Estimation of prediction interval in ANN-based multi-GCMs downscaling of hydro-climatologic parameters

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Introduction:

·Middle East countries.
·Coarse spatial resolution of GCMs causes weak application in local scale modeling.
·Artificial neural network (ANN).
·*Prediction intervals* (PIs) and *confidence intervals* (CIs) are two prevalent measures for assessment of prediction uncertainty.
-PIs: assimilate the accuracy of the predicted values versus the measured values.
-CIs: the accuracy of the prediction of the regression.
-*PIs* are included more sources of the uncertainty and are wider than CIs and as so are more beneficial from practical aspect.

Method and Data (Monthly):

Data:
·Three GCMs:
Can-ESM2 (Canada)
INM-CM4 (Russia)
BNU-ESM (China)

·Two stations data:
Tabriz and Ardabil

Methods:
· ANN(3 layers), BP算法
·RMSE, NSE, CC
·1951-2012、2020-2055
·RCP8.5

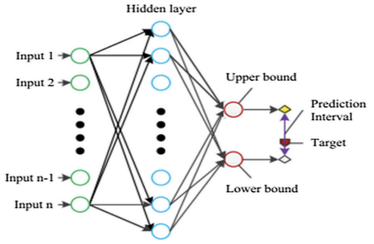


Fig. 2. ANN model for estimating upper and lower bounds of PIs (Quan et al. 2014).

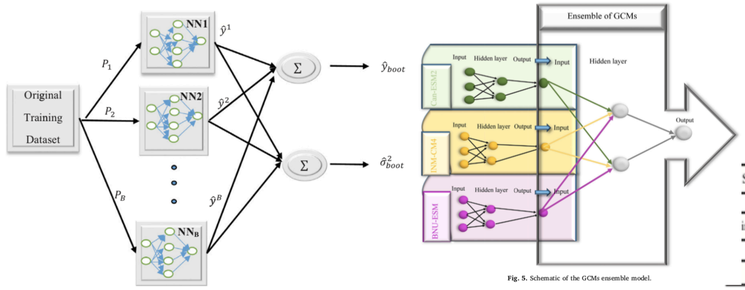


Fig. 4. Schematic of the Bootstrap method (khosravi et al. 2011b), P_i stands for training data sub-sets.

Fig. 5. Schematic of the GCMs ensemble model.

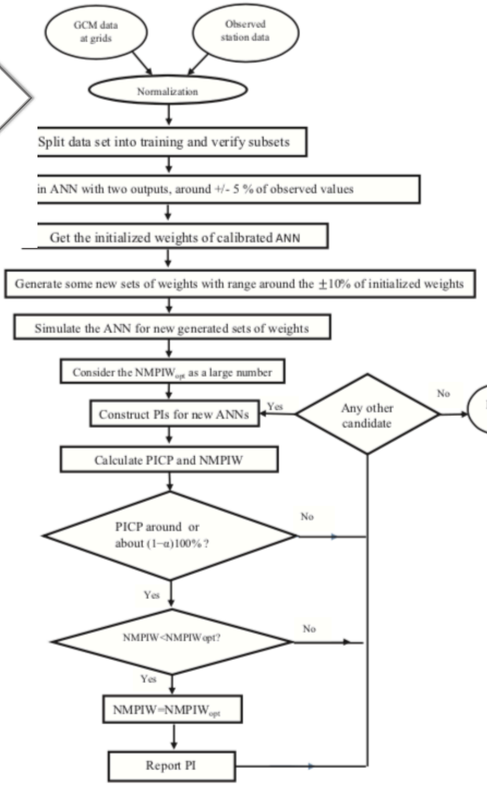


Fig. 3. Schematic of the proposed LUBE method.

Table 3
Selected dominant inputs by MI for different GCMs.

Model	Selected inputs for precipitation modeling of Tabriz	Selected inputs for precipitation modeling of Ardabil	Selected inputs for temperature modeling of Tabriz	Selected inputs for temperature modeling of Ardabil
BNU-ESM2	Hfls(A5)	Ua85000(A6)	va92500(A5)	hur100000(A6)
	zg3000(A2)	hus2000(A6)	va20000(A1)	hur10000(A3)
	uas(A2)	hus15000(A2)	hur7000(A1)	ta100000(A6)
	Hus10000(A4)	Hus5000(A3)	hur15000(A4)	zg70000(A6)
	ua1000(A5)	evspsbl(A5)	hur15000(A2)	zg3000(A2)
Can-ESM2	Hus7000(A1)	Hus1000(A2)	Hur15000(A2)	Va70000(A4)
	hus10000(A5)	hur1000(A3)	va70000(A1)	hur10000(A2)
	hur700(A4)	tas(A2)	hur15000(A1)	va30000(A5)
	Evspsbl(A4)	Uas(A3)	va92500(A5)	hfls(A6)
	hus7000(A4)	hus300(A3)	hur10000(A4)	hur7000(A6)
INM-CM4	hus3000 (B5)	Hus7000(B3)	Evspsbl(B1)	hur10000(B2)
	Hur30000(B5)	hur1000(B3)	Evspsbl(B2)	hur7000(B2)
	Hus7000(B5)	hur3000(B6)	hur15000(B1)	hfls(B3)
	zg3000(B1)	zg7000(B6)	va3000(B4)	va70000(B2)
	prc(B1)	Hus92500(B6)	va3000(B5)	ta50000(B3)

Note: GCMs grid points are based on Fig. 1, (at A1, A2, …, B1, B2, …).

