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Impact assessment of climate change and human activities on GHG emissions and agricultural water use

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The agriculture sector is one of the largest users of water and a significant source of greenhouse gas (GHG) emissions. The development of low-GHG-emission and water-conserving agriculture will inevitably be the trend in the future. Because of the physiological differences among crops and their response efficiency to external changes, changes in planting structure, climate and input of production factors will have an impact on regional agricultural water use and GHG emissions. This paper systematically analyzed the spatial-temporal evolution characteristics of crop planting structure, climate, and production factor inputs in Heilongjiang Province, the main grain-producing region of China, from 2000 to 2015, and quantified the regional agricultural water use and GHG emissions characteristics under different scenarios by using the Penman-Monteith formula and the Denitrification-Decomposition (DNDC) model. The results showed that the global warming potential (GWP) increased by 15% due to the change in planting structure. A large increase in the proportion of rice and corn sown was the main reason. During the study period, regional climate change had a positive impact on the water- saving and emission reduction of the agricultural industry. The annual water demand per unit area decreased by 19%, and the GWP decreased by 12% compared with that in 2000. The input of fertilizer and other means of production will have a significant impact on GHG emissions from farmlands. The increase in N fertilizer input significantly increased N₂O emissions, with a 5% increase in GWP. Agricultural water consumption and carbon emissions are affected by changes in climate, input of means of production, and planting structure. Therefore, multiple regulatory measures should be taken in combination with regional characteristics to realize a new layout of planting structure with low emissions, water conservation, and sustainability.