Dear Martin Schultz,

Thank you for your letter and the chance of revising our paper on “GPRChinaTemp1km: a high-resolution monthly air temperature dataset for China (1951–2020) based on machine learning” (Manuscript ID: essd-2021-442). We thank you a lot for giving our manuscript insightful comments to further improve our manuscript.

We have revised our manuscript following your advice. We have included the comments in this letter and responded to them individually. The revisions have been approved by all three authors. The responses to the comments are listed below in blue.

thank you for carefully considering the reviewer comments and submitting a revised manuscript version. While most comments have been resolved, there are two important issues that remain and which need to be addressed through further analysis, before the paper can be published:

(1) please remove the sentence "This tool considers the randomness both in the data and the spatial distribution of the data", because this statement is misleading. The reviewers' point is that the data are *not* randomly distributed but correlated in space. You can obtain a more robust estimate of the model error by cutting out a region of, say, 300-400 km length in longitude and latitude and using all stations inside this region for testing, while stations outside this rectangle are used for training. By randomly positioning this rectangle a few times, you will get a useful uncertainty measure.

Response: Thanks a lot for your constructive comment. We deleted the sentence you mentioned in the revised manuscript as requested (Lines 103-104).

As you suggested, we conducted an experiment using rectangles. We cut out the study area region using squares with the side length of 300 km in longitude and latitude (Figure 1).

The stations inside the square were used as the testing stations and the stations outside the square were used for training the models. Sixteen years of data were used for the experiment: 1980, 1983, 1985, 1988, 1990, 1993, 1995, 1998, 2000, 2003, 2005, 2008, 2010, 2013, 2015, and 2018 (We selected some years to do the experiment due to the huge data volume and the time-consuming modelling running on our computer). For the data of each month per year, the square numbers are 142. We trained models for each month per year using the training stations outside the squares 142 times, so 27264 models were trained.

We obtained the accuracy (MAE, RMSE, and R^2) for the testing stations in each square. The accuracy results are shown in Figure 2. The MAE, RMSE and R^2 (median values of RMSE, MAE and R^2 are 0.49, 0.56 and 0.92, respectively) indicate that the accuracy of the GPR models by cutting out a square as testing is high, which can prove the robustness of the GPR models. The monthly comparison also shows the stability of the GPR models in different months using the square strategy (Figure 3).

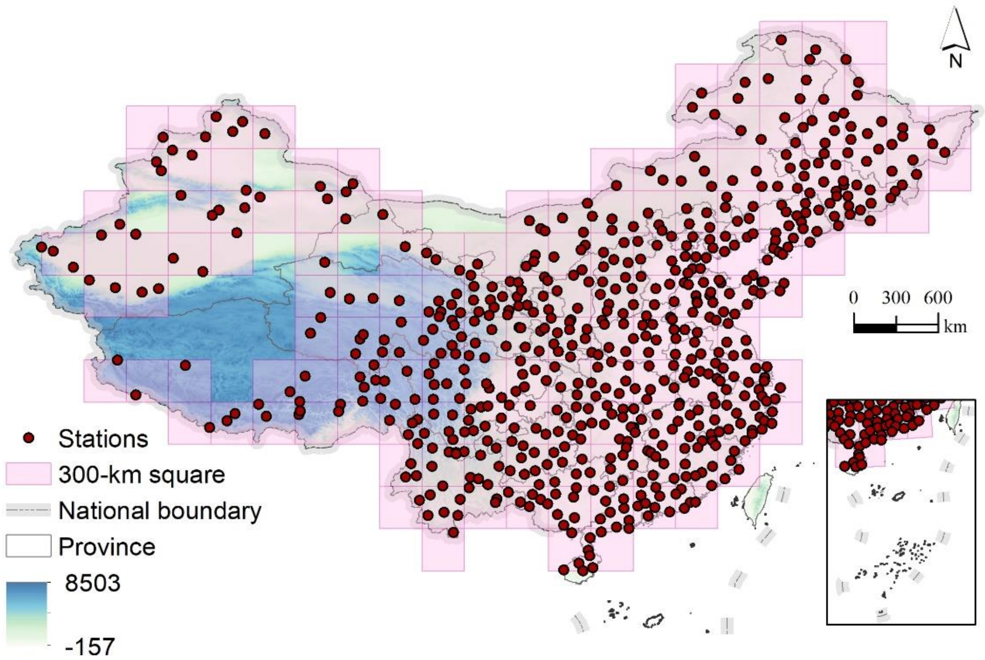

Figure 1 Illustration of the squares used for the experiments.

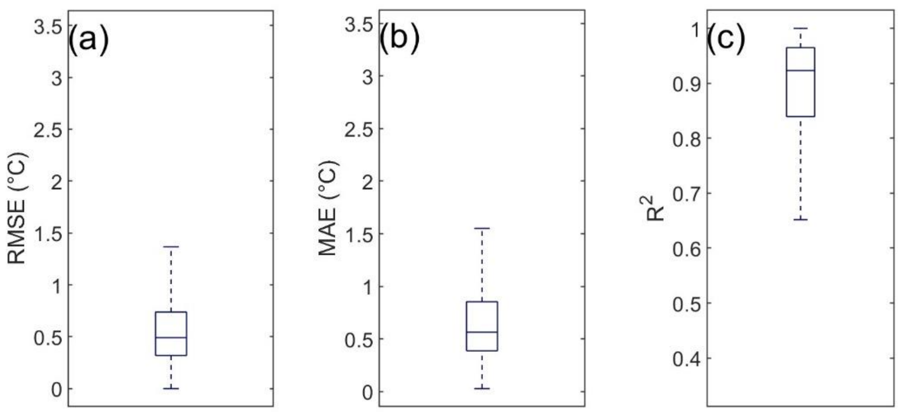

Figure 2 Boxplots of the accuracy of the testing stations for the cut-out 30-km squares of all months in all years.