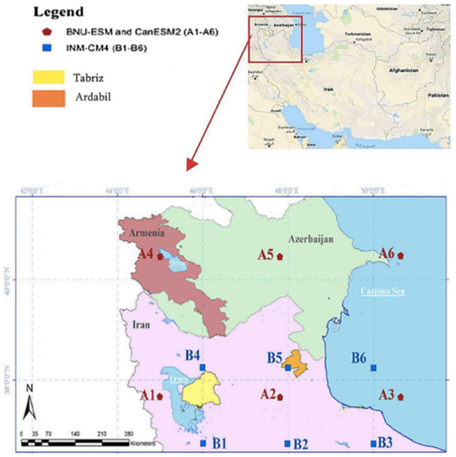


Fig. 1. Case study map and grid points around two stations of Tabriz and Ardabil.

Results:

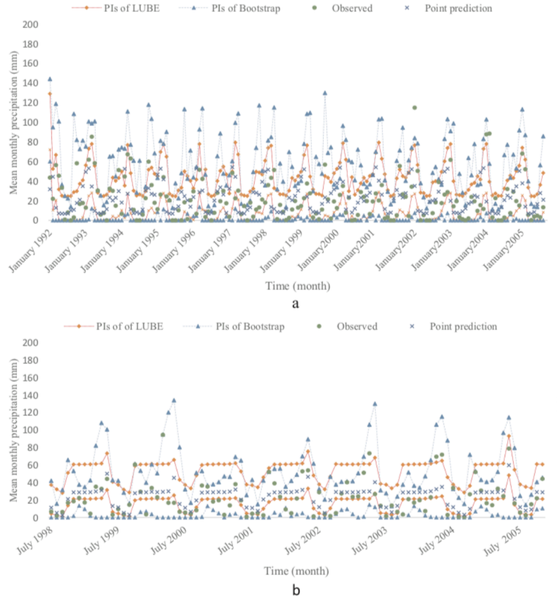


Fig. 6. Validation results of point prediction and PIs construction by LUBE and Bootstrap methods a) precipitation of Tabriz b) precipitation of Ardabil c) temperat of Tabriz d) temperature of Ardabil.

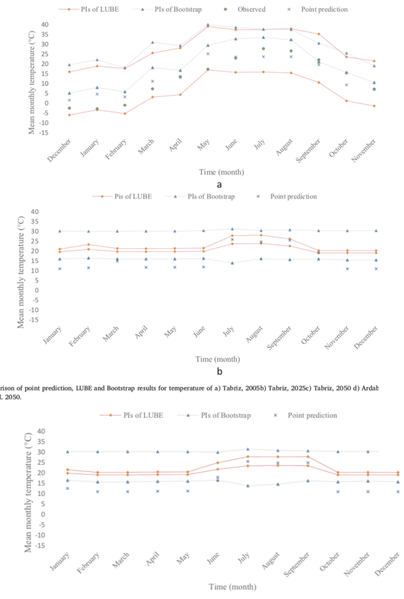


Fig. 8. Comparison of point prediction, LUBE and Bootstrap results for temperature of a) Tabriz, 2005b) Tabriz, 2025c) Tabriz, 2050 d) Ardab 2025f) Ardabil, 2050.

Conclusions:

·同时使用多个GCMs数据作为输入的结果会比单个GCM作为输入的效果更好；
·而如果在三个GCMs中比较，由CAN-ESM2得到的结果最好；
·与Bootstrap方法相比，LUBE方法可以更好的构建PIs；
·两个台站之间比较，Tabriz（大不里士）要比Ardabil更好。

2020/04/07

Report

2020.4.21

張慕琪

Methods

实验设计：

已完成图片记录： time series (Beijing, China); Maps_differences; taylor diagram (Beijing), histogram(Beijing)

待完成绘图：

1. taylor diagram (China)；
2. histogram(China);
3. future time series(Beijing, *China*);
4. future maps(*2090-2100, 2090s-1990s*).

时间： Train & validation (=historical), test (future projection)

