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- Title and Author Search

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[Volumes and Issues](#) [Contents of Issue 2](#)

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## Historical droughts in Mediterranean regions during the last 500 years: a data/model approach

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**Abstract.** We present here a new method for comparing the output of General Circulation Models (GCMs) with proxy-based reconstructions, using time series of reconstructed and simulated climate parameters. The method uses *k*-means clustering to allow comparison between different periods that have similar spatial patterns, and a fuzzy logic-based distance measure in order to take reconstruction errors into account. The method has been used to test two coupled ocean-atmosphere GCMs over the Mediterranean region for the last 500 years, using an index of drought stress, the Palmer Drought Severity Index. The results showed that, whilst no model exactly simulated the reconstructed changes, all simulations were an improvement over using the mean climate, and a good match was found after 1650 with a model run that took into account changes in volcanic forcing, solar irradiance, and greenhouse gases. A more detailed investigation of the output of this model showed the existence of a set of atmospheric circulation patterns linked to the patterns of drought stress: 1) a blocking pattern over northern Europe linked to dry conditions in the south prior to the Little Ice Age (LIA) and during the 20th century; 2) a NAO-positive like pattern with increased westerlies during the LIA; 3) a NAO-negative like period shown in the model prior to the LIA, but that occurs most frequently in the data during the LIA. The results of the comparison show the improvement in simulated climate as various forcings are included and help to understand the atmospheric changes that are linked to the observed reconstructed climate changes.

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