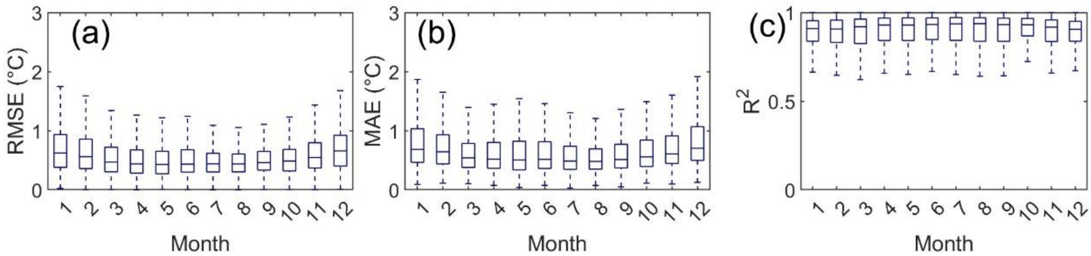

Figure 3 Boxplots of the accuracy of the testing stations for the cut-out 30-km squares for each month.

Besides, we also compared the accuracy of the testing stations using the rectangle strategy with the accuracy of the testing stations used in our original study. Figure 4 shows the scatter plots of the predicted mean temperature (Tmean) in our original study and the predicted Tmean obtained by the square strategy for the testing stations. It can be found that the predicted values by the square strategy are almost the same as the predicted values in our study, which can confirm the robustness of the models used in our study. We also provided all the scatter plots of each month of all years in a ZIP file. The accuracy comparison of MAE, RMSE and R^2 between the original prediction (i.e. the prediction in our original study) and the prediction obtained by the square strategy also shows that they have similar accuracy.

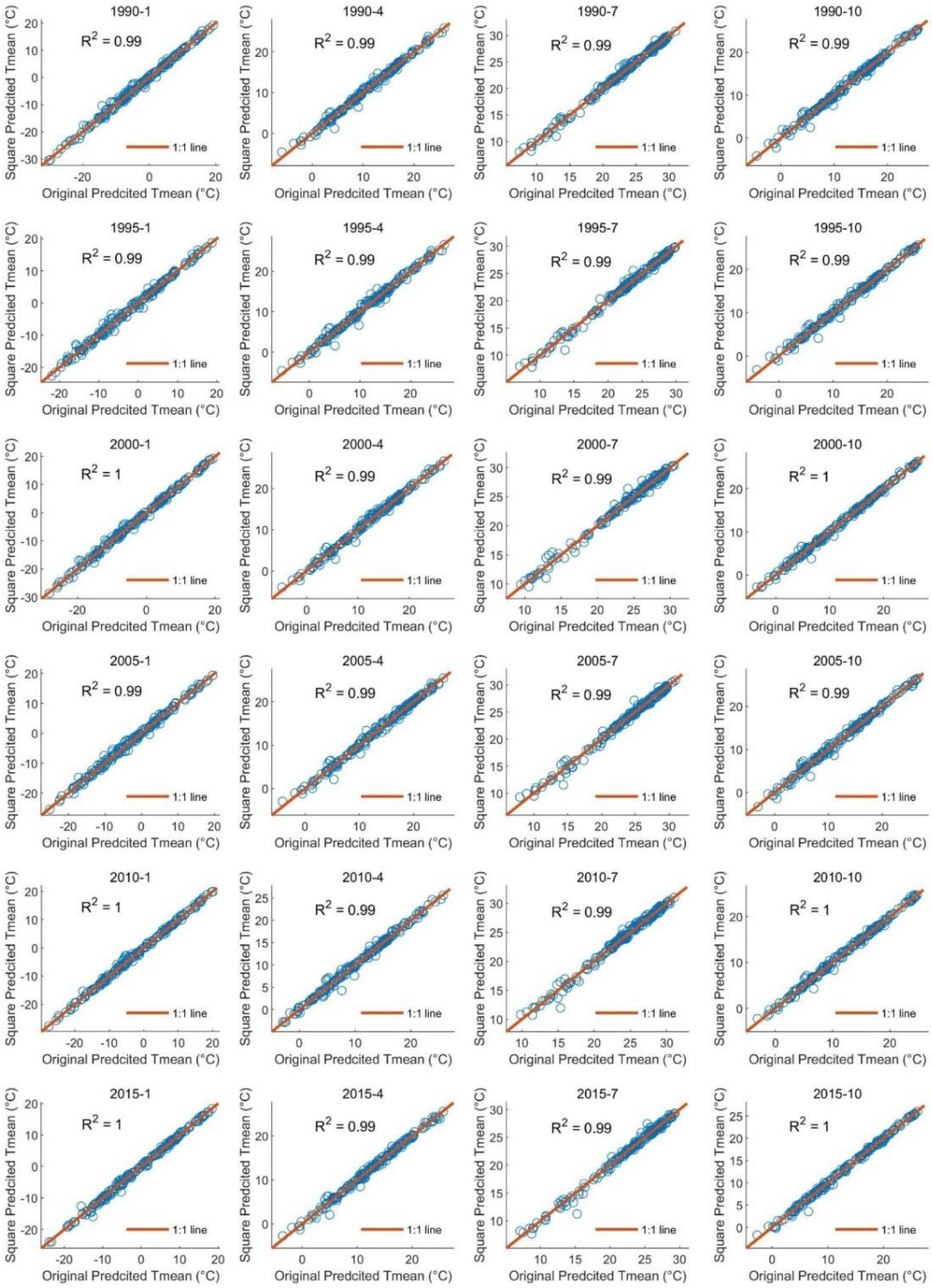

Figure 4 Scatter plots between the original predicted Tmean and the predicted Tmean using the square for the testing stations. The scatter plots for the rest months in different years are provided in a ZIP file.

