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Influence of bias-corrected reanalysis-derived lateral boundary conditions on dynamical downscaling

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Global reanalysis datasets, when downscaled to finer resolutions using a dynamically consistent downscaling approach, can be used as the basis of many hydroclimatological forecasting and climate change impact assessment studies. Despite this, systematic biases have been noted to be present in the global reanalysis datasets, biases which can be carried into the downscaled simulations thereby reducing their accuracy or efficacy. In this work, two Weather Research and Forecasting (WRF) model downscaling experiments are undertaken to investigate the impact of bias correcting European Centre for Medium-Range Forecasts Reanalysis Interim (ERA-I) atmospheric temperature and relative humidity using Atmospheric Infrared Sounder (AIRS) satellite data. The downscaling is performed over a domain centered over southern Africa between the years 2003 and 2012. One correction uses the mean for each variable and grid cell location, and the other uses both mean and standard deviation in a similar setting. The resultant WRF simulations of near-surface temperature and precipitation are evaluated seasonally and annually against global gridded observational datasets and compared with raw ERA-I reanalysis forced WRF simulations. The study reveals inconsistencies between the impact of the bias correction prior to downscaling and the resultant model simulations after downscaling. This raises questions about the efficacy of alternatives to correct for biases in the lateral boundaries of downscaling applications. Advanced and/or alternative statistical bias correction procedures prior to downscaling including bias correction of wind fields, along with altered relaxation zone formulations and parameterizations of the modelled physics should be considered for future improvements over this domain.