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## Supplemental Material

2 **Will cities keep getting hotter? The interplay of urban expansion and**  
3 **greening reshapes future urban heat trajectories**

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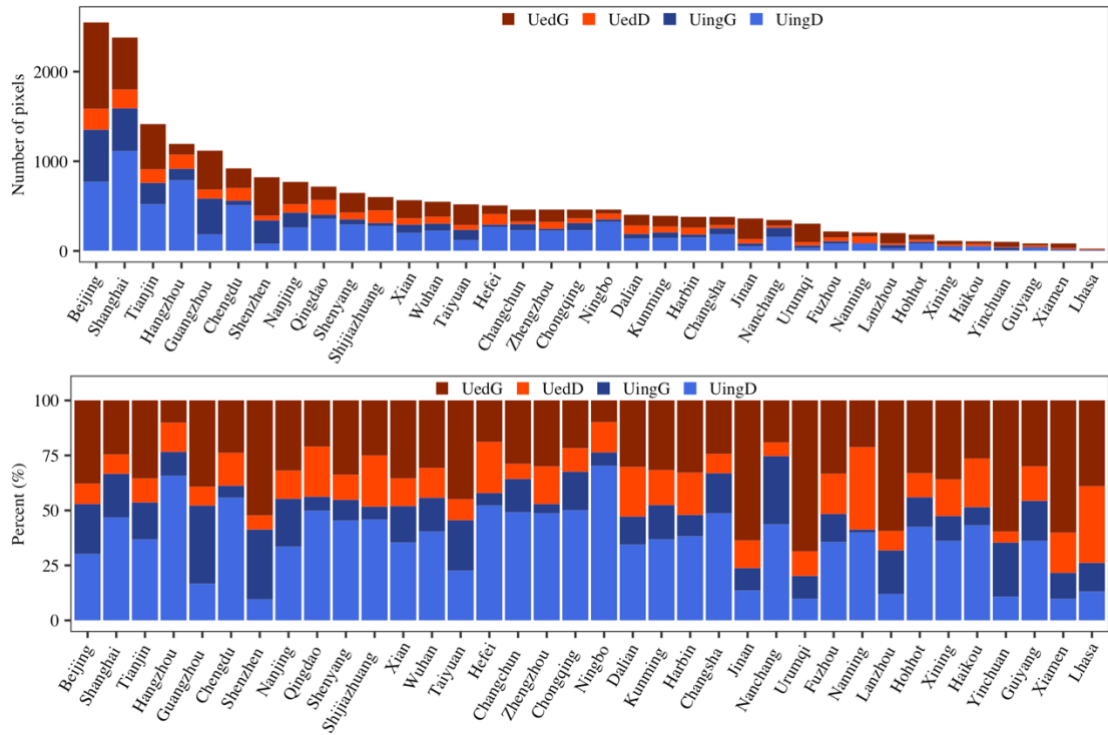
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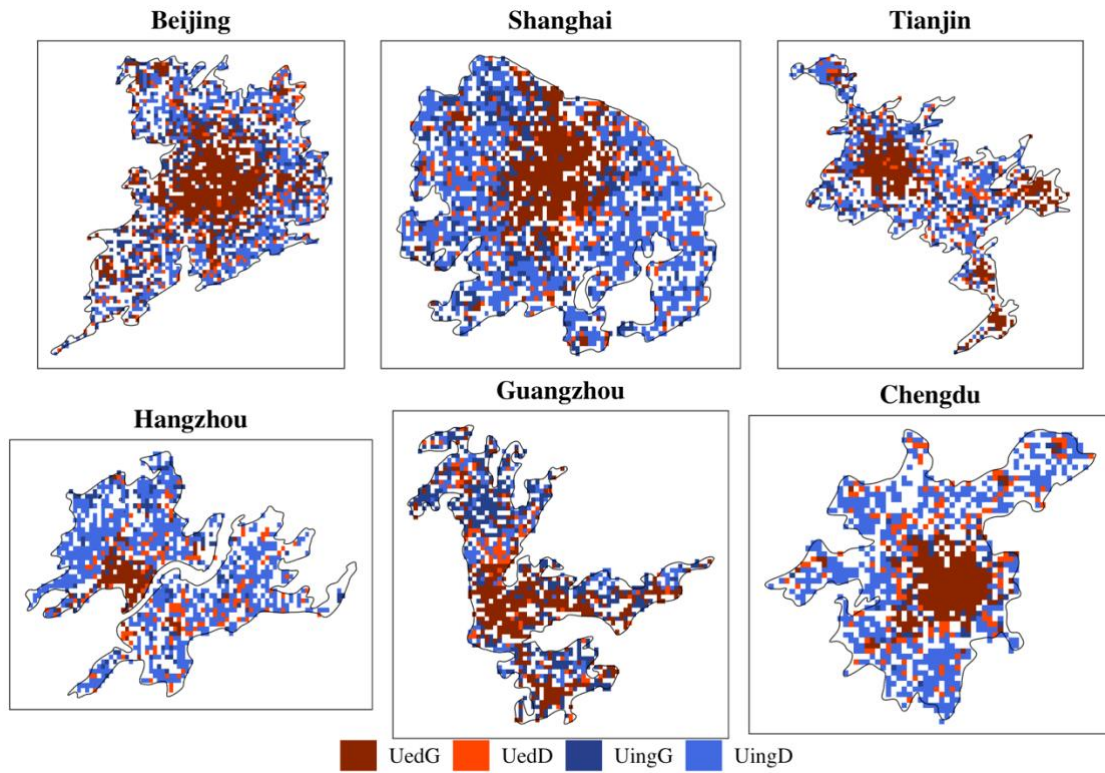
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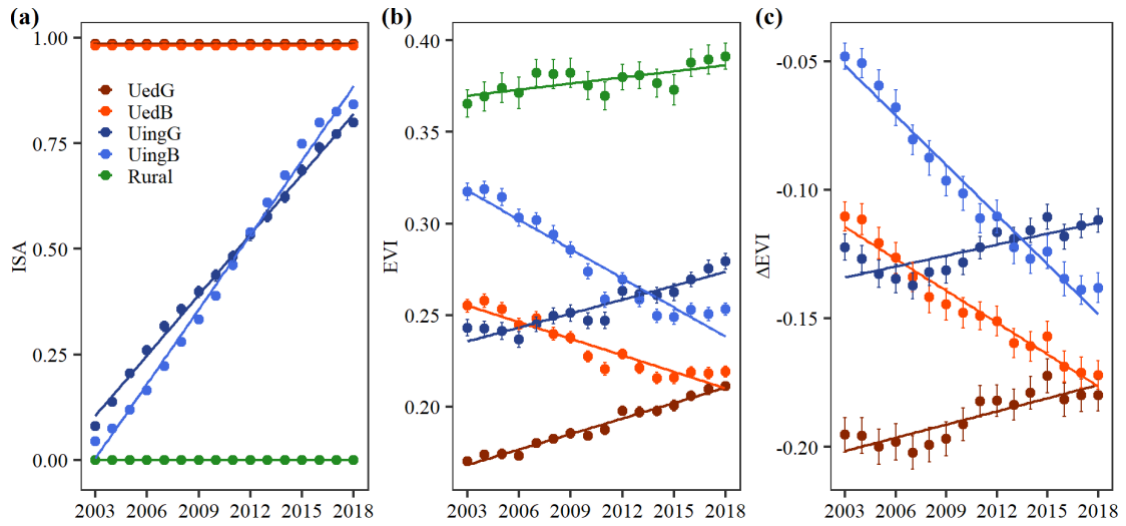
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22 **Fig. S1** Size and percentages of four urban dynamic categories in 36 study cities  
 23 along with their city size.