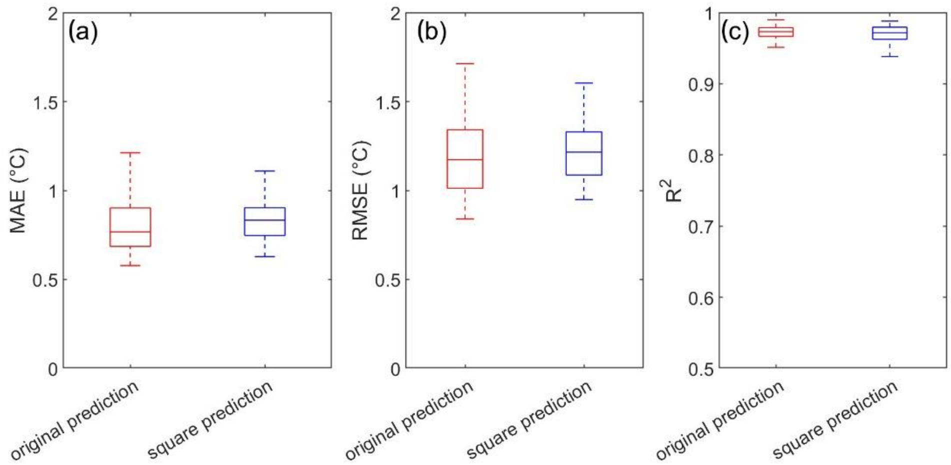

Figure 5 The accuracy comparison between the original prediction and the new prediction using the square strategy.

We added this discussion in the revised manuscript (Lines 393-395).

(2) a more critical test of the model's interpolation capabilities can be obtained by evaluating spatial anomalies (i.e. monthly value of a specific year minus mean monthly value over all years). If the model has real power, then it should be able to reproduce such spatial anomaly patterns, for example during the heat episode in Sichuan in 2006, which you showed. On the other hand, if longitude, latitude and altitude are the only predictor variables, one might expect that the spatial anomalies look identical each year.

Response: Thanks a lot for your valuable advice. As you requested, we did a test of the model's interpolation capabilities. We obtained the spatial anomalies for each month over all years. We collected some historical heat/cold wave events as well as some droughts which are related to heat waves as the events to validate the applicability of our datasets. The events are mainly selected based on previous literature and some Chinese news, as well as the historical documents in our research group; the references have been put in the caption of the figures. Eleven events in total are used for the validation. We presented the spatial mean temperature anomaly of the year with the extreme temperature-related events as well as the mean temperature anomaly of the two years before and two years after the event year.

The results are shown in Figures 6-16, and the event year has a different colour of the frame. It can be found that our datasets can reproduce the spatial anomaly patterns in the year with extreme temperatures. Besides, the spatial anomalies for the same month in different years are different because we trained the model for each month using the monthly temperature in that month which consider the dynamic characteristics of the temperature. Just as shown in Figure 66-16, the spatial difference can be clearly seen in the same month for different years.

We have added this part in the Discussion session in our revised manuscript (Lines 433-434). We also added these spatial maps in our Supplementary materials (Figures S60-70)

