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Crop phenology and drought stress in changing climate

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Projected changes for climate extremes in 21th century show that there will be a marked increase in extremes in Europe in heat waves, droughts, and heavy precipitation events. Changes in extreme precipitation depend on the region, with a high confidence of increased extreme precipitation in Northern Europe (all seasons) and Continental Europe (except summer).
Projected increases in extreme climatic events are expected to increase crop yield variability and to lead to yield reductions in the future throughout Europe. Increasing the accuracy of crop productivity estimates is a key element in planning adaptation strategies under climate change.
Process-based crop models are effective means to project climate impact on crop yield but have large uncertainty in yield simulations. We want to see how recent climate change has affected crop phenology in Latvia. We analyze trends in precipitation, drought indexes, evapotranspiration, and soil temperature as well crop phenology for the last 30 years, considering, barley and rye.
In general, the changes in drought indexes are in line with trends of precipitation. The number of consecutive wet days in Latvia have a statistically significant increasing trend only in half of the studied time series. Overall, the long-term changes in climatological drought indices shows the significant wetter conditions during winter (December-February) and cold half (October-March) of a year. At most of the stations a general drying tendency is apparent in warm season. All the stations have shown the increase of maximum number of dry days (CDD index) also, SPI6 and SPI3 indexes have shown the decreasing tendency. However, the tendency to more drying conditions is pronounced to all the inland (continental) stations. Droughts are more common at the end of the studied time series.
We use simple soil water and evapotranspiration models for selected crops to estimate actual water availability for the plants and onset of water stress. Soil model parameters (field capacity, wilting point, soil depth) reflect typical soils in the study region. Species specific rooting depth and water demand constrained by phenology is used. Numerical weather prediction reanalysis ERA-5 is used to force the soil-plant model. It is expected that process-based modeling will provide more nuanced view for drought stress for plans than the general drought indexes.

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