1.downscaling

"Technical Note: Bias correcting climate model simulate daily temperature extremes with quantile mapping. "B. Thrasher, E.P.Maurer, C.McKellar, and P.B.Duffy.

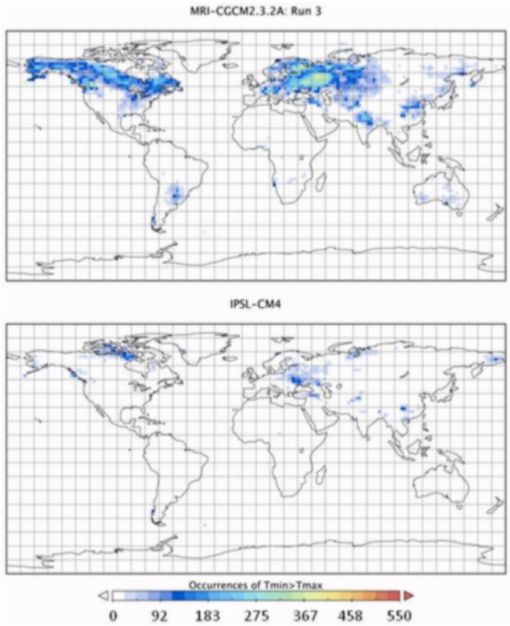


Fig. 1. For Case 1, the total number of occurrences for the validation period of 1981–1999 where $T_{min} > T_{max}$ after BC. Results for two GCM simulations are shown: a high number of occurrences (upper panel) and a low number of occurrences (lower panel).

Appendix A: Detailed description of the quantile mapping procedure

Let s be a location associated with some analysis grid point and x be a location associated with some forecast grid point in the vicinity of s. The basic idea of quantile mapping is to determine, for each forecast f_x, to which quantile $q_{f,x}(p), p \in [0,1]$ of the forecast climatology it corresponds, and then map it to the corresponding quantile $q_{o,s}(p)$ of the observation climatology. The quantile functions $q_{f,x}$ and $q_{o,s}$ are estimated from the training sample; specifically, we calculate the sample quantiles $\hat{q}_{f,x}(k/100)$ and $\hat{q}_{o,s}(k/100)$ for $k \in \{1,2,\ldots,99\}$, and interpolate linearly between these discrete values.

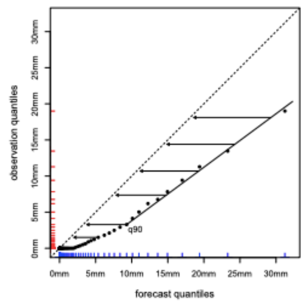
Since the variance of the sample quantiles strongly increases with increasing p, we only perform this direct mapping of (interpolated) sample quantiles for forecasts $f_x \le \hat{q}_{f,x}(k_l/100), k_l = 90$. For $f_x > \hat{q}_{f,x}(k_l/100)$ we use a linear approximation of the quantile mapping function and define the adjusted forecast $\tilde{f}_x$ through

$$\tilde{f}_x := \max\left\{\hat{q}_{o,s}(k_l/100) + \xi \cdot \left(f_x - \hat{q}_{f,x}(k_l/100)\right), 0\right\} \tag{1}$$

This corresponds to a linear mapping function defined through the point $\left(\hat{q}_{f,x}(k_l/100), \hat{q}_{o,s}(k_l/100)\right)$ and the slope parameter ξ which is estimated via

$$\xi = \frac{\sum_{i=k_l+1}^{99}\left(\hat{q}_{o,s}(i/100) - \hat{q}_{o,s}(k_l/100)\right)\left(\hat{q}_{f,x}(i/100) - \hat{q}_{f,x}(k_l/100)\right)}{\sum_{i=k_l+1}^{99}\left(\hat{q}_{f,x}(i/100) - \hat{q}_{f,x}(k_l/100)\right)^2} \tag{2}$$

Moreover, it permits extrapolation for $f_x > \hat{q}_{f,x}(99/100)$. The following plot illustrates the mapping function for the quantiles corresponding to the right panel of Fig. 2 from the paper:



In this mapping procedure, we make sure that zero forecasts are always mapped to zero, and that none of the forecasts are mapped to a value larger than the largest observation at s.

At very dry locations, it can happen that either $q_{f,x}(90/100), q_{o,s}(90/100)$, or both are equal to zero. In this case we increase the k_l in eqns. (1) and (2) until both $q_{f,x}(k_l/100)$ and $q_{o,s}(k_l/100)$ are positive, and proceed as before. If either $q_{f,x}(99/100)$ or $q_{o,s}(99/100)$ are equal to zero, we set $\xi = 1$. Eqn. (1) then reduces to a purely additive adjustment:

$$\tilde{f}_x := \max\left\{f_x + \hat{q}_{o,s}(99/100) - \hat{q}_{f,x}(99/100), 0\right\} \tag{3}$$

Abstract and Introduction:

当基于Quantile mapping的偏差校正应用于全球气候模型（GCM）模拟日常温度极值时，最大和最小的温度变化值会发生变化，而DTR可能会变的不符合实际物理意义。可能是融雪和偏差校正期间反照率反馈中的GCM偏差之间存在着较强的关系，导致DTR十分不准确。本文提出了一种偏差校正DTR的技术，基于比较观察数据和GCM历史模拟，并将其与偏差校正的每日最高温、最低温相结合。通过在1961-1980年的数据对1981-1999年进行验证，证明偏差校正DTR和日最高温可产生更准确的日常温度极限估计，同时避免不切实际的DTR值出现。

虽然气候的季节、年度变化会对生态系统和人类发展有所影响，所以人们对此的兴趣日益增加。短期极端事件可能会导致数小时或数天内造成数十亿美元的损失，所以对于它们的大小和频率变化的预测将导致未来几十年内损害的风险。

为了评估每日极端降雨和温度的区域变化，GCM必须缩小到更适合的区域范围。在此，只讨论偏差校正形式——Quantile Mapping，与所有统计降尺度方法一样，它假设在预测期间相对于历史观测的偏差是恒定的。虽然这种方法已经广泛用于降低月平均降水量和温度，但是对于日变化数据的适用性较少。

在本研究中，用不同的替代方法与（1）最小化偏差校正的Tmax和Tmin值的误差进行比较，同时（2）降低在BC过程中Tmax和Tmin相反情况的频率。

Conclusion：

使用QM方法对GCM进行偏差校正可以较为有效的改变DTR异常，其中使用偏差校正Tmax和DTR并导出Tmin的方法最为有效。

2.续：

GCM：General Circulation Model. 大气环流模式，描述行星大气或海洋的数学模型，基于Navier-Stokes 方程，包括了热力学项以模拟地球大气或海洋的复杂计算机程序基础。

CMIP：Coupled Model Intercomparison Project. 耦合模型对比项目。由世界气候研究计划（WCRP）的耦合建模工作组（WGCM）于1995年组织，分阶段开发，旨在促进气候模式的改进。