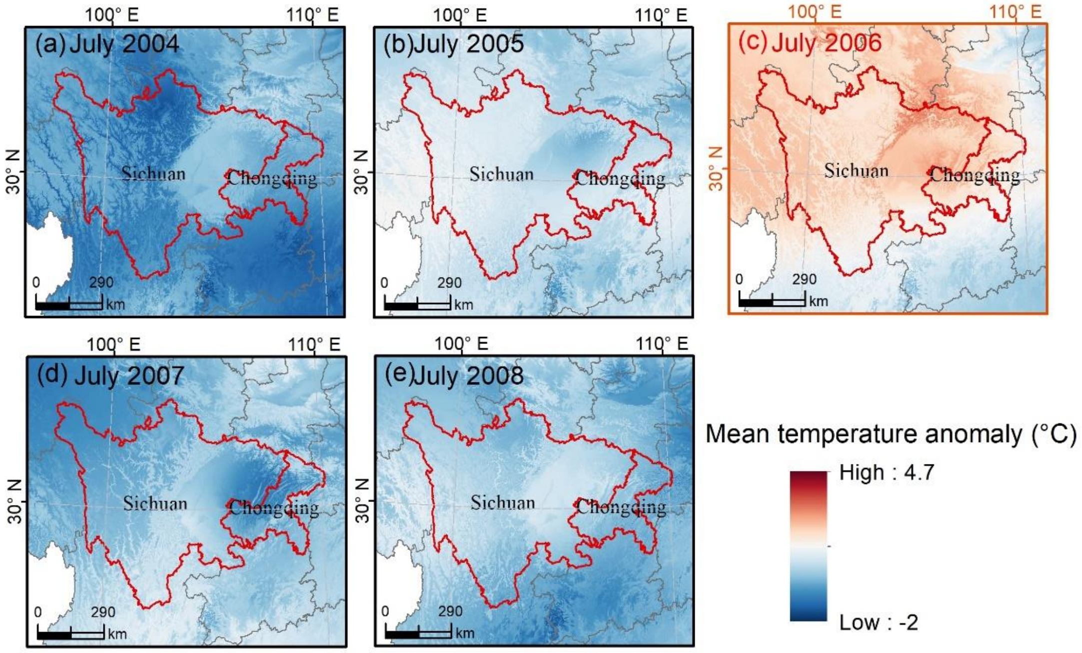

Figure 6 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. A drought event happened in Sichuan and Chongqing and neighbouring regions in July 2006 which is associated with heat waves (Li et al., 2011).

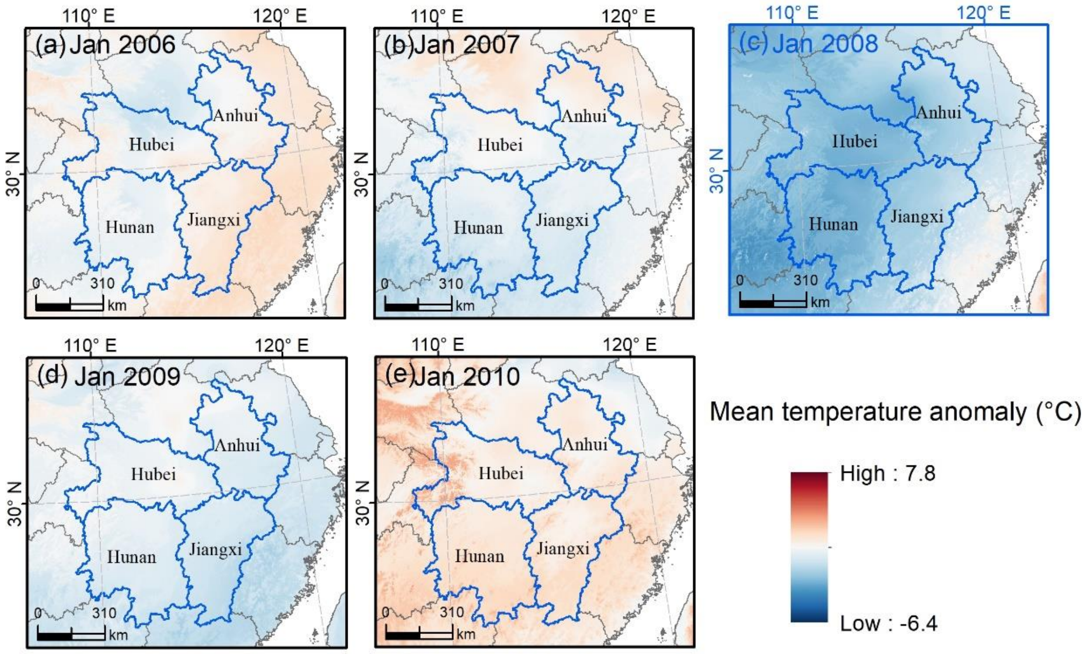

Figure 7 Comparison between the year with lower mean temperature anomaly (for Tmean) and the

adjacent years. Hubei, Anhui, Hunan and Jiangxi and surrounding areas were affected by cold temperatures in the 2008 Chinese winter storms (Liu et al., 2016; Zhou et al., 2014; Lu et al., 2010).

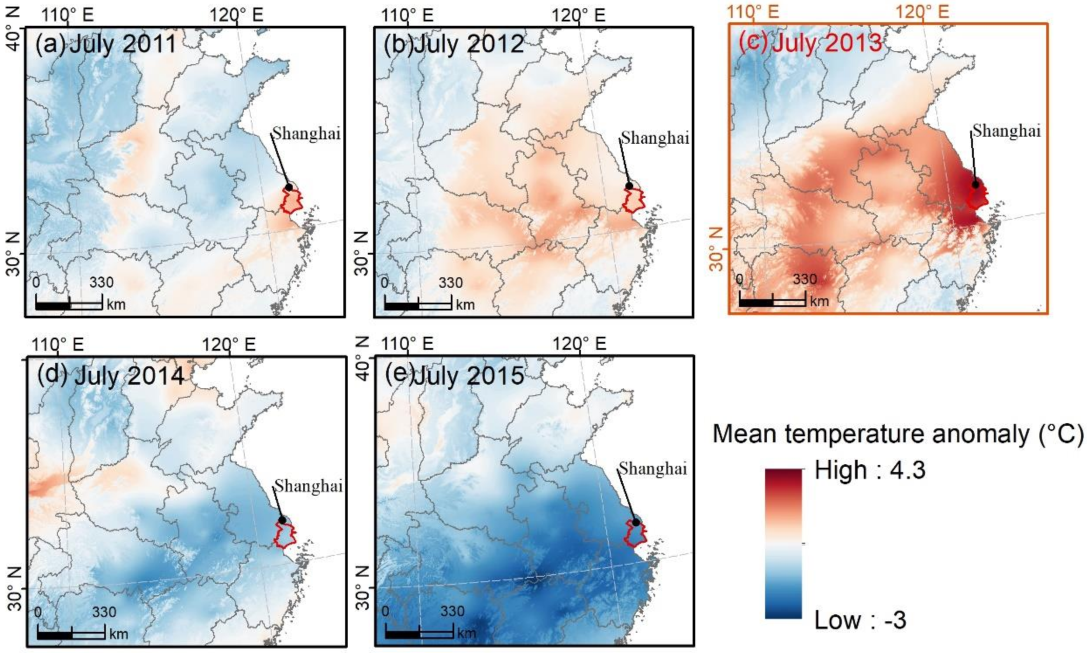

Figure 8 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. Heat waves hit Shanghai and neighbouring regions in July 2013 (Pu et al., 2017; Ding and Ke, 2015; Li et al., 2015; Jing-Bei, 2014).

