Geophysical Research Abstracts
Vol. 21, EGU2019-17809-1, 2019
EGU General Assembly 2019

Dynamic modelling of management events under climate change conditions and impacts on C and N dynamics in pre-alpine grassland ecosystems

Krischan Petersen (1), Ralf Kiese (1), David Kraus (1), and Pierluigi Calanca (2)

(1) Karlsruhe Institute of Technology, Institute of Meteorology and Climate Research - Atmospheric Environmental Research (IMK-IFU), Garmisch-Partenkirchen, Germany (krischan.petersen@kit.edu), (2) Agroscope, Bern, Switzerland

Pre-alpine grasslands provide important economic value via fodder used for milk and meat production. Grassland soils also support environmental key functions such as carbon and nitrogen storage, water retention, erosion control and biodiversity. At present, these functions are jeopardized by climate change, which is likely to be accelerated in coming decades. Beside climate change, management decisions (most important cutting and manuring frequency/amount) have a high impact on grassland yields and soil C and N dynamics.
In pre-alpine regions climate change is increasing the length of the growing season mainly due to an earlier start in spring (Chang et al. 2017). Together with later autumn senescence, higher temperatures, higher CO_2 concentrations and changed soil water and nutrient availability this can lead to significant changes in biomass development throughout the year. Under real field conditions, the farmer cuts the grass on demand and influenced by biomass development as well as climate and soil conditions. With an earlier start of the growing season farmers likely do the first cut earlier, which will also influence timing of further cutting and manuring events throughout the year. Similarly, drought will likely cause a delay in cutting. Thus, instead of using fixed management dates (for cutting and manuring) derived from current climate conditions, within long term climate change scenarios (e.g. RCP4.5, RCP 8.5), it is necessary to dynamically fit the timing of management practices depending on plant development as affected by predicted climate conditions.
A new management module for the process-based biogeochemical model LandscapeDNDC (Kraus et al., 2014; Haas et al., 2013; Kiese et al., 2011), was designed and implemented which fulfills this topic by imitating an intensive managing farmer. Depending on simulated aboveground biomass development and detailed rule-sets, timing of grassland management (cutting and manuring) are set dynamically over the time of climate change scenario studies.
The new management module was applied on two different pre-alpine grassland sites for which comprehensive data on management and yields were available. At first, the module was calibrated and successfully validated for the time period of measurements; i.e. 2012-2016. It was then applied on 90 years of climate change scenario simulations with the representative concentration pathways (RCP) 4.5 and 8.5 and comparing grassland C and N dynamics with a scenario run based on static management i.e. fixed dates.
Results show that climate change affects grassland growth of especially during the start of the growing season with significant earlier first cutting dates particularly for RCP 8.5. Overall, the carbon and nitrogen stocks decrease with climate change highlighting a risk on soil fertility and thus productivity of montane grassland soils.