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Impact of vegetation control measures on the bedform of braided gravel-bed river

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Braiding is among the most dynamic landscape on Earth. It provides diverse habitats for freshwater creatures. Unfortunately, the number of braided rivers is reducing affected by human activities in the Anthropic period. The increase of the vegetation cover within the river corridor is one important factor, which is induced by flow regime change, land-use change, or alien vegetation invasion. Vegetation clearance could be a promising measure to mitigate vegetation overexpansion. Several previous research suggested vegetation clearance may induce geomorphological metamorphosis. However, quantitative prediction of the morphological change resulted from the vegetation clearance is still an open question to date. We simulated the river morphological response of vegetated braided river with gravel bed to the vegetation clearance using the Nays2DH model combined with a vegetation module. Except for vegetation removal, the developed conceptual model considered vegetation colonization and the destruction induced by floods. Multiple scenarios have been tested, considering two vegetation types (strong and weak vegetation), two clearance methods (full clearance and partial clearance), and two maximum discharge. The full clearance scenario stood for the removal of above-ground and underground biomass simultaneously, and the partial clearance scenario stood for the removal of above-ground biomass. Braided rivers had developed for both no vegetation and river with weak vegetation cover. The bedform affected by strong vegetation coverage consisted of a main channel and small channels on the floodplain, which was consistent with previous experimental results. The distinctive morphology of developed bed form depended on the dominant factor in the vegetation-geomorphology interaction: vegetation dominant or physical process dominant. River morphology responded differently to the vegetation control measure based on the dominating factor. For the vegetation dominated river, the developed main channel tended to be braiding after the vegetation removal, and the river morphology change was sensitive to the vegetation clearance method. By contrast, river morphology changed insignificantly by vegetation colonization and after vegetation removal if the river physical process was dominant. We also found that the small channels on the floodplain promoted sediment transport from the floodplain to the main channel after the vegetation clearance. Thus, the morphological response to the vegetation clearance method was also affected by the reduction of maximum discharge because the connectivity between floodplain and channel was reduced. To improve vegetation clearance effectiveness, we recommend increasing the connectivity between the floodplain and the main channel, such as excavating small channels on the floodplain.