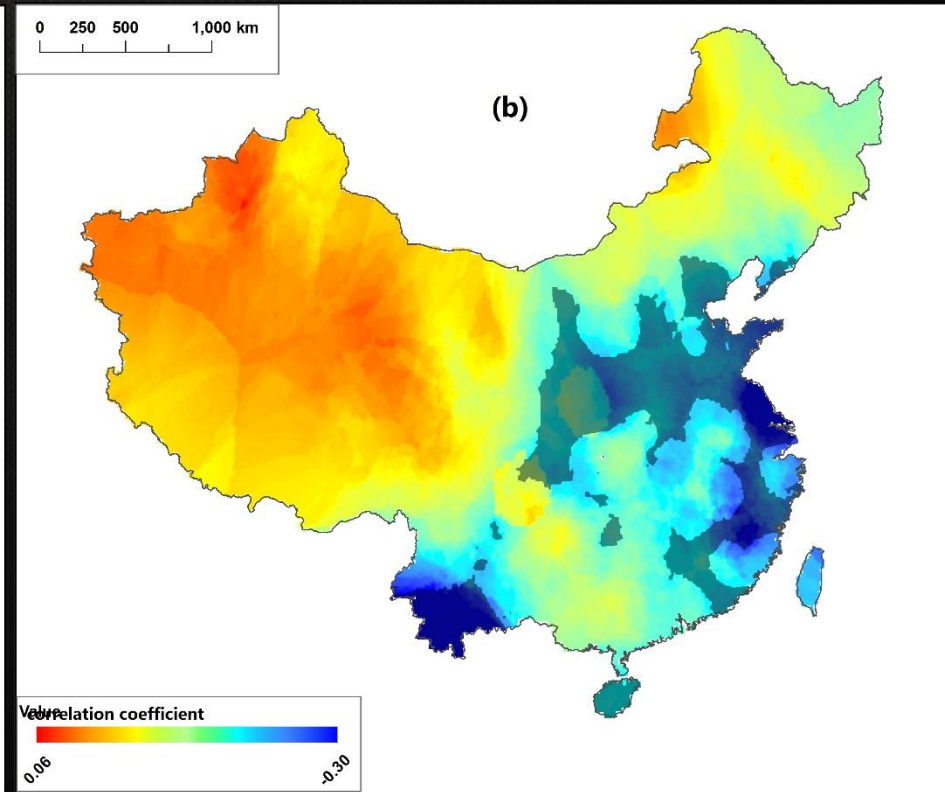
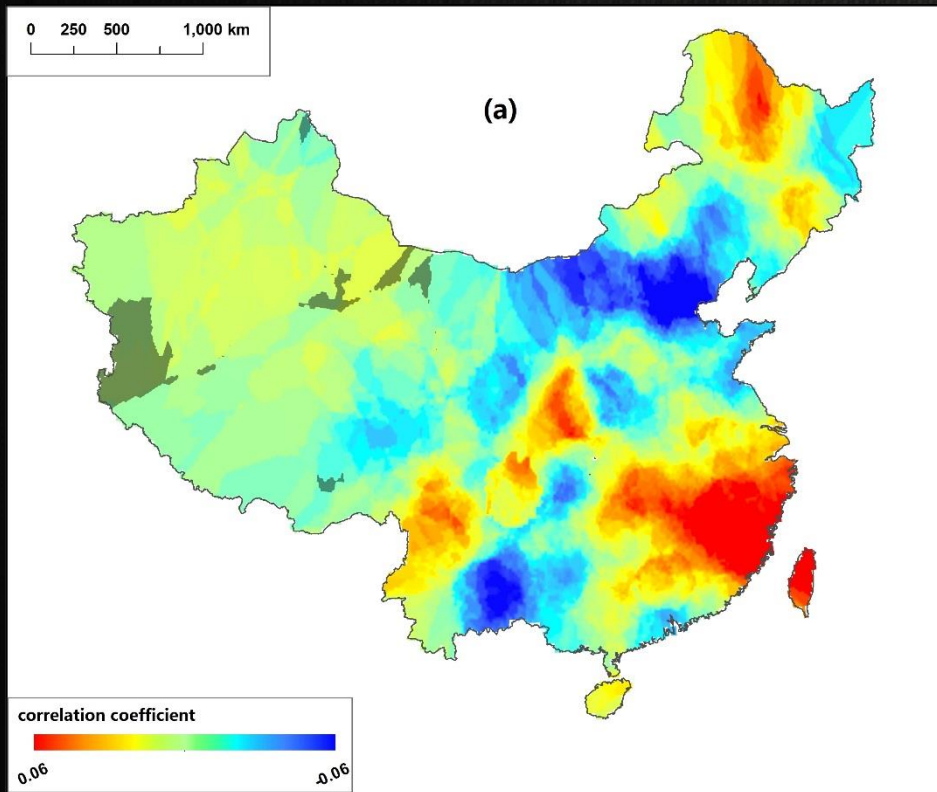
2. Results