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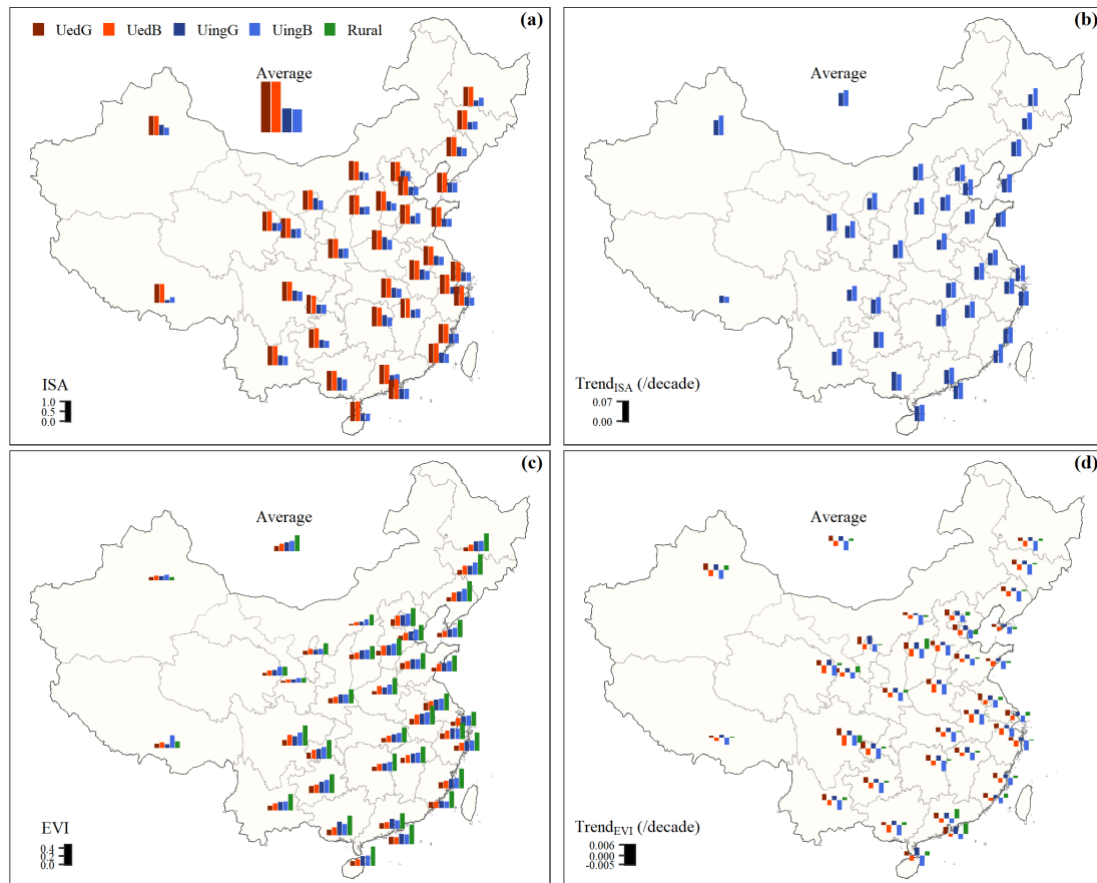
25 **Fig. S2** Spatial pattern of four urban dynamic categories in the largest six cities.  
 26 Urbanized-greening (UedG), urbanized-browning (UedB), urbanizing-greening  
 27 (UingG), and urbanizing-browning (UingB).



