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Future regional changes of extreme precipitation : What can we learn from inter-model cross-validation?

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Regional information on future climate is usually obtained from regional circulation models (RCMs), driven on their boundaries by global climate models. Despite much improvement, RCMs still have deficiencies, as measured by their ability to reproduce the present climate. This is so for the average climate and for the extremes. Furthermore, even when the present climate is reproduced, this does not guarantee a correct representation of future climate.

To overcome these shortcomings, adjustment procedures are applied. These exist in two versions: either one determines the difference between the modelled present-day climate and the observations and assume that this difference is unchanged in the future climate; a procedure known as bias correction. Alternatively, in the delta-change procedure, one assumes that the modelled climate change signal is correct and therefore is added to the observations to obtain the future climate. Each of the above procedures can be applied as above with simple addition of a signal, or in more complex versions, in which quantiles are matched. For extreme value statistics, the quantiles are approximated by extreme value distributions using either the annual maximum or the peak-over-threshold method.

A cross-validation technique to compare the performance of the different adjustment procedures was applied in (Räisänen and Räty 2013) and (Räty et al. 2014). The idea was to use an ensemble of different models and let each model in turn play the role of observations, against which the remaining adjusted models are evaluated.

In the present work, the cross-validation procedure is applied to return levels of rare events of strong precipitation intensity. We use hourly rainfall model data from the CORDEX database; these data are available for ten different GCM/RCM combinations, giving 10x9=90 model-'observation' combinations available for the cross-validation exercise. The validation exercise is carried out for 1 h and 24 h rainfall durations and both for the annual maximum and peak-over-threshold methods. We present performance statistics for the different approaches and assess and discuss whether a best method can be appointed.