7. The correlation coefficient between heavy rain(a) and PDO, the correlation coefficient between slight rain(a) and PDO.



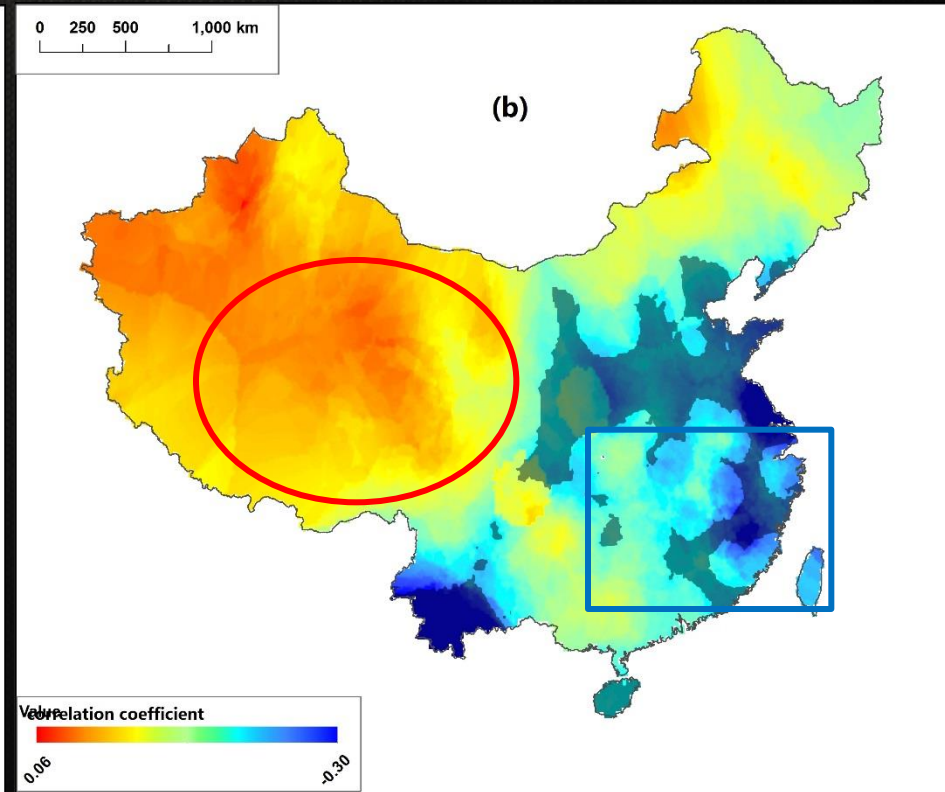
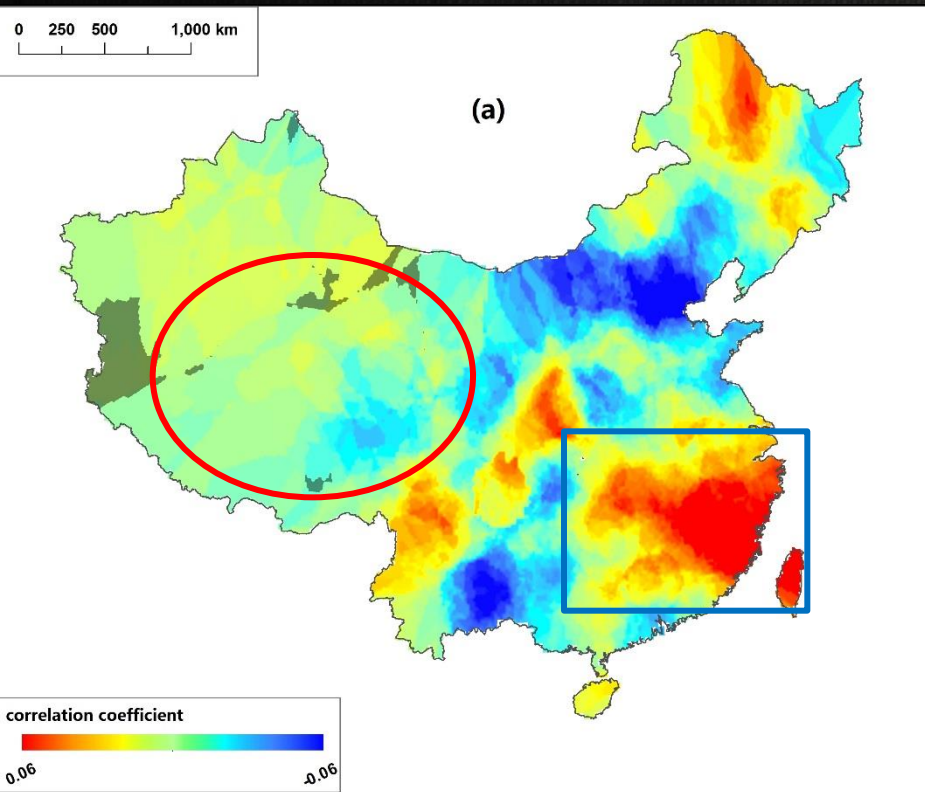
2. Results