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29 **Fig. S3 Time series of imperviousness and greenness for different urban dynamic**  
 30 **categories across all study cities during 2003-2018.** (a): ISA; (b-c): EVI and its  
 31 urban-rural difference. Error bar represents one tenth of the standard deviation among  
 32 cities. The color represents different urban dynamic categories: urbanized-greening  
 33 (UedG), urbanized-browning (UedB), urbanizing-greening (UingG), and urbanizing-  
 34 browning (UingB).

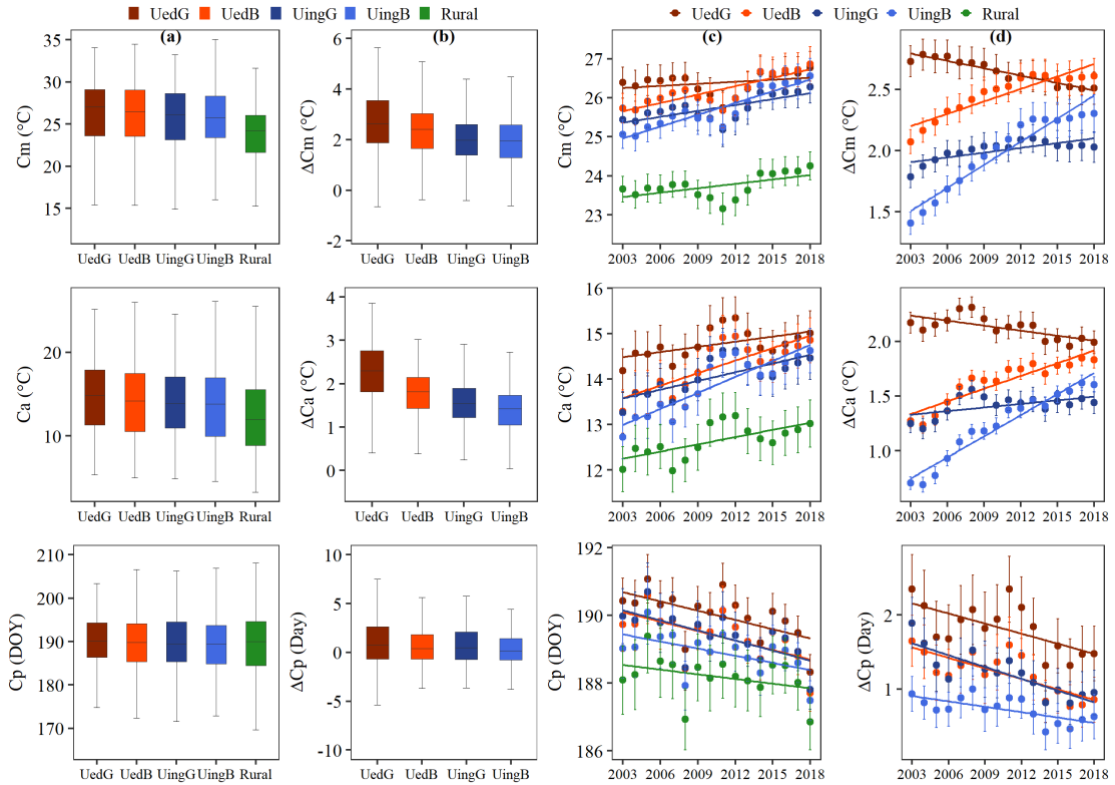
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37 **Fig. S4 Spatial patterns of ISA, EVI, and their trends from 2003 to 2018 across**  
 38 **the 36 cities.** (a-b): ISA and its trend; (c-d): EVI and its trends. The average values  
 39 across all cities are shown at the top of each figure. The color represents different  
 40 urban dynamic categories: urbanized-greening (UedG), urbanized-browning (UedB),  
 41 urbanizing-greening (UingG), and urbanizing-browning (UingB).