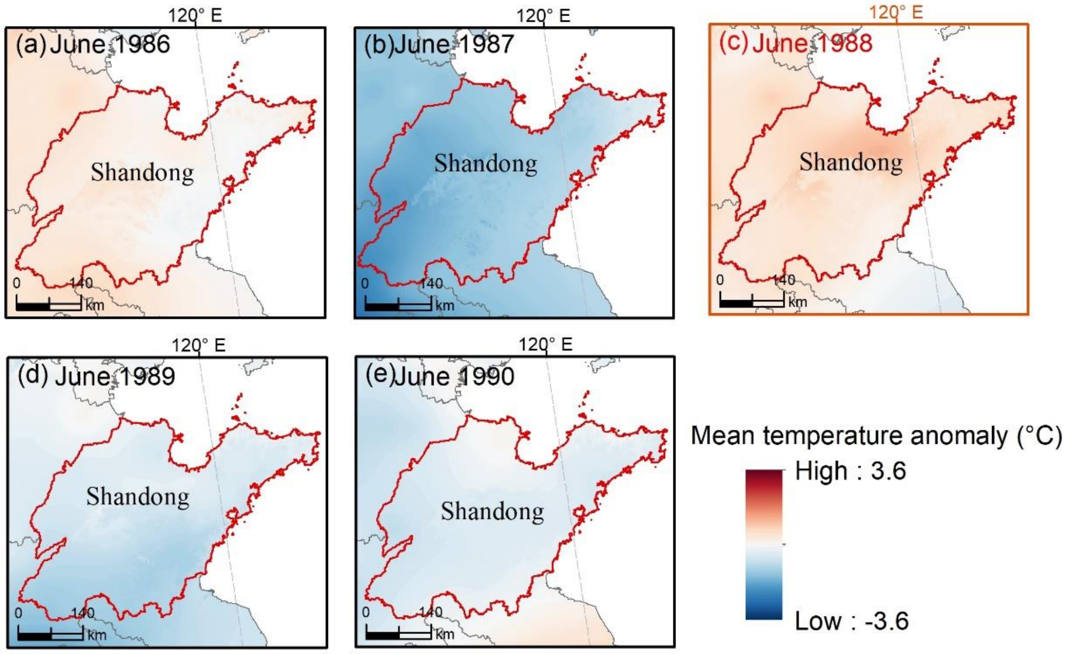

Figure 9 Comparison between the year with extremely high temperature and the adjacent years in Shandong. A drought event with heat wave happened in 1988 in Shandong province and neighbouring areas.

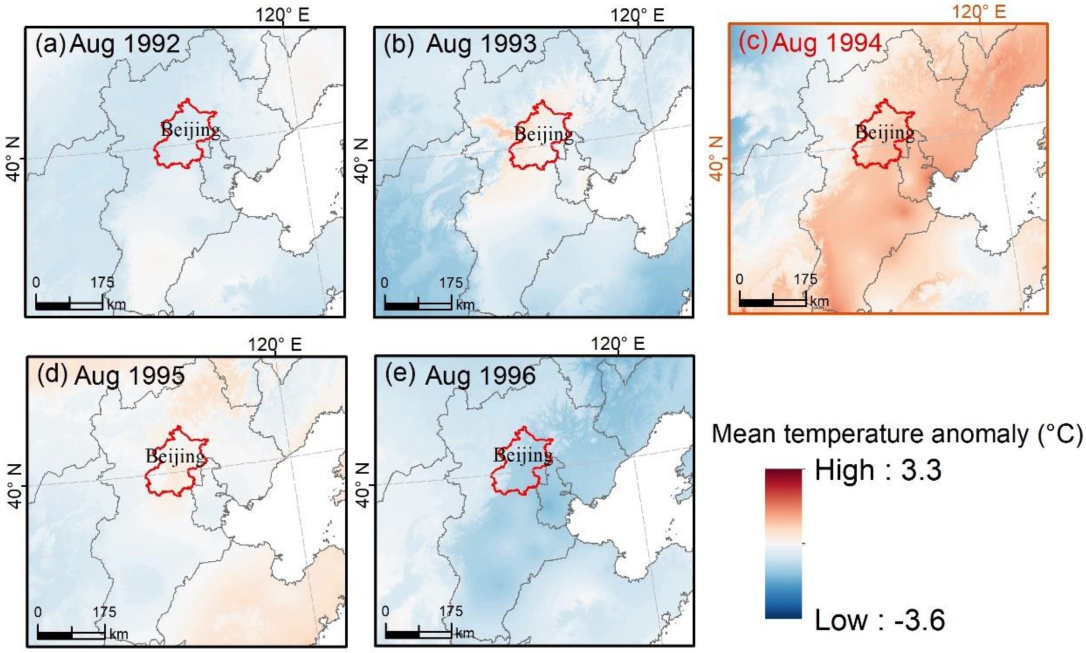

Figure 10 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. Heat waves happened in Beijing and the surrounding areas in August 1994 (Zhang et al., 2018; Park et al., 2012).