数据： CCSM, GMFD, ANN(before BC) , ANN(after BC), Linear

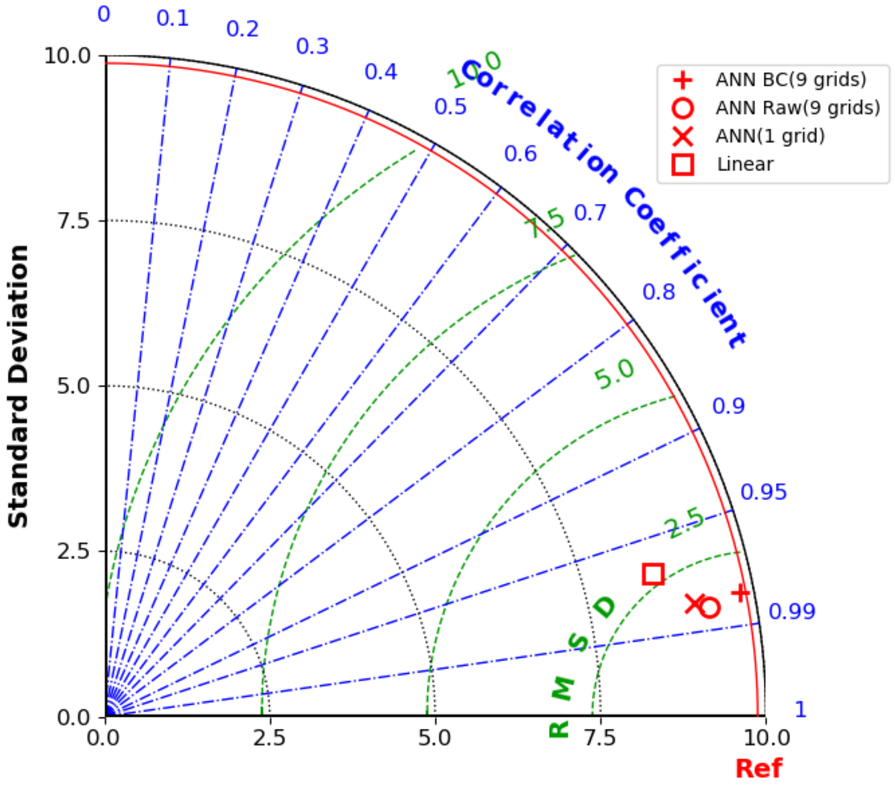
变量：

·Temperature

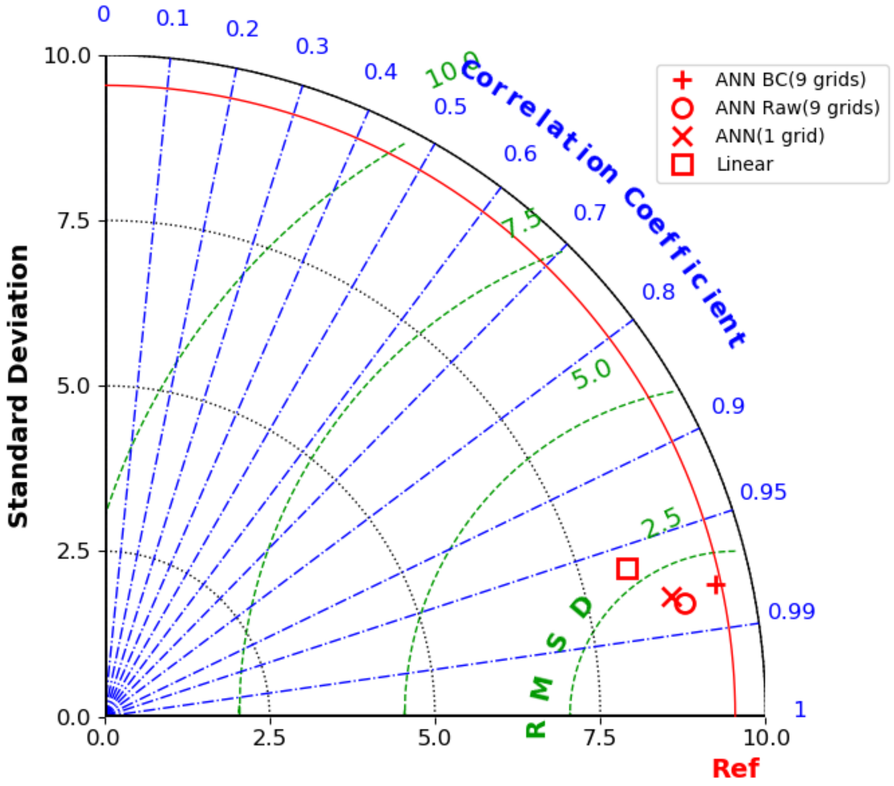
Results

Taylor Diagram China Historical

Tmin

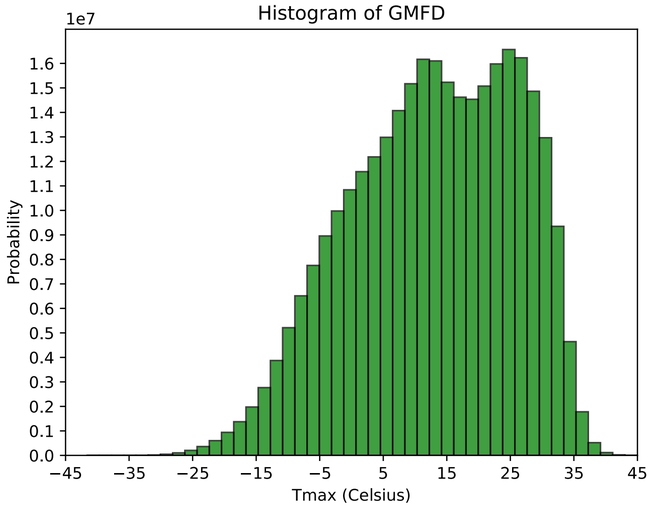