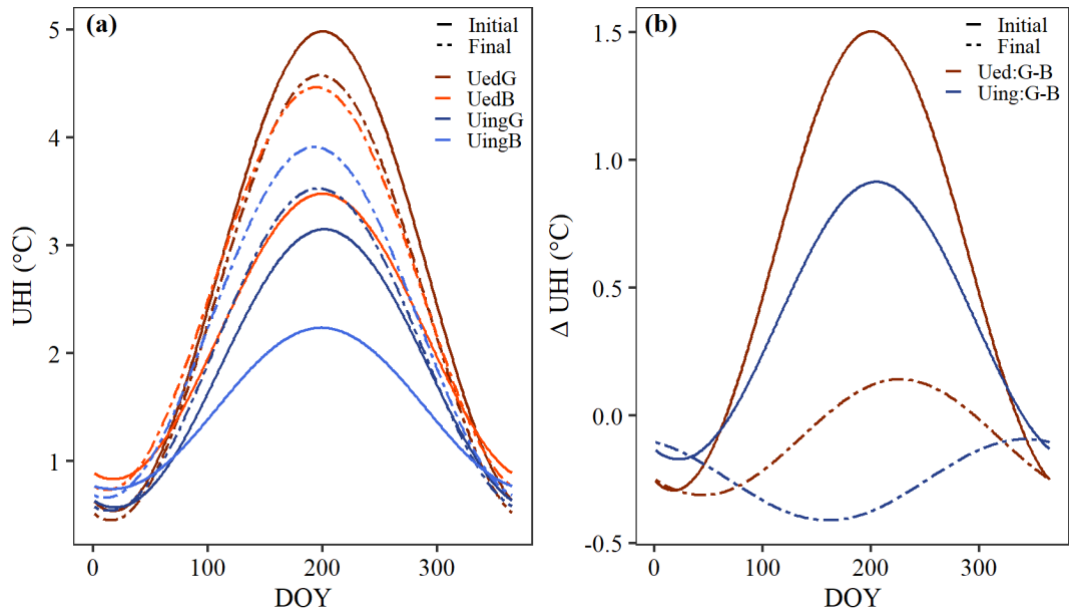
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44 **Fig. S5 Variations of annual temperature cycle parameters.** (a-b): spatial variation  
 45 and their urban-rural difference among urban dynamic categories. The middle line in  
 46 each box plot represents the median value, while the box spans the interquartile range  
 47 (IQR), capturing the middle 50% of the data. The whiskers extend to 1.5 times the  
 48 IQR. (c-d): temporal variation and their urban-rural difference during 2003-2018.  $C_m$ :  
 49 annual mean temperature;  $C_a$ : annual temperature difference between max and min;  
 50  $C_p$ : Julian day with the highest temperature.  $\Delta$  represents the difference between urban  
 51 categories and rural areas. Error bar represents one tenth of the standard deviation  
 52 among cities.

