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MORPHODYNAMICS OF THE PARANA RIVER IN THE LIGHT OF CLIMATE CHANGE

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The work highlights the sediment dynamics that takes place at different scales along the Middle and Lower Parana River (Argentina), by means of different numerical models. The principal aim of this study is to provide a multi-disciplinary and multi-scale approach to predict the future river's morphodynamics in the light of climate change. This approach may be applied to evaluate the long-term impact of the river's morphodynamics on anthropogenic structures and activities over or nearby the watercourse (i.e., bridges, levees, navigation way). The study was realized by using three different levels of detail of mathematical modelling. Climate models give the input ensemble, i.e., future precipitation and temperature over the La Plata Basin. The VIC hydrological model simulated the flow discharge time-series, which were then used as input for an own-developed 1-D hydro-morphodynamic model. This 1-D code was able to simulate future rate of sediment transport and corresponding bed-level changes at watershed scale and provided the initial and the boundary conditions for a more detailed 2-D model. Therefore, future evolutions of a specific part of the main and the secondary channels were simulated with the MIKE21C code, developed by the Danish Hydraulic Institute.

The performed analysis indicated a rather low sensitivity of the Middle and Lower Parana River bed profile to the relevant increase forecasted in flow discharge, whereas the channels appreciably divagates. In particular, variability increase rather than averaged value of predicted discharges appeared effective in driving current bifurcated morphology into a meandering-multithread pattern.

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ACOUSTIC TECHNIQUES FOR THE INDERECT MEASUREMENT OF SEDIMENT TRANSPORT

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Measurement of bed-sand transported in river streamflow is desirable for the evaluation of many issues related to river hydro-morphodynamics, such as climate change impacts, maintenance of navigation way and water intakes capacity. Suspended- and bed-load have traditionally been investigated by deploying traps and pressure-difference samplers. These measurements procedures are difficult, especially in large rivers, where permanent installations like pits or slots are unfeasible and water sampling may take from hours to days for a single cross-section. More recently, the ADCP was used to assess (i) the backscatter from suspended particles to be related to suspended-load, and (ii) the Doppler velocity induced from moving particles at the river-bed thus inferring the bed-load rate. Time and space resolutions of the ADCP's methods are particularly attractive for the investigation of flow field-sediment patterns. Unfortunately, these techniques strongly depend on acoustic properties (e.g., frequency, pulse length) coupling to in field features (e.g., sediment size and concentration, bed sedimentology and roughness).

Aiming to solve the inherent ambiguities in acoustic methods, some laboratory and field tests were conducted. Regarding the suspended-load, the calibration of backscatter at different frequencies versus water-sediment samples demonstrated the ability of multi-frequency in reducing the ambiguity in sand concentration and size assessments at the large Parana River (Argentina). For the bed-load rate, tests were performed aiming to parameterize the Doppler velocity detected near a flume sand-rippled bed on the basis of acoustic properties of used device. This relationships may be applied for the interpretation the induced bias of bed-load on ADCP's bottom tracking (i.e., the instrument ability of measuring its velocity relative to a fixed bottom) to finally infer the actual rate of transported sediment near bed.