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When will climate scenario runs show a statistically significant change in drought indices?

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Climate models can be used to evaluate the consequences of various emission scenarios. A common application is to look at scenario runs and find out what will happen to e.g. temperature or precipitation in the future. Typically, the result is that some model observable will increase or decrease in the mean as time passes in the model. Given the model level of variability it is possible to ask when a particular quantity rises (or falls) so much that the change, relative to some base period, can be said to be statistically significant. We investigate when the mean of two drought indices - the Standardized Precipitation Index (SPI) and the self-calibrated Palmer Drought Severity Index (scPDSI) - change by a statistically significant amount over regions of Europe in the A1B scenario runs from the ENSEMBLES project. Assessment of the statistical significance hinges on a thorough understanding of the number of degrees of freedom - N - in the model fields - in time and space. We use a simple approach and set upper and lower limits on N, and calculate the probabilities corresponding to model field mean changes. The results are that a statistically significant change in the mean scPDSI index occurs in some of the European regions in the models - with good uniformity across the range of models. For the SPI a similar result is found, but less distinctly, with the most similar results in the NW and SW tending to occur a little later than for the scPDSI. Typically the clearest change-signals are seen in the North-West and South-West of Europe. The scPDSI depends on temperature as well as precipitation so the clarity of the signal in the scPDSI may be due to the more robustly modelled future temperature changes. A similar analysis of the changes of drought-index variance has not yielded any clear results. We use these findings to discuss the extent to which scenario runs may be used in predictions of real-world drought-condition changes across Europe.