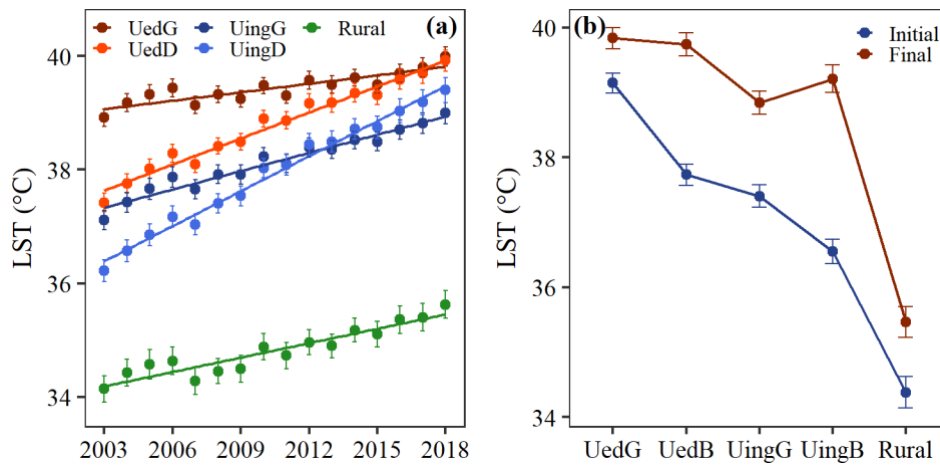
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55 **Fig. S6 Changes of annual UHI cycle between initial (2003-2015) and final (2016-**  
 56 **2018) years. (a) changes for each urban category. (b) changes of the difference ( $\Delta$ UHI)**  
 57 **between greening and browning areas.  $\Delta$ UHI was calculated by subtracting values in**  
 58 **browning areas from greening areas. Urbanized-greening (UedG), urbanized-**  
 59 **browning (UedB), urbanizing-greening (UingG), urbanizing-browning (UingB),**  
 60 **UedG-UedB (Ued:G-B), and UingG-UingB (Uing:G-B).**

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63 **Fig. S7 Temporal variations of summer temperature along urban-rural gradient.**

64 (a): temporal change of temperature in urban and rural categories; (b): change in

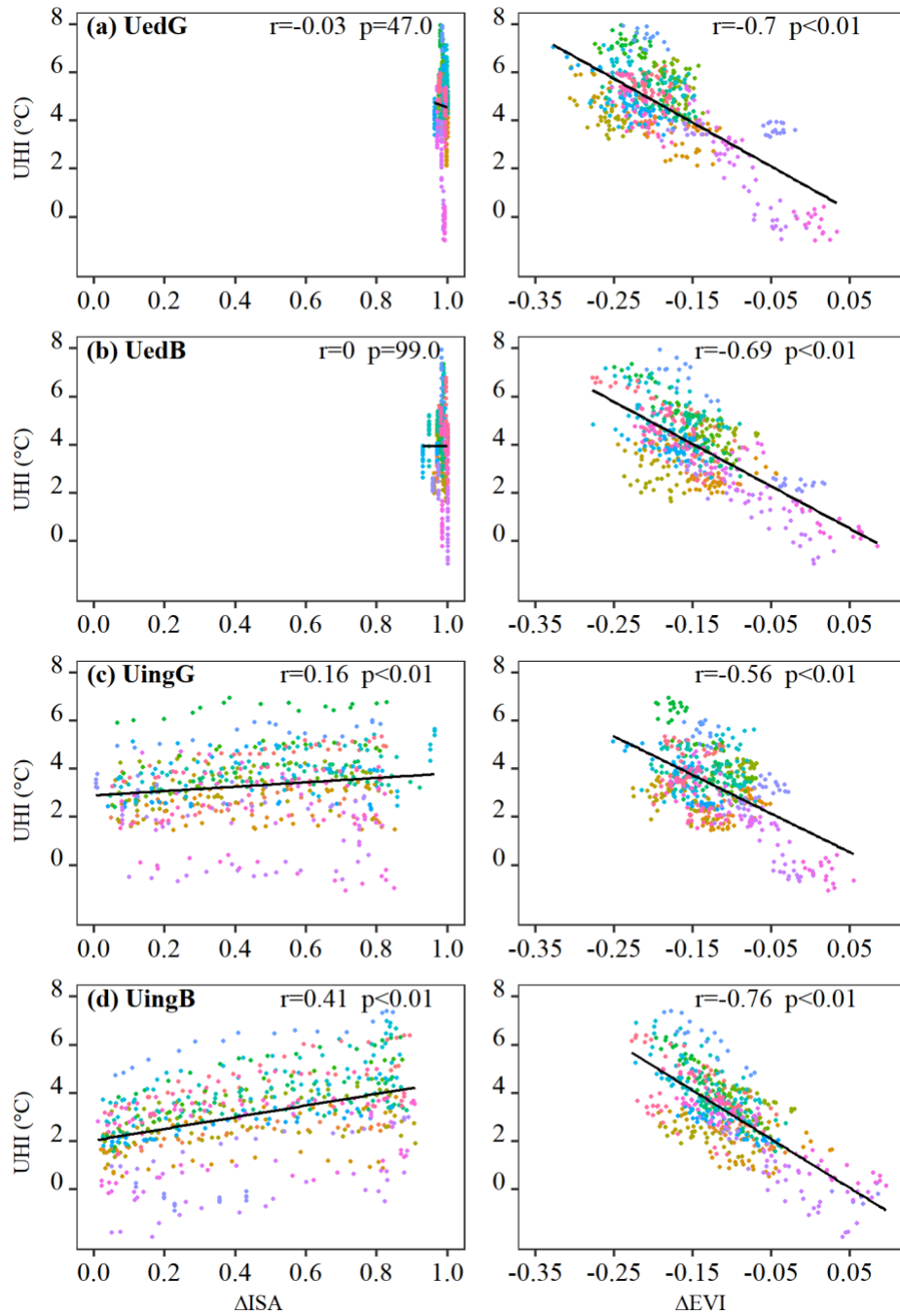
65 temperature profile between initial (2003-2015) and final (2016-2018) years. Error

