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Responses of aboveground and belowground forest carbon stocks to disturbances in boreal forests of Northeastern China

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Boreal forests represents about 1/3 of forest area and 1/3 of forest carbon on earth. Carbon dynamics of boreal forests are sensitive to climate change, natural (e.g., fire) and anthropogenic (e.g., harvest) disturbances. Field-based studies suggest that disturbances alter species composition, stand structure, and litter decomposition, and have significant effects on boreal forest carbon dynamics. Most of these studies, however, covered a relatively short period of time (e.g., few decades), which is limited in revealing such long-term effects of disturbances. Models are therefore developed as important tools in exploring the long-term (e.g., hundreds of years) effects of disturbances on forest carbon dynamics. In this study, we applied a framework of coupling forest ecosystem and landscape model to evaluating the effect of fire, harvest and their interactions on carbon stocks in a boreal forest landscape of Northeastern China. We compared the simulation results under fire, harvest and fire-harvest interaction scenarios with the simulated value of succession scenario at 26 landtypes over 150 years at a 10-year time step. Our results suggest that aboveground and belowground carbon are significantly reduced by fire and harvest over 150years. Fire reduced aboveground carbon by 2.3±0.6 ton/ha, harvest by 6.0±1.4 ton/ha, and fire and harvest interaction by 8.0±1.9 tons/ha. Fire reduced belowground carbon by 4.6±3.4 ton/ha, harvest by 5.0±3.5 ton/ha, and fire-harvest interaction by 5.7±3.7 tons/ha. The divergent response of carbon stocks among landtypes and between disturbance scenarios was due to the spatial interactions between fire, harvest, and species composition. Our results indicated that boreal forests carbon stocks prediction needs to consider the effects of fire and harvest for improving the estimation accuracy.