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Potential impacts of anthropogenic forcing on the consecutive 2018-19 droughts in the central Europe

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The damages caused by climate extremes to socio-economy and environment is unprecedented during the recent decades, and it causes even more damage when the climate extremes occur in consecutive years. Since the starting of this Century, Europe has witnessed a series of extreme droughts (2003, 2010, 2015, 2018-19) with substantial socioeconomic and ecological losses. This study, with the help of long term data inventory starting from 1766-present, evaluates the occurrence of consecutive two-year droughts using Standardized Precipitation Index (SPI) and Standard Precipitation-Evaporation Index (SPEI) during the vegetation period. Although, the 2018 drought is reported in many of the recent studies, 2019 also suffered a huge rainfall deficit together with rising atmospheric temperature. This indicates an increasing evapotranspiration rates, which may intensify the existing drought conditions that originally developed from rainfall deficits. These effects are further noticed in terms of widespread reduction in the overall vegetative development during 2018-2019.

Considering this impact, we evaluate 2018-19 droughts in terms of both SPI and SPEI and compare its extent with the extreme hot drought of 2003 to place these ongoing droughts within a climatological context. The average severity of the combined two-year drought event (2018-19) is comparable to that of the 2003 drought. However, for the 2003 event, the drought recovered during the proceeding year, which was not the case for the year 2018-19, which is evident from decline in vegetation development dynamics. Furthermore, the analysis with consecutive droughts during 2018-19 in Central Europe shows that it is a very rare event with a return period of over 200 years; and therefore can be considered as one of the most severe droughts in Europe since 1766.

Using a suite of climate model simulations from CMIP-5 (N=12), we detected an important and potential role of human-induced climate change in increasing the risk of occurrence of the consecutive droughts over central Europe. Here, with the implementation of the fraction of attributable risk (FAR), we show the signifying role of human influence (or anthropogenic forcing) in modulating the consecutive year droughts. Furthermore, these events in the future projection of climate models suggest an increasing frequency in the latter part of 21st century.