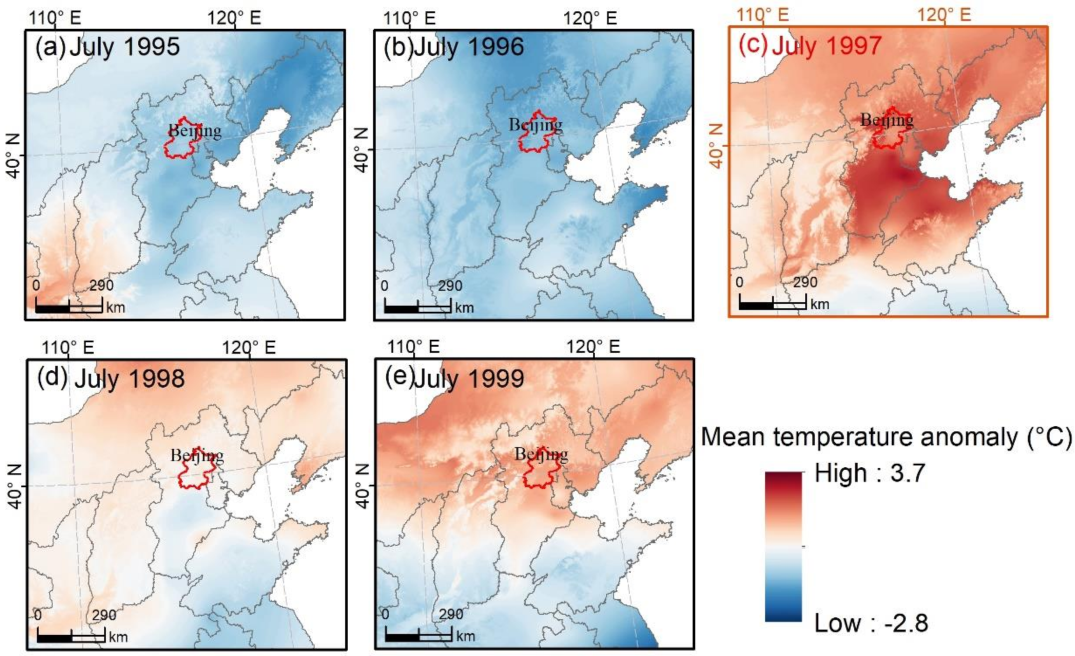

Figure 11 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. Heat waves hit Beijing and the neighbouring regions in July 1997 (Park et al., 2012; Zhang et al., 2018).

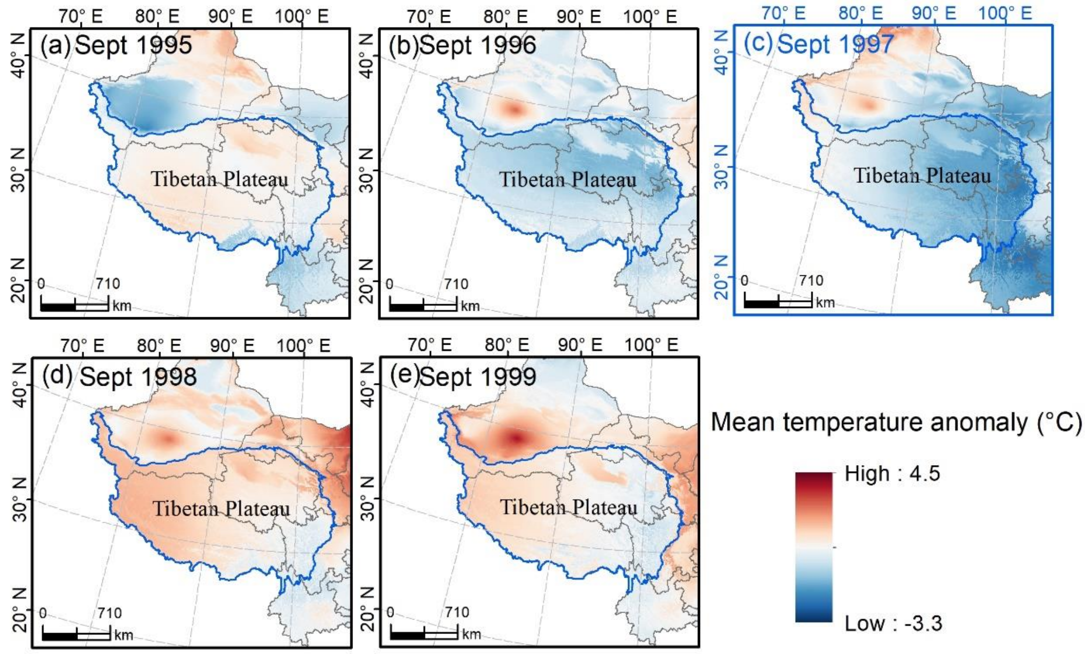

Figure 12 Comparison between the year with lower mean temperature anomaly (for Tmean) and the adjacent years. Cold waves hit the Tibetan Plateau and neighbouring areas in September 1997.

