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Building High Resolution Climate Change Ensembles for Forecasting Future Rainfall in the Middle East

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A divergence metric is used to combine four high resolution climate models and generate more reliable future rainfall simulations. The approach is based on the assumption that the use of multiple models (ensemble) is superior to the use of one model, even if one model is shown to better capture past trends. Such an approach is specifically useful in areas with steep climatic gradients where the large scale climate models have difficulty capturing orographic and local effects. We apply the methodology to the region of Israel in the Middle East, where the climate shifts from arid, to semi-arid, to savannah to almost tropical over a distance of just over 400 kilometers. The weights of the models are determined by calculating the similarity between the probability distribution of given parameters from the models with the probability distribution from historical data using the Jenson-Shannon divergence metric. These weights are then applied to the model results for two future climatic periods to generate ensemble future simulations. Average annual rainfall amounts, number of wet days and number of 3-day wet spells per season are analyzed. Upon comparison, the skill of the weighted ensemble outperforms the ensemble of equal weights which outperforms the best model. Average annual amounts are shown to decrease in both the near and far future period, with most of the change occurring in the peak and left hand tail, and less change in the right hand tail of the probability distribution. This suggests that while drought will be more common as overall rainfall is expected to diminish, the frequency of extreme rainfall events will remain constant, and in certain places increase. While these results focus on specific stations and parameters, results for additional stations and simulations from additional climate models (when available) can be included with little difficulty.