8. The correlation coefficient between heavy rain(a) and GMT, the correlation coefficient between slight rain(a) and GMT.



2. Results

8. The correlation coefficient between heavy rain(a) and GMT, the correlation coefficient between slight rain(a) and GMT.



2. Results

	Heavy precipitation				Slight precipitation			
	Tibet Plateau		Southeast China		Tibet Plateau		Southeast China	
	+	-	+	-	+	-	+	-
EA/WR		✓	✓		✓			✓
ONI		✓		✓	✓		✓	
NINO1+2	✓		✓			✓	✓	
NINO3		✓	✓		✓		✓	
NINO4		✓	✓		✓			✓
NINO3.4		✓	✓		✓			✓
PDO		✓	✓		✓			✓
GMT		✓	✓		✓			✓

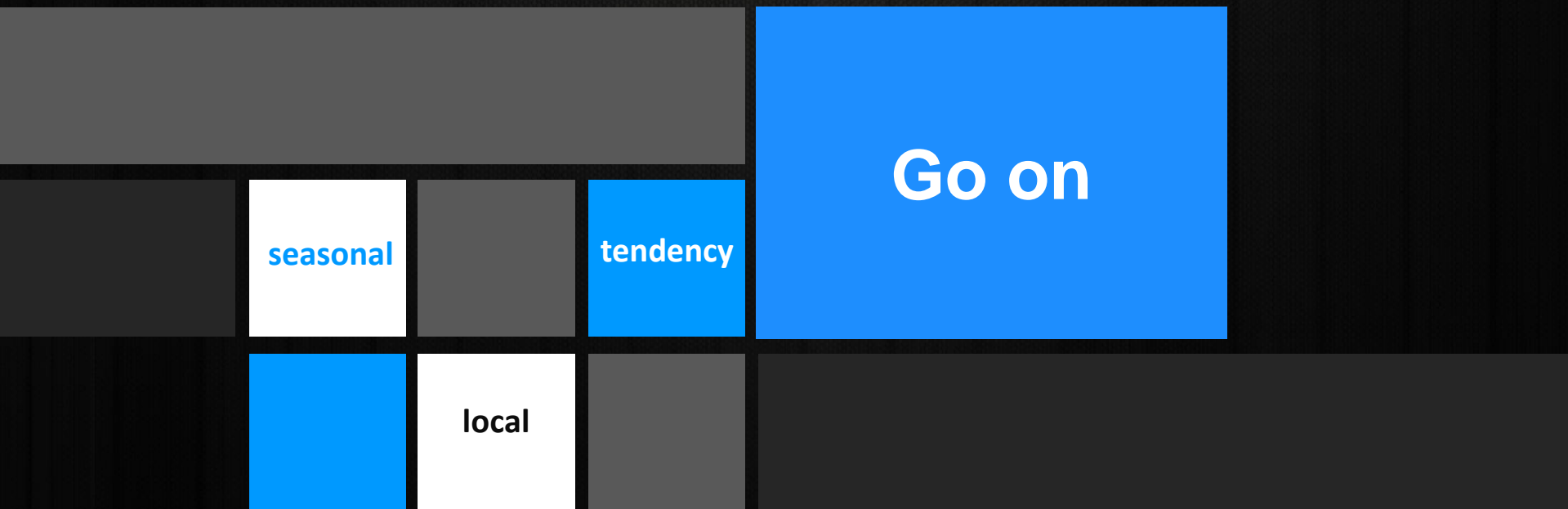
2. Results

	Heavy precipitation				Slight precipitation			
	Tibet Plateau		Southeast China		Tibet Plateau		Southeast China	
	+	-	+	-	+	-	+	-
EA/WR		✓	✓		✓			✓
ONI		✓		✓	✓		✓	
NINO1+2	✓		✓			✓	✓	
NINO3		✓	✓		✓		✓	
NINO4		✓	✓		✓			✓
NINO3.4		✓	✓		✓			✓
PDO		✓	✓		✓			✓
GMT		✓	✓		✓			✓