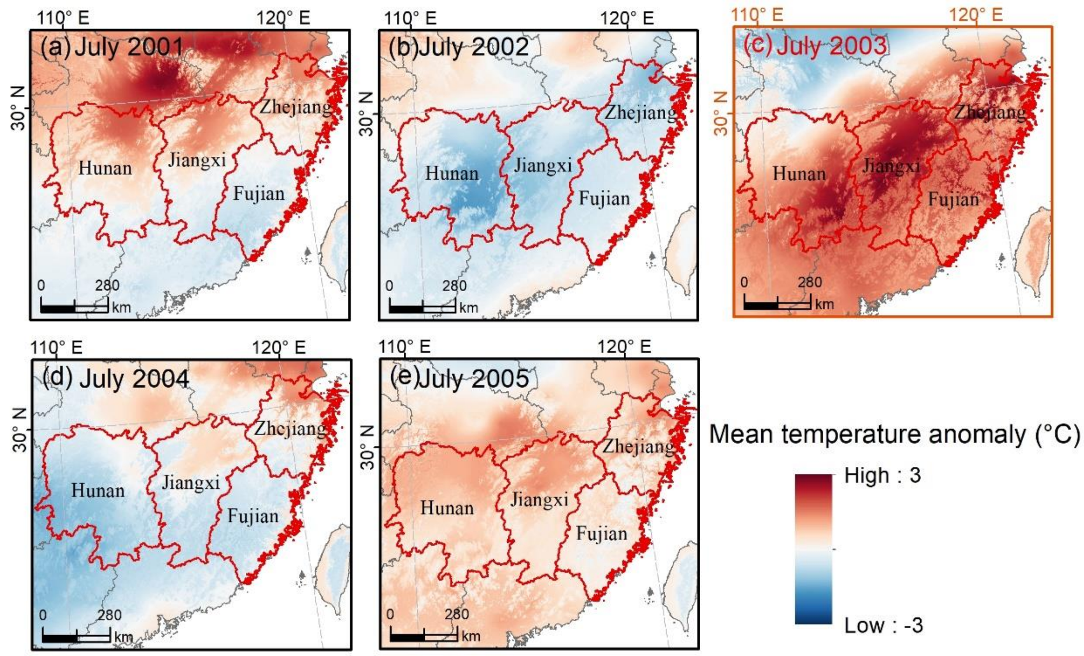

Figure 13 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. Drought happened in Hunan, Jiangxi, Zhejiang and Fujian provinces and neighbouring regions in July 2003 which is caused by the lack of precipitation and heat wave (Wang and Yan, 2021; Zhang et al., 2017; Ding and Ke, 2015). In 2001, the summer drought with high temperature happened in the southern China as well, such as Hubei, Zhejiang (Pandey et al., 2007, p.36–37). There were also heatwaves in the southern cities in 2005, for example Guangdong province (Yang et al., 2013).

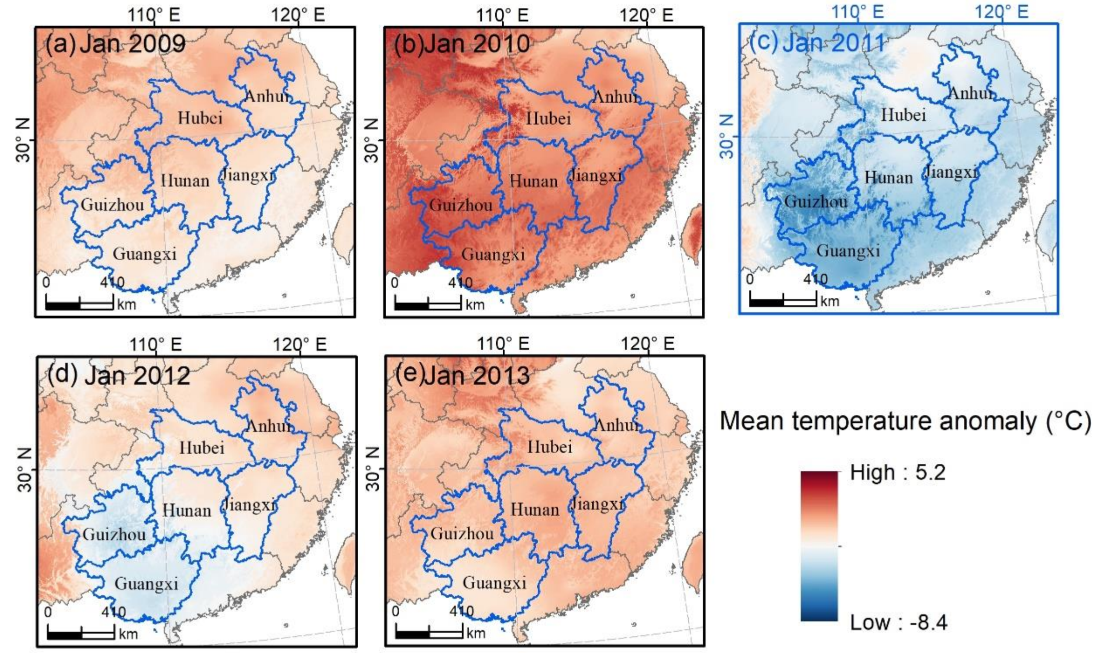

Figure 14 Comparison between the year with lower mean temperature anomaly (for Tmean) and the adjacent years. Guizhou, Guangxi, Hubei, Hunan, Anhui, and Jiangxi as well as the neighbouring regions were affected by cold waves in January 2011 (Qi et al., 2017; http://www.gov.cn/jrzg/2011-01/05/content_1778886.htm, last access: 18 May 2022).

