

EGU2020-11637

<https://doi.org/10.5194/egusphere-egu2020-11637>

EGU General Assembly 2020

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The effects of flooding and drought on water quantity and quality in agricultural drainage systems and streams in Latvia

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This study was conducted based on systematic and regular water quality and quantity monitoring activities carried out as a part of the Agricultural Runoff monitoring programme in Latvia. This programme was initiated in 1995 and since then aims to document and evaluate the current status and long-term trends in nutrient concentrations and losses at different spatial and temporal scales as affected by meteorological, hydrological, and farming conditions.

Water sampling and flow measurements were carried out at several spatial scales where subsurface and open drainage systems have been installed including 16 experimental plots, 3 subsurface drainage fields, 3 small agricultural catchments, 24 small and medium size rivers. In addition, 21 groundwater monitoring well was established at 6 locations to investigate the effects of agricultural activities on groundwater quality. Water samples were collected on a monthly basis and analyzed for nitrate-nitrogen, ammonium-nitrogen, total nitrogen, orthophosphate-phosphorus, total phosphorus. Continuous flow measurements were made at experimental plots, subsurface drainage fields and small agricultural catchments using hydraulic measurement structures, pressure sensors and data loggers.

The long-term monitoring data (1995 – 2019) showed that water quantity and quality in subsurface and open drainage systems were strongly affected by meteorological conditions at the research site mainly in terms of annual and seasonal patterns of precipitation. Moreover, the flooding conditions in 2017 and drought conditions in 2018 and 2019 indicated that the agronomic activities at the research sites such as crops, tillage operations, types and application rates of fertilizers have a minor role on water quality leaving the agricultural fields. Intensive precipitation outside the growing season in 2017 resulted in the highest nutrient losses, while drought conditions in 2018 resulted in the lowest nutrient losses since this monitoring programme was established. One year of flooding and two consecutive years of drought have emphasized that more specific water and nutrient retention measures are needed in agricultural areas to secure timely removal of excess water from fields and water storage for later use. The analysis of nitrate-nitrogen concentrations obtained at different scales of measurements showed that nutrient concentrations, especially nitrate-nitrogen, decrease if the scale of measurements increases with the highest concentrations at the experimental plot scale followed by subsurface drainage fields, small catchments, and rivers.