66 bars represent one tenth of the standard deviation among cities. Urbanized-greening

67 (UedG), urbanized-browning (UedB), urbanizing-greening (UingG), and urbanizing-

68 browning (UingB).

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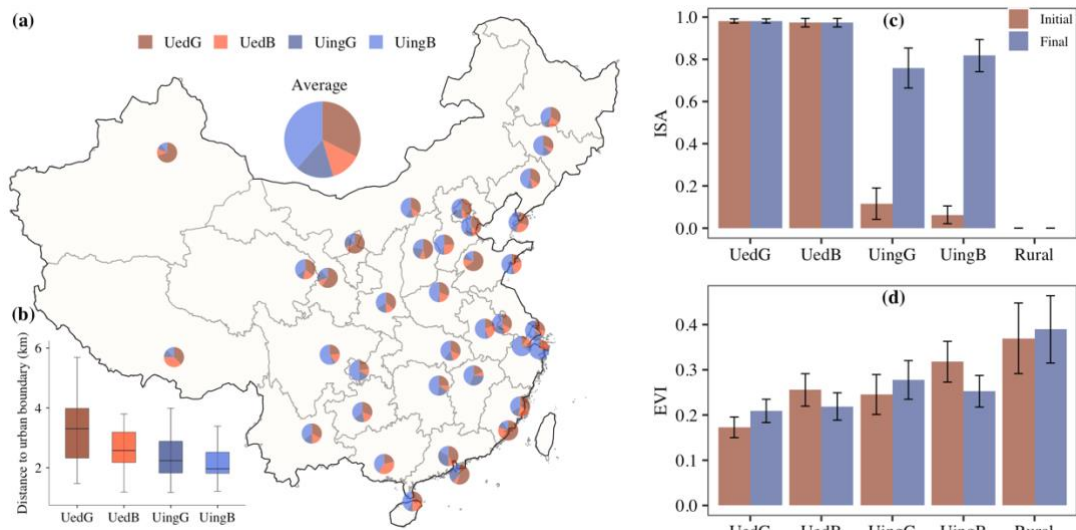
71 **Fig. S8 Relationship between UHI and the urban-rural difference of ISA (left)**

72 **and EVI (right) for four urban dynamic categories (a-d).** Color represents different

73 cities. Fitted linear regressions with correlation coefficient (r) and p-values are shown.

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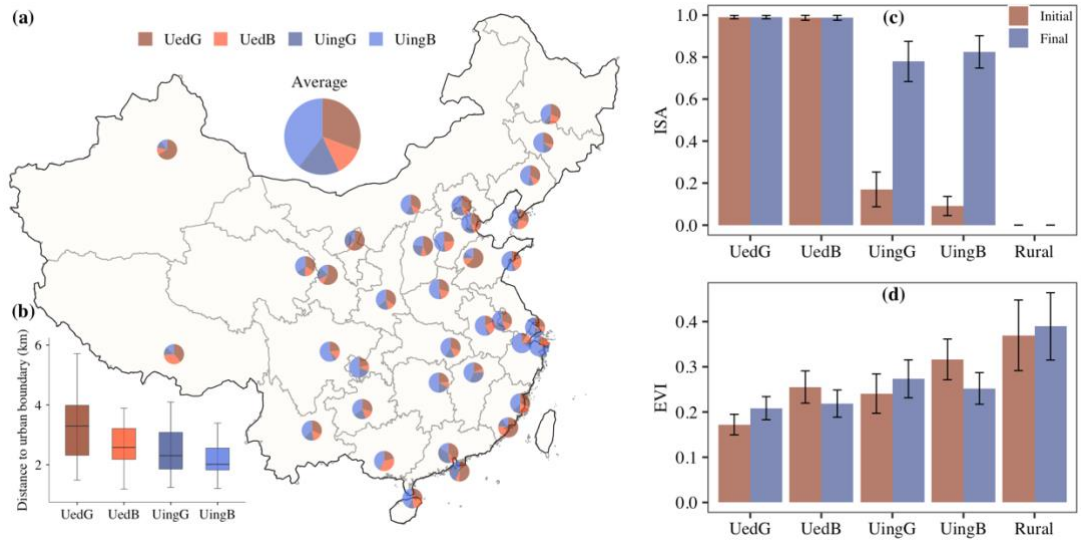
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77 **Fig. S9** Same as Fig. 1, but use the ISA=0.4 for urbanized and urbanizing  
78 **classification. Divergent urban development pathways across all study cities.** (a-  
79 b): Spatial pattern of area percentages of four urban dynamic categories in 36 cities  
80 and their distance to urban boundary. (c-d): Mean ISA and EVI between initial years  
81 (2003-2005) and final years (2016-2018). Error bar represents one standard deviation  
82 among cities. Urbanized-greening (UedG), urbanized-browning (UedB), urbanizing-  
83 greening (UingG), and urbanizing-browning (UingB).

