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Surface soil moisture in sub-seasonal to seasonal (S2S) prediction driven by a hybrid model over drought-prone regions

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The prediction skill of the S2S period (usually referred to as two weeks but less than a season) always suffers from the integrated influence between weather and climate. Although S2S prediction has attracted more attention than before and multiple efforts have prompted related studies, the accuracy of surface soil moisture prediction in the dry condition is generally inferior to that of other variables in the S2S period. This study proposes a framework combing an ensemble empirical mode decomposition (EEMD) and Multilayer perceptron (MLP) to predict the surface soil moisture (0-7 cm) in two drought-prone regions. The proposed method has been verified and optimized in the Netherlands and Spain by using hindcasts driven by ERA5 reanalysis which can be regarded as a proxy for the real weather. The concrete practice consists of 1) calculating intrinsic mode functions (IMFs) collection and their residual components of selected ERA5-Land variables that are sensitive to surface soil moisture after data pre-processing, 2) similar IMFs curves classifications, 3) further feature selection according to classified sets, and 4) performing IMFs-driven MLP daily predictors and integrating the predicted IMFs and residual components to obtain the predicted surface soil moisture. The positive results show that this framework can be served as a regional S2S forecasting approach based on ERA5-Land reanalysis data, and with an expected daily ERA5-Land update of 5 days behind real time in 2022 instead of the current 3-month latency, the employed hybrid model is anticipated to explore realistic hydrological and agricultural applications.