2019年10月10日

A hierarchical analysis of the impact of methodological decisions on statistical downscaling of daily precipitation and air temperatures

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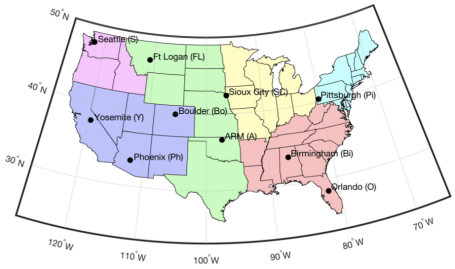
Methods:

研究变量：Tmin, Tmax, PoP(Probability of precipitaion), Amount of precipitation on a wet day.
涉及模型：Generalized linear models[GLMs] and Artificial neural networks[ANNs].
研究区域：涵盖美国不同气候区域的10个地区.
数据来源：预测值(Tmin, Tmax, precipitation occurrence and amount on a wet day)来自Livneh data set(Livneh et al., 2013).



Model 1: 使用GLM和三个输入（Z500 T700 Q700）；
Model 2: 使用ANN和三个输入；
Model 3: 使用GLM和七个输入；
Model 4: 使用ANN和七个输入；
Model 5 and 6: GLM和ANN使用PC scores。

Results:

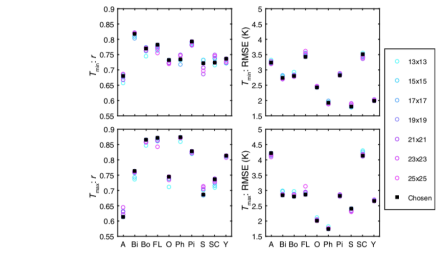


FIGURE 2 Pearson correlation coefficient (r) and RMSE between independent observed daily T_{max} and T_{min} anomalies and downscaled predictions for each of the 10 locations. The ESD transfer functions are built using ANN (using three hidden layers) where the predictors are PC scores from different domain sizes (where the number of grid cells used in the spatial domain presented to the PCA is shown in the legend). Results from a domain of 19 × 19 grid cells that is used within this manuscript are highlighted by the black squares. The locations are referred to using the abbreviations introduced in Figure 1 [Colour figure can be viewed at wileyonlinelibrary.com]

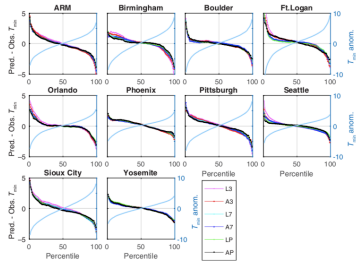


FIGURE 3 Difference in the 1st to 99th percentile of daily anomalies of minimum temperature (T_{min}) from climatology in observations from the independent data set (even years) and six different transfer functions. The solid light-blue lines denote the 1st to 99th percentile observed daily T_{min} anomalies (the scale is shown on the right-hand axes). The abbreviations used to identify the transfer functions are as follows: L3 denotes a transfer function built using multiple linear regression with three grid cell predictors (Z500, T700 and Q700). A3 indicates transfer functions built using ANNs with three grid cell predictors (Z500, T700 and Q700). L7 is for a transfer function built using the seven grid cell predictors (Z500, T500, Q500, T700, Q700, U700 and V700) but allowing for first-order interactions of the predictors and stepwise procedure for selecting the predictors (based on BIC) and the regularized multiple linear regression. A7 is for a transfer function built using ANNs with seven grid cell predictors (Z500, T500, Q500, T700, Q700, U700 and V700). LP is for a transfer function built using the PC scores, allowing for first-order interactions of the predictors and stepwise procedure for selecting the predictors (based on BIC) and the regularized multiple linear regression. AP is for a transfer function built using ANNs and PC scores [Colour figure can be viewed at wileyonlinelibrary.com]

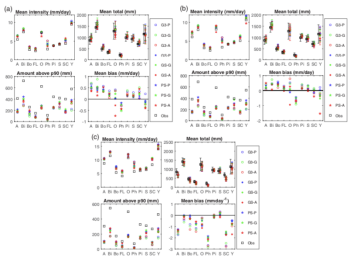


FIGURE 11 Results for the 10 stations of four aspects of the precipitation climate; mean intensity on a wet day, MI8 on a wet day, mean annual total (and interannual variability) and the amount (in mm) of precipitation above the 95th percentile value. Note in the panel showing annual total precipitation and interannual variability therein, the observed values are slightly displaced on the horizontal axis to aid legibility. Frame (a) shows results for a precipitation threshold of 0 mm/day, (b) for 0.1 mm/day and (c) for 1 mm/day for a wet day. Nine transfer functions (ESD models) are shown the first two letters denote the predictors; G3 = 3 predictors are used (grid cell values of Z500, T700 and Q700), G5 = 7 grid cell predictors, and PS denotes models built using the PC scores as predictors. The final letter denotes the transfer function form; P is Poisson for the link function in the logistic regression, G is for gamma for the link function in the logistic regression, and A is ANN [Colour figure can be viewed at wileyonlinelibrary.com]

Input网格并非越多越好

Phoenix和Yosemite的偏差在±2C内；
ARM的偏差在±5C内；
无论是Tmin还是Tmax变量，GLM有更多的输入（L7和LP）会比仅有三个输入（L3）时表现更佳；
使用ANN比GLM的偏差更小。

Poisson分布比Gamma分布较好一些，但两者都没有ANN表现好

Conclusions:

1. 无论哪种回归模型对于PoP的预测总是不尽人意；
2. 本文使用的数据划分是奇偶年特征，有人曾提出如果使用干旱年进行训练，非干旱年进行测试的新方法，但这种方法更多的是侧重于捕捉气候的内部变化而非辐射平衡导致的气候变化；
3. 非线性模型（ANN）要比GLM更具有技巧性，表现更好。