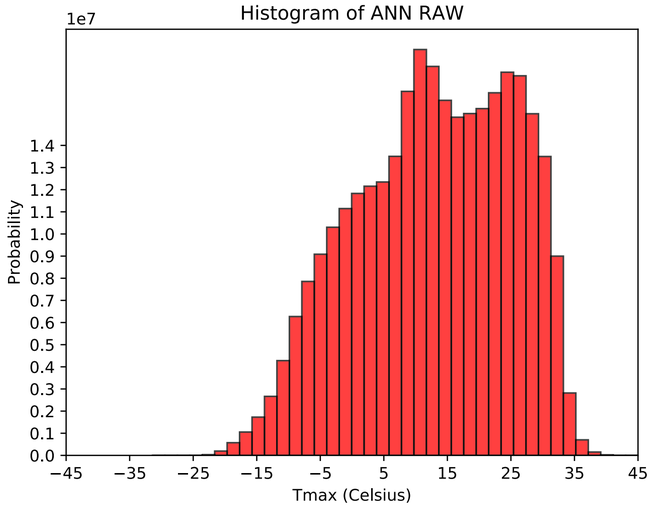
Tmax

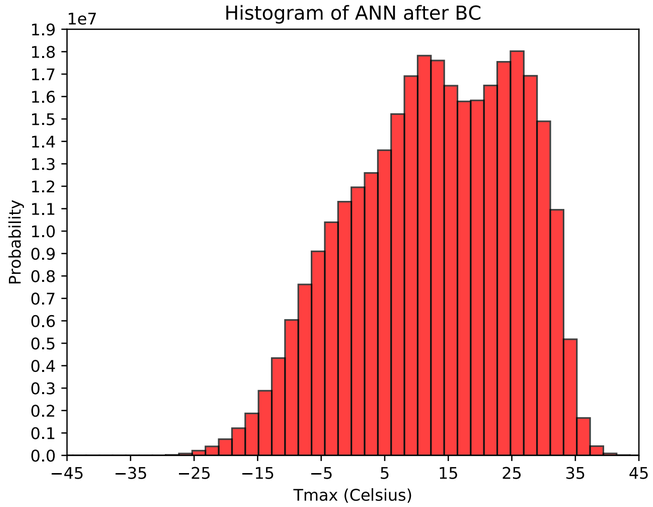


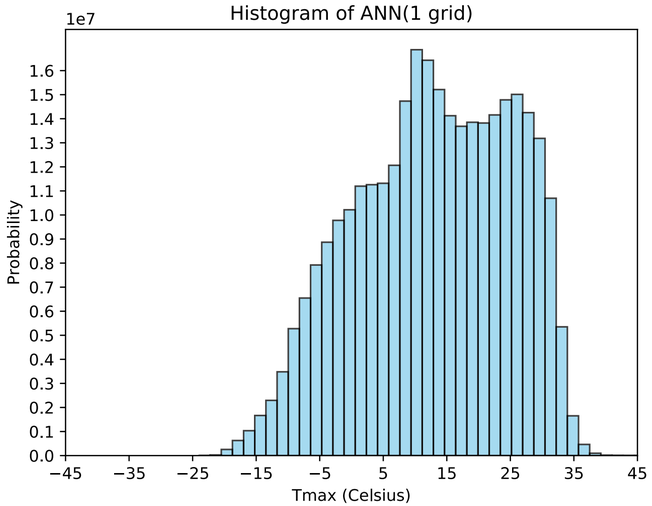
Results

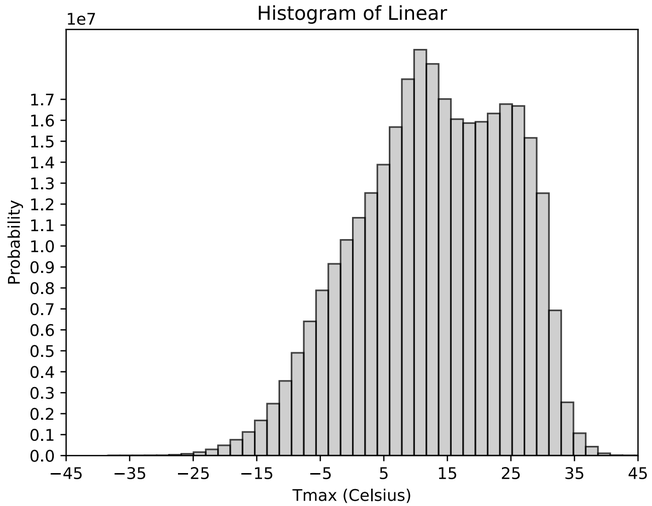
Histogram China Historical Tmax





