Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09094, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09094
EGU General Assembly 2008

On width variations triggered by channel curvature

R. Luchi, G. Zolezzi, M. Tubino

Department of Civil and Environmental Engineering, University of Trento, Italy

(rossella.luchi@ing.unitn.it / Fax: +39 0461 882672 / Phone : +39 0461 882480)

Longitudinal variations in channel width are not uncommon in meandering rivers although most simulation models of meander dynamics have been developed so far assuming a constant channel width. Deviation from the constant width configuration may be due to several causes, such as the local unbalance between erosion and deposition mechanisms at the same cross-section as well as processes related to the flow – bed topography field generated by the meander itself.

Commonly employed bank migration laws assume that bank retreat (accretion) be due to local excess (deficiency) of the near-bank longitudinal velocity; under this assumption cross sectional widenings (narrowings) may indeed be triggered by symmetrical transverse perturbations of the flow field with respect to the reach-averaged value in equilibrium with the mean channel width.

This mechanism has already been investigated in the case of channels with a straight alignment of their axis (Bittner, 1994, Repetto et al., 2002) as a possible generator of mid-channel bar patterns and a potential initiator of channel bifurcation.

In the present work we concentrate on the development of laterally symmetric flow patterns within meandering rivers, in order to assess their potential for inducing longitudinal width variations that are often observed close to meander bends (e.g. Hooke, 1986, Seminara, 2006). We employ a perturbation solution of the depth averaged morphodynamic model for river meandering.

We show that the first nonlinear self-interaction of the curvature-forced linear solution (e.g. Seminara and Tubino, 1989) is able to generate a transversally symmetric flow

structure and also to trigger the development of mid-channel bars. The model is able to predict the tendency of meandering channels to develop regular oscillations of channel width in sine-generated meanders as well as their phase lag with respect to the bend apexes and to the mid-channel bar location. The lag variably depends on the reach averaged flow conditions and on the meander wavelength. Preliminary simulations suggest that the position of the widest section within a meander loop strongly depends on meander wavelength at low width-to depth ratios, while progressively loosing such dependence in wider and shallower streams. The structure of the governing systems inherently contains the information that the wavelength of width oscillations is half that of channel curvature.

REFERENCES

BITTNER, 1994. River bed response to channel width variation. *Master thesis*, University of Illinois.

HOOKE, J., 1986. The significance of mid-channel bars in meandering channels. *Sedimentology*, 33, 839–850.

REPETTO R., TUBINO, M., PAOLA, C. 2002. Planimetric instability of channels with variable width, *Journal of Fluid Mechanics*, 457, 79–109.

SEMINARA, G., 2006. Meanders, 50th Anniversary issue of the *J. Fluid. Mech*., 554, 271–297.

SEMINARA, G. AND TUBINO, M., 1989. Alternate bars and meandering: Free, forced and mixed interactions, pp. 267–320, in *River Meandering*, S. Ikeda and G. Parker (Eds.), Water Resources Monographies, 12.