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Morphodynamics structures induced by variations of the channel width

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In alluvial channels, forcing effects, such as a longitudinally varying width, can induce the formation of steady bars (Olesen, 1984). The type of bars that form, such as alternate, central or multiple, will mainly depend on the local flow width-to-depth ratio and on upstream conditions (Struiksma et al., 1985).
The effects on bar formation of varying the channel width received attention only recently and investigations, based on flume experiments and mathematical modelling, are mostly restricted to small longitudinal sinusoidal variations of the channel width (e.g. Repetto et al., 2002; Wu and Yeh, 2005, Zolezzi et al., 2012; Frascati and Lanzoni, 2013).
In this work, we analyze the variations in equilibrium bed topography in a longitudinal width-varying channel with characteristic scales of the Waal River (The Netherlands) using two different 2D depth-averaged morphodynamic models, one based on the Delft3D code and one on Telemac-Mascaret system. In particular, we explore the effects of changing the wavelength of sinusoidal width variations in a straight channel, focusing on the effects of the spatial lag between bar formation and forcing that is observed in numerical models and laboratory experiments (e.g. Crosato et al, 2011).
We extend the investigations to finite width variations in which longitudinal changes of the width-to-depth ratio are such that they may affect the type of bars that become unstable (alternate, central or multiple bars). Numerical results are qualitatively validated with field observations and the resulting morphodynamic pattern is compared with the physics-based predictor of river bar modes by Crosato and Mosselman (2009).
The numerical models are finally used to analyse the experimental conditions of Wu and Yeh (2005). The study should be seen as merely exploratory. The aim is to investigate possible approaches for future research aiming at assessing the effects of artificial river widening and narrowing to control bar formation in alluvial rivers.

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