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Controlled drainage in future climate scenarios

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Climate change is projected to result in higher temperatures, higher annual precipitation and more uneven distribution of precipitation in the northern regions. This requires adaptation in agriculture where both excessively wet and dry cycles pose challenges to cropping. Until now, water management in northern agricultural fields has been resting primarily on efficient drainage, but interest towards more flexible measures has increased.

This study focuses on the hydrological effects of climate change and controlled drainage operated with subsurface drains and an open collector ditch in an agricultural field. The objective was to computationally estimate how groundwater levels and water balance respond to controlled drainage and open ditch scenarios in climate conditions projected to take place in Finland during this century. A hydrological model FLUSH was used to simulate the hydrology of an experimental field in Sievi, Northern Ostrobothnia, Finland during years 1970–2100. Down-scaled climate projections from EURO-CORDEX (RCP 8.5 and RCP 2.6) were used as meteorological input. The temporal development of the field hydrology and the effects of controlled drainage were examined by dividing the time series into four subsequent time intervals (historical period and three future periods).

Two different control scenarios were studied. Drainage intensity was reduced during growing seasons in summers (Jun.–Aug.) and either in autumn (Oct.–Nov.) or from autumn to spring (Oct.–Mar.). During these periods, groundwater table was on average 17–29 cm, 28–30 cm and 36–40 cm higher, respectively, in the control scenarios when compared to conventional subsurface drainage in different study intervals and emission scenarios. The implementation of controlled drainage reduced annual drain discharge by 21–46 mm. The projected temporal evolution of the effects of controlled drainage on groundwater levels and annual drain discharges were not monotonous, but the projected effects were larger during the future periods when compared to the historical period. Controlled drainage effect on groundwater levels was seen during both dry and wet years. Controlled drainage was assessed to be an effective method to control field water processes currently and in the future decades. The open collector ditch lowered groundwater levels within a distance of 115 m from the ditch.