Vegetation change in response to climate change and human activities in a typical alpine region on Tibetan Plateau

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The study of attribution analysis and sustainability of vegetation dynamics is of great significance to assess effectiveness of ecological engineering, make policies of adaptive ecological management, and improve ecological environment. By using datasets of MODIS NDVI, annual temperature and precipitation datasets, and land cover datasets, methods such as trend analysis, multiple regression residuals analysis, Hurst index analysis were employed to distinguish interannual change of vegetation dynamics during 2000-2020, determine contributions of climate change and human activities on vegetation dynamics, and assess sustainability of vegetation dynamics in Gannan Prefecture (a typical alpine region on Tibetan Plateau), which is located in Gansu Province of China, especially in ecological restoration project areas. The results showed that NDVI increased at a rate of $2.4 \times 10^{-3}/a$ during the growing season across 2000-2020, showing vegetation improvement in most parts of the study area, and only a few sporadically degraded areas, and the increasing rate was the fastest in the Grain to Green Project. Clear spatial pattern about the effects of climate change and human activities on vegetation change was found, which is the southern part mainly affected by climate change, while the northern part dominated by human activities, and their contributions to vegetation change were 52.32% and 47.68%, respectively. Among ecological restoration projects, Grain to Green Project (59.89%) was most obviously affected by human activities. Moreover, the main future trend of vegetation change in Gannan was continuous improvement through Hurst index analysis. In the future, more attention should be paid to the areas with conditions of present improvement and future anti-sustainability as well as present degradation and future sustainability.