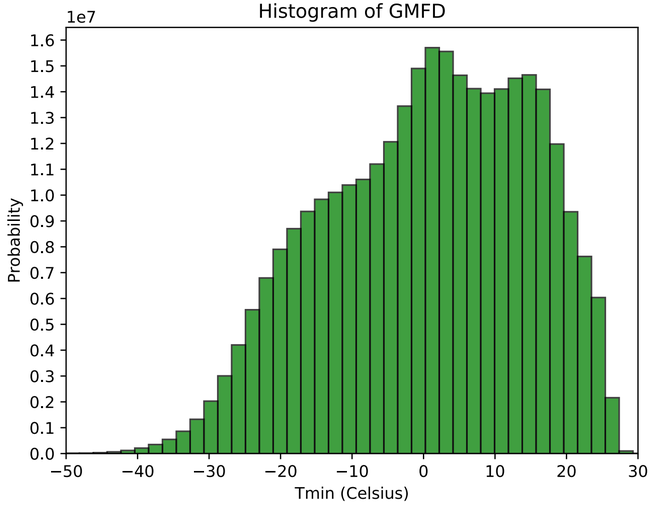


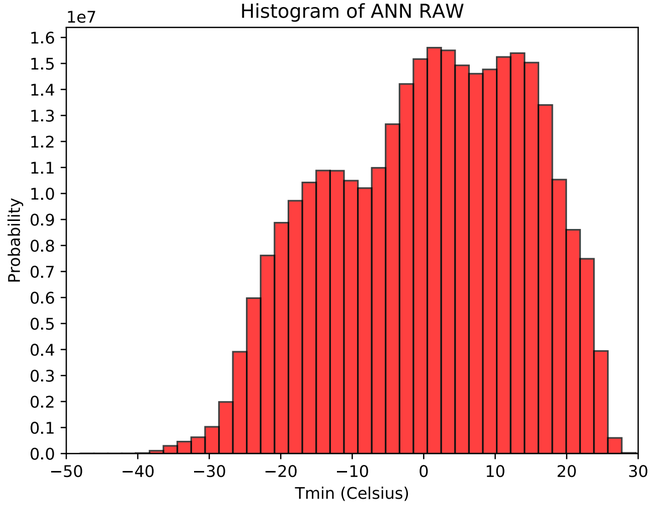


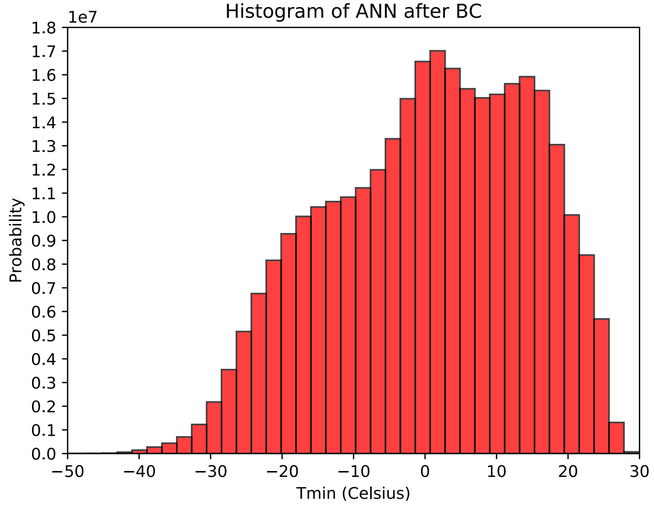


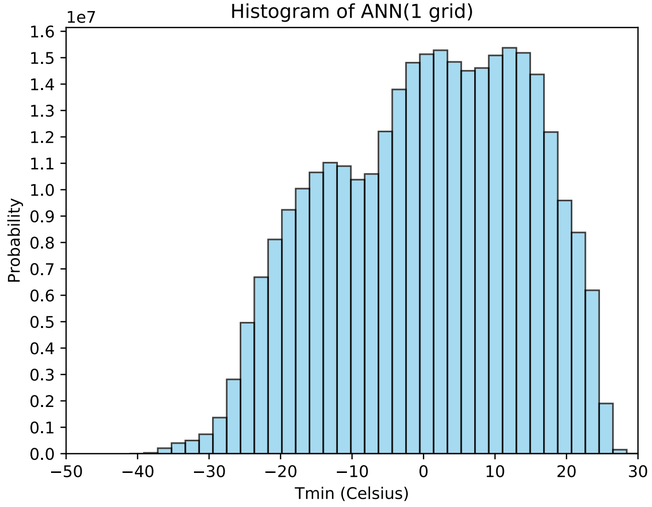
Results

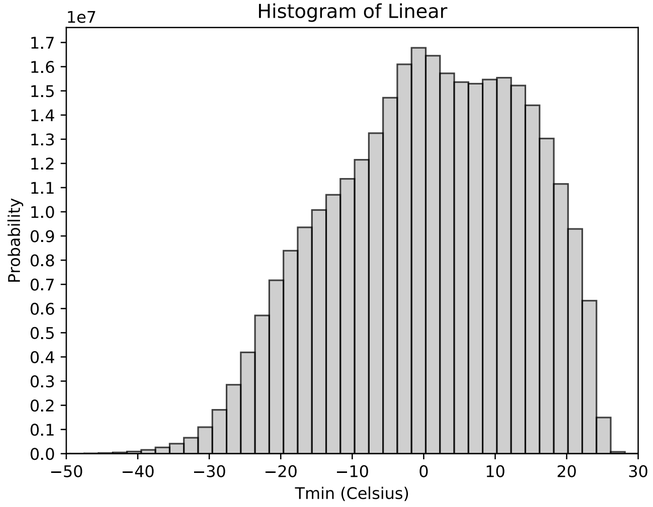
