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Evaluations of bias-correction methods for monthly temperature and precipitation data by multiple GCM outputs

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In order to use the data outputted by a General Circulation Model (GCM) in climate impact studies, it is vital that a bias-correction method be applied to it. In hydrological impact studies, the correction of precipitation and temperature generates satisfactory results. Many correction methods have been proposed. Several studies have investigated their correction ability in detail; however, it has been noted that a number of these studies have used the aforementioned methods without adequate validation. Moreover, these methods have not been compared adequately. The objective of this study is to compare the results of the bias-correction methods. Because of their high cost of calculation, we applied these methods to monthly averaged temperature and total monthly precipitation data obtained from GCMs that are available from the Phase 3 of the Coupled Model Intercomparison project (CMIP3) although many previous studies focused on and proposed daily scale methods. This study focuses on the statistical characteristics of bias-corrected data. Therefore, the methods proposed using previous methods were organized from this viewpoint. Two analyses were conducted in this study. The first is reproductive experiment, which has the calculation span including the period in which observation data exist. In this experiment, the data from 1948 to 1968 were used as baseline period data, and that from 1978 to 1998 were corrected using these methods. The corrected data are compared with the observed data. For evaluation, we split the world into six climate zones. These methods are evaluated by comparing the reproducibility of statistical characteristics such as the mean and standard deviation of bias-corrected data in each climate zone. The second is a future projection experiment. In this experiment, the bias-corrected data of the future period have been generated, and the future data corrected using different methods were compared. The results revealed the characteristics of individual methods. Although the mean of the series calculated using each bias-correction method does not differ greatly, the standard deviation and extreme values exhibit a significant difference. The difference between the results of the bias-correction of GCM models is minor to be the mean of the bias-corrected data but not minor to be the standard deviation or extreme values. Furthermore, in the future projection experiment, the distribution of the bias-corrected CMIP3 GCM data indicates significant differences in their values of standard deviation and extremes. From this analysis, the existence of a non-negligible difference between the results obtained from each method is apparent. Therefore, researchers should notice when a bias-correction method is applied to remove model bias in CMIP3 GCMs, else it will generate considerable bias in the analyses.