EGU21-1108
https://doi.org/10.5194/egusphere-egu21-1108
EGU General Assembly 2021

Modelling the effects of normal faulting on alluvial river morphodynamics.

Hessel Woolderink[1], Steven Weisscher[2], Maarten Kleinhans[2], Cornelis Kasse[1], and Ronald Van Balen[1]

[1]Vrije Universiteit (VU), Amsterdam, Netherlands

[2]Utrecht University, Utrecht, Netherlands

Normal faulting acts as a forcing on the morphodynamics of alluvial rivers by changing the topographic gradient of the river valley and channel around the fault zone. Normal faulting affects river morphodynamics either instantaneously by surface rupturing earthquakes, or gradually by continuous vertical displacement. The morphodynamic responses to normal faulting range from longitudinal bed profile adjustments to channel pattern changes. However, the effect of faulting on river morphodynamics and morphology is complex, as they also depend on numerous local, non-tectonic characteristics of flow, river bed/bank composition and vegetation cover. Moreover, river response to faulting is often transient. Such time-dependent river response is important to consider when deriving relationships between faulting and river dynamics from a morphological and sedimentological record. To enhance our understanding of river response to tectonic faulting, we used the physics-based, two-dimensional morphodynamic model Nays2D to simulate the responses of a laboratory-scale alluvial river to various faulting and offset scenarios. Our model focusses on the morphodynamic responses at the scale of multiple meander bends around a normal fault zone. Channel sinuosity increases as the downstream meander bend expands as a result of the faulting-enhanced valley gradient, after which a chute cutoff reduces channel sinuosity to a new dynamic equilibrium that is generally higher than the pre-faulting sinuosity. Relative uplift of the downstream part of the river due to a fault leads to reduced fluvial activity upstream, caused by a backwater effect. The position along a meander bend at which faulting occurs has a profound influence on channel sinuosity; fault locations that enhance flow velocities over the point bar result in a faster sinuosity increase and subsequent chute cutoff than locations that cause increased flow velocity directed towards the outer floodplain. Our study shows that inclusion of process-based reasoning in the interpretation of geomorphological and sedimentological observations of fluvial response to faulting improves our understanding of the natural processes involved and, therefore, contributes to better prediction of faulting effects on river morphodynamics.