Histogram China Historical Tmin







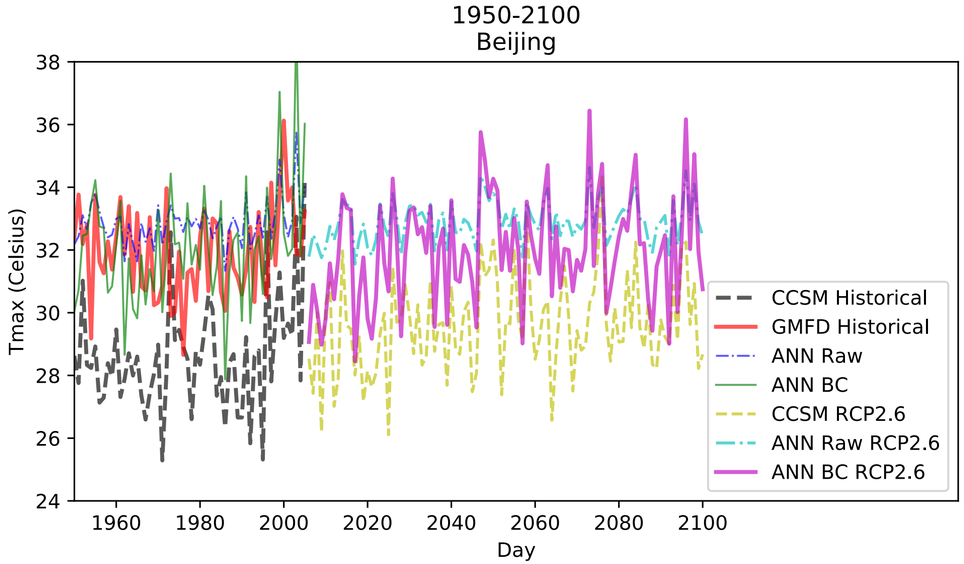


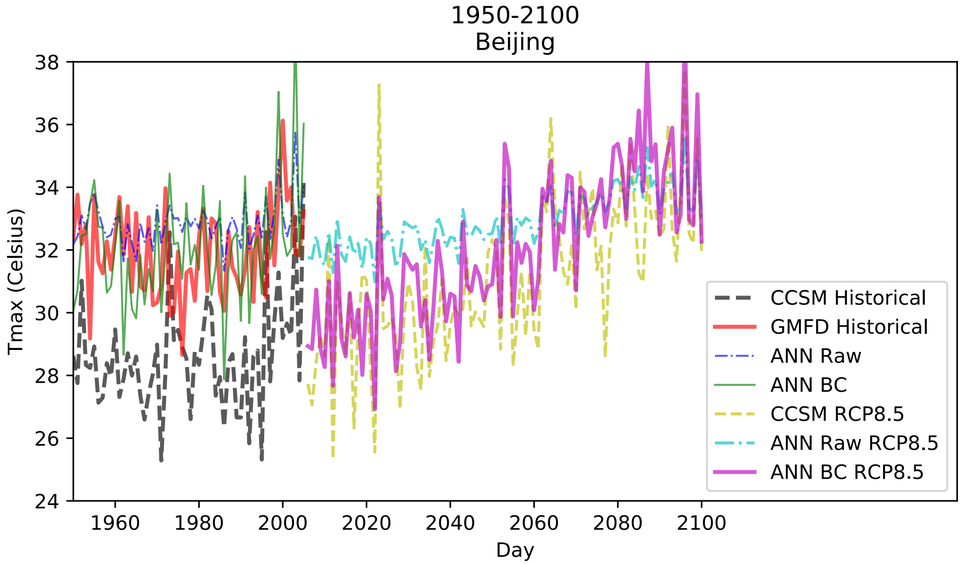


Results

Time series Beijing Future

Tmax

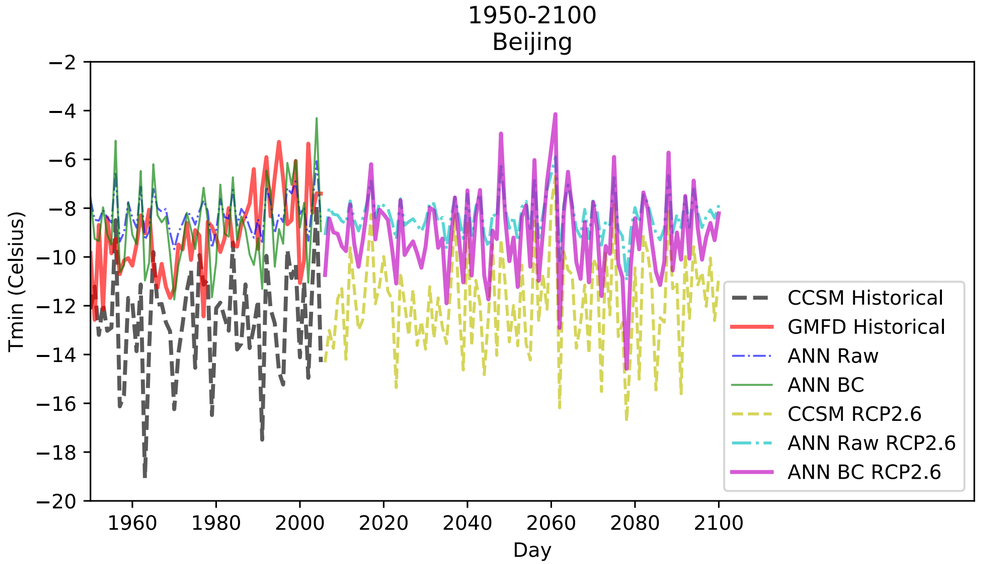