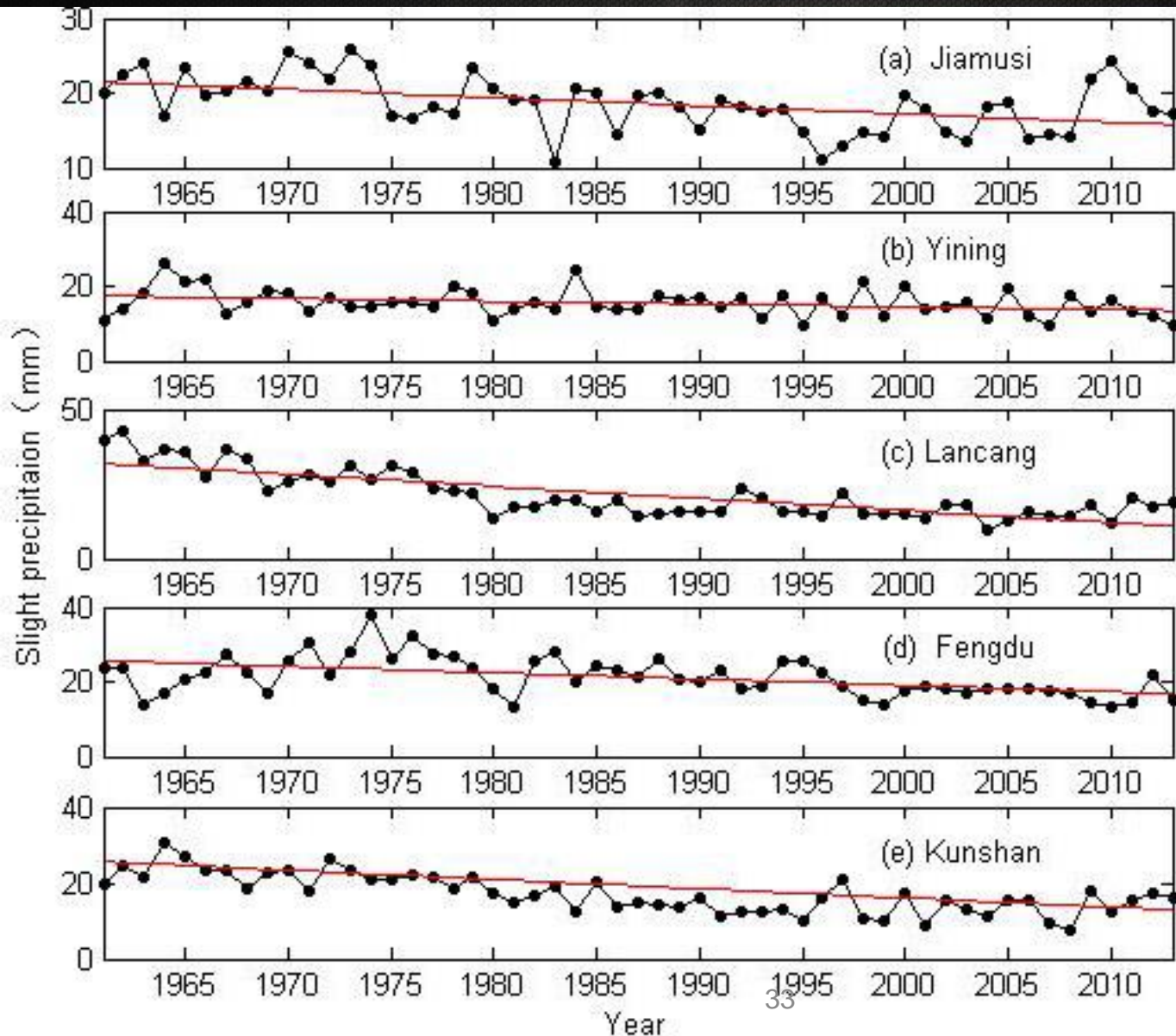
2. Results

	Heavy precipitation				Slight precipitation			
	Tibet Plateau		Southeast China		Tibet Plateau		Southeast China	
	+	-	+	-	+	-	+	-
EA/WR		✓	✓		✓			✓
ONI		✓		✓	✓		✓	
NINO1+2	✓		✓			✓	✓	
NINO3		✓	✓		✓		✓	
NINO4		✓	✓		✓			✓
NINO3.4		✓	✓		✓			✓
PDO		✓	✓		✓			✓
GMT		✓	✓		✓			✓

3. More about Slight Precipitation



3. More



3.1 The variation of the annual precipitation in Jiamusi, Yining, Fengdu, Lancang and Kunshan from 1961 to 2013 and the red line show the linear tendency.

3.2 Spatial distribution of trend for seasonal slight precipitation days during the period of 1961-2013.



3. More

3.2 Trend of seasonal slight precipitation in eight regions of China

Percentage %	spring		summer		autumn		winter	
	amounts	days	amounts	days	amounts	days	amounts	days
NEC								
Stable	6.80	58.25	1.94	6.80	0.97	18.45	12.62	52.43
Uptrend	47.57	13.59	3.88	0.00	14.56	0.97	43.69	14.56
Downtrend	45.63	28.16	94.17	93.20	84.47	80.58	43.69	33.01
NC								
Stable	8.57	52.86	2.86	15.71	4.29	31.43	11.43	57.14
Uptrend	30.00	5.71	5.71	0.00	25.71	7.14	42.86	11.43
Downtrend	61.43	41.43	91.43	84.29	70.00	61.43	45.71	31.43
EC								
Stable	0.93	0.06	12.15	28.04	2.80	0.93	4.67	7.48
Uptrend	2.80	0.00	19.63	3.74	0.00	0.00	11.21	0.00
