

Soil moisture anomaly trends in Europe evaluated with Mann-Kendall and EMD methods

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Some studies have analyzed soil moisture (SM) trends, but reconcile all results is not always possible as trends strongly depend on several factors such as the period analyzed, the temporal scale or the method used, especially when a monotonic behavior is assumed. Mann-Kendall (MK) has been established as the most widely use method for trend detection in hydro-climatic variables. This nonparametric test allows to identify if a given series has a statistically significant trend. However, this method is influenced by autocorrelation in the data, the length of the series and the magnitude of the trend, and only account for monotonic behavior. Conversely, the empirical mode decomposition (EMD) method decomposes the series into several functions that allows to account the nonmonotonic behavior of the series and can identify the residual or long-term trend. SM related hydro-climatic variables have shown statistically significant changes in last decades in Europe, thus similar changes would be expected in SM. However, in studies at global scale few trends have been observed in Europe when just monotonic behavior is assumed. The objective of this study is to identify monthly and annual SM anomaly trends in Europe for the 1991-2020 period using MK and EMD methods. Two SM products have been used such as the ERA5-Land reanalysis and the LISFLOOD model databases. In addition, the Köppen-Geiger classification was used to analyze the distribution of the trends among the different types of climates in the continent. The results show a general decreasing trend of SM in Europe regardless of the type of climate, temporal scale or method used. Nevertheless, the EMD has shown more significant trends in all cases. Few regions with an increasing trend of SM have been observed, mainly located in Northern Europe with the EMD, which suggest that nonmonotonic behavior would have more weight than the long-term change in these regions. Thus, the results show that MK although being the most widely used method, have lees power to identify SM trends in Europe, and that EMD can be a suitable tool to detect and analyze its general change direction.