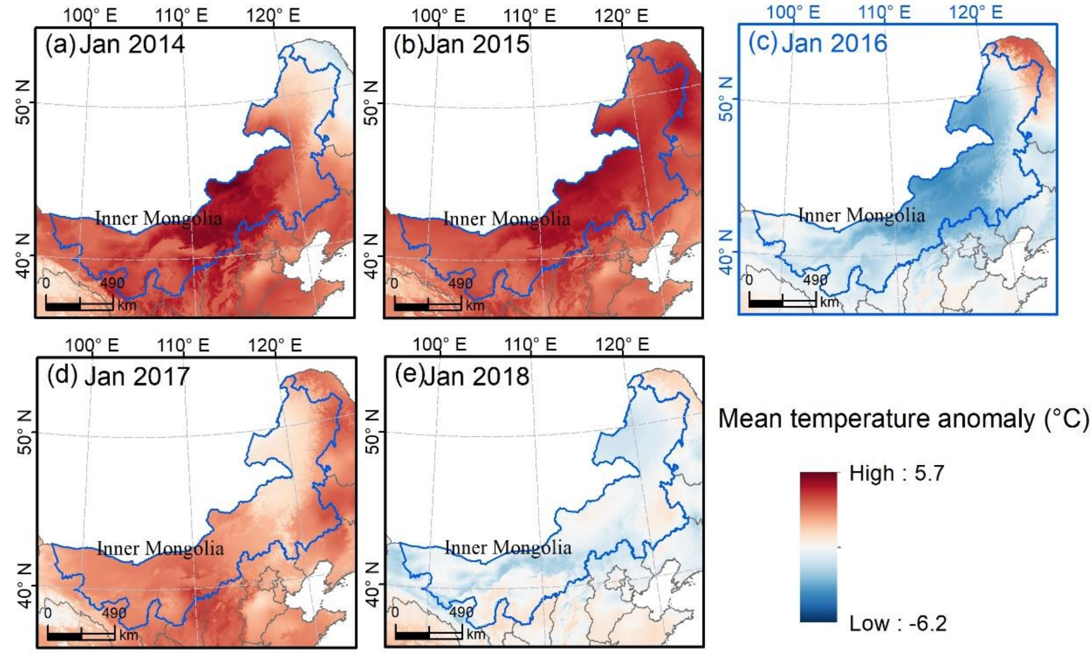

Figure 15 Comparison between the year with lower mean temperature anomaly (for Tmean) and the adjacent years. A cold wave happened in Inner Mongolia and neighbouring regions in January 2016 (Ma and Zhu, 2019; Jiang et al., 2018).

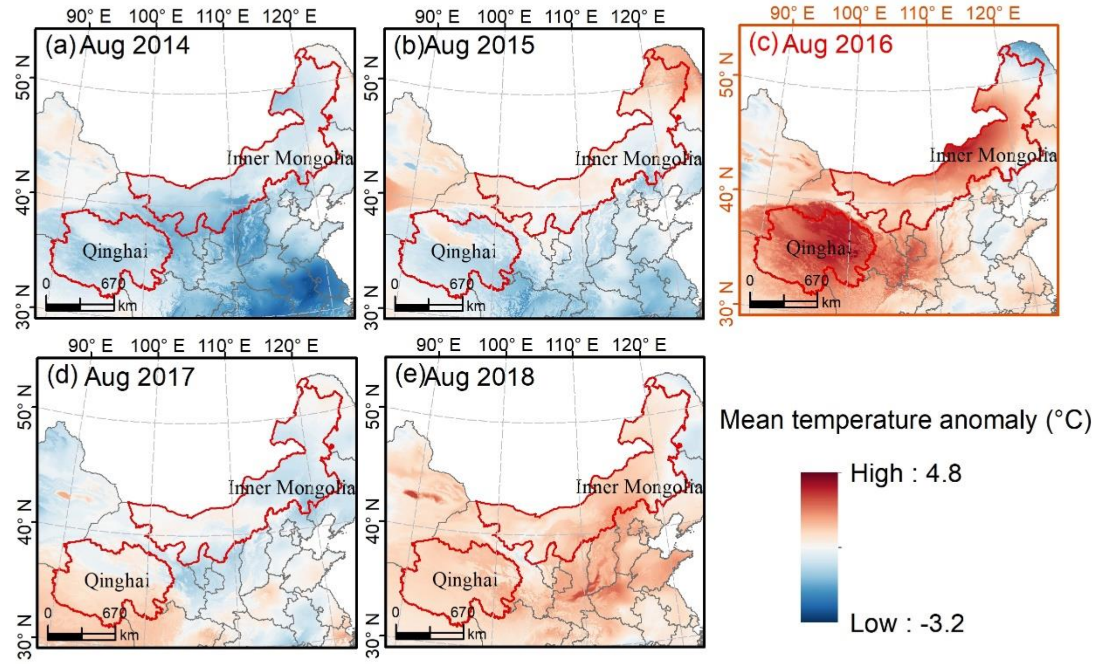

Figure 16 Comparison between the year with higher mean temperature anomaly (for Tmean) and the adjacent years. Extremely high temperatures occurred in Inner Mongolia and Qinghai and other neighbouring regions in August, 2016 (http://www.cma.gov.cn/2011xwzx/2011xqxxw/2011xqxyw/201609/t20160902_320919.html, last access: 18 May 2022).

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