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COMPARISON OF STATISTICAL DOWNSCALING PROCEDURES FOR ASSESSING CLIMATE CHANGE IMPACTS ON WATER RESOURCES AT CATCHMENT SCALE

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Summary. It is well known that climate projections from global circulation models (GCM) are biased and cannot adequately reproduce the variability in climate variables that are present at the local scale. Thus, there is a need for downscaling climate projections from GCMs in order to make reliable impact assessments at the local scale. Regional climate models (RCM) that are set up for a particular region and nested within a GCM are able to resolve the atmospheric processes on a finer scale and better account for complex topographical features and land cover heterogeneities. However, RCM inherits the biases and other deficiencies of the GCM, and hence further downscaling is often needed for RCM projections.

Statistical downscaling has been introduced to relate the climate projections at larger scale (from GCMs or RCMs) to climate variables at the local scale. In this paper downscaling of RCM projections is considered for water resources impact assessment at catchment scale. Different downscaling procedures based on a general change factor methodology are applied and compared. The basic concept in change factor methods is that climate model simulations are used to extract changes in different statistical characteristics of climate variables from the present to the future climate (denoted change factors). These changes are then superimposed on the statistical characteristics of the climate variable representing the local scale, which are subsequently used for the impact assessment.

The paper considers climate change impacts on the water resources in the North-Eastern part of Sealand, Denmark. Climate simulations from the HIRHAM RCM for the period 1950-2100 based on the IPCC SRES scenario A1B are used in the analysis. Three different downscaling procedures are applied to downscale precipitation, temperature and potential evapotranspiration. These include: (i) mean correction (often referred to as the delta change method), (ii) mean and variance correction, and (iii) a stochastic weather generator based on the Neyman-Scott rectangular pulse model. The downscaled climate data are used as forcing to a MIKE SHE integrated hydrological model of the region for analysing the impacts of climate change in relation to (i) regional and sub-catchment water balance components, (ii) droughts and low flow conditions, and (iii) high flows and flooding.