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Weighting CMIP3 & CMIP5 models with respect to Mediterranean precipitation in a statistical downscaling framework

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We investigate the projected precipitation changes of the 21st century in the Mediterranean area with a model ensemble of all available CMIP3 and CMIP5 data based on the four future scenarios A1B, A2, RCP4.5 and RCP8.5. The Mediterranean region represents a so-called hot spot of climate change. Season-based analyses are carried out for eight Mediterranean sub-regions which are derived from principal component analyses. The large model spread of simulated precipitation change signals in the eight sub-regions underlines the need of an evaluation of the individual general circulation models in order to give higher weights to better and lower weights to worse performing models. The model differences mainly result from unknown initial conditions, different resolutions and driving mechanisms, different model parametrizations and model biases. In our study each model weight is based on the particular skill of that model to simulate key atmospheric predictor variables related to large and medium scale atmospheric circulation patterns within a statistical downscaling framework for regional Mediterranean precipitation. Therefore, geopotential heights, sea level pressure, atmospheric layer thickness, horizontal wind components and humidity data at several atmospheric levels are considered. The novelty of this metric consists in avoiding the use of the GCM precipitation data by itself for the weighting process, as state-of-the-art models still have major deficits in simulating precipitation. The application of the weights on the statistically downscaled precipitation changes leads to more reliable and precise change signals in some Mediterranean sub-regions and seasons. The model weights generally differ between sub-regions and seasons, however, a clear sequence from better to worse models for the representation of regional precipitation in the Mediterranean area becomes apparent.