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Climate change, erosion and nutrient loss from agricultural dominated catchments in Norway

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Agriculture contributes a significant portion of the nutrient load to the environment, influencing eutrophication of inland surface waters. Climate change will affect runoff, erosion and nutrient losses and influence on transport pathways in landscape. In Norway, erosion and nutrient losses have been monitored in ten catchments the National Agricultural Environmental Programme since 1991.
The climate change scenarios for Norway indicate among others a wetter, milder winter with increased precipitation amount and intensities. The main objective of this study has been to investigate the effects of extreme weather conditions caused by climate change on runoff, nutrient and soil loss from agricultural dominated catchments at different locations in Norway. Four catchments were selected representing different climatological conditions, agricultural production systems/practices and soil types. The catchments are part of the Agricultural Environmental Monitoring Programme in Norway (JOVA). The projected increase in annual temperature for the catchments varies from ΔT = 3.1 – 3.4 ºC, with the largest increase occurring during the winter season while the increase in yearly precipitation varies from 12.2 – 22.5 %. Characteristics were calculated on the basis of existing runoff and nutrient loss measurements, which have been evaluated with respect to the effects of climate change. Special emphasis has been given to the effects of extreme events in precipitation,either being high amounts of precipitation over both short - or long time periods.
The study showed that in all four catchments climate change will lead to an increase in runoff and the increase will mainly occur after the growing season during the period from September - April. Under similar land use and tillage methods as practiced today, this will lead to an increase in soil and nutrient loss. The soil and nutrient loss processes will be enhanced as more runoff will be generated during less days of the year, implicating increased runoff intensities.
Climate change will lead to milder winters which could lead to more freeze/thaw cycles, less snow cover and a subsequent increase in the frost depth. Frequent freeze/thaw cycles reduces the infiltration capacity of the soil which would lead to more surface runoff while consecutive freeze/thaw cycles lead to a reduction in the aggregate stability and shear strength. Combined with heavy rainfall episodes this will cause serious soil and nutrient loss. Examples of such extreme events occurring in the monitoring period are included.
A characterisation of runoff processes in agricultural catchments based on average daily discharge might be improper as large diurnal variations in discharge occur. Especially during periods with high runoff, considerable amounts of energy are available, leading to the detachment and transport of soil particles and nutrients. Long time series on runoff and water quality such as collected in small agricultural dominated catchments as part of the Agricultural Environmental Monitoring Programme in Norway (JOVA) are rare, but indispensible in evaluating the potential effects of climate change on nutrient and soil loss. Increased runoff and erosion will increase the need of efficient measures in agricultural landscapes, both control with surface runoff, tillage methods and the need of buffer zones and sedimentation ponds. A longer expected growing season can increase with winter wheat .Recent events occurring shorty after sowing documented even higher erosion from autumn tilled winter wheat than from autumn ploughed fields highlighting need for restrictions on tillage methods.