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Basin infilling of a schematic 1D estuary using two different approaches: an aggregate diffusive type model and a processed based model.

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Fluvial sediment transport creates great challenges for river scientists and engineers. The interaction between the fluid (water) and the solid (dispersed sediment particles) phases is crucial in morphodynamics. The process of sediment transport and the resulting morphological evolution of rivers get more complex with the exposure of the fluvial systems to the natural and variable environment (climatic, geological, ecological and social, etc.).

The earlier efforts in mathematical river modelling were almost exclusively built on traditional fluvial hydraulics. The last half century has seen more and more developments and applications of mathematical models for fluvial flow, sediment transport and morphological evolution. The first attempts for a quantitative description and simulation of basin filling in geological time scales started in the late 60´s of the last century (eg. Schwarzacher, 1966; Briggs & Pollack, 1967). However, the quality of this modelling practice has emerged as a crucial issue for concern, which is widely viewed as the key that could unlock the full potential of computational fluvial hydraulics.

Most of the models presently used to study fluvial basin filling are of the "diffusion type" (Flemmings and Jordan, 1989). It must be noted that this type of models do not assume that the sediment transport is performed by a physical diffusive process. Rather they are synthetic models based on mass conservation. In the "synthesist" viewpoint (Tipper, 1992; Goldenfeld & Kadanoff, 1999; Werner, 1999 in Paola, 2000) the dynamics of complex systems may occur on many levels (time or space scales) and the dynamics of higher levels may be more or less independent of that at lower levels. In this type of models the low frequency dynamics is controlled by only a few important processes and the high frequency processes are not included. In opposition to this is the "reductionist" viewpoint that states that there is no objective reason to discard high frequency processes. In this viewpoint the system is broken down into its fundamental components and processes and the model is build up by selecting the important processes regardless of its time and space scale. This viewpoint was only possible to pursue in the recent years due to improvement in system knowledge and computer power (Paola, 2000).

The primary aim of this paper is to demonstrate that it is possible to simulate the evolution of the sediment river bed, traditionally studied with synthetic models, with a process-based hydrodynamic, sediment transport and morphodynamic model, solving explicitly the mass and momentum conservation equations. With this objective, a comparison between two mathematical models for alluvial rivers is made to simulate the evolution of the sediment river bed of a conceptual 1D embayment for periods in the order of a thousand years: the traditional synthetic basin infilling aggregate diffusive type model based on the diffusion equation (Paola, 2000), used in the "synthesist" viewpoint and the process-based model MOHID (Miranda et al., 2000).

The simulation of the sediment river bed evolution achieved by the process-based model MOHID is very similar to those obtained by the diffusive type model, but more complete due to the complexity of the process-based model. In the MOHID results it is possible to observe a more comprehensive and realistic results because this type of model include processes that is impossible to a synthetic model to describe.
At last the combined effect of tide, sea level rise and river discharges was investigated in the process based model. These effects cannot be simulated using the diffusive type model. The results demonstrate the feasibility of using process based models to perform studies in scales of 10000 years. This is an advance relative to the use of synthetic models, enabling the use of variable forcing.

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