Geophysical Research Abstracts
Vol. 19, EGU2017-15369, 2017
EGU General Assembly 2017

Hydrodynamics of concordant and discordant fixed bed open-channel confluences

Olga Birjukova Canelas, Rui Miguel Lage Ferreira, and António Heleno Cardoso
CERIS, Instituto Superior Técnico, Universidade de Lisboa, Lisbon, Portugal

The detailed characterization of the flow field in river confluences constitutes a relevant step towards the understanding of the hydro-morpho-dynamics of these key zones of the fluvial system. With a few exceptions, existing works on this topic covered concordant bed scenarios, meaning that both confluent channels had the same elevation. This laboratory study aims to contribute to a detailed three-dimensional characterization of the flow field at a fixed bed confluence, as well as to shed light on how bed elevation discordance modifies the flow patterns of the converging flows. While the junction angle and the discharge ratio were kept fixed, two scenarios were studied on the basis of detailed water level and 3D ADV measurements at the denser mesh ever. The internal flow structure of the concordant bed scenario mostly complied with the classical conceptual models. A relevant difference concerns the size of the stagnation zone, much smaller close to the bed of the discordant bed confluence. A more significant difference is a horizontal flow structure, not previously identified in the literature, characterized by strong streamwise mean vorticity and strong secondary motion. It is observed for the discordant bed case, occurring along the inner wall of the main channel and downstream the junction corner. This structure is spatially well-correlated to a pronounced imbalance of cross-stream and vertical normal Reynolds stresses. This highlights the role of Reynolds stress anisotropy (RSA) that is generated in the shear layers than accompany the entrance of the tributary flow. Since this structure is not present in the concordant case, where RSA is also evident, it is argued that convective effects should also play a role in its formation, presumably due to deflection of the flow in the main channel by the tributary. The newly identified secondary motion should, thus, be a combination of Prandtl′s second kind and Prandtl′s first kind of secondary flow. The relative importance of each generating mechanism is still under investigation.
Acknowledgements
This research as partially supported by Portuguese and European funds, within programs COMPETE2020 and PORL-FEDER, through project PTDC/ECM-HID/6387/2014 granted by the National Foundation for Science and Technology (FCT).