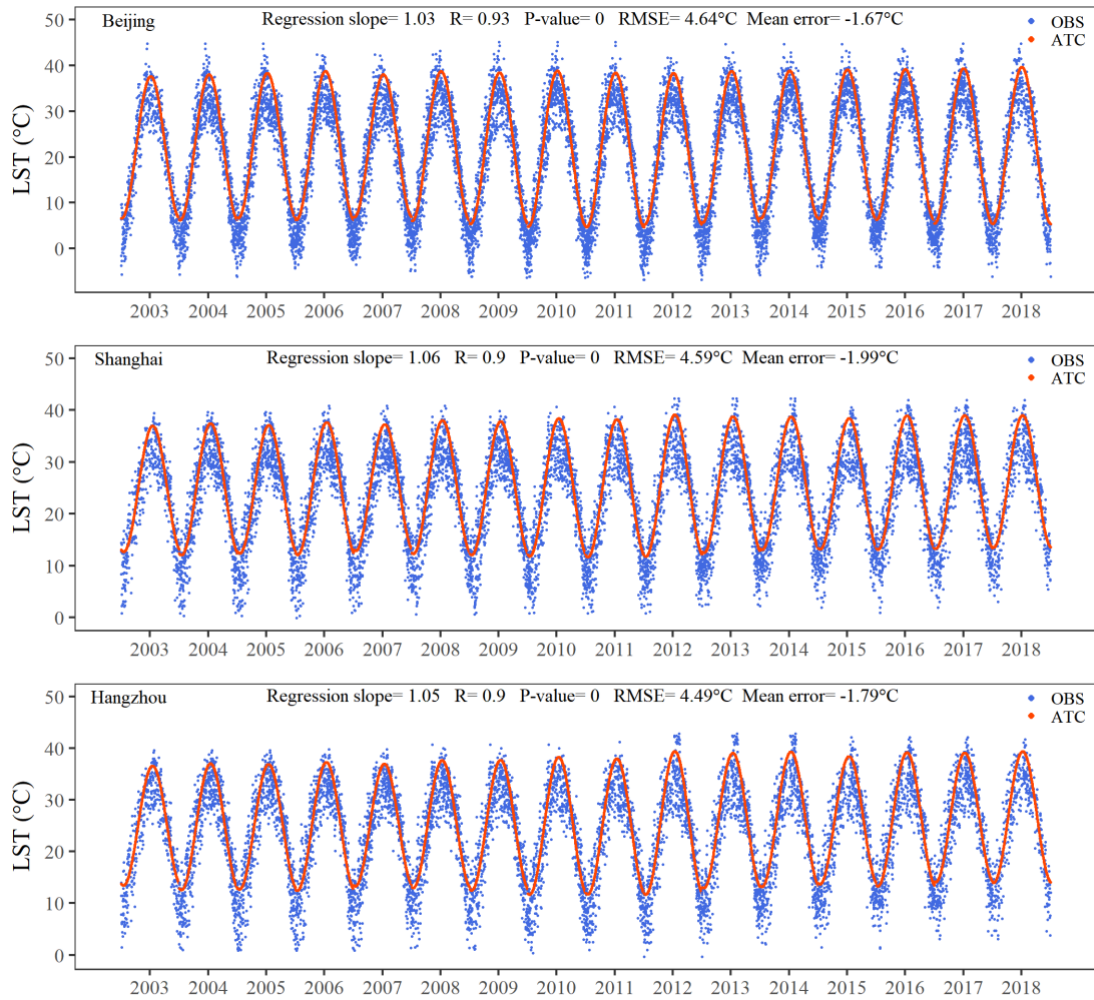
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86 **Fig. S10 Same as Fig. 1, but use the ISA=0.6 for urbanized and urbanizing**  
 87 **classification. Divergent urban development pathways across all study cities. (a-**  
 88 **b): Spatial pattern of area percentages of four urban dynamic categories in 36 cities**  
 89 **and their distance to urban boundary. (c-d): Mean ISA and EVI between initial years**  
 90 **(2003-2005) and final years (2016-2018). Error bar represents one standard deviation**  
 91 **among cities. Urbanized-greening (UedG), urbanized-browning (UedB), urbanizing-**  
 92 **greening (UingG), and urbanizing-browning (UingB).**

