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Stationarity of regression relationships: Application to empirical downscaling

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The performance of a statistical downscaling model is usually evaluated in terms of its ability to explain a large fraction of predictand variance. In this note it is shown that although this fraction may be high, the longest time scales, including trends, may not be explained by the model which implies that the model is non-stationary over the training period of the model and this questions the basic *stationarity assumption* of statistical downscaling. This is exemplified by using a simple regression-model for downscaling European precipitation and surface temperature where appropriate Monte Carlo based field significance tests are developed taking account for inter-correlation between predictand series. Based on this test it is concluded that care is needed in selecting predictors in order to avoid this form of non-stationarity. Even though this is illustrated for a simple regression-type statistical downscaling model, the main conclusions may be valid for more complicated models also.