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Projecting future vegetation change for northeast China using CMIP6

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This study aims to establish future vegetation changes in the east and central of northern China (ECNC), an ecologically sensitive region in the transition zonal from humid monsoonal to arid continental climate. The region has experienced significant greening in the past several decades. However, few studies exist on how vegetation will change with future climate change, and great uncertainties exist due to complex, and often spatially non-stationary, relationships between vegetation and climate. In this study, we first used historical NDVI and climate data to model this spatially variable relationship with Geographically Weighted Logit Regression. We found that temperature and precipitation could explain, on average, 43% of NDVI variance, and they could be used to model NDVI fairly well. We then establish future climate change using the output of 11 CMIP6 models for the medium (SSP245) and high (SSP585) emission scenarios for the mid-century (2041-2070) and late-century (2071-2100). The results show that for this region, both temperature and precipitation will increase under both scenarios. By late-century under SSP585, precipitation is projected to increase by 25.12% and temperature is projected to increase 5.87^{o}C in ECNC. Finally, we used future climate conditions as input for the regression models to project future vegetation (indicated by NDVI). We found that NDVI will increase under climate change. By mid-century, the average NDVI in ECNC will increase by 0.024 and 0.021 under SSP245 and SSP585. By late-century, it will increase by 0.016 and 0.006 under SSP245 and SSP585 respectively. Although NDVI is projected to increase, the magnitude of increase is likely to diminish with higher emission scenarios, possibly due to the benefit of precipitation increase being gradually encroached by the detrimental effects of temperature increase. Moreover, despite the overall NDVI increase, the area likely to suffer vegetation degradation will also expands, particularly in the western part of ECNC. With higher emissions and later into the century, region with low NDVI is likely to shift and/or expand north-forward. Our results could provide important information on possible vegetation changes, which could help to develop effective management strategies to ensure ecological and economic sustainability in the future.