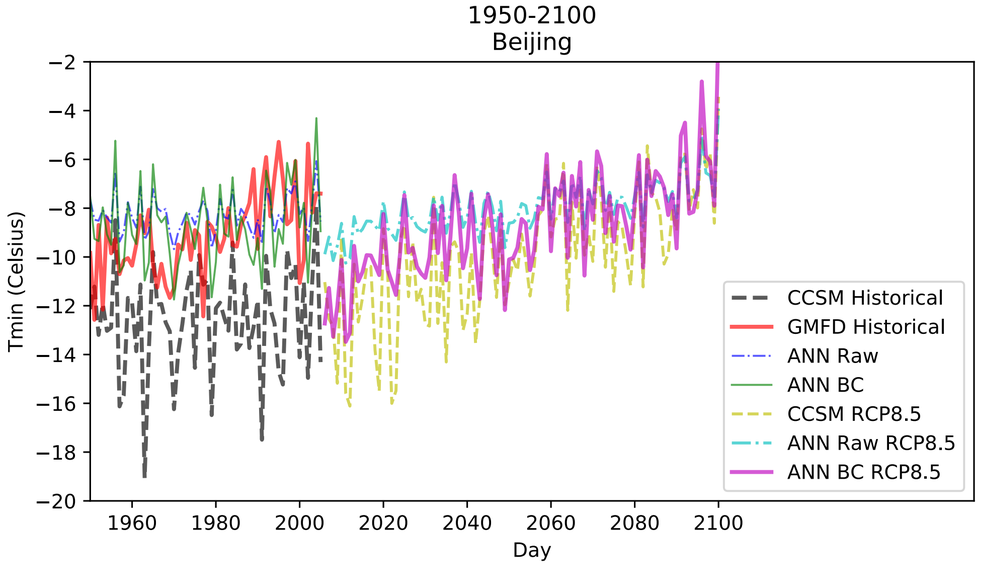


Results

Time series Beijing Future

Tmin

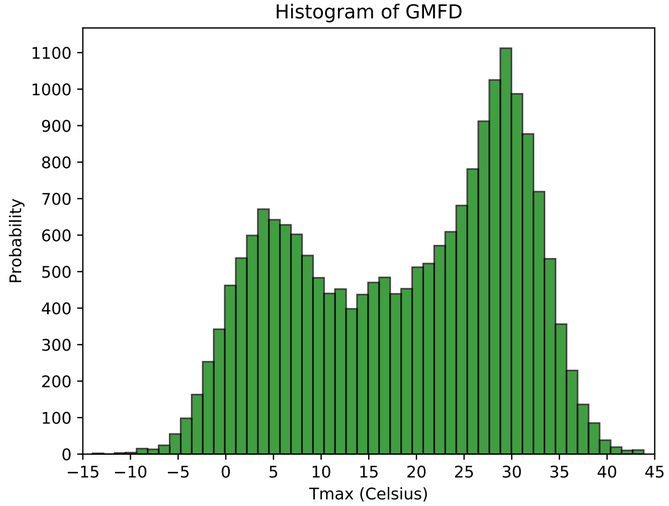


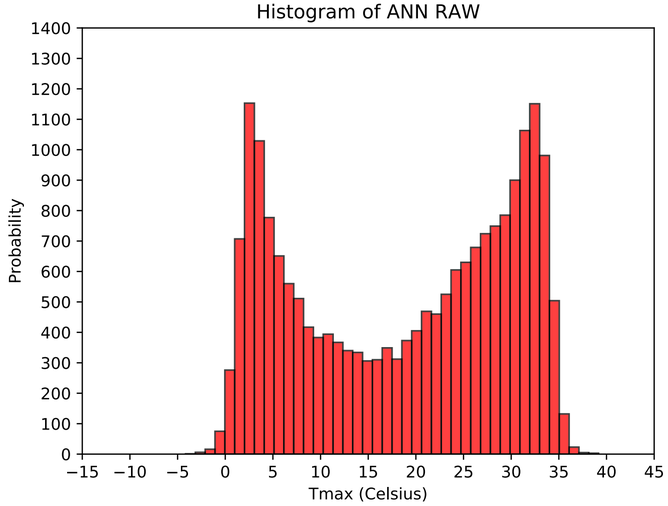


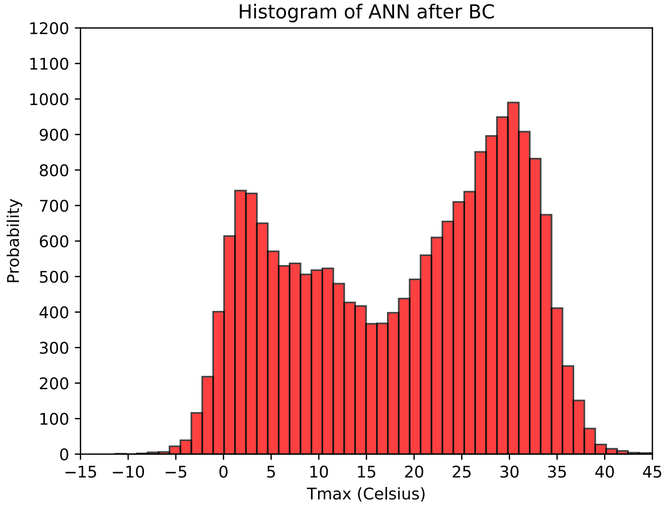
谢谢

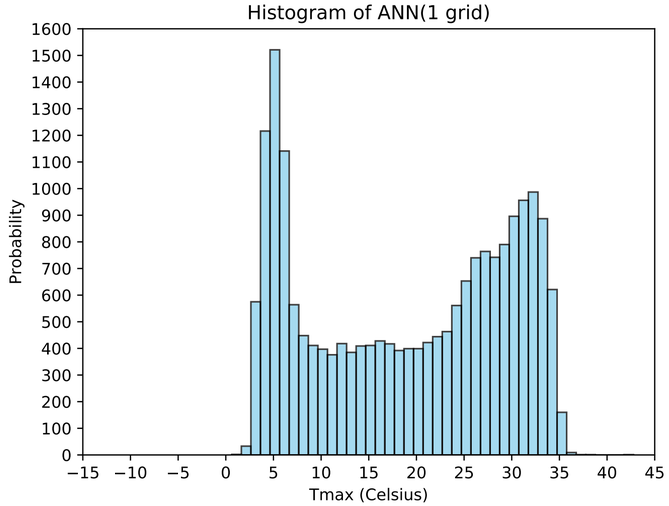