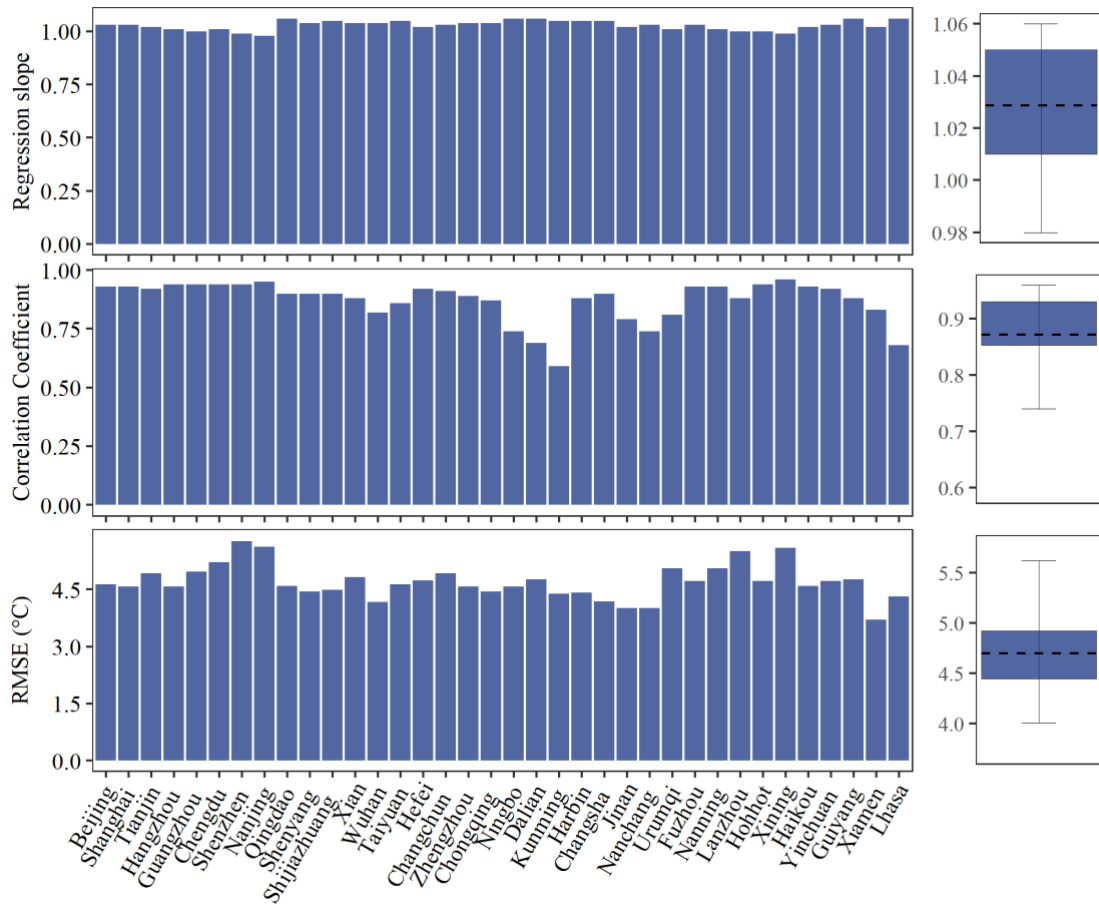
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95 **Fig. S11 Comparison of ATC model estimated and observed LST in three**  
 96 **selected cities mentioned in the results (i.e. Beijing, Shanghai, and Hangzhou).**  
 97 **Correlation coefficient (R), mean error, root mean squared error (RMSE), and**  
 98 **regression slope are shown.**

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**Fig. S12 The error matrix of the estimated temperature using the ATC model.** Boxplot on the right shows the distribution of error matrices. The middle line in each box plot represents the median value, while the box spans the interquartile range (IQR), capturing the middle 50% of the data. The whiskers extend to 1.5 times the IQR.

107 **Table S1. Correlation and variance inflation factor (VIF) between EVI and ISA**  
108 **in urbanizing regions across all study cities.** UingG is urbanizing-greening, and  
109 UingB is urbanizing-browning.

Categories	Correlation		VIF
	Value	Significance	
UingG	0.02	P>0.05	1.00
UindD	-0.52	P<0.01	1.36

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