Downtrend	96.26	0.94	68.22	68.22	97.20	99.07	84.11	92.52
CC								
Stable	8.00	16.80	3.20	16.00	1.60	8.00	7.20	28.00
Uptrend	6.40	1.60	15.20	3.20	5.60	0.00	24.00	3.20
Downtrend	85.60	81.60	81.60	80.80	92.80	92.00	68.80	68.80
NWC								
Stable	18.63	67.65	2.94	42.16	19.61	62.75	17.65	57.84
Uptrend	34.31	6.86	38.24	11.76	27.45	5.88	58.82	33.33
Downtrend	47.06	25.49	58.82	46.08	52.94	31.37	23.53	8.82
SWC1								
Stable	9.09	42.05	4.55	32.95	3.41	27.27	12.50	51.14
Uptrend	36.36	19.32	23.86	3.41	19.32	3.41	44.32	15.91
Downtrend	54.55	38.64	71.59	63.64	77.27	69.32	43.18	32.95
SWC2								
Stable	2.94	23.53	0.00	14.71	2.94	2.94	2.94	8.82
Uptrend	11.76	0.00	14.71	5.88	0.00	0.00	5.88	0.00
Downtrend	85.29	76.47	85.29	79.41	97.06	97.06	91.18	91.18
SC								
Stable	4.72	28.30	0.94	16.98	0.94	4.72	1.89	4.72
Uptrend	27.36	4.72	12.26	2.83	0.94	0.00	8.49	0.00
Downtrend	67.92	66.98	86.79	80.19	98.11	95.28	89.62	95.28

4. discussion

1. The mechanism of distribution in slight level.

2. Climate correlation, why totally opposite?

3. Concentrate on slight precipitation

There are much more slight precipitation days than heavy ones.

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THANK YOU

For Your Potential Watching

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Bengang Li, Xinyue Li
Peking University