Geophysical Research Abstracts
Vol. 17, EGU2015-14809-2, 2015
EGU General Assembly 2015

Can quantile mapping improve precipitation extremes from regional climate models?

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The ability of quantile mapping to accurately bias correct regard to precipitation extremes is investigated in this study. We developed new methods by extending standard quantile mapping (QMα) to improve the quality of bias corrected extreme precipitation events as simulated by regional climate model (RCM) output. The new QM version (QMβ) was developed by combining parametric and nonparametric bias correction methods. The new nonparametric method is tested with and without a controlling shape parameter (Qmβ1 and Qmβ0, respectively). Bias corrections are applied on hindcast simulations for a small ensemble of RCMs at six different locations over Europe. We examined the quality of the extremes through split sample and cross validation approaches of these three bias correction methods. This split-sample approach mimics the application to future climate scenarios. A cross validation framework with particular focus on new extremes was developed. Error characteristics, q-q plots and Mean Absolute Error (MAEx) skill scores are used for evaluation. We demonstrate the unstable behaviour of correction function at higher quantiles with QMα, whereas the correction functions with for QMβ0 and QMβ1 are smoother, with QMβ1 providing the most reasonable correction values. The result from q-q plots demonstrates that, all bias correction methods are capable of producing new extremes but QMβ1 reproduces new extremes with low biases in all seasons compared to QMα, QMβ0. Our results clearly demonstrate the inherent limitations of empirical bias correction methods employed for extremes, particularly new extremes, and our findings reveals that the new bias correction method (Qmß1) produces more reliable climate scenarios for new extremes. These findings present a methodology that can better capture future extreme precipitation events, which is necessary to improve regional climate change impact studies.