



SUSALPS

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Inventory of a pre-Alpine grassland region –stressors and drivers for yields and nitrogen losses

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Grasslands are the basis for milk and meat production in Alpine and pre-Alpine regions, where climate warming is occurring twice as fast as in global average. Warmer and drier conditions have been found to lead to versatile effects on grassland productivity and yields depending on pedo-climatic conditions. Experimentally, it has been discovered that higher and cooler elevations benefit from warming in the absence of drought, whereas lower elevations are more vulnerable to yield losses under climate change. These findings are based on sites covering only a few discrete climatic, soil, and management conditions. In the present study, we compiled a highly detailed field-scale dataset including cutting dates (2018-2020) from remote sensing, informing regional grassland management routines of the biogeochemical model LandscapeDNDC which was applied in the pre-Alpine Ammer region (530 m a.s.l to 2200 m a.s.l., 4600 km²) in southern Germany. The strongest predictor of yields was the management intensity with an average yield increase of 1.3 t ha⁻¹ a⁻¹ per additional cut and associated manure application. We found a mean regional yield decrease of 5 % in the drought year 2018 compared to the year 2020 with average climatic conditions. Yields from extensive management were less sensitive to climatic parameters than the ones from intensive fields. Soil organic carbon had a positive effect on yields, especially in drier years. Yield increases of 0.18 to 0.24 t ha⁻¹ a⁻¹ per % increase in soil organic carbon were observed. The strongest correlation for nitrogen losses was also the management intensity. Nitrous oxide emissions were found to anti-correlate with yields, and correlate with soil organic matter. Nitrate leaching was overall very low (2 kg N ha⁻¹ a⁻¹). Our results illustrate the complex interactions between management, soil, and climate factors influencing C- and N-cycles in grassland, including differences in their importance in drought and non-drought years.

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