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Towards a sub-seasonal agricultural drought forecast

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Insufficient precipitation and subsequent water stress for crop production are among the biggest risks in agriculture. Especially the past two years (2018, 2019) in central Europe show that dry and hot summers enhance the probability of harvest failures due to long term drought situations. Hence, a better prediction of long-term crop water stress situations could improve the resilience and adaptation of agriculture. One important indicator for agricultural drought is the plant available water in the top soil (0-60 cm). This soil moisture is a storage parameter which depends not only on the meteorological input but also on the vegetation cover and soil properties. In comparison to precipitation the soil moisture changes slowly with moderate variability, due to its buffer capacity for incoming rainfall. Here we try to take advantage of this persistence behaviour by performing long range soil moisture forecasts for Germany based on sub-seasonal forecasts. Therefore we combined the ECWMF extended range forecasts with a 1-D hydrological model AMBAV, which is capable of parameterizing regional soil properties and crop growth. Reasonable skill for predicting low soil moisture under winter wheat in early summer can be found with a 3-4 week forecast lead time. Therefore, a forecast of the hot and dry summer in 2018 was possible. The soil moisture forecasts had lower mean absolute error rates and higher rank correlation skill than regarding the precipitation directly as drought predictor, though the precipitation forecast is used as input for the subsequent hydrological modelling. However, further analyses are necessary in order to evaluate forecast skills for less extreme soil moisture situations. Nonetheless these results could be a first step towards an improved sub-seasonal agricultural drought forecast system for Germany and should be able to be adapted in other European countries.

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