

Modelling of Meandering River Dynamics in Colombia: A Case Study of the Magdalena River

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Abstract : The analysis and study of Open Channel flow dynamics for River applications has been based on flow modelling using discrete numerical models based on hydrodynamic equations. The overall spatial characteristics of rivers, i.e. its length to depth to width ratio generally allows one to correctly disregard processes occurring in the vertical or transverse dimensions thus imposing hydrostatic pressure conditions and considering solely a 1D flow model along the river length. Through a calibration process an accurate flow model may thus be developed allowing for channel study and extrapolation of various scenarios. The Magdalena River in Colombia is a large river basin draining the country from South to North with 1550 km with 0.0024 average slope and 275 average width across. The river displays high water level fluctuation and is characterized by a series of meanders. The city of La Dorada has been affected over the years by serious flooding in the rainy and dry seasons. As the meander is evolving at a steady pace repeated flooding has endangered a number of neighborhoods. This study has been undertaken in pro of correctly model flow characteristics of the river in this region in order to evaluate various scenarios and provide decision makers with erosion control measures options and a forecasting tool. Two field campaigns have been completed over the dry and rainy seasons including extensive topographical and channel survey using Topcon GR5 DGPS and River Surveyor ADCP. Also in order to characterize the erosion process occurring through the meander, extensive suspended and river bed samples were retrieved as well as soil perforation over the banks. Hence based on DEM ground digital mapping survey and field data a 2DH flow model was prepared using the Iber freeware based on the finite volume method in a non-structured mesh environment. The calibration process was carried out comparing available historical data of nearby hydrologic gauging station. Although the model was able to effectively predict overall flow processes in the region, its spatial characteristics and limitations related to pressure conditions did not allow for an accurate representation of erosion processes occurring over specific bank areas and dwellings. As such a significant helical flow has been observed through the meander. Furthermore, the rapidly changing channel cross section as a consequence of severe erosion has hindered the model's ability to provide decision makers with a valid up to date planning tool.

Keywords : erosion, finite volume method, flow dynamics, flow modelling, meander

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