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Effects of riparian vegetation on development of meandering channel in Tarim River, Northwest China

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Unique fluvial morphology develops along the Tarim River, the longest allogenic and perennial dryland river in an extreme arid region in China. Though the channel planform pattern of the upper reach of the river is dominantly braided, in the middle and lower reaches meandering channel with quite distorted bends develops. The sinuosity index of the meandering channel ranges 1.6 to 2.2, with high spatial variability and lateral migration rate. Strangely, sediment composition of the bank is quite even with majorly coarse silt and fine sand and almost none clay content, the strength of the channel bank is hence very low and prone to be scoured or even collapsed if riparian vegetation is lacking. Little is known on the causes underlying the development of the meandering planform pattern in Tarim River. Here we preliminarily examine the effects of the root of riparian vegetation on development and sustainment of this somehow special meandering channel. Hydraulic (discharge, runoff, sediment transport) and geometric (channel slope and cross section) features and root characteristics are analyzed by using hydrological data, remote sensing images and field root survey. In-situ measurements and sampling of roots from local typical riparian vegetation (i.e. populous trees, Tamarix, and Phragmites Australis) along meandering channel of the river were conducted to obtain root parameters like diameter and root area ratio. BSTEM model is used to quantitatively estimate the effects of different root conditions on improving channel bank strength. Four vegetation root scenarios were modelled, i.e. tree (populous), shrub (Tamarix), grass (Phragmites Australis) and no root. The results show that root supplies effective cohesive force for the soil of the channel bank and enhances the channel bank safety factors (Fs). The root of Populous trees in general has highest enhancing effects on channel bank stability, that of the Tamarix ranking the second, and that of the Phragmites Australis ranking the third. All the three root conditions have obvious enhancement on channel bank strength than the bank without any root. Riparian vegetation hence has important role on development and sustainment of meandering channel in Tarim River.