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The influence of basin slope and fluvial flow on deltaic built-up processes off mountainous, seasonal rivers

Patricia Bárcenas (1), Jorge Macías (1), Luis Miguel Fernández-Salas (2), Nieves López-González (3), and Francisco José Lobo (4)

(1) Dpto. Análisis Matemático, Facultad de Ciencias, Universidad de Málaga, 29080 Málaga, Spain (pbarcenas@uma.es), (2) Instituto Español de Oceanografía, Centro Oceanográfico de Cádiz, 11006, Cádiz, Spain, (3) Instituto Español de Oceanografía, Centro Oceanográfico de Málaga, 29640, Fuengirola, Málaga, Spain, (4) Instituto Andaluz de Ciencias de la Tierra (CSIC-Universidad de Granada), 18100, Armilla, Granada, Spain.

The construction and evolution of submarine deltaic deposits are influenced by a combination of allogenic factors, such as fluvial flow (Q), and autogenic factors, such as basin slope (BS). Numerical simulations of turbidity currents are used to propose a morphodynamic model that quantifies the effect of both the slope and river input variations on the development of small deltaic environments in the northern shelf of the Alborán Sea, western Mediterranean Basin, that are linked to short and mountainous fluvial systems controlled by a seasonal Mediterranean climate. Traditionally, this type of model has been used for simulating hyperpycnal flows (Parker et al. (1986), Kubo (2004), Khan et al. (2005) & Morales et al. (2009)). In this study, the turbidity-HySEA model has been used taken into account the parameter settings and the numerical resolution specified in Bárcenas (2013) and Morales et al. (2009), respectively. These simulations were performed along a time period of eight days under two different fluvial flow conditions (constant and variable flow during the simulation period). Two different types of bathymetric profiles have been considered: a) piecewise linear profile and b) real bathymetric profiles from EM3000D multibeam echosounder data obtained off the present-day and artificial mouths of the Adra River. Five morphometric parameters were measured for each simulation (time and slope necessary for the formation of the topset, offlap break distance to the coastline, distal boundary depth and submarine delta length). The numerical experiments performed demonstrate the nonlinear relationship between the input variables (Q and BS) and the measured morphometric parameters. The morphodynamic of the sedimentary wedges considering the sediment dispersion and the offlap-break distance to the coastline can be represented by two extreme cases with many intermediate cases in between. The first case would be conditioned by proximal sedimentation while in the second case sedimentation is dominated by dispersion. From the morphodynamic model and the simulation results, some implications can be outlined: a) both Q and BS contribute to the basinward progradation of sedimentary wedges; and b) the dominant condition is a balance of the accommodation space (A) and the sediment discharge less than 1 (A/S<1) which implies a regression and the progradation of the deltaic system, except for high values of Q and BS, that lead to vertical aggradation (A/S=1). We conclude that both the river flow and the basin slope are key factors for the development of large-scale morpho-stratigraphic features of submarine deltas at different spatial scales. ACKNOWLEDGMENTS: This research has been partially supported by the Junta de Andalucía research TESELA project (P11-RNM7069).