附录

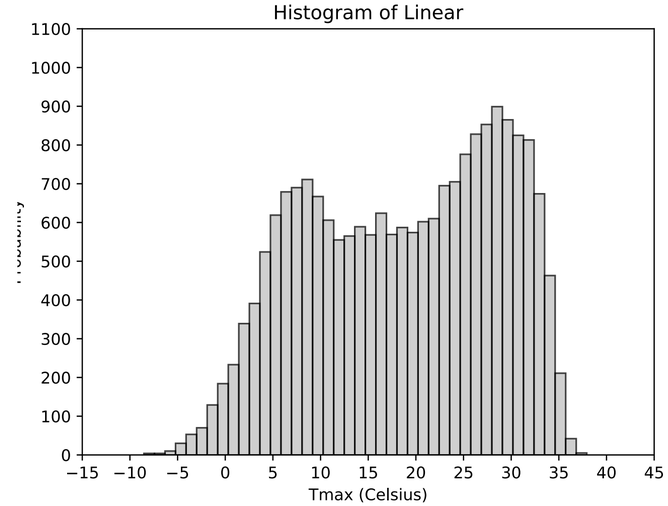
Histogram Beijing Historical Tmax







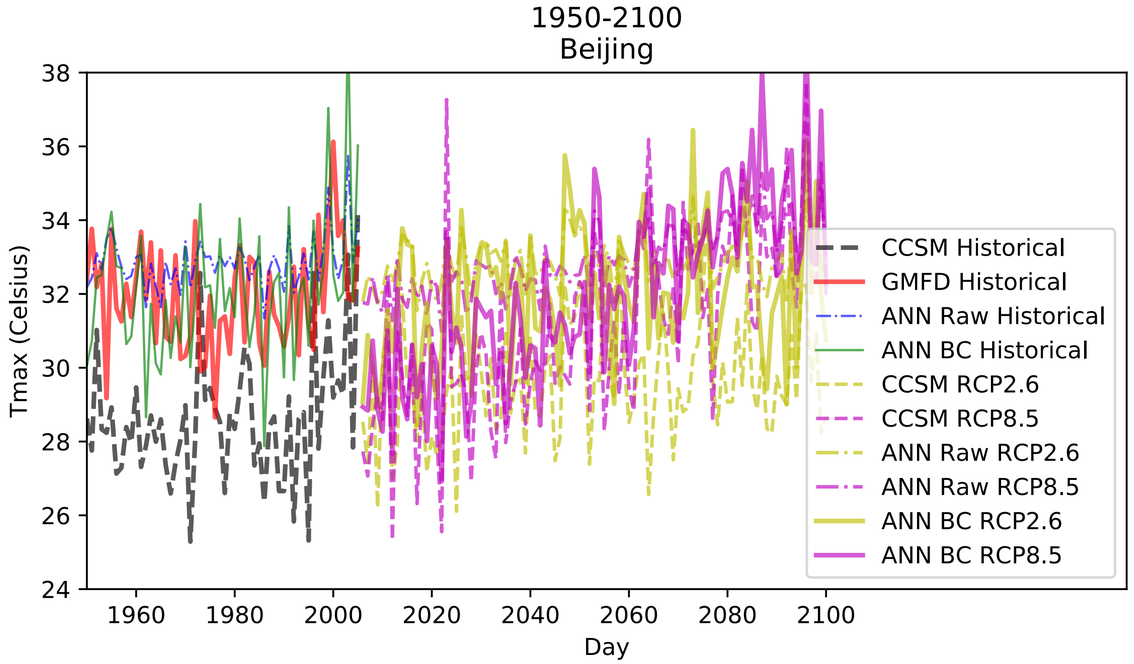




Results

Time series Beijing Future

Tmax



Results

Time series Beijing Future

Tmin